# Northern Fibre





Options for successful fibre processing in the Yukon

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## Executive Summary

This feasibility report examines the possibility of building and operating a craft size fibre mill in the Yukon. Initially thought of as an opportunity for a sustainable business to complement the fledgling fibre market in the Yukon, this study on small scale fibre processing revealed that there is a much larger demand for processors than is currently being met.

This report gives some history on the animals and their fibre and a brief description of the milling equipment and processes commonly used in craft fibre mills.

Research on the Internet, in the library, in local and telephone discussion with producers, and visits to different mills in Alberta provided information that was compiled and analyzed on the current state of the milling industry. The current market environment and competition were also examined.

Analysis was done on the market, machinery, management and operating options to provide a business model by examining the strengths, weaknesses, opportunities and challenges of each option.

Actual craft fibre mill requirements were developed from this analysis including the estimates for an operating facility and equipment. Marketing was examined and financial costs were calculated.

Using comparative data from similarly sized mills, the resulting current market prices were used against the estimated cost of production to confirm or preclude the feasibility of a mill.

Although there are many unknown parameters until an actual craft fibre mill goes into production, this study reveals that with a secure niche market, properly sized machinery, trained personnel and a well developed business plan, a craft fibre mill in the Yukon is possible.

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# Fibre and Fibre Producing Animals

It is helpful when examining the feasibility of a craft fibre mill to explore the wide variety of fibre producing animals and the special characteristics of their fibre.

## *Alpaca*

### The Animal

Alpaca are small members of the camelid family. Domesticated over 5,000 years ago, alpaca provided the food, fuel and clothing for a civilization that thrived in a hostile environment.

Alpacas have a life span of 20 - 25 years. Adults weigh 100 - 175 lbs and stand 34 - 36 inches at the withers. Baby alpacas, called cria, generally weigh 14 - 20 lbs at birth. Gestation is around 11 months.

Caring for alpaca is not difficult. Fences should be designed to keep out dogs, coyotes and other predators. A three-sided enclosure or lean-to is adequate for shade, as well as winter wind protection even in the Yukon. Alpacas require 2 pounds of low protein hay daily, and fresh water. They require little space; 6-8 animals/acre if forage is sufficient and you rotate pastures. Alpacas are extremely hardy and adaptable to most climates, elevations and conditions.

### The Fibre

The two breeds of alpaca, huacaya and suri; differ primarily in the character of their fibre. The huacaya has a crimped or wavy fleece whereas the suri has straight, fine fibre. Alpaca fibre is known for its fineness, lustre, light weight and insulating quality. There are 22 officially recognized colours of alpaca. Sweaters, blankets, mitts, socks, shawls, hats, duvets can be created from this fibre.

A small cottage industry in alpaca has been successfully established in the Yukon. Alpaca have a single coat that is generally sheared once per year. The fibre varies from 20 – 35 microns in thickness and is sorted into 6 grades.

Fibre length varies from short fibres (1.5 inches to 3.5 inches) to long fibres (3.5 inches to 6 inches). Short fibres are usually processed in a woollen method which will result in a softer lofty yarn. Longer fibres are usually processed in a worsted method which will result in a more hard wearing, tightly-spun, light-weight yarn.

## *Angora*

### The Animal

Angora, the fibre, is harvested from one of several breeds of rabbits. Four distinct breeds of Angora rabbits exist in North America: the English, French, Giant, and Satin. Each variety possesses unique breed characteristics.

The English breed is the smallest, at 5 to 7.5 pounds on a compact body. The coat generally contains few guard hairs in proportion to the wool. This breed is not recommended for anyone who does not have the time to spend in daily grooming.

The French Angora is a larger breed than the English, averaging 7.5 to 10.5 pounds. This breed is considered the easy-care breed of Angoras, normally only requiring grooming about once a week, and is the best choice for novices or youths.

The Satin Angora averages 6.5 to 9.5 pounds and has a shiny, satiny quality to its wool fibre.

The largest breed is the Giant Angora, weighing from 10 to 20 pounds. This breed is distinctive in that it is only recognized at show in the non-colour – white. This breed does not moult, or shed its hair naturally as do the other breeds, and so the wool must be harvested by hand shearing.

Angora housing can range from large mesh cages/hutches off the ground or shelters with outdoor mesh runs. Secure housing is imperative to protect the rabbit from predators & other rabbits, which may fight when quartered together. Cleanliness of living conditions is an important factor in maintaining fibre quality.

Gestation of Angoras is only 30 days. The buck should always be housed by himself and only put in the cage with the doe (female) for breeding purposes. Angora rabbits can live up to 10 years or longer.

### The Fibre

The English Angora is distinctive because of its prolific hair/fur on the face and ears. The wool wraps tightly when spun. This breed of Angora requires daily grooming to keep its fibre free of debris and mats.

The French angora has a higher guard hair ratio to wool, which allows for more intense and varied colours in the fibre. Most colour on the body of a rabbit is contained in the guard hair, rather than the under-wool that is normally light or white in colour.

The distinct hollow hair of the Satin Angora accounts for the intensity of colouration available in the breed. The fibre is preferred by hand-spinners for ease of spinning, and the dense coat is considered a pleasure to groom and harvest.

Angora wool can be harvested year round, and most fibre enthusiasts do this by holding the rabbit on their lap and either combing, plucking or hand shearing. The fibre from a well-groomed animal will not require washing or carding. Angora wool has a superior ability to retain dye colour. Angora wool is normally mixed with other soft fibres such as silk, cashmere, mohair or sheep's wool when knitted into clothing. Garments made of 100% Angora would be too warm, and the texture too fine to provide density in knit stitches.

## *Cashmere*

### The Animal

Cashmere is the soft, downy undercoat of a goat, grown to its maximum length by mid-winter and shed in early spring. Any goat can grow cashmere, but those called “cashmere goats” have been selectively bred to produce it in significant amounts. In order to be considered Cashmere, the fibre must be under 18.5 microns in diameter and be at least 3 centimetres long.

There is no such thing as a “purebred” cashmere goat. Feral goats from Australia, and Spanish meat goats selected for fibre traits form the basis of the Cashmere goat industry. Traditionally, cashmere goats are not de-horned. Both male and female goats have horns, which serve to dissipate heat during

the summer, and make convenient handles when working with the animals.

Good fences will protect goats from predators and gardens from goats. Three to seven strands of electric fencing or livestock fencing should work. Although cashmere goats are rugged and adaptable and can survive with minimal housing, they need places to escape from wind and wet weather. A three sided shed is usually all that's necessary. Hoof trimming is an important part of goat management, although frequency depends on terrain.

Goats are discriminating eaters, but they are incurably curious, and will nibble on anything to see if it's edible. They eat pasture and browse bushes in the summer and hay or greenfeed in the winter. Grain supplements are welcome in periods of extreme cold or stress, prior to kidding and during lactation. Feeding too much high protein dairy ration may coarsen the cashmere fibre. Mineral supplements provide trace elements, and help insure against various ailments.

### The Fibre

Cashmere goats produce a double fleece consisting of the fine, soft under-down of hair with a straighter and much coarser outer guard hair. In order for the fine under-down to be processed further, it must be de-haired. Dehairing is a mechanical process that separates the coarse hairs from the fine hair. After dehairing the resulting cashmere is ready to be carded, spun, dyed and woven or knitted into fabric and garments.

There are several Yukon farms raising cashmere goats. The fibre can be harvested by combing or shearing. Less guard hair is harvested when combing and the fibre is softer because there are no cut ends from shearing. The average Cashmere goat will produce from 50 to 100 grams of dehaired cashmere per year.

## *Dog hair*

### The Animal

The hair from several breeds of dogs can be spun into yarn. Dogs with particularly long hair and dual coats, like Samoyed or Great Pyrenees are best for fibre production, although any dual coat dog produces fibre that can be harvested and spun.

Dog hair fibre is often processed for sentimental rather than practical reasons. Customers who appreciate the novelty of owning a dog hair garment provide a niche market for processing this fibre.

### The Fibre

The hand spinning of dog hair has a long history in North America. First Nations people spun the wool from these animals and wove blankets and warm winter garments from the yarn.

Dog wool yarn has a fuzzy halo like angora or mohair when knit. It drapes well, insulates when wet, and like silk, isn't prone to static.

Any dog fibre with a staple longer than 2-3 inches can be used to make yarn, although longer fibres are easier to spin and make for more durable garments. Shorter fibres can be carded with silk or wool to be made into yarn. Through education and a consistent supply of quality products, spinners and knitters have established a successful local market for dog hair garments, mainly hats and mitts.

## *Llama*

### The Animal

Llamas are members of the camelid family (and the largest member of the genus Lama - one “L”.). Llamas have an average life span of 15 to 30 years. They stand between 3 and 4 feet at the withers. Rather than having a regular heat cycle, llamas are induced ovulators (ovulation occurs 24 to 36 hours after breeding). Gestation is almost a year and the cria generally weigh 20 to 35 pounds at birth.

Llamas thrive in a wide range of environments. They are highly adaptable feeders, being both grazers (grasses and forbs) and browsers (shrubs and trees). Llamas have a very efficient digestive system which allows them to thrive on low protein pasture or hay. Without pasture, a 100-pound bale of hay will last an adult llama for ten days to three weeks. Moderately producing pasture can support about three to five animals per acre. Sheep mineral and

salt blocks (with selenium) should be available free choice. Granulated minerals are preferred since llamas can't lick. Hoofs require regular trimming unless the animals are pastured on hard or rocky ground.

### The Fibre

A llama may be solid, spotted, or marked in a wide variety of patterns, with wool colours ranging from white to black and many shades of grey, beige, brown red, or roan. Llamas are generally sheared once every two years.

Llama fibre is hollow, with a series of diagonal walls through its structure which makes it very light, strong and insulating, as well as soft.

Mechanical dehairing is used to separate llama fibre into the soft undercoat which should have a diameter of less than 28 microns and the coarse outer coat. The finer fibre is suitable for knitwear, textile fabrics and suiting cloth. The strong, protective outer coat can be used for making blankets, rugs, wall-hangings, and rope. The majority of llamas currently being raised in the territory were originally brought in for use as pack animals. As yet, only minimal effort has been made in the Yukon to collect and use the fibre from these animals.

## *Mohair*

### The Animal

Mohair is the name for the fibre produced by an Angora goat. The Angora goat differs from other goat breeds in that it produces a single coat. The long, silky hair of the Angora goat is prized for its lustre. In full fleece, the Angora goat needs minimal shelter from wind and weather. They are susceptible to cold and/or wet weather immediately after shearing though, and need access to shelter at that time.

Gestation is about 150 days with twins accounting for 40% of births. Angora goats have high nutrient requirements and give nutritional advantage to fibre growth at the expense of other demands. Range forage of browse and forbs, protein supplements, grain and crop residues, and cereal crop pastures can help supply needed nutrients for growth and reproduction.

Goats can be pastured with sheep and cattle, since each species prefers different plants. Goats prefer brush, tree leaves, and rough plants. They can improve pasture, clear reforestation areas, control leafy spurge, and destroy roses, knapweed, Canadian thistle, buckbrush, and many other weeds.

### The Fibre

The majority of commercial mohair is white and most co-ops will only accept white fleece. There is, however, a growing market among hand-spinners for coloured mohair. Coloured animals are usually hardier and the fleece is more open and grease free. The coloured Angora originated on the Navajo Reservation where the naturally coloured fleece is mainly used for tapestry. Angora goats are usually sheared twice a year.

The highest quality fleece is from younger animals. Mohair fleece has a natural wax or grease called the yolk that protects the fibre from sun and chemical damage. Very hot water is required when washing a mohair fleece to dissolve the yolk. Angora goats are sheared twice a year and adult hair should be 4-6 inches long at shearing. An adult goat will usually produce 8 to 16 pounds of mohair a year. Kid mohair should be 4 inches long, is finer than adult hair, and may yield 3 to 5 pounds a year. Mohair fibre diameter ranges from 20 to 40 microns.

There are, as yet, no producers involved in mohair in the territory.

## *Qiviut*

### The Animal

Qiviut or qiviuq is the name given to the underdown harvested from a Musk Ox. Musk Oxen are not easily domesticated although herds are successfully kept in captivity in Alaska and the Yukon. Musk oxen belong to Bovidae family which includes bison, buffalo, antelope as well as domesticated sheep, cattle and goats.

Musk ox average 20 – 24 pounds at birth and can mature to 450 pounds with large bulls reaching as much as 800 pounds. Musk ox average just over 4 ½ feet at the shoulder and are grazers with a diet of mainly grass, reeds and sedges. In

captivity they feed on hay with a protein supplement.

### The Fibre

Qiviut can be harvested from wild animals using a system of combing stations. In the spring, when the animals are shedding, they can be encouraged to use the combing stations by providing feed nearby. Much of the commercial qiviut available is sheared from the hides of animals harvested for their meat.

Qiviut fibre is long with a diameter from 12 – 18 microns which makes it even softer than average cashmere. Each animal sheds 5 – 7 pounds of fibre each year. The animals are never sheared unless they've been harvested for meat.

Qiviut lacks the scales or the crimp of wool fibre so it is less irritating to wear next to the skin. Much warmer than wool, it is worn as an insulating layer in clothing because it wicks moisture from the body and doesn't shrink or felt. The fibre doesn't hold shape well when knitted alone so it is often blended with cashmere, alpaca, merino wool or silk.

## *Sheep's Wool*

### The Animal

Wool is the common name applied to the soft, curly fibres obtained chiefly from the fleece of domesticated sheep, and used extensively in textile manufacturing. Wild species of sheep have a short, woolly undercoat covered by long, coarse, straight hair. In domesticated sheep, selective breeding has improved both the quality and abundance of wool and reduced the growth of hair to a minimum. Wool production from sheep is affected by nutrition, climate, and care. Neglected domesticated animals have a tendency to produce hair instead of wool.

There are more breeds of sheep than breeds of any other livestock species. Worldwide, there are more than a thousand distinct sheep breeds. Sheep come in all different shapes, sizes, and colours. They can be differentiated by their

primary purpose (meat, wool, or milk), the type of fibres they grow (fine, medium, long, or carpet wool; or hair), the colour of their faces (black, white, red, or mottled).

Fine wool sheep (20 microns or less) account for more than half of the sheep raised. Fine wool sheep such as the Merino do best in a semi-arid or arid climate. Cool, high rainfall areas are best suited for long wool sheep such as the Lincoln. Their fibre has a much longer staple length and is usually more than 30 microns in diameter. Suffolk, Dorset, and Hampshire produce some medium wool but are usually raised for meat.

Depending on climate and plant growth, sheep on pasture can be stocked at rates as low as 1 sheep per acre to as high as 10 per acre. Sheep need protection from predators especially during lambing. Many breeds of sheep will produce twins. Some breeds are particularly prolific producing up to six offspring in a single lambing. Sheep can do well with three sided shelters for weather protection except after shearing when they can be vulnerable to pneumonia.

### The Fibre

Wool is differentiated from hair mainly by the nature of the scales that cover the outer surface of each fibre. Wool scales are numerous, minute, and pointed and are attached only at their bases; thus the fibres interlock under pressure. The number of scales varies with the fineness and curliness of the fibre. Because of its crimp, or curl, wool is resilient. This quality, together with its high tensile strength and elasticity, gives fine woollen fabrics the ability to retain shape better than cloth made from other natural fibres. The lightness, ability to absorb moisture, and insulating properties of wool make it especially desirable for clothing.

The fleece of sheep raised for wool is generally shorn once yearly, in the spring or early summer. The fleece is cut close to the skin, usually with mechanical shears, and removed in one piece. The average weight of the fleece shorn from better wool-producing breeds is about 4.5 kg (about 10 lb).

Wool from different parts of the same fleece varies greatly in length of fibre, fineness, and structure. Wool from the shoulders and sides of the sheep is usually superior to that from other parts of the body. Quality varies with the different breeds of sheep. About 40 percent of the world's total wool production consists of merino wool, and about 43 percent is obtained from

crossbred varieties. The remainder is composed largely of carpet wools, which are derived mostly from special types of sheep and are employed in the manufacture of blankets, carpets, and tapestries.

## *Wild and Novelty Fibres*

### The Animals

Novelty fibre can be created from the fur, hair or wool of almost any animal. Animals such as bison, mountain goat, bear, coyote, or wolf produce a downy undercoat that reaches its maximum length during mid-winter.

Wood bison is the largest terrestrial animal in North America with large males weighing over 2000 pounds. Calves are 40 – 50 pounds at birth and are running soon after birth. Bison have an average life span of 20 years in the wild, but can live up to 40 years in captivity.

Mechanical combing stations can be set up for animals held in captivity in zoos or wildlife preserves to collect fibre. Traditionally, wild fibre is collected from bushes during the spring moult. Hunters could provide a source of fibre from hides previously left unused.

### The Fibre

The soft fibre from a bison needs to be separated from the coarse outer hair and whiter intermediate hairs. Average diameter for bison underdown is 20

microns with a short staple length of 1 to 2 inches. The fibre is very warm but will matt or felt easily but doesn't shrink. Since there is no lanolin present, the fibre is resistant to moths.

Bison fibre has a broader moisture regain (the ability to hold moisture without feeling wet) than sheep's wool which makes it more comfortable to wear than wool. Spinners find it has more bulk bounce and resilience although it is more difficult to spin because of the short staple length.

Exotic wild fibres from mountain goat, coyote, bear and wolf are very similar in structure and processing needs to fibre from domestic goats or to qiviut from musk ox.

## Milling Equipment Descriptions

In taking fibre harvested from an animal to a finished garment there are multiple processing steps required to produce a consistent end product. Large mills require substantial equipment space and raw product to create efficiencies of scale. For the purposes of this study a smaller craft mill size was explored using a simplified flow chart.

When raw fibre comes in it must be washed, picked clean of debris, and in some cases guard hair must be separated from the desirable undercoat. The fibre must then be carded and drawn out to a consistent density, spun, steamed to set the fibre, then plied and wound into skeins or balls of finished yarn.

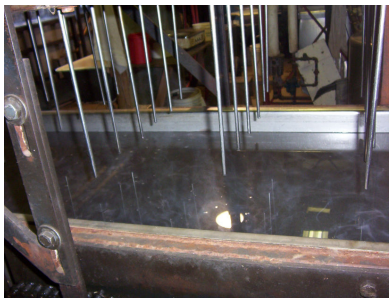
With craft mills, such as the Mini-mills, there is a much higher utilization of all raw product with minimal wastage left on the machines and the advantage of processing smaller lots. A relatively small footprint and lower requirements for utilities such as power and water add to the efficiency of the scaled down equipment. If milling equipment from the turn of the century can be found, it can be a viable option. This equipment is at a smaller scale than what is currently produced for commercial processing, but is larger in scale than Mini-Mills equipment. Turn of the century equipment has the advantage of higher production at a lower cost. It would be important to have an experienced millwright available to tune the equipment.

Turning fibre into yarn isn't a simple case of one machine doing it all. A mill set up for wool must be reconfigured to process double coat fibres such as cashmere or qiviut. Adjustments can be made to the setup to facilitate different fibre processing requirements. With finer fibres from dual coat animals, a dehairing machine is usually required to separate the stiff outer guard hairs from the soft inner fibres used for the yarn. This dehairing machine can also be used with single coat fibres to aid in the removal of debris and second cuts.

Value added machines such as a felting machine, a bump winder, a ball winder, knitting machines or dyeing equipment can be added later. Many small craft mills have moved toward more value added production to enable a greater profit margin. Dyeing locks, roving or yarn as well as knitting or sewing finished garments from the yarn or felt can add value to fibre processing businesses.

The basic process of getting a finished yarn from raw fibre involves scouring the fleece, picking, dehairing, carding, drawing, spinning, plying, steaming, and cone or skein winding.

### Scouring

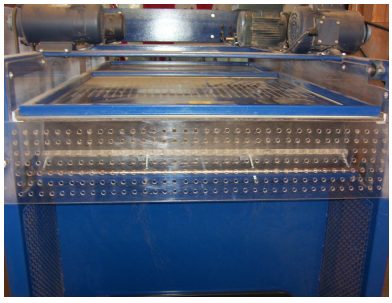


When raw fibre comes in it must be washed and rinsed to remove dirt and small particles along with animal dander and excessive oils. There are from one to three cycles depending on how dirty the raw fibre is. Water recycling should be utilized to conserve water and energy requirements.

### Picking

Once dried, the washed fibre is passed through a picker into a collecting room. The picker teases the fibres apart, opening and separating entanglements and depositing bits of debris under the machine. The fibres are literally thrown into a collecting room where conditioning oils can be added to the loose accumulation of fibre. The picker can also be used to blend fibres of different types and colours into a homogeneous mix.

### Dehairing

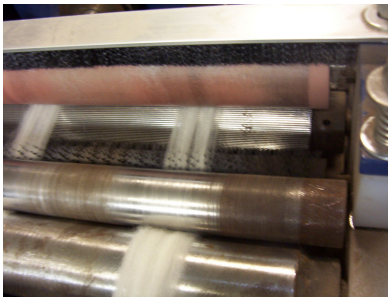


With double coat fibres like cashmere or qiviut, the fibre must be processed by a dehairing machine. This equipment separates the longer coarser guard hairs from the soft undercoat. Fine particles such as seeds and burrs are also removed. Unwanted material is collected under the machine while the gathered undercoat is combed off the end of the machine. Although many fibre types can take advantage of the superior cleaning action provided by this piece of machinery, it is an essential piece for processing dual coat fleeces.

### Carding

The carding process passes the clean and dry fibre through a system of wire rollers to straighten the fibres and remove any remaining vegetable matter. The rollers vary in diameter and turn at different speeds in order to form a thin web of aligned fibres. This web can be turned into batts which are used in quilts and felt making or the web can be consolidated into roving which are further processed into yarns. Blending of colours and types of fibre can be done at this stage.

### Drawing



A draw frame is used to create a roving consistent in size over its entire length. A draw frame blends multiple roving into one fibre stream and uses controlled drafting to size the output roving. Multiple passes through a draw frame or multiple draw frames placed one after another, are used to produce a strong, uniform roving of a size that can be easily managed at the spinner. Unique roving and yarns can be created by blending at this stage.

### Spinning

In spinning, separate fibres are twisted together to bind them into a stronger, long yarn. Characteristics of the yarn vary, based on the material used, fibre length and alignment, quantity of fibre used and degree of twist. A tightly spun yarn with no air in it is called worsted. The fibres all lie in the same direction as the yarn and the yarn is long wearing and has a distinctive sheen. In a woollen yarn, in contrast, the fibres are not as strictly aligned to the yarn created. The woollen yarn thus captures much more air making a softer and generally bulkier yarn. Woollen yarns are usually produced from shorter staple fibre while worsted yarns require a

longer staple length. When working with shorter fibre, such as bison or angora rabbit, longer fibres, such as merino or mohair can be incorporated to prevent yarn breakage.

### Plying

Plying is a process used to create a strong, balanced yarn. It is done by taking two or more strands of yarn singles produced by spinning. The strands are twisted together, in the opposite direction than that in which they were spun. When just the right amount of twist is added, a balanced yarn is created. A balanced yarn is one with no tendency to twist upon itself.

A two ply is thus a yarn plied from two strands; a six ply is one from six strands, and so on.

Some novelty yarns make use of special plying techniques to gain their special effects. By varying the tension in the strands, or the relative sizes of the strands, different effects can be achieved. When a soft, thick strand is plied against a tightly twisted thin strand, the resulting yarn spirals. Boucle is a yarn where one strand is held loosely and allowed to make loops on the other yarn while plying.

### Steaming


After plying, the twist is set in the yarn by steaming. Steaming can be completed after yarn is wound in skeins, or prior to winding on cones for distribution.

### Cone winding

In order for finished yarn to be available for weaving or feeding to a knitting machine, the yarn is wound onto cones. A cone winder controls the speed at which the cone is built, tension at which the yarn is applied and the length of yarn on each cone. The cone winder automatically stops when the desired amount of yarn has been wound.

### Skein Winding

One and a half or two yard skeins are wound using a skein winder. Individual skeins are then hand twisted and looped. Skeins can be opened and hand painted or vat dyed. Skeins must be wound into balls prior to hand knitting.

### Flat plate felting

Felt is a non-woven cloth that is produced by matting, condensing and pressing fibres. In flat plate felting, the structure of the fabric is formed by rubbing layers of fibre that have been sprayed with soapy water. Heat and movement cause the fibres to lock together forming a dense fabric.

### Pin felting

Pin or needle felting is a dry process that involves using felting needles or pins to produce a softer type of felt. Reverse barbs on the pins push surface fibre into the centre of a batt which are released when the pin is drawn out. This technique is used to produce three dimensional as well as flat work.

## Market Environment

There is currently a small community of people in the Yukon that own animals or gather fibre to process. Although this small size could be considered a limiting factor, it can also be considered a vibrant beginning to a sustainable fibre industry.

By visiting a variety of mills in Alberta and listening to their recommendations, it is apparent any mill and accompanying value added services need to be focused on a niche market to be sustainable. In the Yukon it would appear that specialty fibres such as goat (cashmere), dog hair, bison, Musk Ox (qiviut) would be suitable. All of these fibres are from dual coat animals.

There are larger mills in Canada which process sheep wool and alpaca in great volume and speed for lower costs than any small mill could provide. They do however shy away from smaller amounts of specialty fibres requiring dehairing. Several of the mills are also woollen mills and do not have drafting equipment needed for worsted fibre.

The potential market for fibre products includes local knitters and spinners for basic processed fibre such as yarn, roving or batts. Local retail outlets might consider selling yarn, roving or batts with made-in-the-Yukon appeal. With appropriate marketing, outlets catering to visitors could take immediate advantage of specific novelty fibres unique to the Yukon. For locally grown fibre, there is currently only enough to supply a local market and therefore no current advantage to marketing these products outside of the Yukon. What can be marketed outside is a mill in the Yukon as a destination for dual coat fibres such as cashmere or qiviut because there are currently no consistent processors anywhere in Canada. In time, the Yukon could become the processing centre for such fibres.

Mill managers all agree that there is more value in selling finished products directly from the mill or through a cooperative associated with the mill than in custom processing alone. Finished products might include socks, scarves, cowls, mitts, toques, sweaters, comforters, quilt batts, blankets or rugs along with a variety of roving and spun yarns.

The ability to process locally and cater to a consumer interested in purchasing a completely northern product will encourage increased local production of

fibre.

Within the Yukon there are several large chain stores selling yarn and woollen items but there is essentially only one store that sells high quality yarns and finished knitted items. Working in conjunction with the store could be beneficial to fibre producers, processors and consumers. It would take communication and effective marketing to secure the niche for the specialty fibres.

A feature of all the mills visited is the capacity to offer tours and educational material on the machines, the processes involved in creating end products, and the end products themselves. There could be a charge that would offset the cost of a guided tour. Having toured numerous mills and seen the variety of machinery and products created, it is evident mill tours and classes offered in felting, hand spinning and knitting would be an additional benefit to the marketing strategy. There is a strong desire in consumers to own items they've seen created and feel connected to.

## Competition

The mills closest to the Yukon are in southern Alberta and southern British Columbia. With the current abundance of fibre, all mills are busy with each mill offering a variety of services. Many mills have a back log of six month to a year for fibre waiting for processing. Although there is some seasonal down time, machine upgrading and maintenance keep mill operators busy.

With the limited supply of custom processing mills, and excess fibre available, the market between mills isn't highly competitive, yet with profit margins remaining low, quality finishing, efficiency and volume production are essential.

A number of fibre producers are interested in finding new niche markets due to lower prices for breeding stock of fibre producing animals. Education is required for producers on methods necessary for good fibre harvest. Many producers look for high quality finished yarn but supply only dry, dirty and damaged fleece. Many mills find raw fibre must sometimes be rejected or returned to producers as unusable.

With the abundance of some fibre, mills can process great amounts with larger equipment and obtain a lager income. Smaller amounts of specific fibre are often held until sufficient volumes are on hand to make a run.

Entering into the market requires identification of a niche and branding of the product(s). The Yukon has the specialty fibres of dual coat animals and can utilize the pristine northern environment for a very marketable product. Being in the fibre market requires training to grade fibres correctly and to maximize the capacity of the machinery. There can be wasted effort in trying to process fibre into a product it is unsuited for. Recognition of quality fibre and support for producers is requisite to a sustainable fibre processing business.

The largest barrier into fibre milling is the cost of the equipment. Mills that have been in business for a long time have demonstrated the ability to produce quality products and value added items to increase their profit margin. The machinery has survived the test of time and older equipment has been well taken care of by experienced millwrights. Smaller mills suffer predominantly from an inability to process a large enough quantity of fibre, a lack of operator experience on the machines and with fibre, insufficient or non-existent retail sales and little public awareness/support through tours or classes.

## State of the Industry

There are not many processing mills in western Canada, but each one has identified its own area of specialization. In British Columbia, a cooperative mill on Salt Spring Island utilizes Mini-Mill equipment to produce a semi-worsted yarn. They provide custom processing of local mohair, alpaca and wool. This would also include custom dyeing. As with other cooperative mills, they buy fibre from producers to process into batts, roving, duvets and yarn for sale. They have developed a signature yarn that is a blend of local mohair, alpaca and wool. The limiting factor with the mill is the size of their equipment and the inability to process large volumes. The mill doesn't have a dehairing machine required to process cashmere or qiviut.

In Alberta there are two larger mills using turn of the century equipment and several small mills. Custom Woollen Mill east of Carstairs utilizes turn of the century equipment with the highlight being a spinning mule. Different than modern stationary spinning techniques, the spinning mule uses a travelling spindle which produces a more relaxed twist and softer yarn. They produce a woollen yarn which is unlike the worsted yarn that has all the fibres aligned prior to spinning. Woollen yarn can utilize shorter fibres, has more loft and does not require drafting equipment or combing. The mill has dyeing tanks to produce 30 vibrant colours. They produce batts, roping, yarn, quilted comforters, socks and custom knit items. They process approximately 800 lbs per day of wool or 160,000 lbs per year end employ between 12 to 18 people. Unofficial tours are available and a book highlighting the special nature of this mill provides the opportunity to expand the knowledge of consumers. They currently have an approximate turn around of 8 months on fibre. A minimum of one pound can be turned into roping and a minimum of 20 lbs must be provided for processing into woollen yarn. The limiting factor here is larger lot sizes and a woollen product. They will accept yarn for custom sock making provided it meets their strict requirements. Custom Woollen Mill has recently expanded to include retail space on site for their yarn, roving, knitting kits, socks, and locally produced garments.

Further north in Innisfail, Alberta, Exotic Fibres of Canada is a larger mill with carders similar in size to Custom Woollen Mills. This mill custom processes large volumes of wool, alpaca and other exotic fibres. They buy fibre for processing into duvets, pillows and also send yarn off to be made into socks, toques, scarves and blankets. This mill has a large drafting machine to enable production of worsted yarn on their spinners. This mill has more

capacity than Custom Woollen Mill but currently employs only three people. They don't do any dyeing on site but would consider spinning custom dyed fibre. Limitations here are large lot sizes, no custom dyeing, worsted only and inability to process exotic fibre such as cashmere or qiviut.

Just outside of Edmonton in Rollyview, Twisted Sisters Mill focuses on the custom processing of alpaca from other alpaca producers as well as their own farm. This facility uses predominantly Mini-Mill equipment with the exception of a carding machine produced by Patrick Green. The mill can produce a semi-worsted yarn from raw fleece for custom orders but dyeing is only done for their own retail store. The retail store has been recently added to their operation and sells dyed and natural roving and yarn, felted hats, mitts and slippers, knit socks, hats, mitts, and scarves as well as knitting supplies such as needles. Members of the local craft community supply finished products on consignment. Two people are employed full time in the mill and the store is open two days a week. The owners are wonderful ambassadors for the fibre industry and understand the need for an operation that has a value added component in addition to custom processing. Limitations are the size and capacity of the machines. Turn around time on custom processing is six months to a year.

An option to be considered is piecing together a collection of machinery from different sources including Mini-Mills and larger commercial mills. Stonehedge Fibre Milling Equipment, Inc. located in Michigan has done just that. Here several essential machines have been developed that can provide the additional capacity lacking with Mini-Mills equipment. A larger carder with the capacity of 12 lbs per hour is almost double the capacity of a Mini-Mill carder. Add to that a pin carder with combs for fully worsted fibre and an eight to thirty-two spindle spinner and the capacity increases to around 1500 pounds of fibre a month. Although this machinery is not as widely publicized in Canada as Mini-Mill equipment, it is comparable in price and has a greater capacity. The owner/operator, Chuck McDermott, has identified a number of ways in which to increase capacity without having to go excessively large. He is a good source of information and he is close to the large processors along the US east coast. Although from outside Canada, shipping from Michigan involves a shorter distance than shipping Mini-Mill equipment from PEI.

The manager of Custom Woollen Mills in Carstairs fervently believes that better value could be obtained by picking up older commercial machinery from defunct mills than purchasing new smaller mill equipment. It was

suggested that the best location to find this type of equipment is the North American east coast where many commercial mills are being relocated to foreign countries due to labour costs. Tracking down such machinery and ensuring it is in working condition would require a substantial investment in time. Shipping would be expensive due to the large size of much of this equipment. The mill operator from Exotic Fibres in Innisfail, confirmed such equipment is available and pointed to their refurbished batt carder. He mentioned it weighed over five tons and took a year to get into production because there were no manuals that came with the dismantled equipment and replacement parts had to be custom built.

Other Mini-Mills across Canada process a variety of fibres to varying extents and all of the mills are working at maximum capacity in terms of demand. These mills are limited by low processing capacity, the low price for this processing and the high initial cost of the machinery and related infrastructure. Most of these mills have a secondary income from either value added sales or from outside or other farm businesses. A case in point is Mini-Mill itself in Belfast, PEI. They used to provide custom processing but now do only their own processing along with retail sales and the manufacture and sale of Mini-Mill equipment.

A large mill situated in PEI buys and processes fibre, but does not do any custom processing. Most other large mills are situated in the US and in China. The continental US has seen a surge in the use of Mini-Mill equipment for on-farm processing of fibre, but time will tell how well they survive.

# Business Model

In order to look at the feasibility of establishing a mill in the Yukon a focused SWOC (strength, weakness, opportunity and challenges) analysis was done on both the machinery end and the marketing side.

## *Marketing analysis*

### Strengths

Indigenous fibre is currently present in the Yukon at the Yukon Wildlife Preserve and some might be available through the Fish and Game branch from Bison permit hunts. There is a small amount of farmed fibre available with the possibility of more with increased herd sizes. Fibre in the Yukon is of good quality due to the cold, dry climate which provides the right conditions for optimum fibre production. Although distant from markets and producers, shipping of fibre is not uncommon and most fibre lots are not excessively heavy. The Yukon already has a pristine brand for tourism, agriculture and lifestyle so marketing this brand would not be expensive. The Yukon has a good base of fibre and craft people who are interested in a variety of mill opportunities.

There is support from the volunteer sector to help establish a mill and network more opportunities for the mill. The Yukon population is experienced in tourism activities so the infrastructure is in place to develop plans for a mill. A First Nation presence will enhance the possibilities of the mill as it did with the Oomingmak Musk Ox Producers Cooperative in Alaska. Some of the infrastructure could be accessed through current agricultural funding programs since this is existing technology currently not used in the Yukon. There exists the possibility to form a cooperative management structure for mill operations with proponents in the Yukon. There is interest from producers outside of the Yukon to send fibre here for processing. There is currently a shortage of processing mills across North America especially for fine fibres such as qiviut and cashmere.

### Weaknesses

There is currently no known mill operation knowledge in the Yukon. There is a great distance to southern centres and international markets. Only a small volume of fibre (less than one hundred pounds per year) is currently being

produced in the Yukon. Required equipment must be shipped in, likely from the east coast. There is no infrastructure currently in place. There are currently a few producers with small herds or several animals. There is high initial cost for mill equipment. End products can be subject to trends; consumer demand for yarn types varies and can be seasonal in nature for value added products. Good skill level and training would be required for the mill operator and mill staff must be knowledgeable about fibres. A committed source of fibre input for a Yukon mill is not currently established.

### Opportunities

An international sector of fibre processing is currently grossly under served. Very large mills exist on the east coast for fibre milling but more and more mills are selling out to China because of cheaper labour costs. Unfortunately this leaves most of small North American fibre producers without any access to processing facilities, especially for exotic dual coat fibres. Some small mills are available but consistency of service, long turn around time, and lack of proven product have kept the market small.

There is an opportunity for an increased awareness of fibre mills and how they work. They have the ability to share an educational component for local and imported fibres, classes for processing fibres into yarn and finished products, and training for mill employees. There is an increase in the potential for a cottage industry specializing in the production of finished products from local luxury fibre.

There is the opportunity to open up new partnerships with individuals and groups such as national growers' organizations and mills, international fibre importers, governmental agencies, volunteer groups, employment agencies, and new local producers and marketers.

New funding agencies and government programs can be utilized for different areas of mill development. This might include but is not limited to infrastructure, tourism, education, small business initiatives and employment.

Collaboration with other groups leading to increased resources, may become a prospect. An example is the Palmer, Alaska herd of Musk Ox and the Oomingmak Musk Ox Producers' Co-operative based in Anchorage, Alaska. Other groups might include llama and alpaca producers' association, bison producers' associations and cashmere producers' associations.

### Challenges

Many of the challenges can be met providing they are thought through carefully. Most successful mills have more than one person making decisions. Large cooperative mills have a board of directors and many of the mills have gone through organizational restructuring in order to enhance growth.

In the process of conducting this feasibility study, there have been many eye opening changes from initial assumptions and preconceived notions to the final conclusions. A successful fibre processing facility will need to be flexible and adaptable within the guiding principles necessary for a sustainable business.

Some challenges are more difficult to find solutions for. Challenges such as insufficient funding for start up, difficulty in recruitment of employees, educational programming, public relations and marketing will need to be addressed. It is important to create a long term plan and provide regular opportunity for re-evaluation of priorities and measurable outcomes.

It will be a challenge to create a quality product with secure dependable sources of input fibre. Longevity is one challenge that good mills are continually working at. A secure source of fibre processing for producers can be worth as much as the fibre itself.

## *Equipment, management and operating analysis*

The strengths, weakness, opportunities and constraints for four equipment options, three management options and three operational scenarios will be outlined for a Yukon fibre processing mill. All options include a mill set up with built in viewing opportunities for educational tours and a mill store where batts, roving, yarn, felt, kits, and finished garments such as toques, hats, scarves, mittens, gloves, sweaters, vests, jackets, socks, and slippers can be purchased.

### Equipment analysis

#### Options:

1) Complete use of Mini-Mills equipment from raw fibre to winding balls of finished yarn or production of felt. Equipment includes scouring machine, drying racks, picker, dehairing machine, carder, drafting frame, 8 spool spinner, 4 spool plyer, steamer, skein winder, cone

winder, ball winder, felting machine. Contract knitting, weaving, and sewing.

2) Combined use of different manufacturer's equipment to utilize specific features to process raw fibre into balls of finished yarn or production of felt. Equipment includes regular washing machines without agitators, drying racks, picker, dehairing machine, carder, drafting frame, multiple spool spinner, plyer, steamer, skein winder, cone winder, ball winder, felting machine. Contract knitting, weaving, and sewing.

3) Complete use of Mini-Mills equipment to process raw fibre into roving or batts. Equipment includes scouring machine, drying racks, picker, dehairing machine, carder, drafting frame.

4) Combined use of different manufacturer's equipment to process raw fibre into roving or batts. Equipment includes regular washing machines without agitators, drying racks, picker, dehairing machine, carder, drafting frame.

**Option 1** – Complete Mini-Mills set up from raw fibre to production of finished balls of yarn and felt has the benefits of being a turn key operation. The Mini-Mills manufacturer will travel to the Yukon and assist in the set up of the equipment and with training. The Mini-Mills equipment is very small and therefore will require a smaller building footprint as well as lower power requirements.

Currently, only a small volume of fibre is produced locally and the Mini-Mills equipment is sized for this small volume. There is a high demand from producers for a locally based solution to meet their processing needs. Small scale mill equipment has high re-sale value as there is a high demand from on-farm processors seeking to diversify their farm operation. Parts or additional pieces of equipment are readily available from the manufacturer/supplier in PEI.

The weakness of this option is the very high initial cost of the equipment and the lack of user shop manuals. Production is limited by the small capacity of the equipment and the equipment has a limited production history. A weakness common to all options is the need for the input of raw fibre produced outside the territory due to the limited production of local fibre.

The Mini-Mills 8 spindle spinning machine is good but is limited since there are only eight spindles and the machine cannot produce true lace weight worsted yarn. Although Mini-Mills has a draw frame that can produce a semi-worsted fibre, fibre needs to be run through several time or multiple machines

must be used in line.

This type of mill operation would provide employment for one or two people full time in the mill with several more cottage industry opportunities in knitting, weaving, and sewing finished products for sale to consumers. This type of mill could help meet the need for processing exotic fibres for a niche market. The small production size makes it possible to maintain identification of fibre from particular animals throughout the process. The ability to process locally and cater to a consumer interested in purchasing a completely northern product will encourage increased local production of fibre. The opportunity common to each option is that mills currently in production are having difficulty keeping up with demand. Wait times of six months to a year for custom processing are common.

**Option 2** - This option provides for the advantage of using slightly higher capacity machines in several areas. As with option one, training could be available on the different machines providing the machines are purchased from a manufacturer or from experienced users. Being able to choose different options from different manufacturers allows for the specialization required in a niche market. With something like dual coat fibres, the fibres are much finer and need to be processed with slightly different machines, especially when it comes to spinning. Picking, carding and drafting can all be limiting factors under different circumstances with different fibres, so being able to choose the machines to fit the niche instead of being dictated solely by a machine's performance is a bonus. With a wider selection of machines there is also room to find better prices. Drafting the fibre prior to sending it out for spinning would be improved if the fibre was 100% worsted. This involves combing the drafted fibre to pull out all the shorter fibres and aligning all the remaining fibres in one direction. The Mini-Mills drafting machine isn't capable of this, although other machines with this capability and larger capacity are available.

A drawback to this option is to become too refined in choosing equipment which will limit options for alternatives. This limitation will in turn limit the marketability of the mill. Dealing with numerous manufacturers can also diminish the power of a one stop shop when it comes to parts and/or repairs. Parts or tools might not be interchangeable between different manufacturers. Shipping costs will increase with more than one point of origin for machines unless the delivery is well orchestrated from the various suppliers. There could be compatibility issues between machines in the line if they come from different manufacturers. The operator must ensure that the fibre going from one machine into the next will meet specifications to be processed smoothly,

and not require additional steps. Purchasing all the equipment up front could prove detrimental if costs are not covered. Overextending is an all too common problem with new start-up companies.

Opportunities to find a suitable niche in the mill market have been stressed by mill operators. The profit margin for processing is not large so advantage can be found in obtaining the right machines for the job.

As with option 1, there is an opportunity for employing several people and more when the mill enters into the retail market with value added products. With the added capacity for the mill that results from carefully selecting from a variety of machines, the mill will be sustainable over a longer period with a shorter recovery period for replacement and operating costs.

Finding all the suitable equipment could be a challenge, since there are not very many brands to choose from in the small to midrange size of equipment. Marketing of the mill will be paramount to obtaining sufficient volume to process. Although there is currently high demand for custom processing, the value is in being able to select quality fibres to process. The mill manager must have adequate training to discern fibre quality within the different fibres. Having the appropriate equipment does not necessarily equate with superior product.

**Option 3** – This option provides for Mini-Mills equipment necessary to process raw fibre to a roving or batt stage only. This has the advantage of limiting the start-up costs of the mill by removing the spinning, plying, steam setting and winding of the yarn. Many small mills do this in the US and some in eastern Canada. It provides for the ability to focus on one portion of the processing of fibre with greater volume being the end result. All batts or roving are sold as is or sent out to other mills for further processing. There tends to be a quicker turn around for end product and fewer steps to slow down processing.

Mills commonly choose to produce only batts or roving when there are many suppliers and secondary processors nearby. It works well in populated centres as well where there is a market for these end products. When a mill chooses to limit processing to just batts and roving, prices must be very competitive in spite of the high demand for processing. For a remote mill in the Yukon there is likely to still be sufficient fibre available to process but with the added cost of shipping, the margins would be even smaller. The small size of the Mini-Mills equipment could limit the processing capacity and deliverable product.

Processing completed in a mill to the roving or batt stage would be subject to

stringent requirements from processors who would potentially take the product to the next level. The mill would also lose control over the resultant yarn which might not be the quality product desired.

Opportunities here involve the ability to focus on one step of the process and become excellent at it. Providing an excellent product ready for felting or spinning into yarn is a luxury for many processors to obtain. With higher than standard quality control and a niche market of exotic fibres a brand could be created and marketed.

The challenge for this option would be to establish the mill as a superior processor so the added shipping costs would be worth it. This would take time to establish, additional marketing and a sufficient amount of fibre to process. Although the initial input costs are lower, the profit margin is reduced so there would have to be a tight quality control on both fibre and labour costs. Dealing long distance with additional processing (into yarn) and/or value added processing (from yarn into mitts, scarves socks) will entail good communication and secure contractual agreements for timing and costs.

**Option 4** – This option utilizes the advantage of obtaining the best machines, value and capacity-wise, for the process. Lowering the initial input costs and increasing the capacity is advantageous to the bottom line. Other advantages are similar to Option 3.

A weakness could be the initial shipping costs from a few suppliers instead of only one. Tools and repair items might not be interchangeable and machinery compatibility might be an issue with fibre processing continuity. Custom work from smaller producers cannot be guaranteed to be kept distinct from other fibre once it changes hands. Many producers enjoy this benefit, using one processor from start to finish. Additional weaknesses are similar to Option 3.

Opportunities include the ability to provide superior roving or batts and to have increased capacity for a quicker turn around. Utilizing the best machines for the job should provide this.

The challenge is to create a brand for the roving and batts to help maximize intake of good fibre. Constant monitoring of market conditions and long range planning will be essential. Maximizing the capabilities of different machine suppliers will provide an immediate advantage but the quality will have to be maximized as well to gain an adequate market share.

## Management analysis

### Options:

1) The mill is 100% privately owned and run as a sole proprietorship.
2) The mill is a partnership, either privately owned and operated or a non profit organization and an operating management team made up of the mill manager and an assistant.
3) The mill is operated as a cooperative hiring a mill manager and an assistant.

**Option 1** – Probably the simplest form of organization, a sole proprietorship puts all the decisions into one person's hands. The mill products, long range plans, marketing, success and sustainability, all rely on one self-employed person. There is better control and business administration possible since the owner can make decisions quickly without having to consult others. In most cases, there are no legal formalities to forming or dissolving a business.

Sole proprietors generally have a tougher time raising capital unless there is independent wealth. This form of business will also have unlimited liability, so if the business is sued, the proprietor is personally liable. If the owner chooses not to run the business anymore, or if the owner dies, the business ceases to exist. Another disadvantage of a sole proprietorship is that as a business becomes successful, the risks accompanying the business tend to grow. To minimize those risks, a sole proprietor has the option of forming a limited liability company.

For an individual in the Yukon, it would be a relatively simple procedure to set up the mill as a sole proprietorship and run it much like any other small business. The major stumbling block will be the up-front financing. If an entrepreneur has adequate facilities in place however, the only cost will be the machinery and operating expenses which will be noticeably less than a complete turnkey operation. Other challenges will be the hiring of employees and subsequent paperwork required.

In the eyes of producers there will be risk associated with this operation for the same reasons. There is no guarantee of longevity and there is also no history until it is earned. Family businesses face this challenge since things can change drastically when the business is passed down to a new family member.

**Option 2** – A management team consisting of a partnership opens up more ideas, and more capacity. A partnership is a contract between individuals who, in a spirit of cooperation, agree to carry on an enterprise, contribute to it, by combining property, knowledge or activities. When new financing options are required, a partnership can pick up the extra funds by inviting in more partners. The workload is shared and so are the risks and profits. Many partnerships are based on the fact that each partner brings in a different skill set and together they make the business function smoothly.

With a general partnership, two or more owners share the management of a business, and each is personally liable for all the debts and obligations of the business. This means that each partner is responsible for, and must assume the consequences of, the actions of the other partner(s). This is probably the scariest of set-ups if the partnership is not well thought out. No matter what the percentages are, if the partner with the larger share becomes insolvent the partner(s) with the lower partnership percentage will be held liable for shortfalls. Friendships can be on the line with this type of arrangement especially if it isn't known that one partner can legally bind the other to an agreement without their knowledge.

A second type of partnership is a limited partnership which involves limited partners who combine only capital. They are not involved in managing the business and cannot be liable for more than the amount of capital they have contributed. It's known as limited liability. Beyond these two types of partnerships, there is the possibility of limited liability incorporation.

Possibilities include partnerships of individuals and /or organizations. For instance the Yukon Agriculture Association could partner with a management team that runs the mill. Another possibility might be the Northern Fibres Guild partnering with a Fibre Producers group hiring internally to run the mill. There must be an absolute clarity on the roles of the partners with the emphasis being on the sustainability of the mill and the products.

Corporations offer distinct advantages and disadvantages. Beside the obvious limited liability, there can be tax advantages, there is a perceived continuous existence, it can be somewhat easier to raise capital, ownership is more easily transferable and it is a truly separate legal entity. This biggest disadvantage is the enormity of the legal definition and paperwork required to establish and maintain this entity. It is the most expensive form or organization to create and can be the most regulated as well.

A local business can start as a sole proprietorship or a partnership then move into incorporation at any time. Most of the decisions made relate to the

comfort zones of the person(s) involved and the risk associated with the business plan. With the mills visited there was an underlying aura of satisfaction in the business whether it was a partnership, cooperative or corporation. There is a high level of accomplishment in taking fibre from a raw indistinguishable state to a refined yarn with high demand potential.

**Option 3** – One of the most successful operations was an alpaca cooperative situated in Innisfail. Although it is essentially a clearing house for fibre it could also be viewed as a marketing board for producers. The cooperative has good producer appeal and could be considered a possible business model.

A cooperative is a legal entity that is owned and democratically controlled by its members. Unlike a corporation that has shareholders and a board of directors that make profit based decisions, a modern cooperative is based on the principals of user-owns, user-controls, and user-benefits. Historically cooperatives are characterized by seven ideals: voluntary and open membership, democratic member control, member economic participation, autonomy and independence, education training and information, cooperation among cooperatives, and concern for community.

What this means is that if a group of interested individuals come together they can all contribute equally to the success of the mill. All members would have a single vote but receive no return on capital investment as a condition of membership. Surplus funds are used for the advancement of the cooperative venture, improving services to the members, establishing a reserve, paying dividends, or community welfare.

In the case of a fibre mill, the cooperative gathers funds from members and could also secure additional funding through financial institutions or government agencies. In an ideal situation, members would provide the fibre to be processed for their own use at an agreed upon price and producers from outside of the cooperative would be able to contract custom work from the mill for a slightly higher cost. The cooperative could also buy fibre from producers. Fibre from members would be bought for credit on mill products. The principle here is to maximize the service to members and provide an open market for producers outside of the membership. The advantage to being a member is in receiving preferential rates for fibre processing, receiving credit on fibre sold to the mill or receiving dividends when the mill obtains a satisfactory level of sustainability as determined by the members.

The alpaca cooperative in Innisfail Alberta has an operation similar to this idea of credit for product and the executive director has many contacts within the cooperative that can provide assistance on establishing this type of model.

### Operating analysis

Regardless of management style, the mill can consider different options for obtaining fibre and processing it into finished product.

#### Options:

1) The mill would buy fibre outright and process it for end product sales.
2) The mill would work on a cooperative basis where fibre is submitted and remuneration is given in the form of credit for end products.
3) The mill would only perform custom processing.
4) A combination of the above.

**Option 1** - Buying fibre and processing it for sale is a simple and effective way to do business. The complication here is that it takes money up front to buy the fibre and an expertise to ensure the product is satisfactory for the intended use. Even experienced millers have had the occasional bad batch of fibre and with tight margins a large purchase could prove disastrous. This model assumes a separation of producer from processor with the motivation being profit and not quality or sustainability. Anyone with fibre could try to sell it regardless of the condition of the fibre. It would be necessary to send samples for analysis before purchase or reserve the right to return fibre at the producer's cost if found unsuitable for processing. This option does not provide for an education or tourism component and is not especially conducive to building community.

**Option 2** – Processing solely for credit doesn't necessarily motivate producers to provide the best fibre. Some producers would like to limit their involvement to raising livestock and not be concerned with marketing finished products. This option would be more appealing if members received a dividend at some point. It would work exceptionally well in the short term if there was a profitable margin between accepting the fibre and giving credit. This means that the mill would accept fibre for processing and offer credit minus a certain amount for processing and profit. With the profit the mill could continue to purchase more fibre and improve the mill. The weakness is that there are other mills around and shopping around could provide a better deal for producers. Some producers want their own fibre returned rather than fibre from the group and not everyone wants product as payment.

**Option 3** – In the Yukon, there is not enough fibre production to fully supply a mill so fibre from outside is a requirement. Most of the processors using Mini-Mills equipment cannot survive on processing alone so they are adding a

step to processing into finished items for sale on-site or through Internet sales. For this to work there needs to be a constant supply of fibre with equipment working to maximum capacity. Without finding a niche market, the margins are very tight.

If financial aid was available in the form of grants, then this scenario could work. Many mills do this type of processing but they must be wary of the quality of incoming product. It is important to reserve the right to refuse fibre when people send in old stored fibre requesting it to be processed from a sow's ear into to a silk purse. Although many producers like this option because they get their own fibre back, it can be an issue for the processor with the extra set up required to run small lots. It is usually necessary to have added fees for processing small lots.

**Option 4** – This is where a combination of processing capacities will combine to suit a particular management/owner style. There is a huge market for processing and with a careful selection of opportunities and processing techniques there is room for success. If the mill can identify niche markets and have enough range they can take advantage of the all the options for processing fibre.

It's advantageous to provide a healthy balance between profitability, producer satisfaction and successful marketing of end products. As outlined on the cooperative management style there are a variety of options. Besides utilizing a cooperative management style, a limited company could provide a similar option with frequent suppliers getting a discount price on processing or purchasing. Under private ownership a number of promotional benefits could exist for consistent producers or suppliers of quality fibre.

# Mill Operation and Production Requirements

## *Mill facility*

Utilizing information gathered from the mills visited, Internet sources, personal visits, phone calls and SWOC analysis, a plan for a mill in the Yukon can be created.

There will need to be a physical structure either bought, constructed or leased for operating space, storage and retail sales. For this study, current market prices are used. For a lease space in a commercial area a value of $15 per square foot will be used. Contracting out the construction of a new building will be based on a cost of $125 per square foot in addition to land and utilities such as septic, well or alternative power source such as a generator.

The smaller mills have a lower requirement for space. Mini-Mills equipment runs effectively with a 30' x 40' operating floor along with additional fibre storage and retail space. A 40' x 60' space would provide sufficient operating and storage for the first few years with capacity to add on in the future. This would include a 20' x 30' space sufficient for retail sales and a small class area with an open concept. For inclusion of larger processing equipment like a commercial carder, the floor space would have to increase accordingly.

Many of the mills have high ceilings although it isn't a requirement. Lower ceilings can be beneficial depending on heat source since there is a need for heat and humidity to process fibre effectively. This can be more effectively provided in a building with a lower ceiling height. Most mills provide forced air heating in long ducts the length of the building with added humidifiers. Energy efficient fluorescent lights will work well for lighting requirements.

Hot water is a constant requirement of the milling process for washing fibres – frequently several times. The volume required will depend on the capacity of the mill. Household hot water heaters could work in a very small situation but a larger commercial model would be more economical in the long run. There is a hot water recovery rate of 100 gallons per hour at a minimum temperature of 130 degrees Fahrenheit with a supply of 3 gallons per minute required.

Although many mills were unsure of exact power requirements, a 200 amp household service will run all of the equipment for a Mini-Mills operation. With the larger commercial machinery there is a requirement for 3 phase power. The one mill had a phase converter installed to provide for these

higher power requirements. When older motors wear out it is possible to replace them with newer 110 or 220 Volt motors. The smaller mill motors are usually fractional horsepower requiring anywhere from 5 to 15 amp service, with the majority of draw being on start-up.

## *Mill equipment*

Equipment required includes fibre milling machinery, shop tools and maintenance equipment along with retail and storage shelving.

For the sake of this study smaller equipment will be utilized for several reasons. At this point there was no available source found for pricing large used equipment and most of this type of equipment is sold through auction houses or private sales neither of which are reliable sources for market value.

Upon entering the facility, the fibre will be put on screens and physically separated to confirm quality and appropriate use based on diameter and staple length. Separating the fibre in this way helps to remove any debris such as metal staples, plastic tags or such that can damage machinery.

Once separated, the fibre will be washed in conventional top loading washers with the agitator removed. With a capacity of 8 lbs per load, several machines can be used. The fibre will be rinsed and spun dry then placed on drying racks. It is at this point in the process that bulk dyeing can take place if it becomes a part of the process. The drying racks are a 2” x 3” wood frame with screen, slid into a frame holding several racks on top of one another. The whole rack assembly will be on wheels to facilitate cleaning under the racks and moving them closer to the washing machines for unloading and loading before being pushed out of the way for air drying.

After a couple of days, the fibre will have dried sufficiently to load into the picker. The picker separates the fibre and blows it into either a large box or small room for collecting. Pickers are a fairly consistent style so models are not that different from one another except for capacity. Generally the pickers can process far more than any other piece of equipment so it is not a limiting factor. The picker from Stonehedge can process about 100 lbs of fibre in an 8 hour shift with the Mini-Mills picker doing slightly less. Custom Woollen Mills has built their own custom picker to keep pace with the larger carder that was recently added.

After picking, the fibre can be put into a tumbler to free the fibre from debris that has been loosened up. Although several companies sell a tumbler it is something that can be easily produced locally. The more debris removed prior

to dehairing and carding the better the product and the longer the life of the processing machines.

Dual coat fibres must now go through a dehairing machine which will separate the guard hairs from the soft underdown. The low volume of this machine can be a limiting factor in production capacity for the processing chain. Although the Mini-Mills manufacturer states it can dehair 10 lbs an hour most mills using the machine find the maximum capacity is less than that. Other dehairing equipment was identified by Stonehedge, but details could not yet be provided. Lengthy searches over the Internet did provide sources for large industrial machines that are made in China, France and Australia. When a mill is built it would be productive to find more information on alternatives. Single coat fibre such as that produced by most sheep or from alpaca can go through the dehairing process to improve quality with a reduction in vegetable matter, second cuts and other debris.

Carding is the next process. Once again the Mini-Mills equipment has limited capacity and is still undergoing improvements in design. Twisted Sisters Mill prefers a Patrick Green carder since it has a higher capacity and can process fibre blended with nylon. Stonehedge has developed a carder which is larger and operates more like commercial carding machines and provides a higher output. The machine is suitable for carding fine fibres and can produce either roving or batts. At this point in the process, many mills pass the fibre onto a woollen mill or a worsted mill for spinning. Batts can be laid out for duvets, sleeping bags, felting or sold as is.

The fibre roving can now be processed into yarn once it is drawn out to a consistent thickness for the appropriate yarn weight. Using a drawing frame, the fibre can be processed combining roving and blending fibres several times for a consistent roving. A draw frame produces a semi-worsted fibre. If a comb or combing machine is added for longer staple fibres, a worsted fibre will result. Mini-Mills produces a draw frame capable of producing semi-worsted roving. Stonehedge has a supplier for pin drafting machines to produce a worsted fibre.

Fine fibres like cashmere or qiviut can be spun into a lace weight yarn which varies between 3000 to 4800 yards per pound (ypp) depending on use. There are several options for equipment to process yarn of this weight. Although Mini-Mills equipment can process to a 3000 ypp weight, it is limited by having only 8 spindles. Custom built spinning machines can be obtained from Stonehedge. Spinning fine fibres requires a different setup than processing larger gauge yarn. The company can provide an 8 spindle , 32 spindle or

larger spinning machine. Since spinning fine fibres takes considerably longer, having more spindles is advantageous. The cost to go from an 8 spindle to a 32 spindle machine is not prohibitive. Although the Mini-Mills spinner is initially cheaper, it is not economical when working with fine fibres since it will not be able to spin large amounts of fine yarn in a reasonable amount of time.

The spun yarn must now be taken from the spindles and plyed to produce the final yarn. The spinning machine can be used again although, this time, the fibre is twisted in the opposite direction. In larger production facilities, a second machine is used so spinning can continue simultaneously with plying and the process doesn't slow down. Generally 2 plys are used but a heavier yarn may have 3 or more singles plied together.

After plying, the yarn needs to be steamed to both relax the fibre and set the twist. Some mills wind off the spindles of yarn into skeins and steam it. Mini-Mills has a steamer where the yarn passes through a steam tube from the spindle, then is dried with warm air and wound onto cones or skeins.

Individual skeins can also be dyed or wrapped and sold as is. Some mills wind the skeins into balls to be sold wholesale – an added convenience for consumers.

The sale of yarn and custom processing isn't always enough to provide an adequate return. Many mill operators are in the business because they have a love of fibre and fibre producing animals so the pleasure of dealing with the finished products makes a retail outlet worthwhile. For the majority of mills, product that was purchased outright or produced on-farm can be used for socks, hats, mitts, scarves as well as knitted or woven yardage. Additional machinery is necessary for this step or a mill could contract out to other processors rather than completing the entire operation in-house. Socks have become a favourite value added item for the alpaca industry and there are several sock knitting companies in Alberta such as Motley Woollens Inc in Calgary. Small knitting machines can knit lace weight cashmere and qiviut or heavier yarns into scarves, sweaters or cowls for a cottage industry. There is also the opportunity to contract out hand knit items and encourage local cottage industry.

Based on these suggestions, an expense/cost projection can be made that will provide some idea of how much money needs to be made to cover these costs and provide a reasonable return on investment.

## *Labour requirements*

Labour requirements are low at start up and needn't be much higher throughout the life of the mill. The mill itself requires an operator with a wide variety of skills including machinery repair and maintenance to run the mill. This same person can provide grading and inspection services with training on incoming fibre. They will have to gain a strong knowledge of exotic fibres and how to process them. A second mill helper will be needed at start up as well to watch machinery and help with processing tasks.

As the mill develops, it would be beneficial to have a third person who can handle books, marketing, programming and the retail side of the mill. This employee would need to be very much a people person.

As the mill progresses and increases in market share, it will be beneficial to train more people to take on tasks during periods of high work load and to provide holiday time for employees. A mill this size need never hire more than 4 people.

The mill manager should make an hourly wage of at least $20 and the assistant should receive at least $12. Part time summer seasonal student help should receive the going rate at the time. A prospective job list and job description should be created prior to getting underway.

## *Costs*

| Equipment | Supplier | Cost | |
|---|---|---|---|
| Input sorting table | owner | $200 | $200 |
| 2 washing machines | owner | $2000 | $2000 |
| Drying racks | owner | $500 | $500 |
| Picker | Mini-Mills | $7500 | X |
| | Stonehedge | $7000 | $7000 |
| Dehairing | Mini-Mills | $47000 | $47000 |
| Carding | Mini-Mills | $39000 | X |
| | Stonehedge | $45000 | $45000 |
| Drafting | Mini-Mills | $10500 | X |
| | Stonehedge | $11300 | $11300 |
| Spinner | Mini-Mills 8 spindle | $30000 | X |
| | Stonehedge 8 spindle | $32000 | X |
| | Stonehedge 36 spindle | $37500 | $37500 |
| Plyer | Mini-Mills 4 spindle | $20000 | X |
| Cone winder | Stonehedge | $1300 | $1300 |
| Skein winder | Mini-Mills | $5500 | X |
| | Stonehedge | $3800 | $3800 |
| Ball winder | Mini-Mills | $6500 | X |
| Dye vat | Mini-Mills | $10000 | X |
| Felt machine | Mini-Mills flat plate | $5500 | X |
| | Stonehedge needle felt | $8000 | X |
| Shipping | Trucking estimate | $9000 | $9000 |
| Water heater | Oil fired | $2500 | $2500 |
| Furnace | Oil fired forced air | $2400 | $2400 |
| Plumbing fixtures | laundry sink, toilet, sink | $600 | $600 |
| **TOTAL** | | | **$170,100.00** |

| **Building** | Description | Options | |
|---|---|---|---|
| contracted out cost<br>60' x 40' = 2400 sq ft | 2400 x $125/sq ft = $300000<br>$3000,000 over 15 yrs @ 7.5% interest= $2762/month | $2762/month | $2672 |
| Lease cost on space | 2400 sq ft x $15/sq ft= $36000/year<br>$3600/12 months<br>=$3000/month | $3000/month | X |
| Heating costs | Forced air furnace and water heater | $680/month | $680 |
| Electrical | On grid | $500/month | X |
| | Off grid<br>inverter, generator, battery bank<br>$25000/15 years = $1700/year<br>$1700/12 months = | $142/month | $500 |
| | Fuel cost for generator<br>2 l/hr x 8 hrs/day x 20 days<br>=$320 | $320/month | X |
| | Repair and maintenance on generator | $40/month | X |
| Water | Delivery<br>using 450 gals/day<br>refill 1500 gal tank 2 loads/week @ $85/load x 4 weeks = $680/month | $680/month | X |
| | Well<br>$20000 over 15 yrs @ 7.5% interest<br>=$186/month | $186/month | $186 |
| Septic field | $25000 over 15 yrs @ 7.5% interest =<br>$232/month | $232/month | $232 |
| Maintenance | and tools | $250/month | $250 |

| | | | |
|---|---|---|---|
| Consumables | Soap, oil, bags, ties | $300/month | $300 |
| Marketing | Magazines, local papers | $250/month | $250 |
| Office | Phone, fax, internet, office supplies | $300/month | $300 |
| Insurance | | $400/month | $400 |
| Labour | 2 people total $32/hr x 6% employment costs = $33.92/hour<br>$33.92/hour x 160 hr/month= $5427 | $5427/month | $5427 |
| **Total Building costs** | Monthly recurring costs | | **$11,197** |
| **Total Equipment costs** | $170100 over 15 yrs @ 7.5% interest =$1566/month | $1566/month | **$1,566** |
| **Combined Total Cost** | Cost per month for turn-key mill | | **$12,763** |

Note: there is no insurance cost added onto loan payments, no GST, and no amount for land or taxes. Total cost will be reduced if existing well, existing septic or existing building are available.

## Marketing Strategy

The mill will do well if it fills a niche market and produces quality product(s). The dual coat fibre processing industry is currently is under-served in North America. With the waiting time to have fibres processed between 6 months and a year, there is room for an additional reputable processor.

To gain market access should not be difficult. The majority of producers network with each other through several magazine publications and organizations. These contacts will easily provide a large market access for the bulk of fibre needed to make a mill sustainable.

Forming partnerships with national and international organizations will cement a solid future for the mill. The Oomingmak Musk Ox Producers' Co-operative based in Anchorage, Alaska is interested in talking about the possibility of sending their fibre to a mill in the Yukon. Although the current

members place high value on a US-made product, they would be willing to talk about doing some processing in a northern mill. If the mill took the qiviut fibre through to the worsted roving, the now lighter product could be sent to a US mill for spinning. The qiviut could also be dehaired and carded elsewhere but spun in the Yukon. As long as the majority of fibre production occurs in the US, they would be open to discussion.

The Canadian Cashmere Association president has indicated support for a Canadian mill that would process cashmere. Although the amounts aren't huge at this time, production revolves around having a good mill. Currently China has the majority of the mills with fine cashmere produced in Mongolia. The North American breeders want to enter into this market and would support something North American. Marketing the mill to producers outside of the Yukon would easily be accomplished through a partnership with the national cashmere association.

Locally, effort would be put into giving premier service to producers and keeping them well informed of the mill activities so they can feel a sense of ownership and pride in the mill. Local sales will provide value added articles that promote the pristine nature of the Yukon to tourists, giving the retailers another made in the Yukon focus. Classes and educational tours will provide a supportive marketing aspect. Yukon residents demonstrate support for sustainable businesses providing opportunities for expanded local offerings.

Pricing is driven by two factors. The income for the mill will have to cover costs within a year or two on a business plan to satisfy the lending institution. Pricing will also have to be close to market trends in order to obtain enough business. With good service, a quality product, consistency in processing and a fair turn around time the mill will be able to exert some control over the historical lagging processing costs. The mill could set the standard for processing dual coat fibres.

From examination of other mills, there are areas that can help define the initial start-up and success of the mill. All mills sell three items in bulk and those are batts, roving and finished yarns. In addition to this, once the mill has acquired fibre, value added products such as scarves, socks, duvets and felted items can be sold.

The retail store can open later in the mills existence but tours of the mill could commence immediately with a few days a week during the winter and regular hours during the summer. Bus tours like to stop at local places that can offer information on the Yukon and education and entertainment to passengers. A mill is certainly a lot of moving parts.

The largest limiting factor for the mill will be capacity and making sure there is enough fibre to meet processing requirements. This is currently not an issue since many mills have long wait times for custom processing. Subsequent opening of another equally sized or bigger mill that focuses on similar fibres would be the only drawback.

## Financial Projections

To obtain realistic values for comparison, nine similar craft mills were selected and the average prices for fibre processing were calculated. These numbers were used in conjunction with the calculated monthly cost ($12,763) of operating a turn-key mill to establish whether or not a mill is feasible.

The amounts derived are the minimum weights of fibre the mill needs to process in either exotic fibre such as qiviut or cashmere or standard fibre such as wool or camelid fibre to break even. This does not take into account any retail sales of value added items or decreased costs such as lower lease payments or lower interest rates. This can be considered the bottom line for a feasible mill project.

## Pricing Comparison from small custom craft mills in Canada and US

| | Washing costs | Carding prices | Spinning prices | |
|---|---|---|---|---|
| StoneHedge | $ 3 – 5 pound raw | $ 5.25 – 7.95 lb raw (includes washing) | $24 – 32 lb finished (includes w+c) | US |
| Dreamin' | Na | $6 lb raw (includes washing) | $23 – 28 lb finished (includes w+c) | US |
| Blue Hills | $ 2.75 lb raw | $6.50 lb raw (+1.75 if very dirty) | $15 – 18 lb finished (includes w+c) | US |
| Georgia Mtn | $ 4 lb raw ($5 extra for dehairing) | $12 lb raw (includes washing) | $14 – 28 lb finished (includes w+c) | US |
| Wellington | $1 lb raw | $ 9.5 lb (finished) | $10 – 12 lb finished +2.50 + 9.50 | CAN |
| Montana | $4 lb raw | $12 lb raw (includes washing) | $20.8 finished (+washing and card) | US |
| Mabou | $3 lb raw | $8.80 raw (+washing) | $20 – 22 (+washing) | CAN |
| Twisted | $2 lb finished | $15 finished (includes washing +dehair) | $27 lb finished (includes w+c+dh)) | CAN |
| Salt Spring | $3 lb raw | $15 finished (+washing) | $31.5 – 33 finished (+washing) | CAN |

Assume 1/3 work completed as roving or batts, 2/3 to fingering weight yarn

**Double-Coat exotic fibre**

Calculation for value of fibre to batt or roving is on raw weight; finished weight is about 35% of raw for exotic fibres

| | | |
|---|---|---|
| Average price batts or roving | 8.81 | Based on raw weight exotic fibre |
| Average price exotic yarn | 28.31 | Based on finished weight – multi-ply fingering |
| R*0.33(8.81) +R*0.67*0.35(28.31) = 12,763 | 1337 | Pounds of fibre per month to break even |
| Where R = raw weight of fibre | 66.85 | Pounds of fibre per day to break even |

**Wool or Camelid fibre**

Calculation for value of fibre to batt or roving is on raw weight; finished weight is about 60% of raw for wool or camelid fibres

| | | |
|---|---|---|
| Average price batts or roving | 5.92 | Based on raw weight wool or camelid fibre |
| Average price wool or camelid yarn | 25.21 | Based on finished weight – multi-ply fingering |
| R*0.33(5.92) +R*0.67*0.60(25.21) = 12,763 | 1055.84 | Pounds of fibre per month to break even |
| Where R = raw weight of fibre | 52.79 | Pounds of fibre per day to break even |

The numbers show that the mill would have to process about 53 lbs of wool or 67 pounds of cashmere a day to break even. This could be accomplished with a combination of exotic and standard fibres. The Stonehedge mill in Michigan which is similar in size and capacity does about 75 lbs of fibre a day or 1500 pounds a month.

Although these numbers are estimates, they are within reason with costs generally estimated on the high side. Long range strategic planning would indicate that although the first year would be tight, subsequent years should prove profitable. Actual costs will also include GST, land prices, loan interest, and perhaps a 10% contingency. The best case is not far from what is presented here.

Most new mills have not had the problem of sourcing adequate supplies of fibre but of having enough capacity and sufficient training to get up to maximum operating capacity quickly. The challenges include hiring a mill manager with experience or providing time to train as a volunteer at a mill down south, and having the mill machinery sourced and set to arrive in a way that allows the mill to get up and running as soon as possible. An operating line of credit or contingency fund would be necessary to deal with initial monthly payments. Once the mill is operational, it should be self-sustaining providing there is regular maintenance, no unexpected breakdowns and a steady source of fibre.

For an interested individual or group to move beyond this initial phase, financing will be the major hurdle. A financial adviser would be required to plan a long range financial strategy. Lending institutions will want information on how much capital is needed to start up the business, what assets the party has in place to secure financing and what types of funding the proponent is looking for.

The following financial reports will be required at a minimum: balance sheet projection for three years with inflows of capital, cost benefit analysis, income projections for the first year highlighted, break-even analysis and income projections for the first year.

For some institutions they might also require an exit strategy to ensure assets can be sold to recover debt.

# Conclusion

In today's market there is more demand for local production and processing of fibre. Although there are large global centres that can handle huge quantities of fibre, many producers in North America and especially here in the Yukon, are small cottage industries and cannot provide the quantities that large processors require.

Part of the groundswell is also toward producing fibre and having it processed and returned to so that the producer/farmer can indeed market their own product. This feasibility study is based upon the possibility of meeting these requirements for a local craft style fibre mill.

The report presents the process of taking fibre from the animal to a finished product and closely examines the feasibility of a sustainable mill. The fibre, the equipment, the market, the model and the requirements are all examined in detail.

## *The fibre*

Eight species of animals were discussed in detail regarding their actual appearance, requirements and the fibre they produce. Several novelty fibres were also mentioned as an addition to a locally operated mill.

This section introduces and educates interested and prospective investors/operators to the possibilities for fibre types in the Yukon. All of the species mentioned can be raised successfully in the Yukon and some are already a part of local agricultural operations.

In the world market, sheep and goats are the predominant fibre producers but regional preferences have also supported alpacas, llamas and other camelids. Fine fibre is harvested from merino or other fine fibre producing sheep as well as cashmere goats. Small landholders and hobbyists enjoy a variety of Angora rabbits. Here in the Yukon there are several processors who spin dog hair and have utilized many pet and working dogs coats to knit truly northern keepsakes. One of the very special fibres here in the Yukon is the exceptionally warm and fine qiviut combed from Musk Ox. Although the supply is limited, the fibre is so soft and luxurious a processed yarn demands top prices.

With appropriate handling, fibre from animals such as bison, mountain goats or other wild animals can provide luxurious novelty items. Virtually any

animal fibre can be processed into novelty market yarns if the processing facility is set up to handle the amounts. Although the mill would need to charge a premium for the smaller lots, it is possible to provide the service and support needed in the cottage fibre industry.

## *The equipment*

After meeting with mill operators in person or by phone, the largest single issue identified was the fact that there is an overabundance of fibre with too few small processors, especially in the exotic fibre sector. Although there is not a huge volume available for processing exotic fibres it could be a secure niche market with other fibres being added to supplement the mill's requirements.

The equipment looked at ranged from a commercial size down to a small mill called Mini-Mills, manufactured in Belfast, PEI. Industrial mills that process hundreds to thousands of pounds of fibre daily were not examined.

Small mills have the distinct advantage of being able to process smaller lot sizes, have higher utilization of raw product, traceability of distinct fibre lots, and enjoy a smaller mill footprint which also includes lower utility costs. What needs to be balanced against this is the high cost of the machinery and limited capacity.

Virtually all fibre needs to be washed, picked and carded prior to spinning and plying into yarn. This is accomplished with specialized equipment available from several manufacturers. The end product desired determines which equipment is necessary for the production process. Some mills provide only roving and batts for felting or duvets and cushions while other mills provide the additional spinning required for yarns of a woollen or worsted variety.

Dual coat animals provide a fibre that needs to be separated into coarse guard hairs and soft undercoat. The dehairing machine built by Mini-Mills is an additional piece of equipment that can do this and provides a substantial advantage to a niche market. Drawing out the fibre prior to spinning provides a semi-worsted roving and if combing is done, a worsted fibre will be the finished product.

Depending on the fibre type; long or short, single or dual coat, different machinery will do different jobs. No one piece can accomplish everything so the marketing needs to be thoroughly examined to find the niche that will serve the local community, be sustainable and be able process inputs from outside of the Yukon.

## *The market*

In North America the current processing market is largely under-served with a turn around time of six months to a year being common. With the specialty market of exotic fibres, such as cashmere or qiviut, the wait is longer and at times the ability to get fibre processed is non existent.

Larger mills tend to focus on wool and woollen characteristics because small lots that are worsted and exotic fibres aren't feasible on a large scale. Small scale processors that are recent to the market are finding that small capacity means small profit margins but can provide a second income. Value added production is becoming a common addition to most mills after roving, batts or yarn are produced.

With a virtual open market available to a new mill, success will lie in the product offered or niche, and the organizational structure and management skills. Common to all processing is the high cost of machinery and low price paid for processing.

In the Yukon, with small amounts of raw fibre available, there is little opportunity for a mill without being able to obtain fibre from outside sources or from increased production on local farms. Focusing on dual coat fibres from Musk Ox, cashmere goats, dog hair, bison or other wild fibres could be an effective strategy for a Yukon mill. Effective marketing of this aspect as well as the Yukon brand of pristine northern environment could bring fibre from around North America, making the Yukon the processing centre for these exotic fibres.

With the presence of the Wildlife Preserve there exists the potential to interest visitors in seeing how the fibre from wild animals is processed. Tours of the mill and educational talks can provide a vital link between the sustainability of wild animals in captivity and commercial opportunities.

An examination of mills outside of the Yukon provided information on what currently exists within a relatively close proximity to the Yukon, what is available across North America and what might be possible for a new mill both in opportunities and requirements.

## *The model*

To establish some criteria for a feasible mill in the Yukon, a focused analysis was done of the market, equipment, management and operating requirements.

The market analysis suggests that the fibre industry is currently under-served by small processors. There exists the possibility of creating new partnerships with existing groups. Education is a valuable component and the Wildlife preserve could assist in this area. The Northern Fibres Guild and similar groups might partner with workshops or classes.

Collaboration with First Nation similar to what was established in Palmer Alaska with their Musk Ox project and the Oomingmak Musk Ox Producers' Cooperative is a viable prospect. With a broad based business plan, new funding agencies and government programs could be utilized to create a sustainable mill and bring outside money into the Yukon.

The challenges such as providing a quality product, effective management skills and marketing can also be looked at as opportunities for job prospects, effective communication and community building.

Equipment is the largest single cost next to building a facility and different end products require different equipment options.

Business sustainability and success requires enough variability in the services to keep the supply of inputs sufficient. Large equipment isn't always the answer as long as smaller equipment has the capacity to cover costs. Mini-Mills equipment has proven very attractive to small mills throughout North America; however, capacity and cost are limiting for some of them. The other limiting factor is what the end products are. Processing only to a batt or roving stage, ready for additional processing elsewhere, might be feasible when there is proximity to a large fibre market. In the Yukon a start to finish scenario makes the most sense.

Combining equipment from several manufacturers and specializing in fine worsted spinning of exotic fibre is recommended. The equipment will handle all fibres types producing a spun fibre that will be finer and worsted. Mills in Alberta are much better suited to large lots of woollen or semi-worsted yarns.

The decision to operate a mill as a sole proprietor, a partnership, limited company or cooperative depends on who would choose to operate the mill and what the motivation is for that individual or group.

For a profit driven mill a limited company has proven itself over time but

requires more management skills than any of the other options. There is no public input, no need for an education component or tours, limited liability, added paperwork and more regulatory bodies involved.

Simple partnerships are good in theory but depend largely on a well thought out agreement prior to start up. Businesses in this category often start well but end up being dissolved because of inappropriate use of funds by one of the partners or simple disagreement on direction. Good partnerships work because of different skill sets, low risk ventures and excellent communication skills.

A cooperative lends some of both worlds into the mix. The coop is a legal entity under the direction of its membership. Not driven by a pure profit motive, a cooperative strives to excel at providing benefit to its membership and also to the community through services and dividends.

The operating analysis suggests, like the equipment analysis, that a combination of ideas could work best in the Yukon. Collaboration from agencies and groups inside the Yukon, support from local producers and artisans would help build the fibre industry and outside sources of fibre would help sustain the mill, create a brand for Yukon fibre and processing and bring in outside money.

## *The requirements*

The assumption was made that a building would either need to be built or leased for the mill, storage and retail store. The building does not require specialized construction and the mill could be housed in an existing building of adequate size. A contracted building could be easily converted to other uses if the mill expanded or moved. Estimates included for the requirements to operate the mill off the grid show that the costs are similar to connecting to the local power grid.

In the estimate, the cost for the building was amortized over fifteen years at seven and a half percent interest for a monthly payment of $2672 per month. This amount is pushed higher with operation and maintenance costs. Labour accounts for the single largest monthly amount.

Selecting the right machines will have the most effect upon the success of the mill. Smaller equipment makes sense for a variety of reasons including sourcing, shipping, potential cost, capacity, operating space and employees. Once this decision is made, choices on individual manufacturers and options are provided depending on capacity price and desired end product. This study indicates that other equipment is available, but the equipment examined is

some of the most prominent in craft mills today. Alternate equipment should be similar in capacity and price.

To establish the Yukon as a processor of fine fibre, the mill needs a dehairing machine for dual coat fibre, a pin drafter with combs for a worsted yarn and a large capacity, fine weight, spinning machine. The mill would also require a picker, a large capacity carding machine capable of blending natural and artificial fibres and producing batts or roving. Washing machines, drying racks, sorting tables and a skein winder will also be required. As the mill moves into a retail position in store racks and display materials will be required.

The mill will only require two full time employees at start up with several more necessary as the mill expands services. These will be full time positions offering benefits and training. With good management there should be summer help available and training for additional part time staff as required for high capacity and staff holidays.

Marketing the mill will not need to be extensive with the current high demand for processing. Local producers must be assured premium service. To obtain a good market share in North America and sustainability for the future, the mill needs to develop signature items and an exceptional, consistent product within a reasonable turn around time.

Collaboration and/or partnerships with national organizations such as cashmere, bison, alpaca or llama producers and northern suppliers of qiviut will provide the security of support and supply to establish the niche market.

Utilizing comparatively sized mills, prices and volumes were established for roving/batts and fingering (fine) weight yarns for wool or camelid fibres and exotic fibres. The resulting current market prices were then used against the estimated cost of production to confirm or preclude the feasibility of a mill.

Although items such as land price, GST, loan insurance or taxes were not included the mill appears to be able to sustain itself in this model. Having to process 67 pounds of exotic fibre a day or 53 pounds of wool or camelid fibre is not excessive capacity for this mill. Once the routine operation of the mill is worked out there should be room for another 10 to 20 lbs an hour processing. A comparable mill in Michigan does about 75 pounds a day or 1500 pounds a month based on a 40 hour week with three employees. They average just over $5000 profit per month.

This plan offers an individual or group the opportunity to examine closely the feasibility of opening a craft mill. With local support for a niche market,

selection of appropriate equipment, training, a financial planner and adequate fibre sources locally and internationally, this mill could become a destination point for processing of exotic fibres in North America.

Challenges to the start-up of a project like this will include but are not limited to, financial support, qualified employees, suitable facility, sources of fibre and a strong business plan. Whether it is privately operated or a cooperative venture, with careful planning a local craft fibre mill should be feasible.

# References

Mills and individuals contacted for this study:

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**Exotic Fibres of Canada**
Terry or Jac
#7, 5112 - 47 Avenue, Innisfail
Alberta, Canada T4G-1P8
403-227-4944
bolexec@telusplanet.net
www.exoticfibersofcanada.com

**Belfast Mini-Mills Ltd**
Linda and Doug Nobles
1820 Garfield Rd, Belfast,
Prince Edward Island, Canada C0A 1A0
Main Contact: (902) 659-2533
Fax: (902) 659-2248
richard@minimills.net
www.minimills.net

**Canadian Camelid Cooperative**
Michael Dixon
4928 -49th St
Innisfail, AB. Canada
T4G 1N2
Phone: (403) 227-6617
Fax: (403) 227-6623
dixosin@rttinc.com
www.cancamco-op.com/

**Musk Ox Farm**
John Teal
P.O. Box 587
Palmer, Alaska 99645
Phone: (907) 745-4151
www.Musk Oxfarm.org/
moxfarm@alaska.net

**Oomingmak, Musk Ox Producers' Cooperative**
Marie Texter
604 H Street
Anchorage, Alaska
(907) 272-9225
qiviut@gci.net
www.qiviut.com/

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Other Sources:

**Canadian Fine Fibre Works**
Peers, Alberta
www.canadianfinefibreworks.com/

**Alpaca Dreamin' Fiber Mill**
Arkport, New York
www.alpacadreamin.com/

**Blue Hills Alpacas and Fibre Mill**
Bruce, Wisconsin
bluehillsalpacasandfibermill.com

**Thirteen Mile Lamb & Wool Company**
Belgrade, Montana
www.lambandwool.com

**The Gulf Island Spinning Mill**
Salt Spring Island, British Columbia
gulfislandsspinningmill.com/

**Georgia Mountain Fiber**
Blue Ridge, Georgia
www.georgiamountainfiber.com/

**Motley Woollens Inc. Hosiery Mill, Canada**
Calgary, Alberta
www.motleywoollens.com

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For information on proprietorship, partnership and incorporation:
http://www.canadabusiness.ca/
For information on cooperatives: http://strategis.ic.gc.ca/epic/site/cd-dgc.nsf/en/h_cs02151e.html
New generation cooperatives:
http://www.umanitoba.ca/afs/agric_economics/ardi/
BC's cooperative association act:
http://www.qp.gov.bc.ca/statreg/stat/C/99028_01.htm#section8

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