Forest Stewardship and Management Plan

2008
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Executive Summary

The lands of Bull Run Overseas are currently recovering from the massive devastation from the Southern Pine Bark Beetle infestation of 2002. As a result the vast majority of the forest is young and even-aged with large sections having tree densities well above or below optimal levels. Also the financially self-sustaining nature of the historical stewardship has been compromised for years to come.

The primary objective for the next decades is to steward the forest back to health by following sustainable forestry principles, which integrates the reforestation, managing, growing, nurturing and harvesting of trees for useful products with the conservation of soil, air and water quality, wildlife and fish habitat and aesthetics.

The urgent and critical tasks are to achieve optimal tree density by thinning and planting and to use prescribe burning to reduce the heavy fuel load and competitive vegetation existing over much of the land.

The forest will require material investments of effort and capital for at least the next ten years before any return is seen and most of the beneficial results are several decades in the future. It is believed that by 2020 the forest will return to a financially self-sustaining steady state if support is found for the immediate, intense period of investment required to achieve the urgent and critical tasks. Any delay in the accomplishment of those tasks directly delays the return to health.

It is hoped that the Bull Run forest will provide an important national demonstration model of managing a natural resource in a self-funding environmentally sensitive manner with particular success in the conservation of soil, air and water quality, wildlife and fish habitat.
Background

Management Area

The Bull Run Overseas Ltd. (Bull Run) property lies on the northern end of the Mountain Pine Ridge. The property is bounded on the south by the Mountain Pine Ridge Forest Reserve (shared boundary managed by Pine Lumber Co. (PLC) as a forest management licensee), on the west jointly by the Pine Ridge Enclave and the Elijo Panti National Park and on the north by the hardwood dominated escarpment leading down to Barton Creek, and the Thousand Foot Falls National Park (1200 acres). Although the eastern boundary extends down the escarpment and beyond Roaring Creek, the Eastern Defense Line is for all practical reasons identified as the eastern boundary. Some manageable timber areas do however exist directly adjacent the Eastern Defense Line and will be incorporated in this management plan.

Total acreage of the property is 14,486 acres.
Physiography of the Forest

The forest cover is primarily pine, Caribbean pine (Pinus caribaea) accounting for 100% of the stand. *Pinus oocarpa* is found in small amounts in the higher elevations on the eastern portions of the property. There are small bands of tropical hardwoods found in the riparian zones along the waterways. These are very narrow and do not constitute any appreciable area or volume. Hardwood areas intruding up from the escarpment and those of the escarpment have been excluded from the project area. The pine stands are evenly aged, healthy and well stocked, although some under stocking due to wildfire is evidenced in the eastern areas.

Geology

The reserve lies within the Mountain Pine Plateau. Geological history begins in the Permian period (280-300 million years ago) when the area consisted of folded metamorphosed sediments (metasediments); rocks of which are assigned to the Santa Rosa Group. In the early Triassic period (220-330 million years ago) the Santa Rosa Group was intruded by granite. Later, in the Cretaceous period (140 -180 million years ago) the area was submerged under a shallow sea and substantial layers of limestone were deposited over the metasediments and granite. Subsequent erosion removed this limestone mantel except in the west of the reserve and in scattered areas where limestone capped hills are found. Today, the central part of the reserve comprises a dissected basin of heavily-weathered and eroded granite which is bordered on the west by limestone hills and to the southeast, east and northeast by a crescent shaped ridge of the more resistant metasedimentary rocks.

Landform and Topography

The area supporting predominantly pine can be divided into two principal sub-units: the upland plateau, a low dissected basin of heavily weathered and eroded granite (the Granite Basin), and the dissected ridge of metasedimentary rocks called the upland range. Altitude varies from 300m (above mean sea level) on the western edge of the upland plateau to over 900m on the summit of the upland range. Topography of the upland plateau is gently undulating, whereas the upland range is strongly dissected and comprises steep to very steep topography often with slopes in excess of 35°.

Climate

Rainfall averages 80 inches per year on the west side of Bull Run land and close to 100 inches per year on the east. A distinct dry season extends from March to May and a wet season from November to January. Figures for mean monthly temperature indicate that January is the coldest month and May the hottest. The mean monthly minimum temperature and extreme low are 55°F and 42°F respectively. The extreme low is sufficiently severe to have a deleterious effect on some agricultural crops, although it is unlikely that either of the two pine species in the MPR would be permanently affected. The normal temperature ranges between a low of 50°F in January and a high of 95°F in May.
Drainage

The Cooma Cairn Ridge divides the land into 2 major catchments: south and east the land drains into the Eastern Branch and to the north it drains into the Roaring and Barton Creeks. All the land ultimately drains in the Belize river.

Soils

Soils supporting pine within the Mountain Pine Ridge can be arranged into one of two suites; the Stopper suite which is derived from granitic parent material, of which the main subsuite is pinol and the Ossory suite which is derived from the metasediments whose main subsuites are cooma, baldy and chiquibul.

The primary soils on the Bull Run lands are pinol and cooma with the eastern most area comprising baldy subsuite except in the riparian corridors.

Pinol subsuite

Soils derived from the pinol subsuite are formed from intense in-situ weathering and are distinguished by their loamy coarse sand to clay loam topsoil with a sandy loam-clay subsoil and their abundant angular quartz component. This subsuite is less resistant to weathering than the Santa Rosa Group and therefore tends to occupy the lower terrain. Compaction, seasonal water-logging, acidity of the subsoil and their droughty nature makes for an inhospitable root environment. Nutrient deficiencies (principally phosphate and nitrogen) and nutrient imbalances are also a major constraint. Pinus caribaea is the predominant vegetation, but stand density appears to be mainly determined by the history of the site i.e. disturbance by fire or logging.

Chiquibul subsuite

Soils are derived from in-situ weathering of the metasediments. The chiquibul subsuite is common in the Mountain Pine Plateau and is intermixed with soils of the cooma subsuite. Compared to the cooma subsuite these soils are shallower and less well developed. They occur on steep erodible slopes and are often downslope from cooma soils. Topsoils range in texture from sandy loam to clay loam. These soils are leached, acidic and base deficient (particularly available phosphate and nitrogen), and their shallowness and stoniness makes them droughty. The predominant vegetation is Pinus oocarpa, and when disturbed they are often invaded by dumb cane and tiger bush.

Cooma subsuite

Soils are formed from in situ weathering, they tend to be deeper and more developed. Topsoils are silty or fine sandy loam-clay loam with an underlying stony horizon and below that a silt clay-clay layer. Available phosphate is low. P. oocarpa predominates on the steeper slopes and when the soils are disturbed they are often invaded by dumb cane and tiger bush.
Soils are formed by weathering of underlying argillites. The surface of these soils is very stony, and the top-soil is of stony loam texture. These soils are very leached, acidic and base deficient. Available phosphate is nearly zero. Soils are droughty and chemically infertile. Vegetation is typically grass savanna with scattered and stunted *P. caribaea*.

**Vegetation types**

Five broad vegetation types have been identified in the Mtn Pine Ridge:

- broadleaf forest on limestone
- broadleaf forest on granite
- pine forest dominated by *P. caribaea* with a broadleaf understory of differing density
- pine forest dominated by *P. oocarpa* which tends to form pure stands and is associated with dumb cane and tiger bush and,
- grassland.

**History of the Forest**

The lands of Bull Run have been in private ownership since the 19th century and have had a variety of land management approaches through the last century. Active management of the forest did not begin until the 1960’s when current ownership commenced. Several major natural disasters have occurred in the last 50 years which have had a major effect on the forest.

The major hurricane of 1961 (Hattie) levelled large sections of the forest, in particular the older three maturity classes. Immediately after the hurricane, intense salvage logging occurred for several years followed by a thorough harvesting of the remaining standing timber. According to Johnson and Chaffey’s 1973 forest inventory, they came to the conclusion that little harvestable pine remained in the Mountain Pine Ridge.

The next two decades were a period of largely unmanaged natural regeneration of the forest though there were efforts put towards prescribed burning and wildfire suppression.

As the stands were beginning to approach the necessary maturity for sustainable forestry stewardship the second major disaster occurred. Although a natural part of the pine ecosystems, the Southern Pine Bark Beetle (*Dendroctonus frontalis*) found abundant habitat in the highly drought-stressed stands of pine. The unmanaged infestation reached epidemic proportions in the lands of the Mountain Pine Ridge Forest Reserve and swept over the Bull Run lands in 2002 with devastating effect. Approximately 90% of the pine timber was killed, although the effects were somewhat less on the eastern side.
Forestry Management Principles and Methods

The forest management and stewardship activities of Bull Run operate on the following well-established forestry principles, guidelines and methods.

**Sustainable Forestry**

Sustainable forestry means managing the forest to meet the needs of the present without compromising the ability of future generations to meet their own needs by practicing a land stewardship ethic which integrates the reforestation, managing, growing, nurturing and harvesting of trees for useful products with the conservation of soil, air and water quality, wildlife and fish habitat and aesthetics.

Sustainable forest management is built on the following five principles, which should be implemented to the degree practicable:

1. Sustainable forest management places the highest priority on maintaining the long-term integrity of the forest ecosystem.

   Sustainable forest management should:
   - Maintain the productive capacity of the soil
   - Protect water quality, wetlands, and riparian zones
   - Maintain habitat for native, forest-based flora and fauna
   - Identify and protect unusual or fragile natural areas

2. Sustainable forest management uses the structure, function, and dynamics of the natural forests as a model when planning and carrying out management activities.

   Sustainable forest management should:
   - Use harvesting techniques and patterns that reflect the natural disturbance regime of the forest
   - Maintain large live trees, snags, and coarse woody debris ("biological legacies") in all harvested areas.
   - Use species native to the site when re-generating stands
   - Restore and maintain a full range of age classes and structures, including a significant component of mature and late-successional trees and stands
   - Include some areas not managed for timber production where natural ecological processes can take place
3. Sustainable forest management is conducted according to a management plan that takes a long-term perspective at all levels.

   Sustainable forest management should:
   ✦ Calculate harvest levels for timber and other products that can be maintained over the long-term, consistent with the maintenance of forest ecosystem integrity and the protection of ecological and cultural features
   ✦ Include regular monitoring of forest composition, structure, and yield
   ✦ Consider varying scales, including stand management, the overall ownership, and the surrounding landscape

4. Sustainable forest management should maintain important cultural values of the forest.

   Sustainable forest management should:
   ✦ Provide appropriate opportunities for public access and traditional uses
   ✦ Mitigate the aesthetic impact of harvesting and other activities
   ✦ Identify and protect important archaeological, historical, cultural, or recreational sites

5. Sustainable forest management recognizes the responsibilities of land ownership as well as the rights.

   Sustainable forest management should:
   ✦ Sustain the potential for long-term economic return to the landowner
   ✦ Give the owner and land manager flexibility in the mix of stewardship methods used to achieve sustainable forestry within a given forest holding
   ✦ Maintain and enhance the long-term social and economic well being of local communities, forest-based businesses, residents, and visitors
   ✦ Support public interests, values, and resources (such as water) when preparing management plans
   ✦ Maintain and enhance the forest-based values and opportunities available to future generations

Management Blocks and Compartments

To aid in forest management prescriptions, the entire management area is currently being subdivided into management blocks and compartments by using one or more of the following methods:

   ✦ The use of roads and creeks as block boundaries
   ✦ The use of creeks, rivers and the escarpment as block boundaries
   ✦ In some cases it is necessary to maintain a boundary line mechanically (round plough) where possible, or by manual chopping
Maturity classes (or age classes) entail that the forest be divided into roughly equal-area compartments. Due to practicality reasons and following the objective that each management compartment be surrounded by either a road or a creek or both, compartment size at Bull Run varies between 67 acres and 220 acres. Although the bigger compartments (those of 150 – 200+ acres) are in contradiction to the preferable 100-acre compartment size according to fire protection guidelines, these bigger compartments are divided by smaller seasonal streams and creeks, often flanked with hardwood belts. To lay out and construct roads to permanently split such compartments is economically unfeasible. Therefore although the acreage size is excessive, the physical layout conforms to roughly 100-acre parcels.

Management blocks are large areas delineated by primary roads and property boundaries and named in lettered blocks:

- Mt Pleasant as Block A
- Hidden Valley as Block B
- Pine Tree as Block C
- East Point as Block D

Subdividing these blocks into compartments shall be numbered from left to right, top to bottom (C1, C2, C3 etc). Should the need arise to divide a compartment after it was numbered, it will be followed by a small alphabetical letter (C3a and C3b).
All future forest operations shall be carried out by management compartment i.e. prescribed burning, planting, weeding, tending, pruning, thinning, and harvesting. A detailed compartment log shall be maintained noting the area, date and type of operation, i.e. date planted and any comments, observations and/or recommendations made. Any research carried out in a specific block shall also be duly noted.

**Maturity Classes**

Maturity classes group trees or stands according to their stage of development from establishment to suitability for harvest. According to Bull Run forest management objectives there are five maturity classes in operation. These are:

<table>
<thead>
<tr>
<th>Class</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1 - 15</td>
</tr>
<tr>
<td>2</td>
<td>16 - 25</td>
</tr>
<tr>
<td>3</td>
<td>26 - 35</td>
</tr>
<tr>
<td>4</td>
<td>36 - 45</td>
</tr>
<tr>
<td>5</td>
<td>45 +</td>
</tr>
</tbody>
</table>

Certain forest management practices are directly coupled to a specific age class. For example, all pre-commercial thinning should be completed during age class 1, the first prescribed burn would take place as soon as canopy closure is reached, which would be achieved during age class 2, a second, commercial thinning may take place during age class 2, depending on existing market conditions, harvesting is limited to age class 4 and harvesting trees reserved for transmission pole production would be in age class 5.

**Stocking or Density Class**

Stocking is an expression of stand density that may be expressed in absolute terms, such as basal area per acre, volume per acre, number of trees per acre, or in relative terms, as a percent of some previously defined standard. Absolute stocking is meaningful in the presence of other information, such as stand size, forest type, etc. Relative stocking, on the other hand, implies a standard that accounts for the effects of stage of development and species composition, and therefore would be a useful tool for interpreting the findings of extensive inventories, where a wide variety of stands are sampled.

According to Bull Run forest management objectives there are three density classes in operation. These are:

<table>
<thead>
<tr>
<th>Class</th>
<th>Density (trees/acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>0 - 500</td>
</tr>
<tr>
<td>b</td>
<td>500 - 800</td>
</tr>
<tr>
<td>c</td>
<td>800 - 2000</td>
</tr>
</tbody>
</table>
Normalization

It is highly recommended that the entire structure of the forest be modified with the ultimate aim of achieving a normal structure. This process is called normalization and is defined as a forest in which each maturity class is represented by an equal area. Normalization of a forest estate is one of the main principles of sustainable forest management and thus all forest management activities shall be oriented in achieving this fully normalized forest as soon as possible. The process of normalization involves delaying (or advancing) time for felling of certain stands with the aim of keeping the total area harvested within the limitations of the specific annual allowable cut.

It should be noted that normalization is a prolonged process, the benefits of which are realized mainly in the long term. This therefore requires a degree of stability and continuity in short and medium term planning.

Land Classification

A typical forest land classification system entails the following:

✦ The land mass is separated into non-forested or forested land
✦ Forested land is subdivided into productive versus nonproductive forest land
✦ Productive forest land is subdivided into forest types
✦ The forest types are subdivided into size classes
✦ The size classes are subdivided into stocking or density classes.

The result is a forest type map that shows stands delineated on stand maturity and density.

Forest zones will substitute for the land classification system until all short term management objectives have been reached either in full or to a satisfactory level.

Forest Zones

Zones are defined as areas with similar management objectives to reach a common goal. Bull Run property is currently characterized by two distinct land classes and zoned accordingly. Each compartment is also assigned to a zone until the land cover of that compartment changes as part of normalization except in the case of Zones 4 & 5, which are hardwood areas along all streams and creeks.

✦ Zone 1 – These are areas under dense natural regeneration with the need to undergo a pre-commercial thinning regime
✦ Zone 2 – These areas have commercial-size timber and are harvestable. The logging is done in such a fashion so as to facilitate the natural regeneration of pine, after which thinning practices will be carried out as soon as possible i.e. 3-4 years of age
✦ Zone 3 – These areas need to be reforested by means of the preferred method suitable for the particular compartment.
✦ Zone 4 – These are areas of the Baldy subsuite soil type with vegetation primarily of grass savana with scattered and stunted Pinus caribaea
✦ Zone 5 – These are hardwood dominated areas, primarily along most streams and creeks.
Thinning

Thinning, as part of sustainable forest management practices are done for the following criteria and reasons:

✦ Selecting the superior trees according to crown, height, form and diameter as well as a function of competition among individual pine trees
✦ Increasing the carrying capacity of the stand by providing the remaining trees with more water and nutrients
✦ Increased timber yields and quality timber according to end product and market
✦ Overall improved forest health due to the fact that healthier, stronger trees offer higher resistance to forest pests, diseases and fire
✦ Preparing the stand for fuel management practices by means of prescribed burning
✦ Overall decrease in fire danger due to a decrease in fuel load
✦ Improved overall access into the forest stand for other forest management activities

The preferred method of thinning is by machete, since this is the fastest and most efficient way. Naturally the trees should be at a young age or two inches in diameter or less. Areas where trees are thicker than this slow production and efficiency down considerably. Due to the immense competition between the trees, tree size here is generally small. In areas where the natural density is less, tree diameter is greater and thinning productivity increases when brush axes are used.

In a pre-commercial thinning, the easiest way to control thinning (by the men doing the thinning) and quality control (by the supervisor or forester) is by implementing the 4-step plot method. Plots are easily visualized by taking four steps from the selected ‘plus’ tree, thus creating a 100th acre plot with roughly 11.8 feet radius. This is your 100th acre plot in which to ultimately leave 4-6 trees. The ruling guideline is to identify your plus tree or anticipated seed tree first, establish the 4-step plot and then select the remaining 3 – 5 trees in that plot. The flexibility decision of 4 – 6 trees to remain in a plot is dependent on the overall amount and quality of the trees before thinning. In other words, stands that are less dense with larger trees require fewer trees to remain per acre (400). Likewise, dense, lesser quality stands require more trees to remain (600). Technically speaking, every tree selected to remain is in fact the ‘plus’ tree in the centre of its own 100th acre plot – the end result the entire stand made of selected ‘plus’ trees based on the following criteria: Crown, Height, Form and Diameter in that particular order as to select the best possible tree with the greatest potential for seed tree characteristics.

Specific requirements of each criterion are:

✦ Crown
  • Full crown 360° around stem
  • Crown not broken off, damaged or ‘forked’
  • Crown in good health and with no visible signs of any disease
  • Good branch formation (no branch whorls)
  • Healthy needle color.
✦ Height
  • Any tree showing dominant height is preferred, however crown form takes preference over height thus should there be a shorter tree, but with a better formed crown right next to it, the shorter one should be selected
Form
• Form generally refers to the straightness of the stem. Trees with obvious sweep, kinks or other stem deformities should be removed from the stand. In high density areas, there are often no perfectly straight stems due to heavy competition, but the best tree should still be selected in anyway.

Diameter
• Trees with the thickest diameter naturally catches the eye first, but can also be misleading and are not always suitable for selection, according to the other tree selecting criteria mentioned above.

It should be noted that the above specifics are only guidelines and with practice and experience, tree selection becomes more natural. However, the ultimate objective should always be to leave the trees with the highest genetic quality remaining in the stand.

The desired distance between remaining trees, while fulfilling in the 400-600 stems per acre requirement is between six and eight feet (6-8) with no remaining trees closer than 6 feet apart, even if they are of equal quality. Leaving trees closer than 6 feet results in undesirable crown development and slower overall tree growth.

Fire Management

Fire Management is an increasingly important management activity. It entails largely fuel management with the main objective of reducing fuel levels to below hazardous levels while still maintaining full forest cover and biodiversity. Fuel management on the Bull Run estate forms the basis of forest management activities as it affects silviculture and harvesting operations, i.e. improving access and weed control.

Other objectives of prescribed burning are:

♦ Reduce hazardous fuels (fuel management as mentioned)
♦ Prepare sites for seeding or planting
♦ Manage competing vegetation
♦ Dispose of logging debris
♦ Improve access
♦ Improve wildlife habitat
♦ Control some insects and disease

Fire Management Zones are management areas where a specified fire management operational objective, strategy, and performance indicator has been developed to mitigate the threat of wildfire.

The principle of this fire zoning model is fuel management. Fuel management is defined as the manipulation, modification and reduction of flammable vegetation to meet fire protection and land management objectives. An adequate program of fuel management will help to prevent the occurrence or reduce the size of fires since fuel will not be available for rapid and intense spread. Fire zoning is thus concentrated on reducing the fuel load (pre-burns and/or slashing), and maintaining it at a low level (prescribed burning under live pine). Fuel load is the dry weight of a fuel in a specific area and varies from fuel type to fuel type and thus also from site to site.
Prescribed burning

As prescribed burning will be performed under live pines (commonly known as underburning), only the fuel loads of the non-pine vegetation (grasses and shrubs) shall be taken into account. Growth of grasses and shrubs are quite rapid after a fire. A baseline study was performed in the Mountain Pine Ridge Forest Reserve, included sites that were burned six months prior to sampling and sites that had not been burned for five years. Results were as follows:

<table>
<thead>
<tr>
<th>Fuel Load (lbs/ac)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Six months after burn</td>
</tr>
<tr>
<td>Five years after burn</td>
</tr>
</tbody>
</table>

In order to make the fire zoning model more practical, three levels of zoning are applied – each of which are associated with a time frame:

**Level 1 – Low risk**

During the first two years after an area is burned, the risk falls into the low category. The state and amount of vegetation will not support a continuous (and thus damaging fire), simply because of the lack of available fuel.

**Level 2 – Medium risk**

Depending on site characteristics which determine rate of vegetation growth, this level is reached in year 3-5 after burning. If burning is conducted with reasonable care, trees 1m in height should not suffer appreciable mortality or increment loss. It is even possible that incremental growth may be enhanced through this treatment. It is thus viable to perform prescribed burning during the Level 2 stage, taking into full consideration the vigor of the pine, fuel load, site characteristics (which include topography and soil conditions), and of course, weather conditions.

**Level 3 – High risk**

This stage is reached in year 6-10 after burning; again depending upon the various site characteristics mentioned above. Relating this to fuel load and fuel accumulation as shown in Table 1, fuel load levels are starting to reach hazardous levels, which regardless of tree height, may cause detrimental mortality within the pine stand. Fuel load should not be allowed to exceed 4,000 lbs/ac.

Each planted and treated area thus forms a very effective firebreak in itself versus the conventional practice of surrounding valuable (planted areas) with costly firebreaks which have to be maintained annually. As soon as the trees are 10 years and older and the sites have undergone the initial prescribed burning after planting, a continuous fire cycle of 3-5 years can be implemented and maintained. As additional protection, firebreak should be maintained along major routes and boundaries, but the objective of such firebreaks will be to reduce problems with incoming fires and prevent damage to outlying areas with outgoing fires.
Harvesting

Bull Run employs the seed tree method for harvesting.

Mature trees are harvested in one operation, leaving 20 to 25 dominant, seed-producing trees per acre. Seed trees should have well-developed crowns and be good seed producers. If you select seed trees several years before the final harvest, you can prepare them during thinning operations for seed production by giving them more growing space for crown development.

Prepare the site by uncovering bare soil and removing competing vegetation. You can substantially reduce regeneration costs by using prescribed fire in pine stands before the final crop is harvested. If you do not remove competing vegetation before the final harvest, you may be forced to use expensive mechanical or chemical site preparation practices.

The value of the seed tree may be more than the cost of artificial regeneration. You may lose several seed trees to lightning, wind, and insects before the new crop is established and the seed trees are harvested. Good seed crops come every 2 to 5 years, so competing vegetation must be controlled before the final harvest, and possibly re-treated after the seed trees are released. This will increase the chances for successful seed germination and seedling survival when a good seed year arrives.

This method leaves the forest with individual stands of even-aged management blocks which, in the overall picture, creates mosaics of different age forest compartments. This has the following advantages:

✦ Coincides with normalization objectives in guaranteeing an even, sustainable cut (and subsequent reforestation) each year.
✦ Provides stronger resistance (per individual stand and per forest) against the future bark beetle outbreaks. This is because each individual stand consists of much stronger and healthier trees that are more resistant to pest attacks making the stand as a whole more resistant. Should a pest outbreak advance upon the stand, the high vigor of the stand will more than likely slow down the spread of the pest outbreak enough so that it could possibly be contained. Mosaic patterns, as earlier mentioned, will ensure breaks between stands of equal susceptibility and thus also slow down or prevent the spread of the pest.
✦ A positive reduction on fire fuel in the stand due to the fact that there is now an absence of ladder fuels (younger pine saplings) responsible for allowing a ground fire to develop into a crown fire or to minimize destructive crown scorch. *Pinus caribaea* has a relatively small crown which aids in the lack of crown fires in the Pine Ridge, but destructive scorch can still occur, setting the growth of the tree back a few years, if not killing the tree. The idea is thus to minimize scorch by minimizing available fuel and aiming to keep the fire as low to the ground as possible.
✦ Improved conservation of bio-diversity. The selective harvesting method results in repeated entry into forest stands each year leading to a greater risk and/or occurrence for soil compaction, siltation of water courses, damage to remaining trees etc. With the seed tree method, repeated entry, and entry with heavy equipment is limited in the stand and the possible, detrimental effects mentioned earlier will be minimized or avoided. Of course, any detrimental effects normally associated with logging should be avoided with environmentally-conscientious logging practices, but the infrequency of stand entry by heavy equipment aids greatly to this.
Forest Audit and Assessment

1997 Audit

In 1997 Bull Run contracted for a complete audit of the standing pine timber over a large section of the lands. The data gathered at that time provides valuable insight into the state of the then twenty-five year old forest and gives useful guidance to the priorities of the current plan.

The project area was divided into 33 management blocks of roughly 247 acres each, following longitude 93-03 and latitude 82-88. Hardwood areas and any areas on or beyond the escarpment were excluded. All blocks were systematically sampled to estimate volumes for the management plan.

A sampling scheme utilizing fixed radius tenth acre plots was employed on a 10 x 10 inch chain rectangular grid for 7,775 acres. A tighter 5 x 5 chain grid was utilized in the 260 acres of Management Area No. 1. Eight hundred ninety one (891) plots were taken. Height measurements and diameter breast high (DBH) measurements were taken or estimated for each tree in each plot. The trees were classified into two product classes – sawtimber and pulpwood.

Sawtimber specifications were 8 inch DBH and larger to a 6 inch inside bark top diameter, with a minimum height of 16 feet. The pulpwood specifications were 5 inch DBH and larger to a 3 inch inside bark top diameter.
Summary of Results

The standing volume per management block varies from a low in the east to higher in the west. Of the 33 management compartments which comprise the project area, the lowest stocked were 32 and 33 on the eastern side which had recently suffered a wild fire. Those compartments contained 3,067 and 3,504 bdft per acres respectively. The highest stocked were 18 and 23 which contained 8,561 and 8,288 bdft per acre. The timber stand is even aged with an average site index of 78.

<table>
<thead>
<tr>
<th>Project Area</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Timber Volume</td>
<td></td>
</tr>
<tr>
<td></td>
<td>42,193,512 bdft sawtimber</td>
</tr>
<tr>
<td></td>
<td>18,184 cords pulpwood</td>
</tr>
<tr>
<td></td>
<td>376,579 tons</td>
</tr>
<tr>
<td>Average Volume per compartment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1,278,591 bdft sawtimber</td>
</tr>
<tr>
<td></td>
<td>551 cords pulpwood</td>
</tr>
<tr>
<td></td>
<td>11,411 tons</td>
</tr>
<tr>
<td>Average Volume per acre</td>
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The detailed results from the audit can be found in Appendix 2.

2005 Assessment

While it appears that 90%+ of the pine timber that existed before the beetle epidemic has died, there are significant pockets of timber still living and growing over the whole Mountain Pine Ridge. The pine beetle infestation appears to be over with a few exceptions, but those exceptions are more normal infestations and not a threat to the remaining stands.

Bull Run has 500+ acres of merchantable pine timber remaining and probably 2,000 – 3,000 acres of pre-merchantable pine regeneration that is 4 to 6 years in age. Most of the pine regeneration occurs in stands that were either burned or logged within 2 years prior to the pine beetle epidemic. The merchantable timber stands are very patchy and are mostly located on the eastern edge of the property in the East Point of Bull Run. A windshield cruise estimate of 500,000 to 1,000,000 board feet of timber is still alive and growing. Another 200,000 – 300,000 board feet of timber can be found alive and scattered over the remainder of the property. The timber on the east seems to have survived the pine beetle infestation because it is located upwind of the prevailing winds. The scattered living pines survived on the rest of the property I believe because of the random nature of the beetles gliding to new trees once the larvae hatch and they simply missed the remaining trees that survived. As a general rule, the scattered trees that lived are either isolated or they are small in diameter making them a harder target for the beetles’ glide path to hit.

Current Stock

There are approximately 3,000 acres of high density natural regeneration, 2,000 acres of low density 2,000 acres of sufficiently stocked regeneration and 1,500,000 – 2,000,000 board ft. of commercial timber.
Management Goals and Objectives

Primary Goal

The primary goal of this plan is to protect and enhance the renewable forest resources of Bull Run while managing and conserving the water, soil, and potential recreational opportunities of Bull Run by implementing sustainable forest management principles (see the prior pages for a discussion of sustainable forestry principles).

Objectives

✦ Protect the forest aesthetics, water, soil and bio-diversity, which as a whole comprise Bull Run lands
✦ To inventory and examine the age, health, vigor, and quantity of the forest resource in order to best manage Bull Run lands
✦ To carefully plan and conduct timber harvest activities without diminishing recreational activities or soil and water quality.
✦ Implement silvicultural techniques, which will improve growing conditions, sustain the productivity of the forest, and harvest forest products that may otherwise be lost.
✦ Identify areas that may support unique and sensitive flora, or fauna.
✦ Establish forestry demonstration areas that use Best Management Practices and sound silvicultural practices.

The Bull Run Overseas Ltd. property was severely affected by the Southern Pine Bark Beetle (dendroctonus frontalis) attack that caused large-scale devastation to the pine resource of the Mountain Pine Ridge during 2000 and 2001. Rapid reforestation, either by planting, direct seeding in ameliorated sites or natural regeneration achieved through prescribed burning, is necessary to prevent mainly environmental pollution, for example the decrease in water quality through siltation that will eventually affect Belize’s Barrier Reef, and prevent the long-term economic loss that will occur due to the decrease in availability and quality of pine timber.

Probably the most pressing management objective currently is the management of overstocked natural regeneration, in some areas densities of 2000 stems per acre occur, which are extremely detrimental in terms of both timber quality and forest protection (pests and fire). This regeneration is due to the areas being burned by wildfire in the last 5 – 7 years. These areas require the treatment of a rigorous thinning regime.

Long-term objectives

✦ To maximize financial returns on investment to Bull Run in management of the resource. This includes
  • Maximize sustainable supply of pine roundwood for sawtimber and transmission poles.
  • Export sales of pine seed as per demand
  • Research orientated towards maximizing sustainable yields through refinement of practices.
✦ To ensure full protection of streams and water catchments.
✦ To maintain and enhance habitats for natural flora and fauna.
✦ To maintain and enhance quality of the forest reserve for tourism and recreational usage.
Short-term objectives

✦ Rebuild forest infrastructure which includes the dividing of the forest resource in clearly defined management blocks (previously the property was uniformly divided into grid scale management blocks which largely complicate practical forest management).
✦ Reconstruction and creation of strategic forest roads to aid largely in the delineation of management blocks as well as act as firebreaks.
✦ Creation and maintenance of firebreaks. Roads and creeks largely doubles up as firebreaks, but in some cases such as the north-western boundary line and the south-western boundary, no roads or natural features exist to act as firebreaks and thus have to be maintained mechanically, where possible, or manually.
✦ Pre-commercially thin the natural regeneration with a goal of releasing the best 400 – 600 trees per acre in the respective stands. Leave a few acres in two or three spots in the natural regeneration as a control.
✦ The use of prescribed burning as a regeneration method and fuel reduction tool.
✦ Reforestation either by nursery grown seedlings, prescribed burning or direct seeding accompanying site amelioration.
✦ The execution of a timber sale to generate some interim financing and to “clean up” some areas so that sustainable management practices can be followed.
✦ Prescribe burn the merchantable stands of pines in preparation for a seed tree timber sale.
✦ Conduct seed tree timber sale and insure that the contract includes a clause that requires the successful buyer to cut all of the pines not marked greater than 4” DBH or 6” on the stump whether the trees are merchandized or not. The reason for this it to prevent the genetically weakest trees from being a source of seed in the regeneration.
✦ Harvest the scattered living timber within the beetle killed areas.
✦ Prescribe burn the un-forested portions of Bull Run starting with the land in the northern compartment of Mt Pleasant first, the land on the south end of Slade Creek second. These fires should be as hot as possible.
✦ Plant Caribbean Pine seed in the nursery for future planting
✦ Plant the graded (best) seedlings spaced eight feet apart in the center of harrow strips along the contour of the land approximately 12 – 15 feet apart.
✦ Establish 5 or 10 permanent one-tenth acre plots in the thinned natural regeneration and 1 or 2 plots in an un-thinned area. Annually measure the DBH (diameter breast high) and total height in feet on these plots.
✦ Make signs to place along Cooma Cairn Road detailing what is being done for education purposes for tourists and students.
✦ Keep good records of everything done – including dates, management activities, and results.
Completed Objectives

✦ Construct two 50,000 seedling nurseries
✦ Thin all of compartment C-4 to 600 stems per acre
✦ Create control plots and sampling plots in C-4
✦ Harvest seed trees in compartments A-1, A-3 and A-4
✦ Build concrete bridge to join Butler Line to Thompson Line
✦ Build all-weather fire lines as compartments boundaries for C-6, C-7 and C-8
✦ Clear, burn, harrow and plant two test plantations, one in A-4 and one in D-4
✦ Prescribe burn all of C-10, D-3, D-4
✦ Cruise, mark and sell standing timber in D-2, D-3, D-4, D-5 and D-9
✦ Contract for watershed preservation consulting and draft plan
✦ Assess maturity and density of all compartments
✦ Bring all equipment, tools and facilities into good working order
✦ Clear northwestern boundary line
✦ Repair all key roads and fire breaks
✦ Develop management plan
✦ Hire forester, foreman and crew leaders
✦ Hire fifteen man thinning team
✦ Establish housing and feeding facilities
Forest Management Activities

Reforestation

Ultimately, forest management practices are geared towards reforestation by natural regeneration (this method coincides with sustainable forest management objectives) and then thinning. However, Zone 3 areas have no or insufficient seed trees left thus natural regeneration will either take a very long time (a few tree generations) or be virtually impossible and the area will revert to being hardwood dominated. The initial reforestation of these areas will be either done with nursery grown seedlings or by direct seeding. A method for direct seeding could be to harrow strips with a bulldozer and harrow and then sow pine seeds (3 or 4 at a time every 8 feet apart). The harrow strips would be roughly 12 feet apart. This method is limited to compartments of higher site quality, where conditions are more favorable for seedling survival and successful regeneration, and the onset of the rainy season. A few trial strips of this method should be put in place in the open field just north of the Bull Run farm and the results (costs, survival, seedling quality) should be compared with reforestation in the same general area with nursery grown seedling. The assumption is that the nursery grown seedlings will have a higher survival rate, but the cost-benefit of this would have to be determined.

Thinning

Un-thinned, high stand density areas for one, pose an extremely high fire danger and two, are highly susceptible to Pine Bark beetle attacks. The desired stand density for *Pinus caribaea* in the Mountain Pine Ridge is 400 – 600 stems per acre. In Block C very dense stands, 2,000 stems per acre, of *P. caribaea* occur due to natural regeneration. These areas of high natural regeneration are incorporated into Zone 1 management. Block C areas will also enjoy priority above other areas as these areas comprise the better site quality areas.

As mentioned, in some cases the property natural generation densities of up to 2000 stems per acre occur. Since the product objectives of the timber is sawtimber based on sawlog rotations, suggested stands are thinned to a density of 400 – 600 stems per acre which would largely constitute the final cut. (400 with bigger and higher quality trees and 600 for smaller diameter, poorer quality trees). A further reason for this is due to the absence of suitable market conditions in Belize. Should this condition change or markets be found internationally, the pre-commercial thinning densities will be 700-800 stems per acre with the second, commercial thinning densities thinned to the required 300 – 400 stems per acre as early as the 12th year.

Thinning should take place as soon as possible, that is, 3 – 4 years of age or as soon as superior trees can be selected. Bar the considerable savings of costs and time, the sooner thinning can take place, the sooner crown canopy closure will be reached thus natural weed suppression will occur due to the lack of sunlight, fire fuel is kept to a minimum, quality saw timber will be produced sooner, access into the stand will be improved and as mentioned, an overall improvement in forest health will take place. It is also likely that a shorter rotation age is possible. We believe that rotation age could be lessened by as much as three years by practicing a well planned and executed thinning regime in natural regenerated stands.

Selected trees in thinning research plots will be measured (height and diameter) annually to determine M.A.I. and C.A.I. (mean annual increment and current annual increment). These measurements will be compared to selected tree measurements in un-thinned research plots.
Fire Management

The focal point of Fire Management at Bull Run is the implementation of a diligent fire management zoning program, or fire zoning.

As the entire property is currently under a high fuel load and fall in a high risk area, this practice should enjoy high priority with the objective of reducing all areas to Zone 1 classification as soon as is safely possible. The process will take years because much of the land is currently at maturity class 1 and must be burned with extreme care and only on the most optimal conditions.

Forest Mensuration

Forest mensuration includes the surveying of timber inventory, in the case of the Bull Run property, either for research purposes or in anticipation of a timber sale.

For research purposes, the objective is to determine MAI (Mean Annual Increment) and CAI (Current Annual Increment) and compare it either with different stands to map high site index areas or in the case of the thinning plots, the difference in CAI between thinned and un-thinned research plots.

For timber sale purposes, the objective is of course to estimate the tree volume in a sale area. This is done by first conducting a timber marking to identify and mark the superior quality seed trees to remain in each stand for future regeneration purposes. The seed trees are selected at a density suitable to the current stand conditions on a tree per acre basis for example smaller and lesser quality seed trees equals more seed trees left per acre. The same applies where better quality trees dominates and would require fewer seed trees left per acre. On average, 20 – 25 seed trees are selected per acre to remain after harvesting. After the required seed trees are selected and marked, the sale area is cruised to estimate the timber volume to be extracted during the sale. This is done by various percentages of sampling. Usually a 10% cruise is conducted representing the entire sale area.
Bibliography


Glossary

**Backfire.** A slow moving fire that burns into the wind.

**Basal Area.** A measure of stand density. It is represented in the average square feet per acre of the cross-sectional area of the trees growing on that area.

**Board Foot.** A unit of wood 1 inch thick, 12 inches long, and 12 inches wide. One board foot contains 144 cubic inches of wood.

**Chip-n-saw.** A size class of timber larger than pulpwood and smaller than sawtimber which yields small dimension lumber and wood chips as products.

**Cord.** A stack of wood 4’x 4’x 8’ (128 cubic feet) which contains both solid wood and air. Generally results in about 90 cubic feet of solid wood.

**Crown.** Top portion of the tree with leaves and branches.

**Crown Class.** An evaluation of an individual tree’s crown in relation to its position in the canopy and the amount of sunlight it receives. The four crown categories are dominant, codominant, intermediate and overtopped or suppressed.

**DBH.** Diameter in inches at breast height (4.5 feet above the ground), usually written in small letters, dbh.

**Dominant trees** The tallest, broadest trees of a forest that get the most sunlight.

**Fire Break.** A natural or man-made area where there are no forest fuels to carry a fire.

**Flank fire.** A fire burning perpendicular to the wind.

**Form Class.** Since tree taper affects volume, most volume tables are constructed taking taper into consideration. Tree taper when expressed as a percent is called "form class."

**Head fire.** A fire moving in the direction of the wind.

**Intermediate Thinning.** A forest management harvest that is performed prior to a stand becoming mature. The harvest is designed to improve growing conditions for the remaining trees.

**Log.** A cut tree 16 feet long.

**Log rule.** Mathematical equations that determine tree and log volumes.

**MBF.** Refers to sawtimber volumes in "thousands" of board feet.

**Merchantable height.** The length of the tree stem from the top of the stump to the smallest part of the tree top that can be sold.

**Prescribed burning.** The application of fire as a management tool to obtain specific objectives desired to maintain and cultivate a forest.
Pole Stand. A stand of trees with dbh ranging from 5 to 9 inches.

Pulpwood. Standing timber or cut roundwood that is suitable for converting to pulp for making paper or cellulose based products.

Saw log or Sawtimber. A log large enough to yield lumber. Usually the small end of the log must be at least 10 inches in diameter for hardwoods.

Selective Harvest. A type of intermediate thinning or harvest designed to improve growing conditions or to create and perpetuate an uneven-aged forest. Trees may be removed singly or in groups (group selection). This term is often misused by non-professionals as a replacement term for “diameter limit” harvest.

Silviculture. The science of producing and tending a forest.

Stocking. A qualitative reference to stand density that compares the existing number of trees and diameters to the number desired for optimum growth. Commonly referred to as full, under or over stocked.

Shelterwood. A regeneration cut designed to stimulate reproduction by removing all overstory trees. This is achieved by a series of cuts over several years.

Slash. Branches, tops and cull trees left on the ground following a harvest. Some slash can be used for firewood or arranged in piles for wildlife cover. Left scattered slash can protect seedlings and sprouts from deer browsing and reduce soil erosion.

Species Richness. The number of tree species present in a forest community or area.

Stewardship. The wise management and use of forest resources to ensure the health and productivity of the forest for future generations.

Variable Plot Cruise. A forest inventory method that uses a calibrated glass prism to determine "count" trees. Larger diameter trees are measured more than smaller trees by mathematical formula. For example, a 12 inch dbh tree can be 33 feet from the plot center; a 24-inch tree, 66 feet.
Appendices

Detailed Maps
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1997 Audit – Detailed Results 34
Detail of the Lands of Bull Run Overseas, Ltd
### 1997 Timber Survey Management Blocks

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**Bull Run Overseas, Ltd.**

**Forest Stewardship Plan**

28
Management Block Overview of the Lands of Bull Run Overseas, Ltd
Detail of Hidden Valley Management Block – Block B

Scale 1:50,000

Hidden Valley

Bull Run Overseas, Ltd.
Forest Stewardship Plan
Detail of Pine Tree Management Block – Block C

Scale 1:50,000
Detail of East Point Management Block – Block D

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