A Forestry Management Planning Strategy for Remote Communities

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ABSTRACT

This forest management framework provides Aboriginal communities with the necessary information and format to develop a long-term and integrated resource management plan. It is designed to be adapted as part of small-scale forestry operations to supply woodchips for burning in biomass heating facilities. The framework allows individual communities to modify the format to suit their needs and recognizes and plans accordingly for the unique circumstances and characteristics of remote Aboriginal communities. The framework is modeled after work done by the National Aboriginal Forestry Association and provincial government agencies. The report includes information with respect to completing a plan for the following: importance of planning, definition of terms and description of component parts including period, land description, history, maps, community objectives, traditional ecological knowledge, inventory data, sustainable harvest levels, activity schedules, monitoring and review. A model-forest is described as a reference example based upon clearly identified community goals and holistic land and resource management objectives. Sample data and information tables are provided. A process to assist with developing a training strategy for community members is included. Planning costs are estimated and formulas provided to allow individual communities to prepare cost estimates and budgets to suit their needs. This is one of two reports with respect to Aboriginal community biomass heating systems completed with financial assistance from the federal government's Energy from the FORest (ENFOR) program.

RÉSUMÉ

Le présent cadre d'aménagement forestier donne aux collectivités autochtones les renseignements et les directives nécessaires à l'élaboration d'un plan de gestion intégrée et à long terme des ressources. Il se veut un outil adaptable aux opérations forestières à petite échelle destinées à approvisionner différentes installations utilisant des copeaux de bois comme combustible. Ce cadre a été conçu de façon à ce que les différentes collectivités puissent le modifier selon leurs besoins particuliers ainsi que prendre en compte les circonstances et les caractéristiques uniques des Autochtones vivant dans des régions éloignées et établir un plan en conséquence. Il s'inspire des travaux effectués par l'Association nationale de foresterie autochtone et des organismes gouvernementaux provinciaux. Ce rapport présente notamment des renseignements sur les aspects suivants : importance de la planification, définition des termes et description des parties constituantes, y compris, la durée, la description du territoire, l'historique, des cartes, les objectifs communautaires, le savoir écologique traditionnel, les données d'inventaire, les niveaux de récolte durables, les calendriers des activités, la surveillance et le processus d'examen. À titre d'exemple type, il décrit une forêt modèle basée sur des objectifs communautaires clairement définis et des objectifs holistiques de gestion des ressources et des terres. Il présente des exemples de tableaux de données et de renseignements. Il expose un processus pour aider à élaborer une stratégie de formation des membres de la collectivité. Il estime les coûts de planification et présente des formules permettant aux différentes collectivités de préparer des estimations des coûts et des budgets adaptées à leurs besoins. Le présent rapport est l'un d'une série de deux concernant les systèmes de chauffage utilisant des combustibles dérivés de la biomasse dans les collectivités autochtones et qui ont été réalisés avec l'aide financière du programme ENFOR (Énergie de la forêt) du gouvernement fédéral.

PREFACE

ENFOR was established in 1978 as part of a federal interdepartmental initiative to develop renewable energy sources. It is a contract research and development (R&D) program aimed at generating sufficient knowledge and technology to realize a marked increase in the contribution of forest biomass to Canada's energy supply.

Administered by the Canadian Forest Service, the ENFOR program deals with biomass supply matters such as inventory, growth, harvesting, processing, transportation, environmental impacts, and socioeconomic impacts and constraints. The program normally provides total funding for contracted studies, the results of which become the property of the federal government and are freely available to the public.

A technical committee oversees the program and develops priorities, assess proposals, and makes recommendations. Approved projects are contracted out to the private sector. Although most project ideas are generated by Canadian Forest Service personnel, proposals from external sources are encouraged and considered. These proposals should be submitted through the appropriate regional offices or the Canadian Forest Service headquarters. Proposals are assessed in the fall of each year. The program operates on the basis of the fiscal year, from April 1 to March 31. Approximately $1 million is spent annually on ENFOR projects. The program normally provides total funding for contracted studies, while the results become the property of the federal government and are freely available to the public.

The program is coordinated by the Canadian Forest Service headquarters, but most projects are managed by one of five Canadian Forest Service centers. Scientists at these establishments initiate project proposals in response to regional and national priorities; they implement and manage approved projects; they carry out in-house R&D; and they prepare information reports. A scientific authority is assigned to each project to follow its progress and serve as the principal contact between the contractors and ENFOR program managers. The involvement of regional personnel provides the local perspective necessary to ensure the success of this national program.

Study results are either distributed as contractors' reports, or published in the Canadian Forest Service Information Report series or in technical journals. Comprehensive and detailed reports on the work are available and may be obtained on request from the addresses indicated with the individual abstracts in this publication.

For further information, write or telephone your nearest Canadian Forest research centre or the ENFOR Secretariat at the Canadian Forest Service headquarters. To have your name added to the national mailing list, write to the ENFOR Secretariat.

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Note: During the first 6 years of the ENFOR program, numerous projects were undertaken in the biomass conversion area. Efficiency and Alternative Energy Technology Branch, Natural Resources Canada, is now responsible for this topic. Information can be obtained from the Bioenergy Group, 580 Booth Street, Ottawa, Canada K1A 0E4, (613) 996-6226. For ENFOR projects initiated before 1990, please see previous volumes of the ENFOR Review.

The ENFOR program is funded by the federal Panel on Energy R&D (PERD).

PRÉFACE

ENFOR a été créé en 1978 dans le cadre d'une initiative interministérielle fédérale visant à développer les sources d'énergie renouvelable. C'est un programme contractuel de recherche développement (R-D) visant à générer un volume suffisant de connaissances et de technologies pour entraîner une augmentation marquée de la contribution de la biomasse forestière à l'approvisionnement énergétique du Canada.

Administré par le Service canadien des forêts, le programme ENFOR traite des questions d'approvisionnement en biomasse comme l'inventaire, la croissance, la récolte, le traitement, le transport, les incidences sur l'environnement de même que les répercussions et les contraintes socio-économiques.

C'est un comité technique qui surveille le déroulement du programme et établit l'ordre des priorités, évalue les propositions et formule des recommandations. Les projets approuvés sont sous-traités au secteur privé. Même si la plupart des idées de projet proviennent du personnel du Service canadien des forêts, les propositions de l'extérieur sont vivement encouragées et prises en considération. Ces propositions doivent être soumises aux bureaux régionaux compétents ou à l'administration centrale du Service canadien des forêts. Les propositions sont évaluées chaque année à l'automne. Le programme fonctionne sur la même base que l'exercice financier, soit du 1er avril au 31 mars. On consacre environ 1 million de dollars chaque année aux projets ENFOR. Le programme assure normalement le financement total des études sous-traitées, dont les résultats deviennent la propriété du gouvernement fédéral et sont mis à la disposition gratuite du public.

Le programme est coordonné par l'administration centrale du Service canadien des forêts, mais la plupart des projets sont administrés par l'un des cinq centres de foresterie du Service canadien des forêts. Les chercheurs qui travaillent dans ces établissements émettent des propositions de projet en fonction des priorités régionales et nationales; ils mettent en oeuvre et gèrent les projets approuvés; ils font certaines activités de R-D à l'interne; enfin ils préparent les rapports d'information. Un responsable scientifique est affecté à chaque projet pour suivre son avancement et servir de personne-ressource principale entre les entrepreneurs et les gestionnaires du programme ENFOR. La participation du personnel régional procure l'optique locale indispensable au succès de ce programme national.

Les résultats des études sont diffusés sous forme de rapports d'entrepreneurs ou publiés dans la série des rapports d'information du Service canadien des forêts ou dans des revues techniques. Des comptes rendus complets et détaillés des travaux sont disponibles et il suffit d'écrire à l'adresse qui accompagne chacun des résumés de cette publication pour se les procurer.

Pour d'autres précisions, veuillez écrire ou téléphoner au centre de foresterie du Service canadien des forêts le plus proche de chez-vous ou au Secrétariat ENFOR à l'administration centrale du Service canadien des forêts. Pour faire inscrire votre nom sur la liste nationale d'envoi, veuillez écrire au secrétariat ENFOR.

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Note : Au cours des six premières années d'existence du programme ENFOR, de nombreux projets ont été entrepris dans le domaine de la conversion de la biomasse. C'est aujourd'hui la Direction de la technologie de l'énergie de Ressources naturelles Canada qui est responsable de ce domaine. Pour tout renseignement, s'adresser au Groupe des technologies des énergies renouvelables, 580, rue Booth, Ottawa, Canada K1A 0E4, (613) 996-6226. Pour les projets ENFOR entrepris avant 1990, consulter les volumes antérieurs du Bulletin ENFOR. Le programme ENFOR est financé par le Groupe interministériel de recherche et d'exploitation énergétiques (GRDE).

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Introduction

Many Aboriginal communities are looking very seriously at self-governance and self-reliance. The road to achieving this goal will involve generating opportunities and capitalizing on at least two primary challenges, economic development and sustainable employment opportunities.

The Canadian commitment to sustainable forest management is enshrined in the 1998 National Forest Strategy and the criteria and indicators for the sustainable management of Canadian forests. These principles should help to guide the forest management planning process and implementation of the plan. Aboriginal communities may also wish to develop principles of sustainable forest management that will reflect specific needs within the community and community objectives for forest land use. A popular view, amongst forest managers and workers, is that planning success can best be achieved through adherence to the following general management principles (The Scientific Panel for Sustainable Forest Practices in Clayoquot Sound 1995):

- respect for traditional values and spirituality;
- incorporate existing Aboriginal people's knowledge and practices into planning;
- conduct a meaningful consultation/involvement process within the community
- incorporate Aboriginal forest land management guidelines established by National Aboriginal Forestry Association (NAFA) (Smith et al. 1995).

Many remote Aboriginal communities in Canada (approximately 150), are surrounded by vast forested areas creating potential forest management opportunities for small-scale, integrated forest harvesting operations. Expanding the use of forest biomass in remote communities requires, among many other requirements, an integrated sustainable approach to forest management to ensure a continued supply of wood while maintaining the ecological integrity and productive capacity of the forest. It is perhaps of greater importance to ensure that Traditional and Ecological Knowledge and values of the Aboriginal community are highly regarded in all stages of the process, (i.e., community consultation, planning, design, implementation and operation).

This Information Report is one of two providing information about forest biomass as an alternative for fuel-oil heat energy. Specifically, this report focuses on a community-based approach to sustainable forest management planning for First Nation Reserve lands and other classes of Aboriginal land in Canada, perhaps with particular relevance to the Prairies and Ontario. In addition, we present a framework for management planning, with examples to illustrate various components of a management plan. Checklists, forest inventory tally and compilation sheets, and a management planning costing worksheet are included.

Forest Management Planning Systems

What is a forest management plan? A forest management plan is a written document that establishes the long-term strategies and objectives for sustainable forest management for a defined forest area. The management plan guides proposed forest operations over the duration of the plan through recommended forest development and improvement activities (Smith et al. 1995). For remote Aboriginal communities, which may be contemplating integrated forestry operations including wood-chip production for energy, the forest management plan could form part of a broader outline for forest development identified in a community business plan.

Why is a forest management plan required? An Aboriginal forest management plan should integrate forest management objectives with broader community objectives. The forest management plan guides forest operations by establishing sustainable forest harvest schedules, silvicultural prescriptions, and operating guidelines. Monitoring and evaluation of management activities are important elements of forest management plans. This process, to be repeated at periodic intervals, identifies those activities that are working well and allows for changes to activities that are not sustainable.

There are numerous forest management planning systems in use across Canada and elsewhere. Many of these systems have been designed to accommodate large-scale (e.g., 50,000 ha or more; conversion: 1 ha = 2.471 acres) landscape- or forest-level planning. In addition to the formal planning requirements, most planning systems include silvicultural guidelines, best practices guidelines, and forest auditing protocols. Many large-scale forest management planning systems are also accompanied by sophisticated wood supply models and geographic information systems. The data requirements for these planning systems are generally beyond the scope of forest-level data which would be available in most remote communities. Although useful for strategic forest-level multi-resource planning, the plans derived from these planning systems are generally not site-specific and often do not accommodate the various intangible forest values and traditional ecological knowledge that are important to Aboriginal communities.

Many First Nations are actively engaged in forest management (Bombay 1996) and there is much to be learned from their approaches to management planning.

The scale and scope of forest management planning in remote communities is perhaps more closely mirrored by the planning requirements of non-industrial forest owners and smaller commercial forest operations. These small-scale (<10,000 ha) forest management planning systems provide useful models for developing a framework and guidelines for sustainable forest management in remote communities. These planning approaches include greater flexibility to accommodate non-timber values, simple but effective data requirements, and are often associated with a more intimate knowledge of the forest land and all values.

A community-based approach to sustainable forest management planning is proposed for First Nation Reserve lands and other classes of Aboriginal lands. This approach does not attempt to address all of the planning requirements that might apply where access is granted to provincial Crown lands, either as tenure-holders or as parties to co-management agreements. Forest management on provincial Crown lands may also affect the forest management objectives and land use decisions of Aboriginal communities on adjacent Reserve lands.

Framework of a Forest Management Plan

A forest management plan should summarize the community's objectives, the character of the property and proposed long-term (e.g., 20 years) and short-term (e.g., 5 years) management activities. The proposed framework of a forest management plan is modelled after forest management planning guidelines proposed by the National Aboriginal Forestry Association (NAFA) (Smith et al. 1995), and guidelines for non-industrial private and small-scale commercial forest management plans, (e.g., Ontario Ministry of Natural Resources 1997, Decker et al. 1990). This framework (Table 1) can be used as a checklist to ensure that all planning activities and plan contents have been included.

Plan components are generally completed in the order listed in Table 1. However, some planning activities such as mapping and forest inventory may proceed simultaneously. The forest management plan and five-year management schedule serves as a guide for the preparation of Annual Work Plans. The annual work plan provides details of all management activities that will be carried out in the coming year. These include work schedules and location maps of harvesting and renewal activities, stand tending, and road construction.

Example Forest

Components of the forest management plan are illustrated with an example assuming a goal of sustainable forest management on approximately 1400 ha of land around a remote community. Wildlife habitat, timber production, and forest fire control are among the many objectives which the community might have for realizing their goal.

Plan Period

Aboriginal communities may wish to consider a plan period that spans 100 or more years, consistent with the seventh generation principle that is embodied in Aboriginal society. At the very minimum, a 20-year plan (e.g., January 1, 1999 to December 31, 2018) accompanied by a five-year (January 1, 1999 to December 31, 2003) schedule of management activities is recommended. For those

Table 1. Framework for a forest management plan.

Plan Activity/Item	Comments	Date Completed
Plan Period		
Forest land description		
Area history		
Forest land map		
Community objectives		
Consideration for Traditional Ecological Knowledge		
Forest resource inventory		
Timber Needs or Demand		
Five-year management schedule		
Plan approval		
Monitoring and review		

compartments where forest biomass will be produced or where other management activities will be undertaken, an annual work schedule is also recommended. The annual work schedule establishes a time frame for undertaking harvesting, forest renewal (regeneration), and stand tending (e.g., thinning, weed control) activities. The work schedule also provides access plans for each stand that will be actively managed during the year.

Forest Land Description

It is often convenient to separate the forest into *compartments* or blocks according to forest types, land uses, or management goals. The forest land description is a legal and physical description of the forest land represented in the plan, including a compartment- and forest-level summary of area by broad land classes (Table 2).

Area History

As much as possible, the plan should summarize the past history of the forest, perhaps over the last 20 years, although many Aboriginal communities may be able to recall events that occurred several decades in the past. This includes a history of land use by the community, traditional Aboriginal uses such as hunting and fishing, trapping, fuelwood harvesting, and cultural uses. There may also have been previous industrial uses of the land such as forestry and mining. It is also useful to record a history of natural disturbances such as forest fires, insect outbreaks, and areas of significant windthrow. Recording past management practices will help the community and forestry professionals or managers understand the current condition of the forest and may also clarify future objectives or modify existing ones. For example, previous harvesting activities or recent forest fires may have created scattered patches of juvenile forest that may require thinning. Areas of juvenile forest often provide wildlife habitats that are not available in a mature forest. Therefore, although these areas may not be harvested over the duration of the plan, they may be important to achieving the overall forest management objectives of the community. Describing and documenting the natural history of the forest may also further a community's understanding of its relationships with the land and the effects of community activities on the land. As plans are renewed, a historical record of management activities and evaluation of accomplishments is established. This assists in the evaluation and revision of objectives and management strategies.

Forest Land Map

Maps generally provide a record of permanent features as a backdrop for forest stand data and management decision-making. Such maps will usually show:

- reserve property and area boundaries, forest compartment boundaries;
- water bodies (lakes, rivers, wetlands);
- roads and trails including winter access routes, access points to lakes, canoe portages;
- traditional harvesting sites (hunting, fishing, trapping, and gathering);
- summer and winter campsites;
- historical, cultural and sacred sites, sites for gathering medicinal plants, hunting lodges, recreational areas;
- fish and wildlife habitats;
- ecologically sensitive sites;
- forest areas with potential for biomass and timber production;
- gravel/aggregate deposits;
- areas excluded from forest land use or which may be designated as restricted land use (e.g., traditional harvesting sites, historic, cultural, and sacred sites).

Separate maps showing land ownership (Reserve lands, Provincial Crown lands, and patent [private] lands), soils, topography, elevation, and geology may also be helpful.

While base maps are generally available from provincial government agencies, in more remote locations base maps may not be available. In these circumstances, their creation will be based on the acquisition of remotely

Table 2. Area summary for an example forest.

Land Class	Compartment 1 (ha)	Compartment 2 (ha)	Total (ha)
Forest land (all stands)	427.4	596.8	1024.2
Lakes and wetlands	77.6	172.7	250.3
Development area (community)	45.8	–	45.8
Area excluded from management	7.2	50.7	57.9
Gravel pits	–	15.6	15.6
Total	558	835.8	1393.8

sensed imagery, such as aerial photographs or digital satellite imagery. For small-scale bioenergy applications in northern remote communities, black and white panchromatic photography with scales in the 1:15,000 (i.e., 1cm=150m) to 1:20,000 (i.e., 1cm=200m) range are recommended. At these small scales, photo interpretation provides an efficient means of delineating forest stands and collecting information on species composition, stand height, stocking or crown density, and sometimes stand age or maturity class. If more detailed stand information is required, larger scale photography at 1:5,000 may be necessary.

Physical boundaries, such as lakes and rivers, can be used to delineate compartment boundaries. Alternatively, compartments could be separated according to forest types or land use. A compartment could contain one or more forest stands. These compartments may also be shown on the forest land map, which may serve as both an area and compartment map. For more complicated areas, several maps may be required. All maps should include a scale, an arrow designating north, a legend, and the plan period such as shown on the forest land map for the example forest.

Maintenance of base maps and compartment maps is often facilitated by the use of computerized Geographic Information Systems (GIS). The initial time and cost of data entry may be quite high, but longer term cost savings in data maintenance, management and analysis are possible. Using forest inventories for other applications, such as wildlife habitat mapping, is greatly facilitated through the use of a GIS. At some point, a community may consider acquiring a GIS and investing in the technical training and support required to operate the system. Where this is not practical, the community could retain a GIS contractor to assist with forest management planning.

Identifying Community Objectives

The "Aboriginal Forest Management Guidelines: A Community Approach" (Smith et al. 1995) and The Scientific Panel for Sustainable Forest Practices in Clayoquot Sound (1995) provide blueprints for informed community decision making.

Trust, and respect for community structures and protocols are essential for community-based forest management planning. Formalization of goals and objectives into forest management plans should take place under the supervision of a forester or other natural resource expert (Smith et al. 1995), along with Chief and Council and other community political leaders, and traditional leaders such as Elders (Dene Cultural Institute 1991). Community education regarding forest management principles and practices may be required before community-based management planning can proceed (Smith et al. 1995). For example, a community may hold vast knowledge about the surrounding forest land (Bombay 1996), yet possess relatively little information about conventional forest management practices (Merkel et al. 1994).

Formal goals (e.g., maintaining environmental integrity and balance, sustainable forest management) and objectives for forest management may already exist in communities. Assume, within the broad goal of sustainable forest management, that the community in our example has identified three forest management objectives:

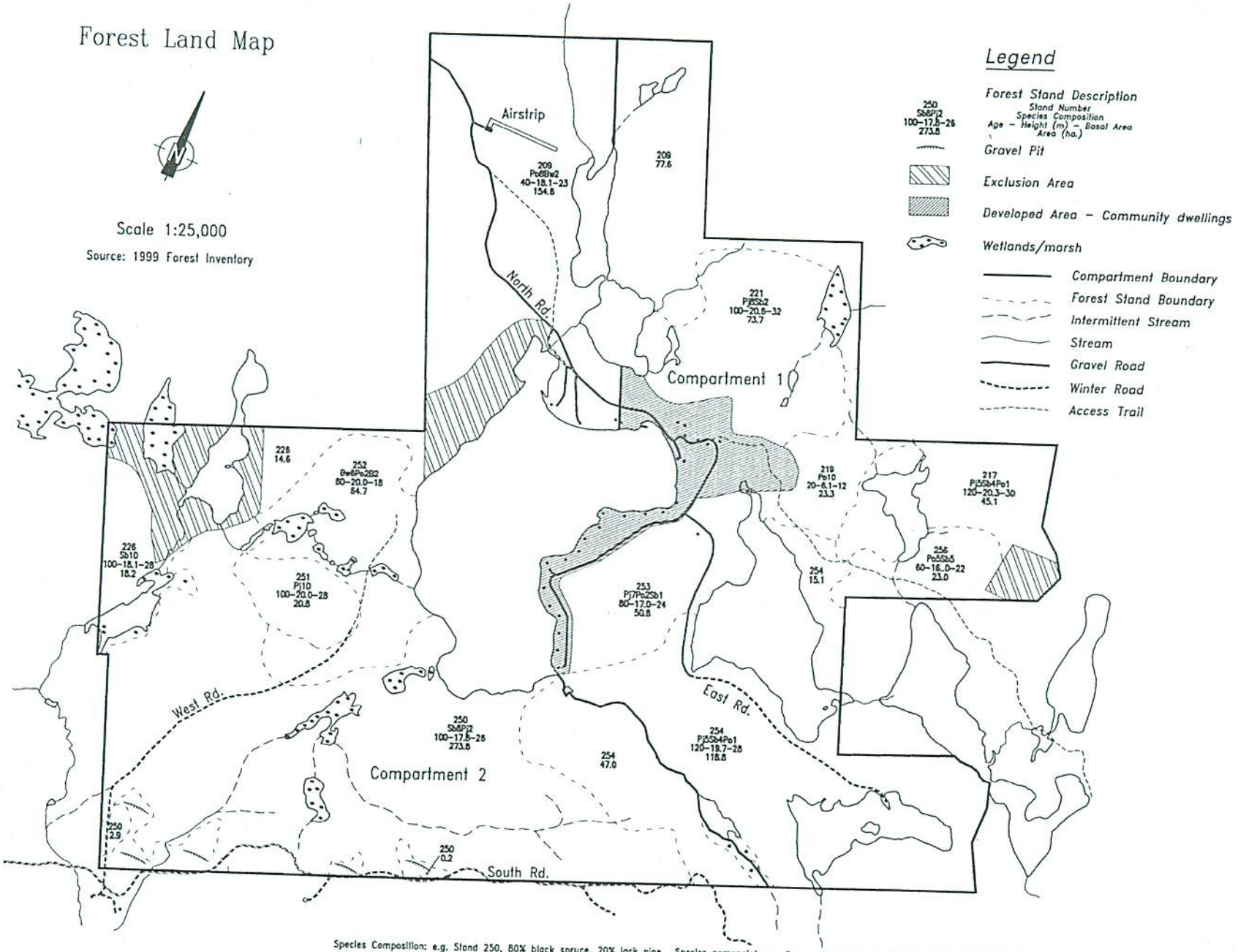
1. Maintain and enhance habitats for wildlife;
2. Manage forests to provide sawlogs for a sawmill and wood-chips for energy;
3. Forest fire control.

Goals and objectives may also exist informally, and merely require a process of setting them down formally. Informal goals may be expressed in past and present uses of the forest, as well as in attempts the community may have made to regain control of the forest and/or to change the way the forest has been managed by others. Existing community planning studies and other community information may also provide useful background information on forest management goals. Community input into the plan can be acquired through informal and formal discussion (workshops, discussion circles, personal interviews, etc.). Community input has several components, including the views of political and administrative staff, technical support staff, key stakeholders such as Elders and resource users, and the general community (Smith et al. 1995). Each component of the community input may require different public consultation techniques to ensure their meaningful involvement.

Including Traditional Ecological Knowledge

As reported in the National Aboriginal Forestry Association's Discussion Paper entitled Aboriginal Forest-Based Ecological Knowledge in Canada, numerous terms have been coined to describe Aboriginal forest-based ecological knowledge, including "traditional ecological knowledge," "indigenous knowledge," "indigenous science" and "naturalized knowledge systems." These terms refer to the knowledge that Aboriginal peoples have accumulated over countless generations of intimate contact with all aspects of local ecosystems, including plants, animals and other natural phenomena.

Forest Land Map



Legend

Forest Stand Description
Stand Number
Species Composition
Age – Height (m) – Basal Area
Area (ha.)

Gravel Pit

Exclusion Area

Developed Area – Community dwellings

Wetlands/marsh

Compartment Boundary

Forest Stand Boundary

Intermittent Stream

Stream

Gravel Road

Winter Road

Access Trail

Scale 1:25,000

Source: 1999 Forest Inventory

Species Composition: e.g. Stand 250, 80% black spruce, 20% jack pine. Species nomenclature: Bw = white birch, Po = poplar, PJ = jack pine, Sb = black spruce.

James Brant, a Mohawk working with the Cree and Ojibway of the northern boreal forest in Ontario, describes this knowledge as:

". . . a body of information about the interconnected elements of the natural environment which traditional Indigenous people have been taught, from generation to generation, to respect and give thanks for." (Bombay 1996)

The methodology for applying Traditional Ecological Knowledge (TEK) in forest management planning is in its infancy (Bombay 1996). TEK is used for developing various forest inventories such as traditional-use maps and historical land use patterns (Smith et al. 1995, Dene Cultural Institute 1991), current forest uses, identification of cultural and environmentally sensitive areas, data bases of geophysical features, soil and forest types, and identification and classification of local flora and fauna (Bombay 1996, Smith et al. 1995, The Scientific Panel for Sustainable Forest Practices in Clayoquot Sound 1995). TEK could also be used to "form the analysis of forest practice standards...along with an analysis of what long term regional harvest rates would be appropriate" (Pinkerton 1990, 13). Pinkerton (1990) also suggests that TEK has considerable potential in environmental monitoring after a harvesting regime has been implemented and for predicting the effects of forest management practices, a feature which remains largely unexplored.

The use of TEK continues to be a highly controversial subject in Aboriginal communities. TEK is cultural knowledge, much of which is sacred and central to the continued existence of the community and the culture. First Nations wish to retain control over the documentation, distribution and application of this knowledge to preserve its meaning and to prevent abuse of the information. Thus, TEK application and community decision-making go hand in hand (Bombay 1996, Dene Cultural Institute 1991). Attempts to apply TEK without granting the community decision-making capacity on how and where TEK will be used have resulted in limited and improper use of the knowledge (Bombay 1996).

Attempts at incorporating TEK into forest management planning must involve key community members such as Elders, resource users (e.g., trappers and hunters), and other knowledgeable individuals. Chief and Council can usually identify individuals who have traditional ecological knowledge. As in other stages of planning, it is important to follow community processes with respect to establishing open lines of communication and trust. Various consultation techniques will need to be followed to effectively share information with different stakeholders.

Forest Resource Inventory

Forest resource inventory needs should be defined in close relation to forest management planning objectives, the type of forest products to be produced (e.g., sawlogs, biomass for energy), and the decision-making process that requires the inventory data. The methods used to estimate biomass resources for small-scale forest biomass installations will parallel those established for estimating timber volumes for conventional forest products, such as sawtimber and pulpwood. These established procedures are described by Gillis and Leckie (1993), among others. Most forest inventory procedures across Canada have a forest classification that separates productive forest land into forest units based on species composition, either predominant species or species group - i.e., hardwood, softwood, or mixedwood. For bioenergy biomass inventories, it may only be necessary to have the inventory separated into species groups, rather than predominant species. However, a more narrowly defined classification system, such as a system that further stratifies species groups into age or site classes, may permit the application of the biomass inventory for other management applications, such as wildlife habitat identification and mapping.

All inventory procedures require a certain amount of ground-truthing to confirm, and where necessary, refine the image interpretation. Avery (1994) provides details on determining sampling intensity. Selection of actual ground locations for field samples is usually subjective, with attention often given to accessibility. The primary difference between volume-based inventories for conventional forest products and biomass inventories occurs during the field sampling. The differences deal mainly with the treatment of small material (i.e., <9cm diameter-at-breast height [DBH[1]]) and the inclusion of other tree components, beyond just the main stem. In almost all cases, the primary data recorded in a field plot includes basal area by species (the area, in m^2 per hectare, of the cross-section of all trees in the field plot measured at 1.3m above the ground), species and DBH for all trees in the plot, with height (needed for tree biomass equations) and age also recorded. A blank field tally and inventory compilation worksheet (Table 3a) are provided as an example. Information for individual sample plots within a stand is aggregated to determine stand-level averages and totals (Table 3b). Aggregations of stands within a compartment yield compartment-level information.

Other supplementary stand-level information that can be recorded during a field survey include topography, soil, early and advanced regeneration, ground vegetation, wildlife habitat information such as nesting or cavity

[1]Diameter measured outside the bark at 1.3m above the ground.

Table 3a. Field tally sheet for biomass inventory.

Owner: Example forest
Compartment code: 1 Stand # 221

Type of Survey: 1 (1 = Fixed Plot, 2 = Prism sweep) Plot area: 0.06 ha No. of points tallied: 18

(1)	(2)	(3)	(4)[1]	(5)[2]	(6)[3]	(7)[4]														
DBH Class (cm)	BA/ Tree (m^2)	Species 1: Pj					Species 2: Sb					Species 3:					Species 4:				
		Tally	Whole-tree Biomass (kg)	Stems (# stems)	BA (m^2)	Biomass (tonnes)	Tally	Whole-tree Biomass (kg)	Stems (# stems)	BA (m^2)	Biomass (tonnes)	Tally	Whole-tree Biomass (kg)	Stems (# stems)	BA (m^2)	Biomass (tonnes)	Tally	Whole-tree Biomass (kg)	Stems (# stems)	BA (m^2)	Biomass (tonnes)
4	0.001						2	2.7	2	0.0	0.0										
6	0.003	1	9.7	1	0.0	0.0	3	7.0	3	0.0	0.0										
8	0.005						20	13.7	20	0.1	0.3										
10	0.008	3	28.6	3	0.0	0.1	40	23.1	40	0.3	0.9										
12	0.011	4	42.2	4	0.0	0.2	46	35.3	46	0.5	1.6										
14	0.015	5	58.6	5	0.1	0.3	53	50.5	53	0.8	2.7										
16	0.020	20	77.9	20	0.4	1.6	59	69.0	59	1.2	4.1										
18	0.025	31	100.0	31	0.8	3.1	29	90.8	29	0.7	2.6										
20	0.031	46	125.2	46	1.4	5.8	21	116.1	21	0.7	2.4										
22	0.038	80	153.3	80	3.0	12.3	5	144.9	5	0.2	0.7										
24	0.045	120	184.5	120	5.4	22.1	3	177.5	3	0.1	0.5										
26	0.053	88	218.8	88	4.7	19.3	3	213.9	3	0.2	0.6										
28	0.062	64	256.2	64	3.9	16.4	4	254.2	4	0.2	1.0										
30	0.071	26	296.7	26	1.8	7.7	3	298.6	3	0.2	0.9										
32	0.080	11	340.4	11	0.9	3.7	8	347.1	8	0.6	2.8										
34	0.091	16	387.3	16	1.5	6.2	1	399.7	1	0.1	0.4										
36	0.102	21	437.4	21	2.1	9.2	3	456.7	3	0.3	1.4										
38	0.113	4	490.7	4	0.5	2.0															
40	0.126	6	547.3	6	0.8	3.3															
42	0.139	2	607.2	2	0.3	1.2															
44	0.152																				
46	0.166																				
48	0.181																				
50	0.196																				
TOTALS		548		548	27.7	114.3	303		303	6.3	23.0										
TOTAL/HA[5]				507	25.6	105.9			281	5.9	21.3										

Note 1. column(4) = whole tree biomass estimate for dbh class based on established relationship in literature

Note 2. Plot: column(5) = column(3)
Prism: column(5) = column(3)/column(2)

Note 3. column(6) = column(2) * column(5)

Note 4. column(7) = column(4) * column(5)

Note 5. Plot: TOTAL / HA = TOTALS / (plot area * # plots tallied)
Prism: TOTAL / HA = TOTALS * BAF / # plots tallied

Compartment Summary

Species	Stems/ha	BA/ha	Biomass/ha
Pj	507	25.6	105.9
Sb	281	5.9	21.3
TOTAL	788	31.5	127.2

Table 3b. Field tally sheet for biomass inventory.

Owner: Example forest Compartment code:	Type of Survey: 1 = Fixed Plot 2 = Prism sweep

(1)	(2)	(3)	(4)[1]	(5)[2]	(6)[3]	(7)[4]														
		Species 1:					Species 2:					Species 3:					Species 4:				
DBH Class (cm)	BA/ Tree (m^2)	Tally	Whole-tree Biomass (kg)	Stems (# stems)	BA (m^2)	Biomass (tonnes)	Tally	Whole-tree Biomass (kg)	Stems (# stems)	BA (m^2)	Biomass (tonnes)	Tally	Whole-tree Biomass (kg)	Stems (# stems)	BA (m^2)	Biomass (tonnes)	Tally	Whole-tree Biomass (kg)	Stems (# stems)	BA (m^2)	Biomass (tonnes)
4	0.001																				
6	0.003																				
8	0.005																				
10	0.008																				
12	0.011																				
14	0.015																				
16	0.020																				
18	0.025																				
20	0.031																				
22	0.038																				
24	0.045																				
26	0.053																				
28	0.062																				
30	0.071																				
32	0.080																				
34	0.091																				
36	0.102																				
38	0.113																				
40	0.126																				
42	0.139																				
44	0.152																				
46	0.166																				
48	0.181																				
50	0.196																				
TOTALS																					
TOTAL/HA[5]																					

Note 1. column(4) = whole tree biomass estimate for dbh class based on established relationship in literature

Note 2. Plot: column(5) = column(3)
Prism: column(5) = column(3)/column(2)

Note 3. column(6) = column(2) * column(5)

Note 4. column(7) = column(4) * column(5)

Note 5. Plot: TOTAL / HA = TOTALS / (plot area * # plots tallied)
Prism: TOTAL / HA = TOTALS * BAF / # plots tallied

Compartment Summary			
Species	Stems/ha	BA/ha	Biomass/ha
TOTAL			

trees, potential access routes, and proposed season of harvest. Such stand-level information will assist in broadening the application of the biomass inventory to other uses, such as wildlife habitat mapping and suitability analysis. It may also be useful to include an assessment of timber quality and potential for sawlogs or pulpwood should markets for these products become available.

Traditional knowledge of the forest land around the community can be incorporated into the sampling design (Smith et al. 1995). Many Aboriginal communities have, to varying degrees, already completed traditional land use studies and/or maps. Non-timber uses that may be identified include medicinal plants, food supply (animals and plants), sacred areas, trapping, hunting, fishing, and other areas of special significance. Further details of forest resource inventory procedures and a comparison of approaches are presented in "Forest Biomass Inventory Procedures for Remote Communities" (Bevilacqua 1998).

Assessing Needs and Determining Sustainable Harvest Levels

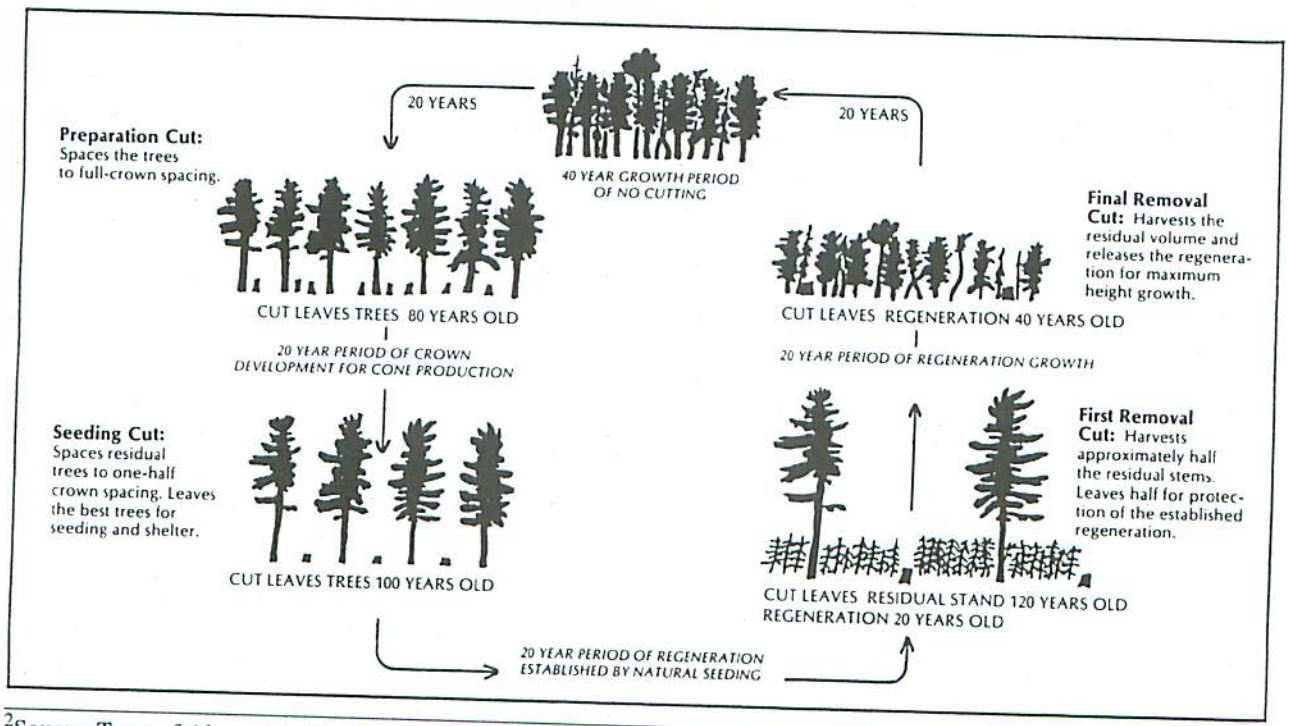
Following completion of the forest inventory, an assessment of the needs or demand for timber is undertaken. For small-scale bioenergy installations, the biomass requirements are expected to be small relative to the timber resources available (McCallum 1998). However, the quantity and quality of biomass will depend on the forest characteristics and whether the biomass is produced from whole trees or from logging residues in an integrated harvesting operation such as might be used to produce both sawlogs and wood-chips for energy. For example, with an integrated operation, harvesting of sawlogs might be confined to mature conifer or mixed forests. Wood-chips for energy could be produced from the logging residues. "Candidate" forest areas, which meet the criteria for the various forest products, are identified through the forest inventory and the forest land maps. From these "candidate" areas, a sub-set of areas is identified for timber production in the next five-year period. For example, remote communities may have access to mature Aspen/Poplar stands. In the absence of other market opportunities for Aspen/Poplar, these stands could be the first ones harvested for wood-chips for energy. Thinnings from juvenile conifer stands can also be chipped into wood fuel.

An integrated approach to forest ecosystem management often requires adaptive management strategies such as strip-cutting or the use of selection, uniform shelterwood (Figure 2), and small-group selection silvicultural systems for biomass production.

Five-Year Management Schedule and Implementation Strategies

The five-year management schedule provides details of the management activities proposed for the current five-year period, for each compartment where activities are to be carried out (Table 4).

Figure 2. 4-cut uniform shelterwood management system[2].



[2]Source: Trees of Algonquin Provincial Park. 1993. Courtesy of the Friends of Algonquin Park.

Table 4. Five-year management schedule for the example forest.

Comp	Objectives	Prescription	Stand #	Area Treated (ha)*	Year(s) Scheduled	Outputs Expected
1	• enhance community fire safety • produce sawlogs and wood-chips for energy	• individual tree selection to harvest 25% of basal area and reduce fuel loading and risk of fire • manual felling and skidding whole trees to minimize residues (slash) left on site • chip logging residues at roadside for energy • protect advance regeneration following best management practices	221 219	40.0 12.5	1999-2004	• 52.5 ha thinned and fuel loading reduced • 625 m^3 of sawlogs • 1390 green tonnes of wood-chips for energy
2	• produce wood-chips for energy • encourage natural regeneration • provide browse for moose	• preparatory cut uniform shelterwood harvesting , harvest 15% of basal area • follow forest management guidelines for the provision of moose habitat • manual felling & wheeled skidder • winter access along West Rd. • retain tops on site as seed source for natural regeneration	250	25.5	1999	• 25.5 ha uniform shelterwood preparatory cut • 510 green tonnes of wood-chips for energy • 17.5 ha browse habitat produced

*Conversion: 1 ha = 2.471 acres.

Operating Guidelines and Best Management Practices

A plethora of guidelines now exist covering practices such as the recommended size of harvest blocks and logging systems recommended for different terrains, to the preservation of habitats or sites of cultural significance. These guidelines provide scientific and technical information to assist in implementing the plan and mitigating against potential negative impacts of management activities. Smith et al. (1995) list a number of guidelines which may be particularly relevant to integrated forest management in remote communities. These guidelines are generally available from provincial and territorial forestry agencies.

Establishing a Plan Approval Protocol

A consultative approach to planning and respect for community protocols are essential to obtaining community approval for the management plan. In the latter stages of planning, community support can be demonstrated through consensus decision-making, community voting, or plan ratification (Smith et al. 1995). A Band Council Resolution (BCR) supporting the plan is usually required. The community as a whole should participate in ratification or voting. In some cases external approvals are required. The appropriate Tribal Council (or other organization that has authority for forest management) may need to be consulted. The Indian Act governs natural resources, including forests on federal reserve lands and may limit certain management activities (Smith et al. 1995). Appropriate approval may have to be sought from Indian and Northern Affairs Canada. The First Nation involved would be responsible for taking this action.

Monitoring and Review of the Plan

Most forest management systems provide for periodic monitoring and auditing of forest management activities recommended in the plan. A successful community involvement program will include TEK as part of the forest management plan and a system for monitoring and incorporating community feedback. This allows for assessment and evaluation of what is and is not working,

as well as for making changes necessary for the continued success of the plan (Smith et al. 1995). At some point, an Aboriginal community may wish to seek certification for Reserve land under one of the sustainable forest management certification systems. Forest certification requires independent forest management audits.

Optional Plan Contents

Communities may wish to include other items in the management plan. For example, this might include spiritual and cultural values such as a poem or story, or a prayer by an Elder.

Some large-scale industrial forest planning systems include a forest management budget and cost-benefit analyses of forest development projects. Aboriginal communities may wish to prepare annual forestry budgets and cost-benefit analyses, however it is recommended that these be undertaken as components in a broader community business plan or community operating budget. The five-year schedule of management activities from the management plan will provide direction for the operating budget and cost-benefit analyses.

Training and Qualifications of Forest Managers

It is recommended that the forest management plan be prepared under the guidance of a professional forester or resource management professional for Aboriginal land. There are few Aboriginal professional foresters in Canada, and the need for natural resource managers and technicians is critical (Smith et al. 1995). In the short-term, Aboriginal communities may find it helpful to retain the services of a forestry professional to assist with training selected community members who are interested in forest management or may be enrolled in resource management studies. The number and type of staff needed and the training requirements will depend on the forest land area and the complexity of the planning and management activities. For example, training for field-level data collection and compilation for forest resource inventory might reasonably be accomplished within six months. Knowledge of computer spreadsheets to assist with data compilation would be useful. Facility with GIS for mapping and planning will normally require extensive training. Hopwood et al. (1993) provides a useful review of Aboriginal forestry training requirements.

Costing Forest Management Plans

The cost of preparing a management plan will depend upon the amount of forest land involved, accessibility, the availability of aerial photographs and maps, and the time required for community participation in the planning process. Table 5 provides a general outline for estimating planning costs. The approximate time required to carry out the various planning activities is based on experience from small-scale planning systems. Communities may wish to modify the worksheet for their own management planning situations.

Table 5. Forest Management Plan Costing worksheet.

User provides information for the shaded areas.

Community:		
	Plan area (ha)	1052
	Forest area (ha)	971

(A)	(B)	(C)	(D)	(E)	(F)	(G)
Planning Activity	**Approx. range person-days**	**Estimated person-days**	**Wages & benefits**	**Transportation cost**	**Other cost**	**Total cost**
			(C)xDaily wage	(C)xDaily transp.rate		(D)+(E)+(F)
Pre-planning	2 - 3	2	250			250
Collect/summarize background information	2 - 3	3	375			375
Community meetings	3 - 5	5	625			625
Forest inventory - field data collection	see footnote 1	12	1517	303		1821
Forest inventory - data compilation/summary	1 - 3	2	250			250
Mapping	(see footnote 2)				900	900
Prepare silvicultural/management prescriptions	1 - 2	1	125			125
Plan writing (see footnote 3)	3 - 5	4	500			500
Plan approval (see footnote 4)	1 - 2	2	250			250
Monitoring and review	1 - 2	2	250			250
Other						
Total		33	4142	303	900	5346

Financial Information	
Daily wage + benefits ($ per day)	125.00
Transportation ($/km or daily rate for vehicle/snowmobile)	25.00
Other:	

Footnotes

1. Time required to gather forest inventory data will vary depending on sampling intensity and area involved. A useful guideline is to allow approximately 1 person-day per 80 ha (approx. 200 ac) of forest land.

2. It is assumed that aerial photographs are available. Contract GIS is assumed.

3. Plan writing usually involves preparing a draft plan for review and comment followed by a final plan.

4. Plan approval may involve several meetings and presentations. Time required may vary considerably.

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GLOSSARY

ADVANCE REGENERATION
Young trees under existing stands capable of becoming the next crop. Regeneration established before logging that has survived the logging operation.

AGE CLASS
A distinct group of trees or portion of growing stock recognized on the basis of age.

ALLOWABLE CUT
The volume of wood that may be harvested, under management, for a given period.

ANNUAL ALLOWABLE CUT (AAC)
The amount of timber that is permitted to be cut annually from a particular area. AAC is used as the basis for regulating harvest levels to ensure a sustainable supply of timber.

ARTIFICIAL REGENERATION
Renewal of a tree crop by direct seeding or by planting seedlings or cuttings.

BASAL AREA
1. Of a tree: The area in square metres of the cross section at breast height of the stem.
2. Of a forest, stand, or forest type: The area in square metres per hectare of the cross section at breast height of all the trees.

BIOMASS
The total mass of living organisms of one or more species per unit of area, or all the species in a community. It can be divided into **above-ground biomass** and **below-ground biomass.**

BLOCK CUTTING
Removal of the crop in blocks in one or more operations, generally for wildlife management purposes, encouraging regeneration, or protecting fragile sites.

BUFFER STRIP
A band of forest left relatively undisturbed so as to protect some element of the environment, such as a streambank from erosion; in experiments, refers to the strip of untreated area between adjacent treated areas.

CANOPY
The more or less continuous cover of branches and foliage formed collectively by the crowns of adjacent trees.

CAREFUL LOGGING AROUND REGENERATION
Harvesting operation based on shelterwood cutting principles, where advanced regeneration is protected during harvesting.

CLEARCUTTING METHOD
A method of regenerating an even-aged forest stand in which new seedlings become established in fully exposed microenvironments after removal of most or all of the existing trees. Regeneration can originate naturally or artificially. Clearcutting may be done in blocks, strips, or patches.

COMPOSITION
The proportion of each tree species in a stand expressed as a percentage of the total number, basal area, or volume of all tree species in the stand.

CONIFEROUS
Refers to a forest stand or category of trees or bush that is popularly called "evergreen ". The wood of conifers is commercially known as "softwood".

CROP TREE
Any tree selected to become or forming a component of the final crop.

CUTOVER
An area of forest land from which some or all timber has recently been cut.

ECOSYSTEM
A dynamic system of plants, animals and other organisms, together with the non-living components of the environment, functioning as an interdependent unit.

ENVIROMENTAL ASSESSMENT
A process designed to contribute pertinent environmental information to the decision-making process of forest management and other resource projects and programs.

EVEN-AGED
Of a forest, stand, or forest type in which relatively small age differences exist between individual trees. The differences in age permitted are usually 10 to 20 years; if the stand will not be harvested until it is 100 to 200 years old, larger differences up to 25% of the rotation age may be allowed.

EVEN-AGED SYSTEM
Silvicultural systems in which stands have an even-aged structure, e.g., clearcutting method, coppice method, seed-tree method.

FAUNA
A general term for all forms of animal life characteristic of a region, period or special environment.

FINAL CUTTING
The last of a series of progressive regeneration cuts which removes the last of the original seed trees when the regeneration is considered established.

FIRE HAZARD REDUCTION
Any treatment of fuels that reduces the threat of ignition and spread of fire.

FOREST TYPE
A group of forest areas or stands whose similar composition (i.e., species, age, height and density) differentiates it from other such groups.

GEOGRAPHIC INFORMATION SYSTEM (GIS)
An information system that uses a spatial database to provide answers to queries of a geographical nature through a variety of manipulations, such as sorting, selective retrieval, calculation, spatial analysis, and modeling.

HARDWOOD(S)
Trees that lose their leaves in autumn; also refers to the wood produced by these trees. Hardwoods belong to the botanical group angiosperm and are the dominant type of tree in the deciduous forest.

HARVESTING
A general term for the removal of produce from the forest for utilization; comprising cutting, sometimes further initial processing and extraction.

IMMATURE
In even-aged management, those trees or stands that have grown past the regeneration stage but are not yet mature. In uneven-aged management, established trees too young for commercial harvest.

IMPROVEMENT CUTTING
A cutting made in a stand past the sapling stage, primarily to improve composition and quality through the removal of less desirable trees of any species.

INTEGRATED RESOURCE MANAGEMENT (IRM)
Management of natural resources to achieve maximum benefits; integrating forest management to nontimber uses and values not only to produce timber, but also to develop the wildlife and recreational capacities of forested areas.

INVENTORY (FOREST)
A survey of a forest area to determine such data as area, condition, timber, volume and species for a specific purpose, such as planning, purchasing, evaluating, managing or harvesting.

LITTER
The uppermost layer, the L-layer, of organic debris on a forest floor, i.e., essentially the freshly fallen or only slightly decomposed vegetable material, mainly foliate (leaf litter) but also bark fragments, twigs, flowers, fruits, etc. This and the less decomposed humus are together often termed **duff**.

LOGGING DAMAGE
General term comprising wounds resulting from cutting, breakage, or crushing of trees that resulted from the felling and the removal of trees designated for cutting. May also include scoring of site and soil leading to exposure of infertile subsoil and soil erosion.

MANAGEMENT PLAN
A detailed long-term plan for a forested area. It contains inventory and other resource data.

MATURE
In even-aged management, those trees or stands that are sufficiently developed to be harvestable and that are at or near rotation age (includes overmature trees and stands for which an overmature class has not been recognized).

MERCHANTABLE
Of a tree or stand that has attained sufficient size, quality, and/or volume to make it suitable for harvesting. Does not imply accessibility, economic or otherwise.

MIXED STAND
A stand composed of two or more species in which less than 80% of trees in the main crown canopy are of a single species.

MULTIPLE FOREST USE
A system of resource use where the forest resources in a given land unit serve more than one use.

NATURAL REGENERATION
Renewal of a tree crop by natural seeding, sprouting, suckering, or layering.

NON-COMMERCIAL TREE SPECIES
A tree species for which there is currently no market.

OVERMATURE
In even-aged management, those trees or stands past the mature stage.

PLANTATION
A stand of trees that has been grown through direct seedling or by planting seedlings.

POLE
A tree between a sapling and small sawtimber size. Size varies by region, e.g., for boreal and eastern forests 12-20 cm dbh.

PULP
Wood chips that have been ground mechanically into fibres and are used for the production of inexpensive paper, such as newsprint, or that have been chemically treated to remove the lignin and are used to manufacture higher quality papers.

QUADRAT
A small, clearly demarcated sample area of known size on which observations are made.

REGENERATION
The continuous renewal of a forest stand. Natural regeneration occurs gradually with seeds from adjacent stands or with seeds brought in by wind, birds or animals. Artificial regeneration involves direct seeding or planting.

REGENERATION CUT
Any removal of trees intended to assist regeneration already present or to make regeneration possible.

ROTATION
The planned number of years between the formation or regeneration of a crop or stand and its final cutting at a specified stage or maturity.

ROUNDWOOD
Round sections of tree stems with or without bark, such as logs and bolts.

SANITATION CUTTING
The removal of dead, damaged, or susceptible trees, essentially to prevent the spread of pests or pathogens and so promote forest hygiene.

SAPLING
A general term for a young tree no longer a seedling but not yet a pole, about 1-2 cm high and 2-4 cm in dbh, typically growing vigorously and without dead bark or more than an occasional dead branch. Also, a young tree having a diameter at breast height greater than 1cm but less than the smallest merchantable diameter.

SAWTIMBER
Trees that will yield logs suitable in size and quality for the production of lumber.

SECONDARY SPECIES
A species of inferior quality and/or size, and of lesser silvicultural value, associated with the principle species.

SECOND GROWTH
The forest growth that has developed (naturally or artificially) following the removal of the original forest.

SHADE TOLERANCE
The relative capacity of a species to become established and persist under a canopy.

SILVICULTURE
The theory and practice of controlling the establishment, composition, growth and quality of forest stands. Can include basic silviculture (e.g., planting and seedling) and intensive silviculture (e.g., site rehabilitation, spacing, and fertilization).

SILVICULTURAL SYSTEM
A process that applies silvicultural practices, including tending (thinning, pruning, etc.), harvesting, and replacement, to a stand in order to produce a crop of timber and other forest products.

SITE PREPARATION
A mechanical, fire, chemical, or hand treatment that modifies the site to provide favorable conditions for natural or artificial regeneration. In Manitoba and Saskatchewan, treatment to promote natural regeneration is termed **scarification**.

SLASH
The residue left on the ground after felling and tending and/or accumulating there as a result of storm, fire, girdling, or treatment with herbicide. It includes unutilized logs, uprooted stumps, broken or uprooted stems and the heavier branchwood (heavy slash), lighter tops and branchwood, twigs, leaves, bark, and chips (light slash).

SPACING
n: The distance between trees in a plantation, a thinned stand, or a natural stand.

STAND
A community of trees possessing sufficient uniformity in composition, age, arrangement, or condition to be distinguishable from the forest or other growth on adjoining areas, thus forming a silvicultural or management entity.

STAND DENSITY
A quantitative measurement of tree stocking expressed in terms of number of trees, total basal area, or volume, per unit of area. More precisely, a measure of the degree of crowding of trees within a stand, commonly expressed by various growing-space ratios of crown length to tree height; crown diameter to dbh or crown diameter to tree height; or of stem spacing to tree height. Expressed on a per hectare basis.

STRIP CUTTING
Removal of the crop in strips in more than one operation, generally for encouraging natural regeneration or protecting fragile sites. Considered to be a variation of clearcutting.

STUMPAGE FEES
The fees paid by an individual or company for the right to harvest timber from public forests or privately owned forest land.

SUSTAINABLE DEVELOPMENT
Sustainable development in forestry expands the principle of sustained timber yield by including wildlife and fish habitats, watersheds and hydrological cycles, as well as gene pools and species diversity, to ensure that the use of forest today does not damage prospects for its use by future generations.

SUSTAINABLE FORESTRY
Management of forested area in order to provide wood products in perpetuity, soil and watershed integrity, persistence of most native species and maintenance of highly sensitive species or suitable conditions for continued evolution of species.

UNDERSTORY PROTECTION
Removal of mature trees while damage to the understory is kept to a minimum.

UNEVEN-AGED
Of a forest, stand, or forest type in which intermingling trees differ markedly in age. The differences in age permitted in an uneven-aged stand are usually greater than 10-20 years.

No they usually form more than three distinct age classes.

UNMERCHANTABLE
Of a tree or stand that has not attained sufficient size, quality, and/or volume to make it suitable for harvesting.

WATERSHED
An area of land that is drained by underground or surface streams into another stream or waterway.

Adapted from **Silvicultural Terms in Canada**, second Edition, 1995 and **The State of Canada's Forests, The People's Forests**, NRCan., 1997-98.