

**Forest Resource Improvement Association of Alberta**

**Forest Resource Improvement Program**

**Foothills Growth and Yield Association**

Revised Proposal Prepared by:

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Submitted by:

**Foothills Model Forest**

P.O. Box 6330  
Hinton, Alberta  
T7V 1X6

September, 2001

## Proposal Summary

### ***Applicant***

Name: Foothills Model Forest  
Mailing Address: Box 6330, Hinton, Alberta, T7V 1X6  
Delivery Address: Environmental Training Centre, Hinton, Alberta  
Contact Persons: Mark Storey, telephone 780 865 8332, fax 780 865 8331  
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### ***Sponsors***

| <i>Company</i>                 | <i>Contact Person</i> | <i>Telephone</i> |
|--------------------------------|-----------------------|------------------|
| Alberta Newsprint Company      | J. McCammon           | (780) 778 7000   |
| Blue Ridge Lumber              | M. Summers            | (780) 648 6325   |
| Canfor                         | L. Greenhorn          | (780) 538 7754   |
| Millar Western Forest Products | J. Russell            | (780) 778 2221   |
| Spray Lakes Sawmills           | G. Lehn               | (403) 932 2234   |
| Sundance Forest Industries     | J. Huey               | (780) 723 3977   |
| Sunpine Forest Products        | K. Branter            | (403) 638 4482   |
| Weldwood of Canada             | H. Loughheed          | (780) 865 8191   |
| Weyerhaeuser Canada            | P. Wearmouth          | (780) 539 8500   |

### ***Project Information***

Type: Inventory / Planning  
Term: April 1, 2000 to March 31, 2005.

|                  |                  |  |
|------------------|------------------|--|
| Amount of funds: | \$520,000        | FRIP funds to Applicant for Development and Management     |
|                  | \$211,106        | external funds to Applicant for Development and Management |
|                  | <u>\$807,277</u> | to Sponsors for Regeneration Project (FRIP eligible)       |
|                  | \$1,538,383      | total  |

(Actual amounts requested for Regeneration Project may vary from estimates contained in this Proposal, and will be specified in supplementary funding applications submitted directly by the Sponsors)

### ***Attachments***

1. Proposal
2. Project Schedules
3. Appendices
  1. Sub-project 2: Plan and Experimental Design
  2. Funding Application Formats for Sub-project 2

### ***Acknowledgement by Applicant***

The Applicant (jointly with the Sponsors and severally the "Signatory") acknowledges having read and agreed to the terms and conditions described on the attached schedule to which the Application under the Program is made subject. The Applicant acknowledges and agrees that by its submission of this application it shall be bound by the terms of the Program, FRIAA's policies, procedures, protocols and guidelines. It is also acknowledged and agreed that this application may be accepted by FRIAA on further terms or conditions, which shall be binding on the Signatory once the proposed project is undertaken by the Signatory.

Applicant: \_\_\_\_\_

# **1. Proposal**

## **1.1. Background**

In response to interest by industry and government, the Foothills Model Forest facilitated collaboration among a number of softwood producers to create a Foothills Growth and Yield Association for co-operative forecasting and monitoring of managed stand growth and yield, particularly of lodgepole pine. Nine companies are now participating in the Association as voting members. The Alberta Land and Forest Division and the Foothills Model Forest are participating as non-voting members, with the Model Forest acting as the coordinating agency.

The potential value of a co-operative lodgepole pine growth and yield research program was recognized in 1997 by a number of companies holding Forest Management Agreements and Timber Quotas on the Eastern Slopes.

The Foothills Model Forest appointed a part-time Director on June 21, 1999, with the mandate to develop a growth and yield co-operative. The Director reviewed background work and consulted with nine companies holding timber tenures in the region, as well as the Alberta Land and Forest Service (now Alberta Land and Forest Division), and the Canadian Forest Service. During the summer of 1999 a scope assessment was undertaken to assess the needs of potential program participants. This was followed by a workshop among the potential co-operators on October 22, 1999. As a result of the workshop, a memorandum of agreement and preliminary work schedule was developed and endorsed by nine companies, the Land and Forest Service, and the Foothills Model Forest.

The Foothills Model Forest, acting as applicant on behalf of the nine sponsoring members, submitted the original proposal for this Project to the Forest Resource Improvement Association of Alberta (FRIAA) in July 2000. The proposal was approved. A contract was issued (FOOMOD-01-01 – *Foothills Growth and Yield Association*) on July 25, 2000, and a requested amendment was approved effective September 12, 2000. The original proposal and contract had an initial term of two years (April 1, 2000 to March 31, 2002). The revision contained in the following pages extends the term to five years (April 1, 2000 to March 31, 2005), and describes changes and expansions to the Project developed during its first year.

## **1.2. Purpose**

The goal of the Project and the Association is to forecast and monitor stand development and timber yields associated with enhanced forest management of lodgepole pine in the Lower and Upper Foothills and the Subalpine Natural Sub-regions of Alberta.

## **1.3. Methods and Deliverables**

The goal of the Project and the Association will be achieved through a series of sub-projects developed cooperatively by members, in consultation with government agencies and other experts in forest growth and yield. Sub-projects of the Association will be designed to deliver yield

forecasts and establish validation programs for treatment regimes and site conditions of common interest to all members.

*Yield forecasts* are defined here as quantitative estimates of future stand timber yields, agreed by the scientific and regulatory community as the most probable outcome of the treatment regime being applied to the range of stand and site conditions specified. *Validation programs* will involve replicated field trials based on valid experimental designs.

The nature of tree growth requires the program to be long term and ongoing. Interim forecasts will be made of the growth and yield parameters being tested at the time of trial establishment, using the best available models and data. (These will be reported for each sub-project in a technical Establishment Report). The full benefits of the program will be derived from periodic growth re-measurements taken throughout the crop rotation. This Application details only the sub-projects, work phases and deliverables currently proposed for the next two years. It will be supplemented as new sub-projects and phases are developed.

Detailed methods are will be specified in sub-project plans and experimental designs. A Technical Committee and the Director develop project plans for approval by a Steering Committee (see Section 1.5).

Measured variables will include (a) stand and site parameters prior to or at time of treatment, and treatment parameters, and / or (b) stand and site parameters at benchmark stand development stages. These variables will include, or be stratified by, a common ecological site classification system. Forecast variables will include future stand conditions, and timber yields from intermediate (if applicable) and final harvests, at utilization standards agreed by the members.

Members of the Association on their tenured lands will carry out installation and measurement of growth and yield trials, and provide data, in a format defined by the Technical Committee and the Director. The Model Forest has engaged a Field Coordinator responsible for the control and compilation of data consistent with approved project plans.

Recognized scientific experts in growth and yield, silviculture, biometrics, tree nutrition, and forest ecology will review project plans and results, and / or participate in analyses. Meetings will be held at least once a year, to which experts will be invited to attend and participate. Formal peer review will be encouraged through the publication of project results.

Three sub-projects are currently at various phases of planning and development:

1. *Development and Management of the Foothills Growth and Yield Association*. The Foothills Model Forest initially supported this work. Commencing April 1, 2000, support has been provided through an Annual Membership Fee, which members may elect to fund from their FRIP accounts.
2. *Forecasting and Monitoring of Growth and Yield in Regenerated Lodgepole Pine Stands ("Lodgepole Pine Regeneration Project")*. Planning, detailed design and pilot installation was undertaken in fiscal year 2000. Approximately 90% of the establishment and initial measurement work phase will be completed by March 31, 2002, and the remainder during 2002. An extension of the Project to compare pre-harvest and post-harvest site indices will be undertaken in the 2001 or 2002 field season.

3. *Management of Nutrition and Density in Fire-origin Stands of Lodgepole Pine* (“*Nutrition and Density Management Project*”, referred to as “*Late-stage Trial*” in original proposal). A conceptual project plan, including preliminary technical and financial proposals, was completed in 2000. The first phase of the Project, a detailed evaluation and scope assessment, will be completed during 2001.

Funding is currently being applied for as follows.

### 1.3.1. Sub-project 1: Development and Management of the Association

The Annual Membership Fee for the period April 1, 2000 to March 31, 2002 is \$10,000 per voting member. In order to maintain a positive balance to March 31, 2005, at projected levels of expenditure and assuming no other sources of income, the annual fee will need to be increased to \$15,000 starting April 1, 2002. The fee is intended to cover the costs incurred by the Foothills Model Forest in management of the Association, and project design, coordination, quality control, and analysis. The associated deliverables will include:

1. annual reports of the activities, expenditures and achievements of the Association;
2. establishment and technical reports for Sub-project 2 (see 1.3.2 below);
3. a detailed scope assessment for Sub-project 3 and a scientific paper on knowledge gaps and the feasibility of operational fertilization and thinning of lodgepole pine in Alberta (see 1.3.3);
4. establishment and technical reports for any ensuing trials under Sub-project 3;
5. at least one technical information-exchange meeting per year, involving invited experts and providing educational value to members.

### 1.3.2. Sub-project 2: Lodgepole Pine Regeneration

The sponsoring partners will undertake establishment, treatment and measurement of the main field trial (see Appendix 1: *Project Plan and Experimental Design*.) plus an extension of the Project to compare pre-harvest and post-harvest site indices (see Appendix 1, Section 7). Costs are estimated and included in Section 2, but will be the subject of individual supplementary applications by the sponsors. The deliverables of the sponsors individually will be field installation, treatment, demarcation, and measurement of sample plots, verified by the Foothills Model Forest. The collective deliverables will include:

1. first preliminary establishment report (see *Foothills Growth and Yield Association – Consolidated Annual Report 2000-2001*);
2. second preliminary establishment report (to March 31, 2002);
3. final establishment report (by March 31, 2003);
4. technical report and scientific paper on comparison of pre-harvest and post-harvest site indices (by March 31, 2003);
5. technical report and scientific paper on early crop performance (by March 31, 2005).

### 1.3.3. Sub-project 3: Nutrition and Density Management

No funding, additional to Sub-project 1, is currently being applied against this sub-project. A scope assessment will be conducted as part of Sub-project 1. Any subsequent phases will be the subject of a new project proposal and new funding, although analytical and coordination services may continue to be provided out of Sub-project 1.

As part of the scope assessment, the Alberta Research Council (ARC) will provide under contract to the Association an expert review that will identify the knowledge gaps and feasibility of operational fertilization and thinning of lodgepole pine in the province of Alberta. Dr. Barry White of ARC will serve as principle investigator. Dr. White will collaborate with fellow scientists at the University of Alberta, namely Dr. Scott Chang and Dr. Victor Lieffers, and other experts as necessary. The ARC will sub-contract a research grant to Dr. Chang of the University of Alberta for this purpose. The final report will be re-formatted and submitted for publication in a peer-reviewed journal article, subject to approval by the Association's Steering Committee.

## 1.4. *Rationale*

This Section further describes how the Project fulfils the key proposal evaluation criteria of FRIAA.

### 1.4.1. Application of Results

The Project will enhance the management of forest resources by providing a continually improved, scientific, quantitative, and credible basis for:

- Evaluating and selecting silvicultural regimes and crop plans for the enhanced management of lodgepole pine;
- Forecasting the sustainable supply of timber from forest tenures containing lodgepole pine, and validating estimates of allowable cut;
- Improving the sustained yield of these forests through enhanced forest management.

Results will apply directly to over two million hectares of tenured and operable pine stands with a current allowable cut of about 5 million cubic metres per year, within the forest tenures of the 9 member companies of the Association. Information from this Project will be used to assess, develop, and approve strategies for enhanced and sustainable forest management within these forest tenures. It will be incorporated into variable regeneration standards, silvicultural prescriptions, crop plans, managed stand yield tables, and forest management plans. Because trials are stratified on an ecosystematic basis, rather than by tenure, the results will be generally applicable to much of the natural range of lodgepole pine in Alberta.

The Project will improve the integrated and sustainable management of forest ecosystems through:

- improved assessment of ecosystem productive capacity;
- improved assessment of the sustainable use levels of a biological resource;
- promotion of cooperation, partnership, and shared responsibility among forest managers and researchers;

- increased levels of knowledge and awareness of sustainable forest management;
- continual improvement of sustainable forest management practices;
- stand-level data providing the basis for assessing impacts of enhanced forest management practices on biological diversity, natural ecosystem processes, and contributions to global ecological cycles.

#### 1.4.2. Relationship to Existing Responsibilities

The work proposed pertains to the voluntary enhancement of forest management information and practices, and is not the responsibility of the industrial sponsors under any legislation, regulation, tenure, policy or specific agreement. The Project will assist the Government of Alberta in meeting its responsibilities for sustainable resource management, by providing improved assessment of forest growth and yield through the development of scientifically rigorous data and third-party evaluations.

#### 1.4.3. Impacts

The Project is not anticipated to have any adverse impacts on any other forest resource values or users. It has the active support of the land management agency involved (Alberta Sustainable Resource Development, Land and Forest Division), and has been reviewed and endorsed by the Board and partners of the Foothills Model Forest, representing a broad spectrum of forest stakeholders and researchers.

#### 1.4.4. Standards

Standards of experimentation will meet those accepted by the scientific community for biometric research. This is being achieved by third-party participation in project planning, and / or review of experimental designs, by recognized experts at the University of Alberta, the Alberta Research Council and other recognized centres of excellence. Measurement standards will follow or exceed those used by the Alberta Land and Forest Division (LFD) in monitoring stand dynamics. (The LFD has assigned mensurational expertise to the Association Technical Committee). Standards for forest site classification and evaluation are based on the latest published and government-approved field guides for west central and southwestern Alberta. High standards of analysis will be ensured by use of qualified personnel, extensive networking with growth and yield analysts and modelers, and peer review of results.

#### 1.4.5. Fair Market Value

Work will be undertaken using a combination of contractors and employees of the Foothills Model Forest and sponsors. Equipment will be leased. General benchmarks, used to ensure that fair market value is obtained for planned expenditures, will include:

- Project Manager. Prevailing consulting or salary rates for senior registered professional foresters with formal post graduate qualifications in forest science and twenty or more years relevant experience.

- Field Coordinator. Prevailing salary or contract rates for a registered professional forester with a minimum of five years leadership experience in forest field measurements.
- Other contractors and field personnel. Prevailing contract or wage rates based on the respective categories of work.
- Equipment rental. Market rates where these can be established. If equipment is leased (e.g. by the Foothills Model Forest to the Project) for which comparable market rates are not available, values will be based on an appropriate depreciation rate on capital value.

## **1.5. Project Management and Responsibilities**

The Association is a cooperative project involving voting members (who are all FRIAA members identified as the “sponsors” in Section 1 above), the Alberta Land and Forest Division (LFD), and the Foothills Model Forest (as Coordinating Agency).

### **1.5.1. Sponsors**

Responsibilities of the sponsors will include:

- Installation and measurement of growth and yield trials on their tenured lands;
- Provision of error-free data, in a format defined by the Coordinating Agency and the Technical Committee, from these trials to the Coordinating Agency;
- Appointment of a representative to the Steering Committee with authority to represent the Member’s strategic and financial interests;
- Assignment a representative to the Technical Committee with authority to represent the Member’s technical views and interests;
- Installation and periodic measurement of growth and yield trials as specified in the work plan approved by the Steering Committee;
- On or before April 1 each year, payment of a membership fee approved by the Steering Committee to support the direct costs incurred by the Coordinating Agency in the management of the Association.

Field trials and associated silvicultural activities will be conducted under authority of the sponsors’ timber tenures.

Overall control of Project management is vested in the Steering Committee, which will:

- Meet at least once each year;
- Elect from among the Voting Members’ representatives a chairperson who shall call and chair meetings (the current Chairperson is H. Lougheed of Weldwood Canada);
- Define, periodically review, and revise as necessary, a minimum project contribution level for Voting Members;
- Set, annually review, and revise as necessary, annual membership fees;
- Review and approve project plans, data standards, annual work plans, annual operating budgets, reports, and priorities for supporting research;
- Review and approve contracts for outside services, data sharing agreements, and other business arrangements proposed by the Director;



- Approve assignment to the Association of personnel hired or contracted by the Coordinating Agency;
- Approve the publication and dissemination of information resulting from Association projects.

The Technical Committee, supported by the Director and a Field Coordinator, will:

- Develop project plans, experimental designs and standards for approval by the Steering Committee;
- Assist the Director in the development of work plans and budgets;
- Coordinate the installation and measurement of field trials;
- Monitor program implementation, quality control, and data delivery;
- Evaluate project results.

### 1.5.2. Land and Forest Division

The Land and Forest Division (LFD) of the Alberta Ministry of Sustainable Resource Development has undertaken to:

- Assign the Director of Forest Management, or an equivalent senior official of the LFD, to participate on the Steering Committee in a non-voting advisory capacity;
- Assign a technical expert, or experts, knowledgeable in forest planning and yield forecasting, to the Technical Committee to provide advice on matters pertaining to project planning, experimental design, quality control, data acquisition, model development and validation, project evaluation, and regulatory requirements for yield forecasting and validation.

### 1.5.3. Foothills Model Forest

The Foothills Model Forest, as Coordinating Agency for the Association, will be responsible for:

- Administration of the Project;
- Ensuring that project plans, experimental designs, and data standards are developed in a timely manner;
- Data compilation;
- Control of data quality consistent with plans and standards approved by the Steering Committee;
- Selection or development (as appropriate), testing, and validation of stand-level growth and yield models which best represent the experimental sites, practices and data evaluated;
- Dissemination of information to, and continuing education of, Association members in matters relevant to the Association;
- Preparation and submission of the Project reports listed in Section 2.1.

The Foothills Model Forest will:

- Continue to retain the services of a Director to manage the Association;
- Retain or assign other staff and contract services, including the services of a Field Coordinator;

- Administer the annual operating budget of that portion of the Project for which it is directly responsible (Sub-project 1);
- Control expenditures in accordance with the approved operating budget, generally accepted Canadian accounting practices, and FRIAA requirements;
- Maintain books of account of all funds contributed and dispersed on behalf of the Project, in accordance with FRIAA requirements and generally accepted Canadian accounting practices, and subject to annual independent audit;
- Procure and maintain equipment and supplies required by the Project;
- If applicable, procure, own, and maintain equipment requiring capital expenditures, and lease such equipment to the Project at rates not exceeding fair market value
- Maintain a secure repository of all Association data.

#### 1.5.4. Project Manager

The Project Manager will be Dr. W.R. (Dick) Dempster, who is contracted to the Foothills Model Forest as Director of the Association.

The Project Manager, subject to the approval and supervision of the Steering Committee, will:

- Prepare an annual work plan and budget;
- Act as chairperson to the Technical Committee;
- Ensure that sub-project plans, experimental designs, and data standards are developed in a timely manner;
- Supervise a field coordinator or other staff approved by the Steering Committee;
- Consult with the Technical Committee regarding the selection, establishment and measurement of field trials;
- Ensure the timely compilation of Project data consistent with approved project plans and quality standards;
- Undertake, or direct the undertaking of, analysis of data and the selection, development, testing, or validation of appropriate stand-level models;
- Report the results of sub-projects to Association members and FRIAA;
- Arrange dissemination to Association members of information on matters relevant to the Project, including a minimum of one educational meeting or field trip per year;
- Provide progress reports to the Coordinating Agency at least every three months, annual reports to the Steering Committee and FRIAA, and technical reports as required and scheduled elsewhere in this proposal;
- Act as Secretary to the Steering Committee;
- Collaborate, cooperate and confer with other agencies as appropriate and necessary to further the interests of the Association;
- Arrange the dissemination or publication of data and results as directed by the Steering Committee.

## 2. Project Schedules

### 2.1. Work and Reporting Schedule

Table 1 summarizes project phases, deliverables, and due dates for deliverables and reports.

**Table 1**  
**Work and Reporting Schedule**

| <i>Sub-project</i>                        | <i>Phase</i>   | <i>Deliverable</i>  | <i>Due</i>   |
|---|--|---|--|
| 1. Association Development and Management | Management (April 1, 2000 – March 31, 2005)                    | Progress reports  | Quarterly  |
|   |  | Annual reports  | March 31 each year                                     |
|   |  | Steering Committee meeting minutes                                | After each meeting as directed by Committee            |
|   |  | Information exchange meetings, tours, and / or technical sessions | At least one per year                                  |
|   |  | Sub-project reports   | See Sub-projects 2 and 3                               |
| 2. Lodgepole Pine Regeneration            | Establishment and measurement (June 15, 2000 – March 31, 2005) | Status reports  | Annually; quarterly if required                        |
|   |  | Establishment and measurement verification reports                | Prior to final payments by FRIAA to sponsors           |
|   |  | Preliminary establishment reports                                 | March 31, 2001 and 2002                                |
|   |  | Final establishment report (including yield forecast)             | March 31, 2003   |
|   |  | Crop performance report & scientific paper                        | March 31, 2005   |
|   | Treatment (August 1, 2002 – March 31, 2005)                    | Industrial Evaluation Herbicide Project proposal                  | May 1, 2002  |
|   |  | Herbicide monitoring reports                                      | Annually following approval herbicide project approval |
|   |  | Technical report and scientific paper                             | March 31, 2003   |
|   | Site index extension (September 1, 2001 – October 31, 2002)    |   |  |
|   | 3. Nutrition and Density Management                            | Scope Assessment (July 1, 2001 – March 31, 2002)                  | Draft report   |
| Final report and scientific paper         |  |   | March 31, 2002   |

Members of the Association have agreed on a schedule for allocating Sub-project 2 fieldwork among members. (See Section 2.2.2 and Appendix 1.)

## 2.2. Budget and Payment Schedules

The following budget and payment schedules summarize the estimated costs associated with the work scheduled above (in Section 2.1). Schedules for Sub-project 2 will be confirmed by supplementary applications from sponsors (see Appendix 2).

### 2.2.1. Sub-project 1: Association Development and Management

Table 2 itemizes income and expenditures for the period April 1, 2000 to March 31, 2005. Those for fiscal year 2000 (i.e. April 1, 2000 to March 31, 2001) are actual; those for the remaining years are forecast. The schedule includes and differentiates all sources of direct income to the Association (i.e. not only FRIP monies). It does not include in-kind or indirect contributions (e.g. field coordinator salary / fee costs for first two years, and administrative costs incurred by the Foothills Model Forest).

**Table 2**  
**Income and Expenditures for Sub-project 1: Association Development and Management**

| Income / Expense                          | 2000    | 2001    | 2002    | 2003    | 2004    | Total   |
|---|---------|---------|---------|---------|---------|---------|
| <b>Income</b>                             |         |         |         |         |         |         |
| Foothills Model Forest (PEF contribution) | 146,106 |         |         |         |         | 146,106 |
| Membership fees - FRIP (FRIAA contract)   | 70,000  | 70,000  | 105,000 | 105,000 | 105,000 | 455,000 |
| Membership fees - FRIP (member direct)    | 10,000  | 10,000  | 15,000  | 15,000  | 15,000  | 65,000  |
| Membership fees - non-FRIP                | 10,000  | 10,000  | 15,000  | 15,000  | 15,000  | 65,000  |
| Total income                              | 236,106 | 90,000  | 135,000 | 135,000 | 135,000 | 731,106 |
| <b>Expenses</b>                           |         |         |         |         |         |         |
| Director                                  | 62,370  | 64,800  | 64,800  | 64,800  | 64,800  | 321,570 |
| Field Coordinator                         | -       | -       | 50,000  | 50,000  | 50,000  | 150,000 |
| Other contract services                   | -       | 45,000  | 5,000   | 5,000   | 5,000   | 60,000  |
| Vehicle (rental and / or mileage)         | 3,394   | 4,358   | 4,358   | 4,358   | 4,358   | 20,826  |
| Expenses (contractors & FMF staff)        | 7,789   | 14,970  | 14,970  | 14,970  | 14,970  | 67,669  |
| Meetings                                  | 4,551   | 7,321   | 7,321   | 7,321   | 7,321   | 33,835  |
| Equipment & miscellaneous                 | 6,721   | 12,809  | 3,000   | 3,000   | 3,000   | 28,530  |
| GST                                       | 5,318   | 9,400   | 9,414   | 9,414   | 9,414   | 42,959  |
| Total expenses                            | 90,143  | 158,658 | 158,863 | 158,863 | 158,863 | 725,389 |
| <b>Ending Balance</b>                     | 145,963 | 77,305  | 53,442  | 29,580  | 5,717   | 5,717   |

## 2.2.2. Sub-project 2: Lodgepole Pine Regeneration Trial

Forecast costs of establishment, measurement and treatment are summarized in Table 3. These costs include the main long-term monitoring trial plus the short-term comparison of pre-harvest and post-harvest site indices. Table 4 shows total costs for the main monitoring trial (i.e. excluding the site-index comparison) broken down by member company, assuming that all companies incur the same costs for each of the operations listed in Table 3, and that only Sunpine undertakes stem-mapping. Estimated costs are indicative only. The actual amount and timing of costs will vary among the sponsors. The estimates are based on a total of 103 installations committed by members.

**Table 3**  
**Unit and Total Costs for Sub-project 2**

| <b>Operation</b>                           | <b>Year</b> | <b>\$ per installation</b> | <b>Total \$</b> |
|--|-------------|----------------------------|-----------------|
| Establishment and initial measurement      | 2001        | 4,625                      | 476,375         |
| Stem mapping (optional)                    | 2001        | 765                        | 10,710          |
| Mortality and competition assessment       | 2002        | 320                        | 32,960          |
| Full measurement                           | 2003        | 1,500                      | 154,500         |
| Mortality and competition assessment       | 2004        | 320                        | 32,960          |
| Brushing (applies to 40% of installations) | 2002-04     | 275                        | 11,330          |
| Comparison of pre- and post-harvest SI     | 2001-02     | n/a                        | 50,000          |
| Overhead (5%)                              |             |                            | 38,442          |
| Total                                      |             |                            | 807,277         |

**Table 4**  
**Indicative Costs by Sponsor for Sub-project 2 Monitoring Trial**

| <b>Company</b> | <b># of installations</b> | <b>Contract cost</b> | <b>Overhead cost</b> | <b>Total cost</b> | <b>Av. cost / installation</b> |
|----------------|---------------------------|----------------------|----------------------|-------------------|--------------------------------|
| ANC            | 6                         | 41,250               | 2,063                | 43,313            | 7,219                          |
| BRL            | 8                         | 55,000               | 2,750                | 57,750            | 7,219                          |
| Canfor         | 6                         | 41,250               | 2,063                | 43,313            | 7,219                          |
| MWFP           | 6                         | 41,250               | 2,063                | 43,313            | 7,219                          |
| Spray Lakes    | 6                         | 41,250               | 2,063                | 43,313            | 7,219                          |
| Sundance       | 6                         | 41,250               | 2,063                | 43,313            | 7,219                          |
| Sunpine        | 14                        | 106,960              | 5,348                | 112,308           | 8,022                          |
| Weldwood       | 21                        | 144,375              | 7,219                | 151,594           | 7,219                          |
| Weyerhaeuser   | 30                        | 206,250              | 10,313               | 216,563           | 7,219                          |
| Total          | 103                       | 718,835              | 35,942               | 754,777           | 7,328                          |

## *Appendices*

# Appendix 1

## Sub-project 2: Plan and Experimental Design

### 1. Project

*Effects of Site, Competition, and Initial Density Management on Early Crop Performance and Stand Growth and Yield of Lodgepole Pine*

Short title: *Lodgepole Pine Regeneration Project*

### 2. Objectives

The general purpose of the Project is to forecast and monitor the growth and yield of regenerated lodgepole stands in relation to site, early crop performance and stocking, vegetative competition, and density regulation.

The Project is designed to answer the following questions:

- What are the relationships between early stand conditions (stocking, height growth, density, competition) and subsequent growth and yield?
- How does stand growth and yield respond to different levels of initial spacing and pre-commercial thinning?
- How do these responses and relationships vary across sites of primary interest?

The experimental objectives are:

1. Estimate the effects of site and establishment factors on early crop performance.
2. Estimate the effects of site and establishment factors on subsequent stand growth and yield.
3. Estimate the effects of early crop performance and density regulation on subsequent stand growth and yield.

The site factor of prime interest is ecosite, including the associated soil and moisture regimes. However, other site factors are also of interest because they are expected to influence early crop performance and subsequent growth and yield. These include:

- local climate as reflected by natural sub-region, ecodistrict, elevation, latitude, and topographic position;
- edaphic factors not necessarily captured by the ecosite classification;
- biotic factors, particularly occurrence of pathogens.

The establishment factors of primary interest are:

- initial spacing (of planted stock);
- natural ingress and mortality (of lodgepole pine);
- competing vegetation (other species);
- density regulation (pre-commercial thinning).

The following attributes of early crop performance will be monitored from installation until the average height of trees on the plot exceeds 1.3 m:

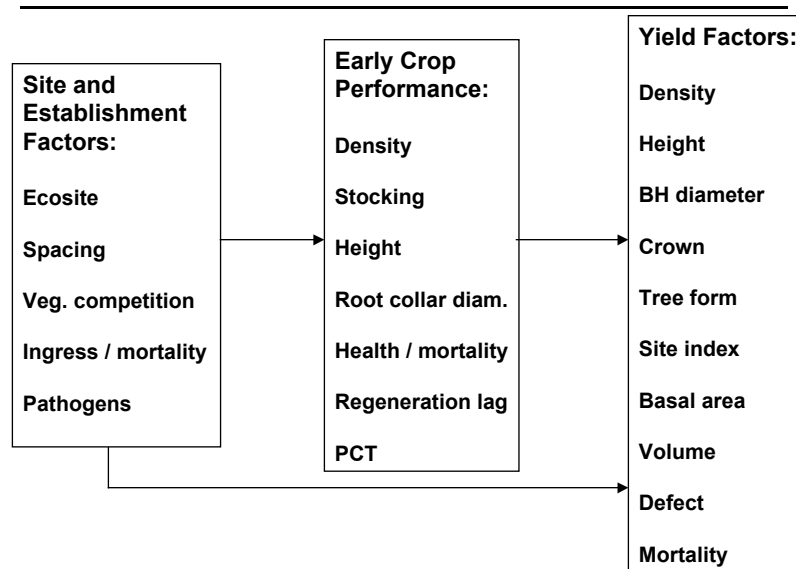
- density;
- stocking;
- height;
- root-collar diameter;
- health;
- mortality
- regeneration lag.

Monitoring of the following attributes of subsequent stand growth and yield will continue or commence when the average height of trees on the plot approaches 1.3 m:

- density;
- height;
- breast-height diameter;
- crown development;
- tree form;
- site index;
- basal area;
- volume;
- health and defect;
- mortality.

The effects to be estimated and monitored are summarized in Figure 1.

**Figure 1. Effects to Be Estimated**





### 3. Experimental Treatments

#### 3.1. Ecosite

Table 1 shows the 5 ecosite categories that will be recognized in the experimental design, and references the associated field guides and natural sub-regions.

*Table 1. Ecosite Categories*

| <i>Ecosite (and Edatope)</i>   | <i>WC</i> | <i>SW</i> | <i>NSR</i>  |
|--|-----------|-----------|-------------|
| 1. Bearberry / lichen / h.w. rye<br>(submesic / subxeric, medium – low)    | b, c      | b         | any         |
| 2. Labrador tea – mesic<br>(mesic – poor)                                  | d         | c         | UF<br>LF    |
| 3. Billberry / cranberry / sarsaparilla /<br>rhododendron (mesic / medium) | e         | d         | SA/UF<br>LF |
| 4. Honeysuckle / fern<br>(subhygric – rich)                                | f         | e         | UF<br>LF    |
| 5. Labrador tea – hygric<br>(hygric – poor)                                | h         | f         | any         |

WC = west-central guide  
SW = southwestern guide  
NSR = natural sub-region

#### 3.2. Management Treatments

Controlled management treatments will involve initial spacing of planting stock (6 levels

*Table 2. Management Treatments*

| <i>Treatment</i>      | <i>N</i> | <i>Explanation</i>   |
|-----------------------|----------|--|
| Spacing               | 6        | control (no planting); plant:<br>816, 1111, 1600, 2500, 4444<br>per ha |
| Vegetation management | 4        | none, weed, pre-<br>commercially thin, weed and<br>PCT                 |

including no planting), and 4 vegetation management treatments (see Table 2).

Details of procedures for management treatments are contained in: *Lodgepole Pine Regeneration Project - Field Manual*, Foothills Growth and Yield Association, 2001.

## 4. Statistical Design

The trial is a three-level split-plot design. The basic balanced design consists of 90 field installations (5 ecosites x 6 spacings x 3 replications), with each installation split into 4 plots (vegetation management treatments). Additional replication may be added. An additional 12 installations (6 spacings x 2 replications) has so far been added in the modal category 3 ecosite, to produce a total of 102 installations. The three levels are described below for the basic balanced design.

### Level A:

Installations within each of the 5 ecosites are blocked into 3 geographic “groups”, to produce a total of 15 groups. Note that these groups are *blocks* in the statistical sense, but not cut-blocks. Rather, they are geographic groups of cut-blocks having the same ecosite and similar climatic, edaphic, and site preparation characteristics. The intent is to reduce the confounding influence of uncontrolled site and management variables on spacing effects and interactions. These uncontrolled variables will also be measured at each installation and may be included in the analysis of variance (see below) as co-variates.

### Level B:

6 installations (one for each spacing treatment) in each of the 15 “groups”.

### Level C:

Each installation is split into 4 vegetation management treatment plots.

Each installation is actually a “split-plot”, and will be split two ways (weeding / no weeding and eventually thinning / no thinning) to produce 4 sub-plots (see Figure 2).

Table 5 shows the design in terms of analysis of variance and degrees of freedom.

**Table 3**  
***Analysis of Variance***

| Analysis of Variance |   | Degrees of Freedom |
|----------------------|---|--------------------|
| Level A              | Ecosite                                   | 4                  |
|                      | Error                                     | 10                 |
| Level B              | Spacing                                   | 5                  |
|                      | Spacing * ecosite                         | 20                 |
|                      | Error                                     | 50                 |
| Level C              | Vegetation management                     | 3                  |
|                      | Vegetation management * spacing           | 15                 |
|                      | Vegetation management * ecosite           | 12                 |
|                      | Vegetation management * spacing * ecosite | 60                 |
|                      | Error                                     | 180                |
| Total                |   | 359                |

## 5. Sample Selection

Initial selection was based on sampling from a list of candidate cut-blocks that were available for planting in 2000 or 2001, are to be managed for lodgepole pine, and fall within one (or more) of the 5 ecosite categories (see Table 1). Sufficient information was required to locate the centroid of the block on the UTM grid, and to identify the most probable ecosite category. Useful additional information included: pre-harvest assessment, area, natural sub-region, ecodistrict, confirmed ecosite(s), edatope, elevation, latitude, aspect, slope percent, slope position, soil classification, pre-harvest ecosite phase, pre-harvest site index, site preparation method and equipment, and proposed planting stock and season.

The preliminary selections required field checking to confirm that each cut-block within a group contained a minimum of 1 square hectare meeting the following conditions common to all other cut-blocks within the group:

1. Same ecosite category and position on edatopic grid.
2. Similar soil texture, drainage, and parent material.
3. Within 100 m elevation.
4. Slope less than 10% or, if 10% or greater, within 5%.
5. Similar slope position: upper, mid, lower (if lower slope position, take particular care to ensure similar soil drainage and nutrient regime).
6. Similar aspect. Ensure commonality with respect to N versus S, and wind exposure. Preferably within 45 degrees.
7. No evidence of differences in brush hazard.
8. Same method and time (season and calendar year) of site preparation, and preferably (but not necessarily) the same site preparation contractor.
9. Maintain a minimum buffer distance of 20 m from the treatment plots to block edges, roads, or other disturbances likely to create edge effects. No burning of slash piles should have occurred, or be scheduled, anywhere within the installation or (blue) protective buffer.

In the event that candidate locations failed to meet these criteria, that access costs were prohibitive for some blocks, and / or that some blocks were geographically distant from the rest of the group, alternative blocks were substituted for the candidate ones providing that the substitute blocks met the above criteria. Where large cut blocks were available, and difficulty was encountered in identifying 6 blocks with common criteria, more than one installation was allowed in a single cut block.

Contiguous or square installations were not always be possible due to discontinuities in ecosites or some of the conditions listed above. In such situations the installation was reconfigured so that the 4 treatment plots were in a line, staggered, or separated

Determination of whether a block is sufficiently accessible was left to the individual member. Although it is desirable to constrain allocation of plots as little as possible, it should be borne in

mind that establishment of the installation creates a commitment to continual monitoring. Plots were located only where the member is willing to pay for subsequent re-measurement.

## 6. Installation and Measurement

Details of procedures for installation and measurement are contained in: *Lodgepole Pine Regeneration Project - Field Manual*, Foothills Growth and Yield Association, 2001. Members committed to installations as indicated in Table 6. Table 6 also shows the number of installations planted as of July 31, 2001.

**Table 6**  
**Allocation and Current Status of Installations by Company**

| Company           | # of installations |                        |
|-------------------|--------------------|------------------------|
|                   | committed          | planted<br>(July 2001) |
| Alberta Newsprint | 5                  | 5                      |
| Blue Ridge Lumber | 8                  | 2                      |
| Canfor            | 6                  | 6                      |
| Millar Western    | 5                  | 5                      |
| Spray Lakes       | 6                  | 6                      |
| Sundance          | 6                  | 6                      |
| Sunpine           | 14                 | 14                     |
| Weldwood          | 21                 | 18                     |
| Weyerhaeuser      | 30                 | 30                     |
| Total             | 101                | 92                     |

Note: An additional installation is required in Group 3, Ecosite Category 5, and is currently unallocated. (The total number of planned installations is 102.) The 9 installations not yet planted will be established in the 2002 field season.

Table 7 shows the measurements required during the first 5 growing seasons.

**Table 7**  
**Timing of Required Measurements**

| Measurement Category           | Growing Season |   |   |   |   |   |
|--------------------------------|----------------|---|---|---|---|---|
|                                | 0              | 1 | 2 | 3 | 4 | 5 |
| Site                           | x              |   |   |   |   |   |
| Planting density               | x              |   |   |   |   |   |
| Coniferous density             |                | x |   | x |   | x |
| Coniferous stocking            |                | x |   | x |   |   |
| Competition – shrubs and herbs | x              | x | x | x |   | x |
| Competition – deciduous trees  | x              | x | x | x |   | x |
| Size and growth                | x              | x |   | x |   | x |
| Mortality                      |                | x | x | x | x | x |
| Health                         | x              | x |   | x |   | x |
| Age                            |                |   |   |   |   | x |

Ten categories of measurement are recognized and required during the first five years of the trial. Note that timing of measurements is expressed in growing seasons completed following planting of the installation. Measurements should be made at the end of the growing season, following terminal bud set.

The required information for Growing Season 0 should be collected for all installations at the time of establishment (or earlier in the case of site index). If an installation is established with cold-stored stock and planted in the Spring of 2001 so that the trees flush in the 2001 growing season, the measurements indicated for Growing Season 1 should also be made in 2001, following bud set. If an installation is planted late in the season with set trees, the measurements for Growing Season 1 should be made after bud set in 2002.

## **7. Project Extension: Comparison of Pre-harvest and Post-harvest Site Indices**

### **7.1. Justification and Purpose**

Site index (SI) change is the most serious impediment to initial forecasting of the growth and yield responses being monitored by the Lodgepole Pine Regeneration Project. In March 2001, the Association Steering Committee decided to proceed with a cooperative extension to the current Project, involving paired-plot sampling of stands in each of the Project's five ecosite categories, preferably in combination with permanent sample plot data contributed by members.

The purpose of the Project extension will be to provide credible and reliable forecasts of post-harvest SI, for the main ecosite categories of interest to members, relative to pre-harvest SI values.

### **7.2. Methodology**

The development by some Association members of permanent sample plot (PSP) data with pre- and post harvest measurements provides an unprecedented opportunity for evaluating changes in SI and stand height development using true time-series information.

Data for at least 80, and possibly as many as 100, permanent sample plots are expected to meet minimum criteria for site index assessment of the regenerated, as well as pre-harvest, condition. Site indices will be estimated from height and age data using available published models for young and mature lodgepole pine. Differences between pre-harvest and post-harvest values will be evaluated by paired samples t-test.

In addition to the above "vertical comparison" based on true time-series data, a contemporaneous ("horizontal") comparison will be made based on paired-plot data collected specifically for the purpose.

Fifty stands or cut blocks throughout members' tenures will be identified, in which the regeneration has reached at least five years breast-height age, and portions of the original parent

stand are still standing on the same ecosite as the regeneration. If possible, 10 such stands will be located for each of the five ecosite categories recognized in the main Project.

Three pairs of plots will be located, each with one plot in the regenerated portion and one in the parent portion of the stand. Each pair will be placed in such a way that both plots occur in the same soil moisture and nutrient regimes. The plots will be installed, and site trees will be selected and measured as described below.

The plots will be circular, radius 9.77 m, with an area of 300m<sup>2</sup>. In the pre-harvest parent stands, the total height and breast-height age of each of the three largest-DBH valid lodgepole pine trees on the plot will be measured. In addition, stand density and other basic mensurational variables will be measured and compiled.

The same plot size, measurements, and tree selection criteria will be applied to immature regenerated stands, in addition to which the last five annual internode lengths will recorded. This will normally require felling the tree. Splitting of the stem may be necessary to locate pith nodes in the event that annual whorls are indistinct, or there is an inconsistency between breast-height age as measured by whorl count versus number of growth rings.

The experimental design will permit the following statistical tests and analyses:

1. Paired samples t-test: a sensitive test to evaluate the overall difference in SI between pre- and post-harvest SI.
2. One-way repeat measure analysis of variance: will determine the significance of origin (pre- and post-harvest) effects relative to between-stand and within-stand variance.
3. Two-way analysis of variance and associated range tests: will allow evaluation of site and origin effects, and assessment of site and origin mean SI values and differences.

### **7.3. Arrangements for Sharing Effort and Data**

Costs will be distributed among members according to the formula developed for the main Project (see Table 6). Existing available PSP data may be recognized as a valid contribution, and therefore should be offset against a member's required level of contribution to the new paired plot data. This will require agreement on an equivalence ratio between PSPs and the new paired plots.

The ultimate product of the Project extension will be a published peer-reviewed scientific report. Although the intent is to make the results public (subject to Steering Committee approval), the PSP data contributed by members will remain their property. Members' rights and privileges in this regard can be protected by a data sharing agreement between the member owning the data and the Foothills Model Forest which, as Coordinating Agency for the FGYA, is charged with conducting the analysis.

## **Appendix 2**

### **Application and Schedule Formats for Sub-project 2**

# Forest Resource Improvement Association of Alberta

P.O. Box 11094, Main Post Office, Edmonton, Alberta T5J 3K4

## PROPOSAL SUMMARY – APPLICATION Forest Resource Improvement Program (the "Program")

### Applicant Information

|                    |  |        |  |
|--------------------|--|--------|--|
| Name of Applicant: |  | Phone: |  |
| Mailing Address:   |  | Fax:   |  |
| Contact Person:    |  |        |  |
| Delivery Address:  |  |        |  |

### Sponsor Information (if applicable)

|                    |  |        |  |
|--------------------|--|--------|--|
| Name of Applicant: |  | Phone: |  |
| Mailing Address:   |  | Fax:   |  |
| Contact Person:    |  |        |  |
| Delivery Address:  |  |        |  |

### Project Information

| Type of Project  | Term of Project                | Amount of Funds Applied For |
|--|--------------------------------|-----------------------------|
| Inventory/Planning<br>Foothills Growth and Yield Association –<br>Sub-project 2: Lodgepole Pine Regeneration | April 1, 2000 – March 31, 2005 |                             |

**Attachments:**

\_\_\_\_\_ Proposal: see "*Foothills Growth and Yield Association*" submitted by Foothills Model Forest, September 2001

\_\_\_\_\_ Proposed payment schedule (attached if different from Section 2 of Proposal)

\_\_\_\_\_ Schedule of financial and technical reports (attached if different from Section 2 of Proposal)

\_\_\_\_\_ Other: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

### Acknowledged by Applicant and/or Sponsor

The Applicant and/or Sponsor (jointly and severally the "Signatory") acknowledge having read and agreed to the terms and conditions described on the attached schedule to which the Application under the Program is made subject. The Signatory acknowledges and agrees that by its submission of this application it shall be bound by the terms of the Program, FRIAA's policies, procedures, protocols and guidelines. It is also acknowledged and agreed that this application may be accepted by FRIAA on further terms or conditions, which shall be binding on the Signatory once the proposed project is undertaken by the Signatory.

\_\_\_\_\_  
Applicant

\_\_\_\_\_  
Sponsor



| <b>Payment and Completion Schedule</b> |                           |                   |                 |                          |             |
|--|---------------------------|-------------------|-----------------|--------------------------|-------------|
| <b>Operation</b>                       | <b># of installations</b> | <b>Start date</b> | <b>End date</b> | <b>Requested payment</b> |             |
|  |                           |                   |                 | <b>Amount (\$)</b>       | <b>Date</b> |
|  |                           |                   |                 |                          |             |
|  |                           |                   |                 |                          |             |
|  |                           |                   |                 |                          |             |
|  |                           |                   |                 |                          |             |
|  |                           |                   |                 |                          |             |
|  |                           |                   |                 |                          |             |
|  |                           |                   |                 |                          |             |
|  |                           |                   |                 |                          |             |

| <b>Schedule of Financial and Technical Reports</b> |               |
|--|---------------|
| <b>Date</b>  | <b>Report</b> |
|  |               |
|  |               |
|  |               |
|  |               |
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|  |               |
|  |               |

Note: these schedules are required only if the scope, cost and / or schedule of work for a Project participant differ from those in Section 2 of the main Proposal.