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SAND & GRAVEL AND PEAT MOSS DEVELOPMENT POSSIBILITIES FOR NORTHERN ALBERTANS

by

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RESEARCH COUNCIL

INTRODUCTION

Our group this afternoon will be considering two kinds of non-renewable mineral resources which have special implications for northern residents, because both are amenable to small-scale development, that is, on a scale of operations within the reach of the smaller businessman and entrepreneur. These are Sand & Gravel and Peat Moss.

Both are industrial mineral commodities which are familiar to most everyone through everyday use, and both (in particular, sand & gravel) are essential commodities that we literally could not get along without. Both also have broadly similar problems and procedures in development.

Our approach for dealing with these subjects is for me to first give a brief and general overview of these commodities as to their resource potential for northern Alberta, followed in turn by my co-panelists, Mr. Sprecher and Mr. Johansen, who will give a detailed account of their own business experiences in developing a sand & gravel and a peat moss deposit.

We will make our presentation in two parts, dealing first with sand & gravel, then with peat moss, after which we'll invite your participation and try to answer questions pertaining to either commodity.

SAND & GRAVEL

The term "sand & gravel" I am using in the sense of a single commodity, which may include both fine and coarse aggregates as commonly found together in the same deposit, the principal use of the sands and gravels being as construction materials.

Importance

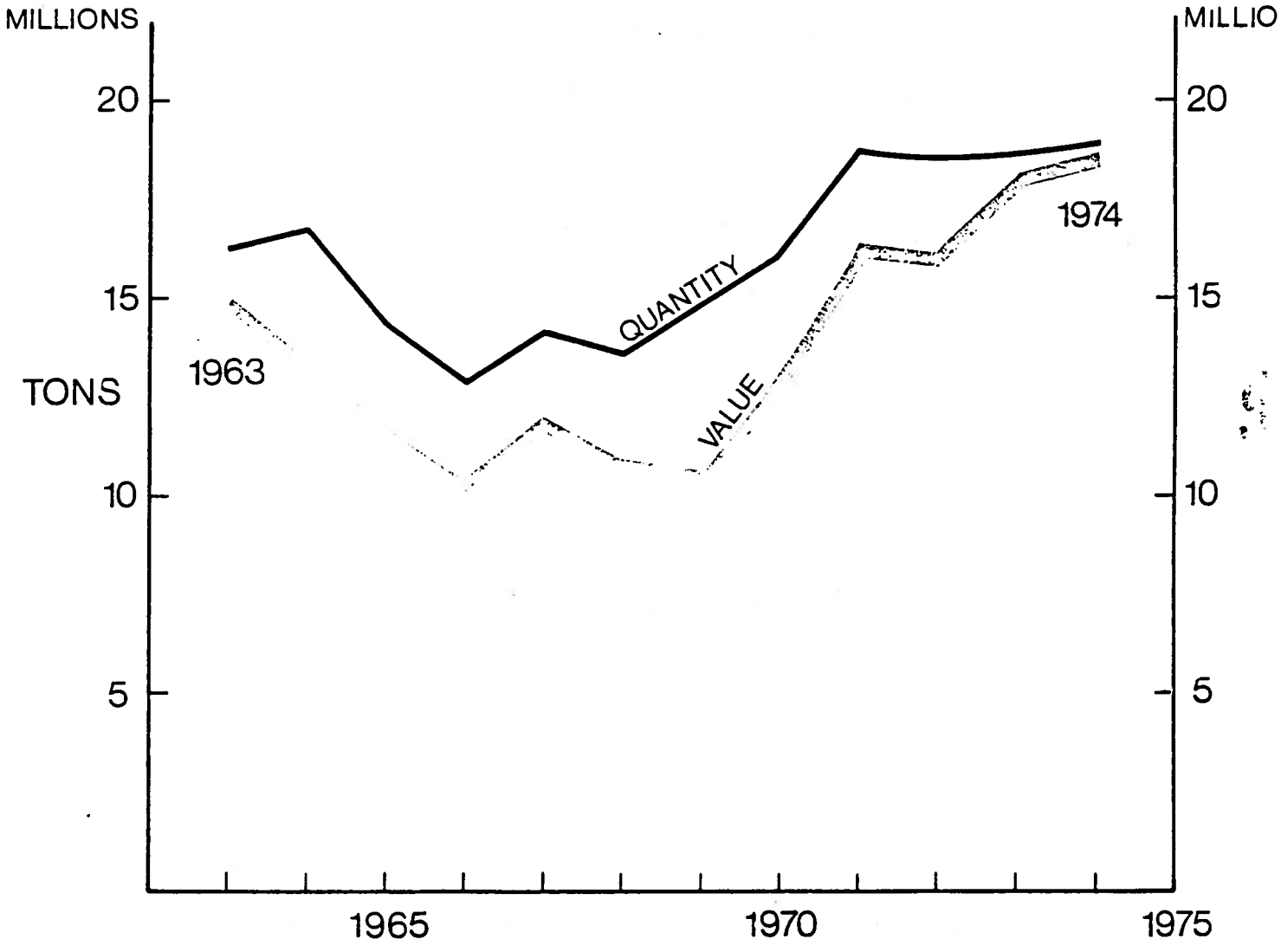
Sand & gravel is a major industrial mineral resource of Alberta. Although perhaps the least glamorous of our mineral resources, it is among the most important and most valuable in terms of everyday need. Any kind or size of construction undertaking in every town, village, farm, roadway, or private home in Alberta requires sand & gravel of some set quality. Because it is a low-value, high-bulk commodity it has no long-distance market potential. All our production goes essentially for our own use.

Production of sand & gravel grows continuously each year to meet demands, and in 1974 it reached 20 million tons. This is by far the largest volume of production of any non-fuel mineral and is exceeded in value of production only by sulfur.

Sand & gravel touches so many people directly in their day-to-day lives that it is taken very much for granted. Yet it is decidedly a non-renewable resource, one we use in such vast quantities that we are rapidly depleting our easy-to-get-at resources and must continually be finding new deposits.

Deposits are getting harder and harder to find. Those days are gone when we could locate new deposits just by driving up and down country roads. These have all been worked out, and we are now having to take a much more systematic approach. Essentially, this involves an understanding of the different geologic types of sand & gravel deposits and their geometry.

ALBERTA SAND AND GRAVEL PRODUCTION



Types of Deposits

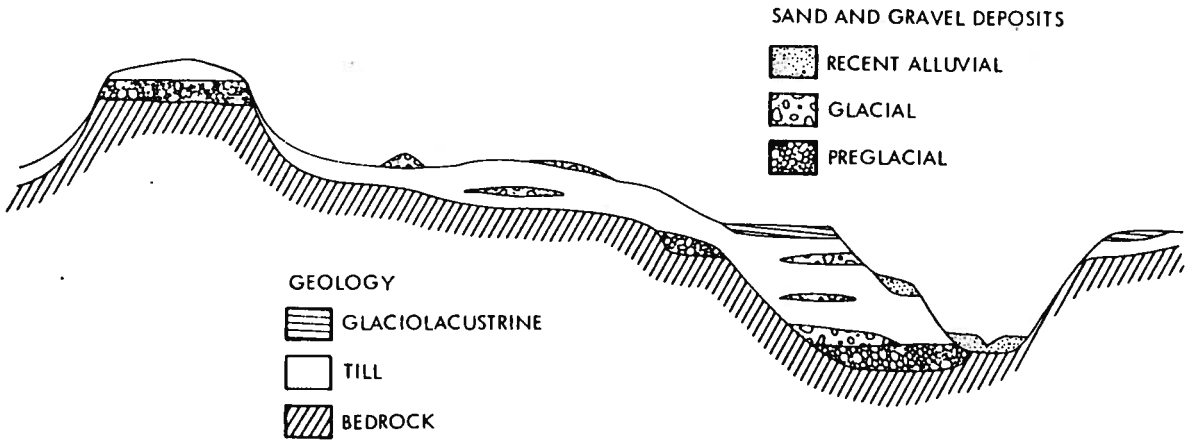
This slide is a schematic cross section of the types of sand & gravel deposits found in Alberta. These fall into three main geologic types; preglacial, glacial, and Recent.

Preglacial deposits are those formed prior to the Ice Age (the period of Continental glaciation that covered almost all of Alberta). They are found in two main geological settings; either capping bedrock topographic highs (such as in the Swan Hills) or occupying buried channels in the bedrock — as terraces or as valley bottom deposits. The gravels generally are of good quality but tend to be deeply buried. Economic deposits of this type are few in number.

Recent deposits are those found in river beds and in some places on terraces, deposited since the Ice Age along present and earlier courses of modern rivers. Recent gravels are commonly of poor quality and not widely used in Alberta except where there is nothing else.

The most commonly used and most widespread throughout the province are the glacial deposits. These are sands and gravels originating from the meltwaters of wasting glaciers, and are found practically throughout the province in a variety of shapes depending on the nature of their deposition.

The most common are the outwash deposits. As the glaciers melted, the debris picked up from the bedrock surface during their advance was washed out and deposited in front of the retreating glacier. Where meltwater flow was high and currents exceptionally strong the finer materials were washed away, leaving the gravels to be deposited. These deposits are somewhat unpredictable in occurrence, found on or near the surface or as scattered lenses buried in glacial till.



Schematic Cross Section of Alberta Sand & Gravel Deposits

Another common glacial gravel deposit is the kame, which forms a distinct mound on the surface. Kames were deposited along the ice-margins by glacial meltwaters flowing beneath or within the ice.

Prospecting for Sand & Gravel

Although gravel deposits, and especially the glacial gravels are widely distributed it is difficult to define any particular location where deposits will be found. In glaciated terrain such as in northern Alberta they could be almost anywhere. Just as "gold is where you find it", so it is with gravel.

Nevertheless, some techniques can be applied to assist in helping to find deposits. One of the most effective (which Mr. Sprecher will describe) is learning to recognize topographic expressions of the different types of deposits. Then, by traversing the countryside or studying air photographs, likely-looking prospects can be pinpointed — subsequently to be checked out by drilling. Generally, the river valleys offer the best hunting ground because of the variety of types of deposits that relate to them.

A good program to follow might be as shown. First, obtain as many maps containing geologic data as you can and study them for whatever clues they may offer on the existence of gravel in the region. Then, proceed as indicated.

Developing a Sand & Gravel Prospect

Let's say that you have found a deposit which you think might have potential and wish to develop it or assess it for possible development. What next?

1. Rights

The first step would certainly be to establish ownership of the gravel rights. If you own the land or can reach an agreement with the landowner, no problem. On private lands the gravel rights are part of the surface rights.

PROSPECTING FOR SAND & GRAVEL

1. Map Study (Surficial Geology, Soils, Hydrogeology Maps)
2. Aerial and Ground Reconnaissance (with aid of Air Photographs, Topographic Maps)
3. Optional - Geophysical Survey
4. Selective Test Drilling in Prospective Areas
5. Preliminary Testing of Drill Samples

DEVELOPING A SAND & GRAVEL DEPOSIT

1. Secure Rights to Deposit
2. Systematic Test Drilling to Determine Limits and Overburden
3. Backhoe Trenching for Bulk Samples and Details on Vertical Variations
4. Extensive Quality Testing of Material
5. Determine Processing Requirements
6. Cost Out Against Alternatives for Market Indicated

If your prospect is on public lands, you must obtain a Sand & Gravel Licence or Lease from the Lands Division (E. & N.R.) to produce the gravel and you must pay a royalty on gravel produced. These Licences and Leases are obtained by application to the Director of Lands through the Special Lands Use Branch.

Leases are long-term rights, granted for a period of 20 years. They require a substantial deposit and carry an annual minimum royalty or acreage payment. A lease can be any size within reason, usually about 40 acres.

Licences are useful only for short-term gravel requirements such as building a road. They are issued for a period of one year or less, carry only a royalty payment for gravel actually produced. The royalty on gravel is 10 cents per yard.

Rights may also be obtained by Exploration Licences. These do not allow for any actual production of gravel, only tie up the rights in your favor during your period of exploration. Leases may be acquired out of Exploration Licences, and the Exploration Licence holder has first claim to the gravel rights.

In applying for gravel rights, you must submit a plan of your exploration and development program, which must be cleared also with the Department of Environment under the regulations of the Surface Land Conservation and Reclamation Act.

Anyone wishing further details on these matters can get in touch with the Alberta Research Council, and we will provide names, addresses and phone numbers to help steer you through the proper course of procedures.

2. Assessment

The next three steps involve detailed assessment of the deposit. The first step is to define the limits of the deposit by systematic test drilling of closely spaced holes,

to provide samples for quality testing and also to determine the overburden conditions. For coarse gravel or layered sand-gravel deposits it may also be necessary to include backhoe trenching. Concurrently, quality tests will be run on the drill and trench samples, and I'd like to come back to quality testing a little later.

From the quality tests determine what the processing requirements are and design the equipment and plant.

The final step is to cost out the whole program to determine if it will pay. Included in this costing will be consideration of the markets and the costs of haulage plus access to this deposit as compared to alternative sources. A deposit closer in, though of poorer quality, may be developed preferentially because of its more favorable location, where the savings in haulage easily pays the cost of upgrading the gravel.

Quality Testing

Finally, a word about quality testing, an extremely important step, for obviously if the gravel has quality deficiences this seriously affects its marketability and may make the deposit uneconomic.

Standard quality tests would be carried out for as many parts of the deposit as possible from the drill and trench samples. The first three are fairly routine tests, done as a matter of course during exploration of gravel. These will indicate textural qualities and show up the presence of deleterious substances such as clay, shale lumps, coal, and chert. The remainder are laboratory measurements designed to evaluate general durability and suitability for concrete aggregate.

QUALITY TESTS FOR SAND & GRAVEL	QUALITY FACTORS CRITICAL FOR COMMERCIAL USE
1. Washing Test	Amount of Fines
2. Sieve Analyses	Maximum/Minimum Particle Size and Size Distribution (Grading)
3. Petrographic analysis	Presence of Deleterious Substances
4. Soundness	Resistance to Weathering and Breakdown
5. "Los Angeles Abrasion"	Resistance to Abrasion
6. Specific Gravity	
7. Atterberg Limits	Type and Plasticity of Fines
8. Compression, Freeze-Thaw (Concrete Specimens)	Strength and Durability in Concrete

Some of these tests can be done at the Research Council, but for most of them we don't have the proper facilities at present. What we would do if you brought in your gravel for testing is refer you to an engineering consultant in materials testing, of which there are a number in Alberta with well equipped testing laboratories.

Be that as it may, the Alberta Research Council stands ready to provide whatever assistance we can, whether it is advice or direction, or actual testing.

Now I think it is time to hand things over to Mr. Sprecher, whom as many of you know has actually gone through this whole exercise and has successfully developed gravel deposits.

PEAT MOSS

Peat, and particularly the moss peat variety, or peat moss as we call it, is a mineral of borderline qualifications. Some people, mineralogists and the like, would argue that it is really a vegetable, not a mineral at all. Nevertheless, it is comprised of dead vegetable matter and is a non-renewable resource; therefore, we classify it as a mineral commodity.

The non-renewable aspect perhaps bears comment, inasmuch as most peat bogs are actively growing plant colonies. However, as far as we can tell, peat bogs in Alberta commenced growth sometime after the close of the Ice Age, which puts them 8 to 10 thousand years old. If we have to wait that long again for the next crop of peat moss, I think we can safely say that it is a non-renewable resource.

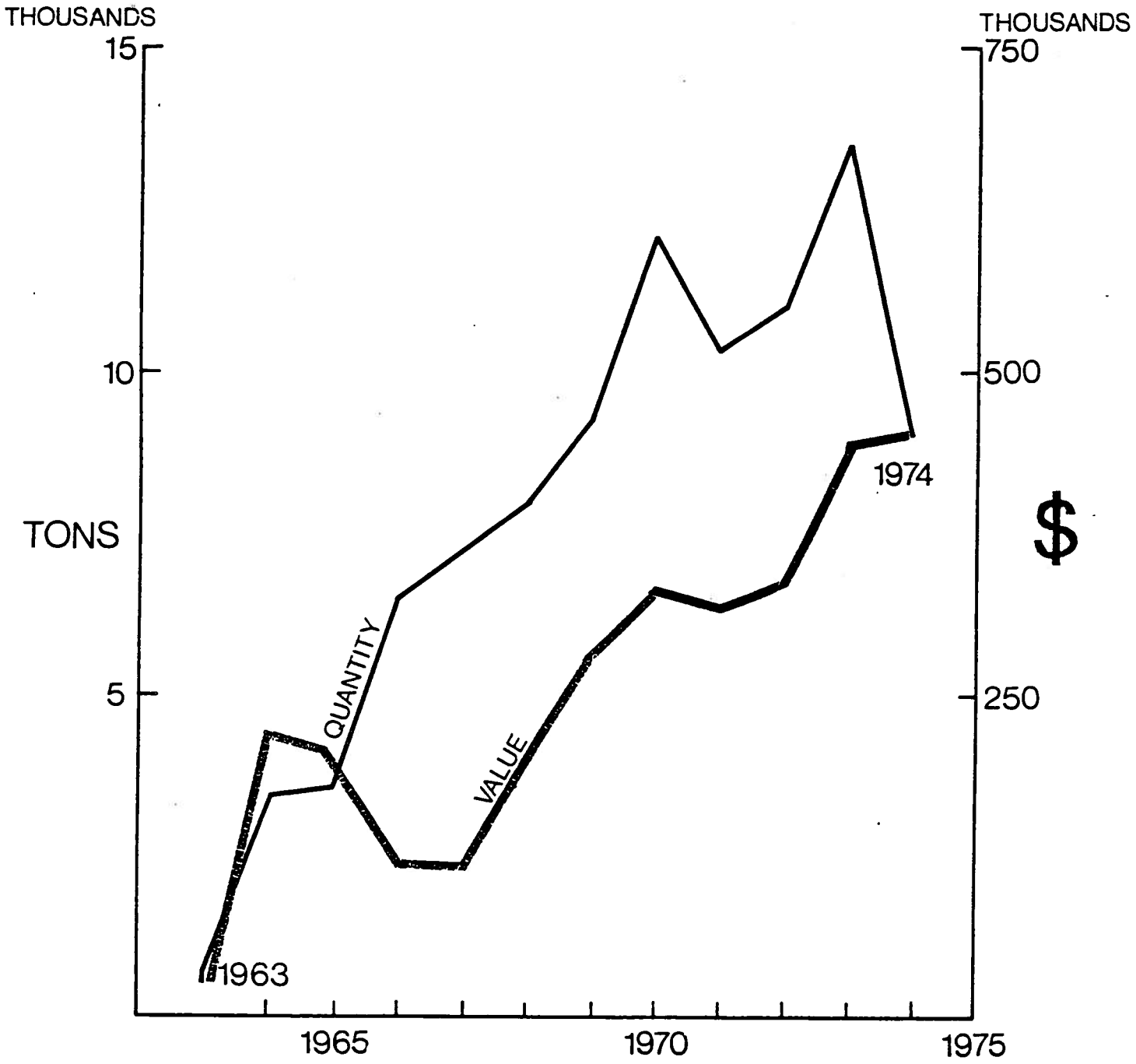
Importance

Peat moss is an excellent example of a mineral resource commodity that lends itself to small-scale development. In Canada and the U.S., out of 200 separate peat producing operations more than 3/4 have annual production of less than 5,000 tons. This figure of 5,000 tons could be taken as an average economic plant size for a small-scale peat moss operation — something within the reach of the local entreprenuer.

Peat moss, like sand and gravel, is also a familiar commodity widely used by the general public. By far the largest single market is the individual home owner, who uses it as a soil conditioner for lawns, shrubs and gardens.

The peat moss industry in Alberta is a growing one. Production has increased substantially since 1963 to nearly $0.5 million in 1974. On the other hand, if we

ALBERTA PEAT MOSS PRODUCTION



PROVINCE	PEAT PRODUCTION - 1973 (Tons)	PEATLAND INVENTORIES (Acres)
Quebec	144,000	255,000
British Columbia	76,000	2,400,000
New Brunswick	73,000	1,700,000
Manitoba	29,000	92,000
ALBERTA	14,000	25,000,000
Ontario	9,000	?
Nova Scotia	8,000	9,000
Saskatchewan	7,000	10,000,000
Newfoundland	-	5,000,000
Prince Edward Island	-	6,000

compare peat production statistics for the rest of Canada and for the world we would have to conclude that our peat moss industry is underdeveloped.

Despite having among the largest resources of the provinces, Alberta ranks only 5th in production. Canada as a whole is well back of European countries in utilization of peat resources. As indicated on this slide, Alberta's peatland areas are as large as the rest of the provinces combined (though the figures in the left-hand column are subject to revision). With our huge resource, with this apparent growth potential, and with the large and potentially expansible market areas in the U.S. (where 90% of Canadian production currently is exported), the future looks fairly promising for Alberta's peat moss industry. This will depend largely on the development of new markets.

Alberta Peat Moss Deposits

As we saw on the previous slide, peatlands are very extensive in Alberta. This slide shows just how extensive. The areas colored in green represent peatlands with bog or muskeg cover of 60 percent or more to depths of two feet or more.

Alberta's peatlands are confined largely to the northern two-thirds of the province, where conditions favorable for the formation and growth of peat bogs are ideally met -- that is, poor drainage and high moisture levels plus cool to moderate temperatures -- such that from 1/3 to 1/2 of the land surface is partially to completely bog-covered. In surface area, this translates into 40,000 square miles of peatland, or about 25 million acres.

In fact, perhaps less than 2 percent of all this would have commercial potential. Let us look at the major constraints to development of this huge resource.

Firstly, access and transportation. The main highways are shown in red and the railways in dotted black for the region lying to the north of Highway 16. Highway 16 is the approximate southern boundary of what we consider to be northern Alberta, and it also corresponds more or less to the southern limit of peatland development (except for the region west of Edmonton). This established transportation network clearly shows the major portion of these peatlands to be inaccessible — now and probably for a long time to come.

Next, we superimpose energy sources -- in this case, natural gas pipelines, shown in orange. Natural gas is a principal requirement for a peat processing operation, and the availability of a pipeline is a critical factor in locating an operation.

Finally, we add some geography constraints. Note that Wood Buffalo Park wipes out a large area from consideration (though these peatlands are too remote anyhow). The principal northern communities have also been added as red dots, marking sites near which peat moss operations conceivably might locate.

Considering these factors all together, we can delimit the peatlands of possible potential as those lying south of the yellow line. This line is rather arbitrarily located to correspond with regular map boundaries, but is probably as good a position of cut-off as any. Peatlands lying south of the line constitute about 35 percent of the total, the rest being just too remote and inaccessible.

This is a closer-in view of our potential peatlands. How much of this would be suitable for commercial harvesting is anyone's guess at the moment. Even if it were

only 5 percent, this translates into a reserves figure of something like 450 million tons of dried peat moss, clearly a very sizable resource for northern Alberta.

Quality of Peat Moss

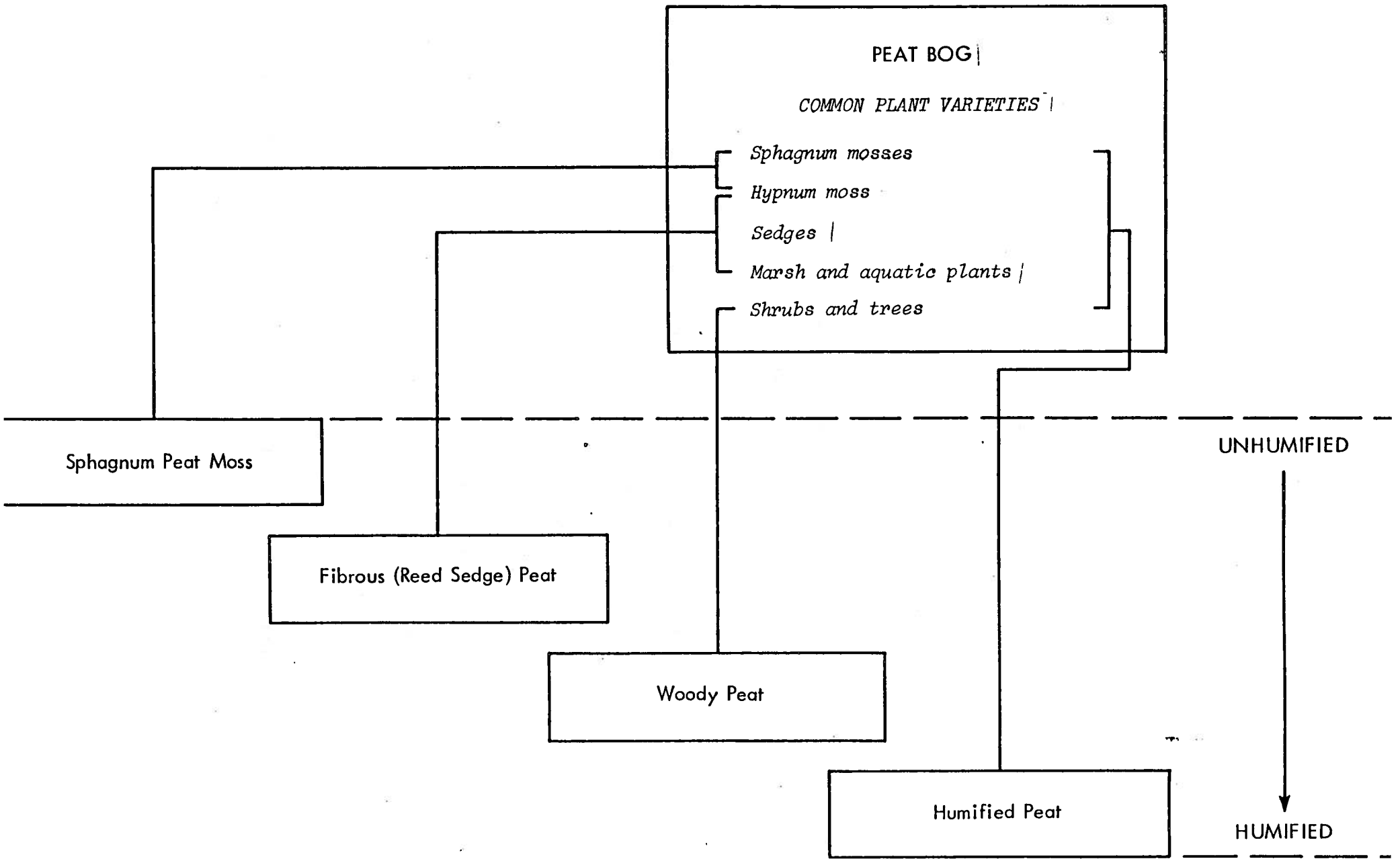
One other major constraint to development of peat resources is the quality of the peat moss. This depends entirely on the plant colonies present, which may vary from one bog to another, even vertically within the same bog.

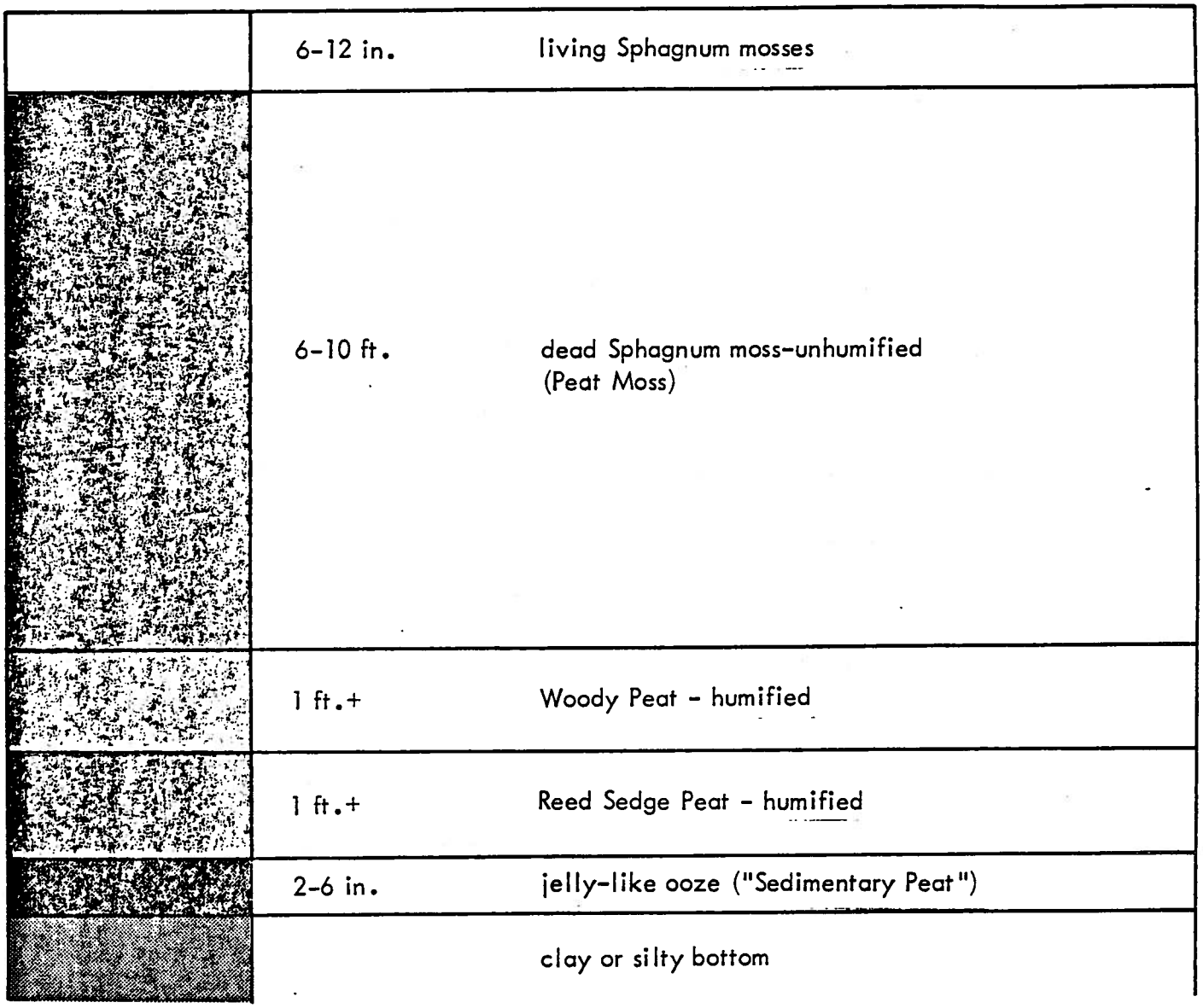
The common plant varieties found in peat bogs are as shown in the top part of the slide:

1. Sphagnum moss is a slender stemmed moss with many short branches and leaves, and a unique cellular structure
2. Hypnum moss is similar but without the good cellular structure which gives sphagnum moss its excellent absorptive properties
3. Sedges are the coarse grasses
4. Marsh and aquatic plants includes reeds, bulrushes, etc.
5. Shrubs and trees include birch, spruce, alder, tamarack.

Peats rarely consist of one plant type only, but usually one of them is a major constituent. The classification of peats is based on this major constituent:

1. Sphagnum peat moss -- a superior product because of its good fibrous structure, elasticity, excellent absorptive properties
2. Fibrous peat -- reed and sedge plant remains, some hypnum mosses, may be finely or coarsely fibrous, much inferior in absorption, elasticity, dust, etc.


PEAT BOG
COMMON PLANT VARIETIES
Sphagnum mosses
Hypnum moss
Sedges
Marsh and aquatic plants
Shrubs and trees
Sphagnum Peat Moss
Fibrous (Reed Sedge) Peat
Woody Peat
Humified Peat
UNHUMIFIED
HUMIFIED



TYPICAL VERTICAL SECTION OF A SPHAGNUM MOSS BOG

3. Woody peat -- particles of partially decayed wood

4. Humified peat -- decomposed organic matter.

Only the sphagnum moss is produced in Canada for export marketing. Only this type commands the premium price necessary for long distance marketing.

A peat bog may consist of any or all of the various types, but only those consisting dominantly of sphagnum peat moss need be considered for development. This is a typical vertical section of a sphagnum peat bog. Generally, these are "raised bogs" that have grown somewhat above the surrounding land surface.

The point to be made from this is that peat bogs can consist of a number of different peat types of wide-ranging qualities, and that a through program of quality testing is necessary to determine the commercial potential of any specific bog.

Thus, in selecting a bog for commercial development, the following factors must be considered:

1. Quality and thickness of peats -- I'll come back to quality testing later
2. Area of bog -- for a minimum thickness of sphagnum moss strata (5 feet) the bog should be 80 to 100 acres in size to support a reasonable sized operation
3. Open character of bog -- fewer trees to clear, the better; heavily forested areas should be eliminated
4. Drainage possibilities -- must be amenable to drainage by simple and inexpensive means

5. Access and Transportation -- should be adjacent to a good road or railway

6. Natural gas service -- should be close by a pipeline

7. Right to deposit

Mineral Rights to Peat Moss

The rights to peat moss are somewhat similar to sand and gravel, in that they go with the surface rights and therefore belong to the landowner. In the case of public lands, you must obtain a lease from the Lands Division of Energy and Natural Resources and pay royalties on peat moss produced.

Leases are obtained by making application to the Director of Lands through the Special Land Use Branch. A lease can be any size within reason, usually 1/4 to 1/2 section, granted for a term of 21 years. The lease carries an annual rental fee on a per acre basis, plus an obligation for payment of land taxes, in addition to the royalty on peat produced (currently 5¢ per yard).

Application for the lease must include full details of the proposed operation for development of the bog, including scale of development, amount of material available, nature of material and subsoil, plant sites, markets, even anticipated sales. The application will also require clearance from the Department of Environment under the Surface Land Conservation and Reclamation Act.

Again I'll suggest to anyone interested in pursuing the matter to get in touch with the Alberta Research Council for direction on who to see and where to go.

FACTORS IN SELECTION OF A PEAT BOG FOR COMMERCIAL DEVELOPMENT

1. Quality and Thickness of Peat
2. Area of Bog
3. Open Character of Bog
4. Drainage Possibilities
5. Access and Transportation
6. Natural Gas Service
7. Mineral Rights

QUALITY TESTS FOR PEAT MOSS

1. Absorptive Value
2. pH
3. Water Content
4. Ash
5. Microscope Examination for Botanical Composition

Quality Testing and Appraisal of Peat Moss

Tests required to assess the quality of peat moss are these:

1. Absorptive value -- how much water the dried peat will absorb; good sphagnum moss content should yield values of 16-24 X dried weight
2. pH -- desired range 3.5 - 5.5; if higher, probably too much reed-sedge
3. Ash -- less than 5 percent
4. Water content -- to indicate amount of dewatering required; normally 85 percent or more water in raw peat
5. Microscopic examination for botanical composition

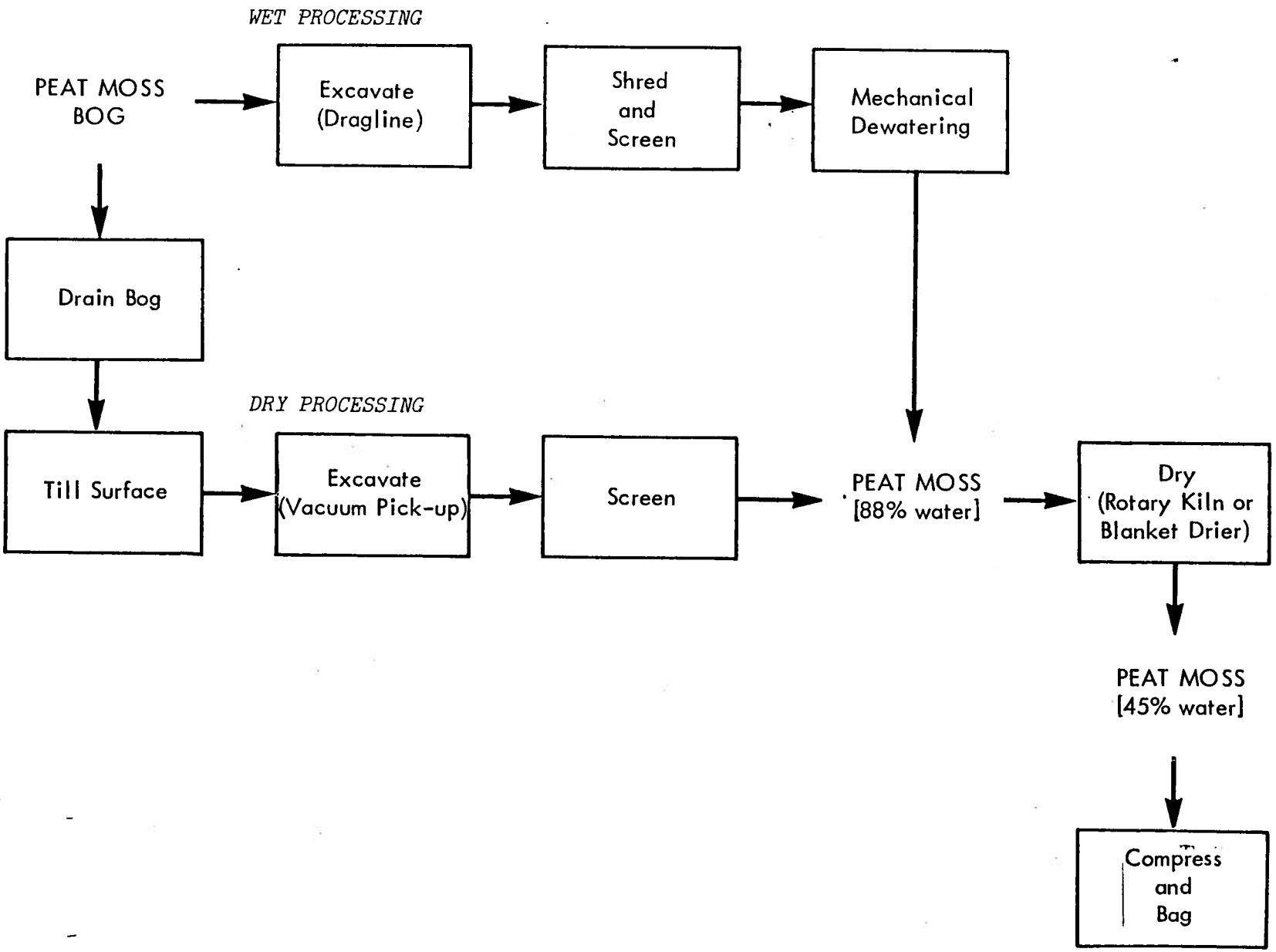
Limited quality testing can be carried out by the Alberta Research Council, Industrial Engineering Services. For a thorough quality assessment, the Mines Branch in Ottawa has facilities.

Processing of Peat Moss

Basically this involves steps of excavating, dewatering, drying, shredding and screening, dust removal, and finally baling and packaging. Although the processes appear simple, the problems are numerous and the technology is fairly involved. In fact, I think I'll leave this aspect for Mr. Johansen to deal with.

Uses of Peat Moss

By far the major use is in horticulture, as a soil conditioner. Some of the other uses are listed here. Not too much progress had been made in the development of new uses, an aspect that needs more research and attention if the peat moss industry is to thrive in Alberta.



PROCESSING PEAT MOSS

USES OF PEAT MOSS

AGRICULTURE	INDUSTRY	OTHER
Horticulture	Construction	Environmental Control
soil conditioner	peat board	absorbent (oil and pollutant spills)
growing medium	"peatcrete"	filtering agent
mulch	insulation	
artificial fertilizers		Miscellaneous & Home Use
nursery stock packing	Manufacturing	fruit and vegetable storage
	pressed peat container	deodorizer
Animal Husbandry	packing material	
poultry litter		
stable litter	Chemical & Metallurgical	
	activated carbon production	
	iron ore pelletizing	

PEAT MOSS

PEATLAND AREAS WITH BOG COVERAGE OF 60 PERCENT OR GREATER

TO DEPTHS OF TWO FEET OR GREATER

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PRELIMINARY COMPILATION
SCALE ONE INCH = TWENTY MILES
W.N. HAMILTON 1975

Not Mapped

Primrose Lake Air Weapons Range

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