Not so Renewable: Implications for continued peat mining in Minnesota

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Executive Summary

Minnesota is the second largest producer of peat in the United States, second only to Florida and first in the nation for active mining operations. In a 2013 USGS survey, 8 active Minnesota peat plants were responsible for a total of 85,400 metric tons of harvested peat (USGS, 2021). While peat mining has been shown to be detrimental to forest ecosystems and native habitats, current state regulations under statue 93.481 allow contractors to apply for permits on vulnerable land (Peat Mining, 2008). Peat mining has been shown to be nearly irreversible. Harvested bogs have decreased hydrologic conditions that make it difficult for mosses to regrow. On top of that, the process of mining peat can cause chemical leeching into nearby streams, rivers, and lakes causing fish-kills and eutrophication. This policy brief outlines current peat production operations in Minnesota, the threats they create, and three key policy-based solutions to help improve the future of Minnesota's peat and wetland environments.

Introduction

Peatlands play a critical role in the sequestration and storage of carbon from the atmosphere. Since the end of the last glacial period, wet lands, of which peatlands are a subset, have been a stable storage option for carbon (Kolka et al., 2018). In addition to the many other ecological services they provide it is estimated that peatlands store 0.096 Peta-grams per year of carbon. However, peatlands are also one of the largest natural sources of methane, the second most present greenhouse gas (Gorham, 1991), with a global warming potential of 28-36 times that of carbon dioxide (Myhre et al., 2013). While scientists have generally agreed that peatlands remain a net positive effect on the environment, the increasing effects of climate change could disturb the delicate balance between these two compounds (Feng et al., 2020; Gorham, 1991; Kolka et al., 2018; Mitsch et al., 2013; Trettin et al., 2005). One of the best ways to continue to preserve that balance is to cease mining peatlands, which can

exacerbate the effects of these climate issues by releasing the stored carbon and destabilizing the water table.

Peatlands are formed as the top layer of the bog, usually a variety of *Sphagnum* moss, decomposes and builds up vertically. Through this biological process the carbon contained in the decomposing matter is stored in the form of soil carbon. These stores make up an estimated one third of total global carbon stores (~500-600 billion tons) (Charman, 2009; Gorham, 1991).

There are two main categories of peatlands: bogs and fens. Bogs are characterized by the fact that they only receive water from precipitation (i.e. snow, rain). They are usually identifiable by their 'domed' center and network of hummock and hollow elevations (Charman, 2009). Fens, on the other hand, receive water from a mixture of precipitation and groundwater, making them more nutrient rich. In scientific terms these are referred to as ombrotrophic systems (bogs) and minerotrophic systems (fens) (Carpenter & Farmer, 1981; Charman, 2009). Peat classification is newer and has been developed based on the inherent commercial qualities of peat. Sphagnum peat is the least decomposed type of peat, usually found near the surfaces of the bog or fen and is the preferred type of peat for horticulture. It is also one of the only types of peat that can be grown in greenhouses (Carpenter & Farmer, 1981). Reed-sedge peat is older and more decomposed peat and has a very fine grain. This type likely comes from existing peat bogs and is commonly used for golf courses and baseball fields (Carpenter & Farmer, 1981).

Dry peat mining directly from a living bog can take several months to years. First, the surface of the bog must be cleared, often involving removing a mixture of brush and forest. This portion of the process commonly occurs during the winter months when the ground is solid. Once cleared, the bog is then drained to lower the water table elevation (WTE). This serves a dual purpose, first to allow the bog to dry out before harvest, and second to solidify the ground to make it easier for the harvesting equipment to operate. Finally, the top layer of the peat is removed, usually using a strip mining technique, and processed for commercial use (Carpenter & Farmer, 1981). Typical mining operations can be anywhere from less than 200 to 2,000 acres (Carpenter & Farmer, 1981).

Peat Mining Statistics

The 2016 United States Geological Survey (USGS) Minerals Yearbook reported that in that same year there had been 71 million metric tons of peat harvested from across the state with a worth of $4.9 million (Krisanda, 2016). This represents a 21.8% increase in quantity and a 71.3% increase in value from 2015. There was also a 48.8% increase in quantity and a 78.8% increase in value from 2016. This increase in peat production is occurring despite current mining regulations attempting to restrict large operations. If the growth of the peat mining industry is allowed to continue at this rate, Minnesota's natural peat resources will soon be depleted.

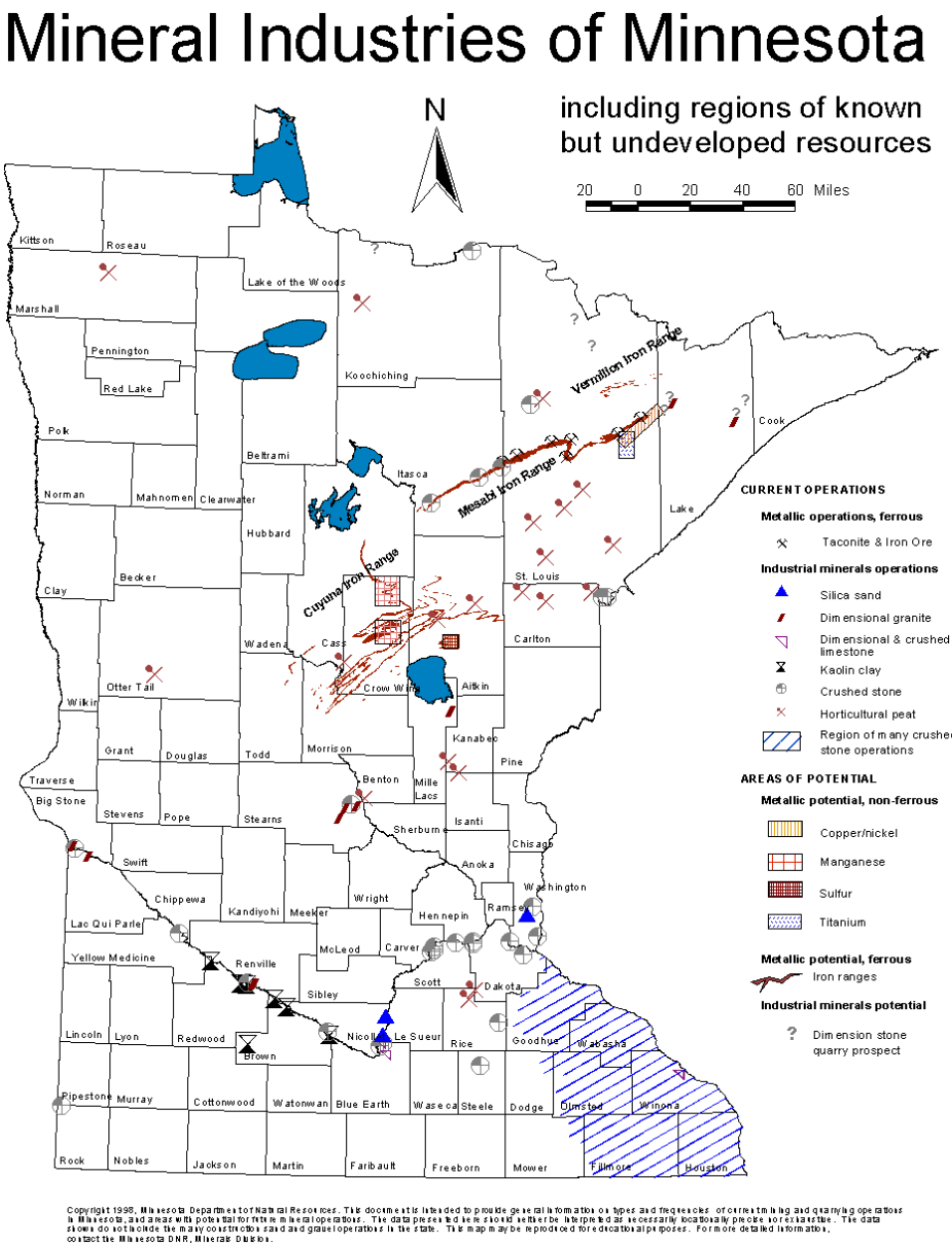

Figure 1. Current overview of mining operations in Minnesota, note that the grouping of maroon cross hatches in the Northeast and west corners signify peat mining operations. Source: (Minnesota DNR, 2021)

Current Mining Legislation in Minnesota

Under current Minnesota mining legislation (Rules 6131, Statues 93.481) there is generally no permit needed for mining operations that are under 40 acres in size or under 1000 tons of dry peat production per year, unless there are significant environmental impacts at hand.

In order to determine these impacts, companies must submit an Environmental Assessment Worksheet (EAW) to the Minnesota DNR with each new permit. This worksheet details the location of interest for the mining operation, the existing natural structures (peatlands, geomorphology, geology, land cover etc.), and a complete plan for harvesting. The DNR then decides if a more thorough assessment is needed. There are four main areas for peat mining standards: Sitting (location), Mine Design, Site Restoration, and Cleanup. All details following are paraphrased from the rules and statutes listed above (Peat Mining, 2008).

Sitting – Peat mining is generally restricted from any areas of protected lands or other areas of 'adjacent noncompatible lands' (Peat Mining, 2008). These include locations such as within a quarter mile of the Boundary Waters Canoe Area Wilderness, national wilderness areas, national parks, monuments as they were defined in August 1985, or state wilderness areas and parks. It also excludes sites on the National Register of Historic Places or public locations such as houses, public schools, churches etc. It also includes within 300 ft of any state trout streams, rivers as defined by section 85.32, subdivision 1 of the Minnesota Statutes, or the Bois de Sioux, Red River of the North, Roseau, Rainy, and Pigeon Rivers. Minnesota does allow mining within the boundaries of the Peatland Protection Management Areas, national wildlife refuge and waterfowl production areas, and other national wildlife management areas with the distinction that mining operations will enhance the use of the area. However, no details are given for how 'enhance the use' is defined.

Mine Design – Under this section the legislative goal is to ensure that any peat mining occurring is making as little impact as possible in terms of water quality and quantity in the area. To do so, mining plots are required to be separated wherever possible by unharvested or restored areas. The ditches, which are essential for lowering the WTE for harvest, are also required to be designed in such a way that the surrounding WTE other than the harvested area is not affected. Finally, any waste from the mining is required to be disposed of in an appropriate manner.

Restoration – One of the main efforts that this piece of legislation attempts to focus on is the importance of site restoration. While peat is classified as a renewable resource, it can take thousands of years for a substantial amount of peat to reform for harvesting. Therefore, if peat mining is going to be sustainable, it is important to return the system to as close to the original ecosystem and hydrological system as possible. In order to ensure this, the law designates the mining corporation as responsible for restoration efforts. However, the corporation is also required to contact the owner of the mined land to determine if they are willing to assume responsibility for management operations.

In their restoration efforts, the mining company must ensure that "within the mining area, all mined peat surfaces, islands, littoral zones, and disturbed peat and mineral surfaces such as ditches, dredge spoil, borrow pits, plant sites, and auxiliary facilities [are] stabilized with vegetation" (Peat Mining, 2008). This process is expected to take at least five years. The expectation is that by the end of the five years, 75% of all mined areas will be supporting healthy vegetative cover. If this benchmark is not met, the holder is in violation of part

6131.0250 of the permit agreement, and the MN DNR reserves the right not to release the permit holder until it is met. In addition to vegetative cover, the corporation is responsible for maintaining steady water levels in all open water areas in and around the mined area.

Under these guidelines, corporations are only responsible for short term restoration efforts on their lands. After the initial five years there are no additional follow-up measures to ensure that the peatland continues to show restorative growth.

Clean up – The final responsibility bestowed upon the permit holder is complete clean up of the mined areas. When the peatland has run dry the mining corporation is responsible for removing all polluting and hazardous material from the site. Within one year they must remove any debris and mobile equipment, and within three years they must remove all temporary roads, parking areas, storage areas, and equipment. Failure to meet these conditions results in a violation of past 6131.0250 of the mining agreement, and the permit will not be terminated until conditions are met.

Active Peat Operations in MN

As of 2013 the Minnesota DNR acknowledged 10 large scale mining operations across the state (USGS, 2021). In a USGS Survey done the same year, eight of these active operations willingly submitted information about their mining operations. Those locations are:

- *Conrad Fafard, Inc. P.O. Box 63 Floodwood, MN 55736* – A subsidiary of a Massachusetts company focused on *Sphagnum* production for individual horticultural use.
- *Hawkes Co., Inc. P.O. Box 14088 Grand Forks, ND 58208* – Focused on Reed-sedge peat from bogs in northern MN.
- *Nelson Peat Topsoil 5354 Highway 194 Hermantown, MN 55811* – Based in St. Louis, MN sells bulk Reed-sedge peat.
- *Peat Inc. P.O. Box 332 11555 205th Avenue NW. Elk River, MN 55330* – A bulk peat supplier that harvests Reed-sedge peat from 6000 year old peat bogs in northern Minnesota.
- *Premier Tech Ltd. 1320 Kalli Road Cromwell, MN 55762* – Sells multiple mixtures directly from peatlands for horticulture uses. They partake in peatland restoration and fund research.
- *Curtis A. Sampson 14534 Glendale Avenue Prior Lake, MN 55732* – Individual producer of Reed-sedge peat for the racetracks at Canterbury Park.
- *Tamarack Peat Moss Co. 18680 County Highway 119 Underwood, MN 56586* – A bulk producer of Hypnum moss. Potentially rebranded as Outdoor Renovations.
- *Traeger Industries 10756 Highway 95 Foley, MN 56329* – A bulk producer of Hypnum moss. Potentially closed as of 2021.
- *Waupaca Northwoods LLC East 3439 Highway 22 & 54 Waupaca, WI 54981* – A Wisconsin based corporation harvesting *Sphagnum* peat for individual and industrial use.

Environmental Impacts of Peatlands and Peat Harvesting

In the late 1970s and early 1980s, peat was being strongly considered as a fuel source in Minnesota. Mining plans were submitted to begin clearing land in the Red Lake peatlands, near Beltrami, Koochining, and Lake of the Woods Counties (Siegel, 1979). The proposals raised a red flag for members of the Unites States Geological Survey (USGS), and questions were asked about the effects that such a mining operation would have on the Red Lake Indian Reservation and the Game Refuge and Wildlife Management Area (Winkler & Dewitt, 1985). In partnership with the MN DNR, the USGS assembled a proposal to study a section of peatlands in the northern most area of Minnesota, where land used to be covered by glacial Lake Agassiz. Before approving mining proposals they requested three years to monitor the hydrology and water quality in the area and determine potential effects that surface mining may have on the natural ecosystem (Siegel, 1979). This was one of the first environmental impact assessments done by the state of Minnesota on peat mining.

In one of the first landmark papers published covering a complete review of the regional, national, and international environmental impacts of peat mining, Winkler & Dewitt identified seven negative biological effects that peat mining can have on its surrounding ecosystem (Winkler & Dewitt, 1985). These effects continue to be the ones influencing our Minnesota ecosystems today. Some of the main impacts are:

1. *Toxic Metals from peat leaching into nearby water bodies*. Because of peat's absorbent qualities, bogs and fens commonly absorb large quantities of metals such as lead, mercury, arsenic, and zinc from flowing groundwater or through atmospheric deposition (Loxham, 1980). When the peat is then harvested, these metals are released back into the hydrologic system (Winkler & Dewitt, 1985). It was this effect that caused widespread fish kills in a stream in Eastern Finland, see 'International Peat Mining News'.
2. *Eutrophication.* Eutrophication is the phenomenon whereby there are excessive amounts of nutrients such as phosphorous and nitrogen present in a body of water. The main effect of eutrophication is the depletion of oxygen, which can kill plants and aquatic animals and also cause harmful algal blooms (Smith, 2009). Runoff from drained peatlands has been shown to contain three times the amount of nitrogen and 28 times the amount of phosphorous than unharvested peatlands (Richardson, 1983; Winkler & Dewitt, 1985).
3. *Ground-water depletion.* One major concern for peat mining in Minnesota is the effect that continued mining will have on the water storage capacity of soils. Because an agricultural state like Minnesota is so reliant on the water table for production, depletion of water storage could have consequences for the farming industry (Minnesota DNR, 1981; Winkler & Dewitt, 1985). Peatlands serve as a way for the water table to recharge and decreased peatland cover could affect the both the water-level and its stability in future years (Winkler & Dewitt, 1985).
4. *Sinkholes.* One of the most direct implications of peat mining to humans is the increased instability that it causes to the earth. In Florida, the combined effects of

drought due to climate change and a decrease in ground-water due to peat mining caused several devastating sinkholes (Winkler & Dewitt, 1985).

5. *Increased Runoff.* Peatlands and other wetland types often serve as a sort of water storage repository. In draining and harvesting them, this water is the released into nearby streams, rivers, lakes, and reservoirs (Camp, Dresser & Mckee, Inc., 1981). This additional runoff likely carries increased metal pollutants and can be hazardous to fish and other aquatic wildlife, as well as effect fish production in Minnesota fisheries (Minnesota DNR, 1981; Winkler & Dewitt, 1985).

The knowledge of these effects is not new, and issues have already arisen with respect to Minnesota mining operations. One critical debate arose in the summer of 2017 when Hawke's Company, a peat production company based in Grand Forks, ND but operational in Minnesota, applied to expand its production into a section of Wildlife Management Area (WMA). See 'Hawke's Peat Company V. US Army Corps of Engineers' for the complete story.

Hawke's Peat Company V. US Army Corps of Engineers

July 2017 – The bog near Thief River Falls, MN that Hawke's Company had been harvesting for nearly 30 years began to run out. In an effort to expand their operation they applied to the Minnesota DNR for a permit to begin mining a 300-acre site near Newfolden, MN (Pierce, 2013). The new site included 198 acres of minable land, the majority of which was on private land, however, 30 acres were on land that was being managed by the New Main Wildlife Management Area (WMA). Under the Minnesota Rules, part 4410.4300, subpart 12A, Hawke's Company was required to submit an Environmental Assessment Worksheet to the MN DNR Environmental Quality Board. This assessment would determine the need for a complete Environmental Impact Statement (EIS), which would outline the full effects that mining in that area would have on the natural ecosystem.

The proposal was stalled because the United States Army Corps of Engineers (USACOE), who claimed jurisdiction over the area, stated that Hawke's would be in violation of the Clean Water Act if they were to mine in that area (Gunderson, 2017). The Clean Water Act regulates the discharge of pollutants into national waters, which the USACOE argued included the nexus of wetlands in the Red River of the North region of Minnesota. The challenge would have required Hawke's to get a federal mining permit under the Clean Water Act, 33 U.S.C 1311(a), 1361 permit from the USACOE (Skelton, 2016). The mining company challenged the USACOE and this challenge reached the U.S Supreme Court, where it was upheld under the assumption that Hawke's would still need to obtain an approved permit from the MN DNR.

The MN DNR eventually approved the permit without any additional EIS inquiries and Hawke's Company was allowed to mine the property without restrictions, including all 30 acres of wildlife management area (DNR, 2017).

Does Restoration Work?

It is very difficult for harvested peatlands to be return to functional ecosystems after being mined and abandoned. The methods for peat extraction expose the surface of the bog and lower the water table, making it near impossible for *Sphagnum* mosses to being growing again. Near the Riviere du Loup, Quebec looked at the water balance in a harvested bog and an active natural bog. Between the two sites there was a marked difference in the amount of evapotranspiration, a proxy for plant growth and health, and streamflow runoff (Van Seters & Price, 2001). When peat is harvest, the water table is lowered, and the peat is allowed to dry out before it is skimmed off the top of the bog. This process hurts the bog's ability to self-regulate the water table level, which creates a hostile environment for the *Sphagnum* plants to regrow (Price, 1997). Despite not having been mined in 25 years, the harvested bog in Quebec had not regained its original hydrological function (Van Seters & Price, 2001).

Peat Mining Innovations

While for many environmentally minded people the solution to the presented issues with peat mining is to cease all harvesting, there have been efforts in the areas of ecological engineering to develop sustainable peat production methods.

Sphagnum Farming

One method is to use previously mined and abandoned bogs as cultivation sites for growing *Sphagnum* mosses in a monitored environment over short timescales (5-10 years), called *Sphagnum* farming. This method is still relatively new but has been successful in several small-scale settings in Canada, Chile, Germany, Ireland, and Finland (Gaudig et al., 2013). A recent experimental set up in eastern Canada showed that *Sphagnum* farming in block-cut cutover bogs ('block-cut' being a specific peat harvesting method) could have comparable feasibility to large-scale peat harvesting efforts from natural peatlands (Pouliot et al., 2015).

Integrated Peat-harvesting

An extraction technique, known as peat-block reclamation (PBR) is gaining popularity as a sustainable way to mine peat that also encourages faster and healthier regeneration of the peat soils (Cagampan and Waddington, 2008). Normally, peat is harvested by removing all native vegetation and scraping off the top, dry layer of peat from a bog or fen. However, this new PBR method involves removing the upper-most 0.3-0.5 meters of living mosses from the peatland and harvesting the peat below that initial block. After this harvesting, the top layer with the live moss is returned to the ground (Wilhelm et al., 2015). By removing and replacing the upper layers, the experimental peatlands have been shown to regenerate in as little as two years (Cagampan and Waddington, 2008).

International Peat Mining News

Saskatoon, Canada – In a current fight, the Lambert Peat Moss company of Quebec is trying to expand their production by harvesting four new sections of peatland from land south of the Lac La Ronge Indian Band Territory. There are competing concerns that the mining would hurt wildlife that rely on the ecosystem and traditional land uses (Jayda Taylor, 2021).

> *"I feel a strong connection to this land, and I just feel like my ancestors are all here with me and they are pushing me to protect this land. You see all the destruction everywhere. They're going to destroy the one thing that we have left." – Kona Barreda* (Jayda Taylor, 2021)

England – A group of environmentally minded gardeners, supported by the UK Wildlife Trusts, banded together during the COVID lockdown to phase out garden center sales of peat. The UK had set a goal of eliminating peat mining by 2020, however, commercial growers have been given until 2030 to cease operations. Progress has been far too slow to meet these goals (*The Guardian View on Peat: Keep It in the Ground | Editorial | The Guardian*, 2021).

Dublin, Ireland – In January 2021, one of the largest peat production companies in Ireland, Bora na Mona, formally ended all harvesting efforts. This closure came after the 2019 ruling by the Irish High Court that required all peat harvesting in bogs larger than 30 hectares to obtain permits and environmental impact assessments. Instead, Bora na Mona is searching for ways to redirect their efforts into more environmentally friendly solutions (Colin Gleeson, 2021).

North Karelia, Finland – Finland is currently the EU's largest consumer of peat for energy usages. Although it makes up less than 5% of the country's energy, it is blamed for 14% of greenhouse gas emissions. With such statistics, eliminating peat mining and consumption should have clear guidelines under the nation's 2035 carbon neutrality plan. However, Finland is aiming to halve their peat use by 2030, an environmental goal that leaves many unsatisfied. One critical case study that shows the impacts of this decision is the degradation of aquatic life in the Jukajoki and Linnunsuo rivers in North Karelia. This area is home to several native populations including the Sami, Karelian, and Savo-Karelian people, each of whom rely on a deep connection with the land for survival. Until recently, nearby peat mining was leaching metals and other harmful substances into the rivers and native fish were dying en masse. Not only are efforts being made to address the shortcoming of the 2035 climate plan, but peatland restoration is becoming more and more important (Sam Kingsley, 2020).

> *"Now that we are losing a lot of carbon sinks in Amazonia, Siberia and elsewhere, Finland matters. We have these millions of hectares of degraded peatlands that have the potential to come back as a natural solution on climate." – Tero Mustonen, author for Intergovernmental Panel on Climate Change (IPCC)* (Sam Kingsley, 2020)

Conclusions

Despite early recognition of the potential environmental impacts, peat mining in Minnesota has been increasing since its beginning in the late 1970s. If production is allowed to continue increasing, there will be irreversible consequences for the natural ecosystems that Minnesotans hold so dear. Under current mining legislation, corporations are given lenient requirements for restoration that focus only on the short term.

Furthermore, while current research has shown the clear negative impacts of peat mining on local and regional ecosystems, it has also provided solutions for these problems that are feasible alternatives to a complete moratorium on peat production. However, if changes are not made to refocus the peat production system in Minnesota according to these reasonable recommendations, Minnesota will lose its peatlands completely and will not be able to produce peat for the next several thousand years.

Policy Recommendations

In response to existing regulations, current events, and data driven research pertaining to peat mining, the following policy recommendations are made:

1. Require all new peat mining operations to submit an Environmental Impact Statement (EIS) when applying for a permit on new land. In turn, all current mining operations will be required to submit an impact statement within 3-5 years of any new regulation to assure that they are not harvesting on particularly vulnerable land.
2. Complete restoration efforts must be pursued following complete mining operations and progress will be assessed every 5 years for the 15 years following the end of the harvesting window.
3. Form a committee to examine the role of peat mining in Minnesota's economy and its relative importance compared to its long-term environmental impacts. As a part of this committee, team with scientists and universities to present guidelines for effective peatland restoration measures and explore further sustainable methods and alternatives for peat mining.

Under these recommendations, the end goal is that peat harvesting in Minnesota will cease within the next 20-30 years. However, in case of the circumstances of extreme necessity or reasonable complications within the industry, alternative methods for more sustainable harvesting should be developed.

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