NATURAL DISTURBANCE:
Managing Wetlands for Fire Risk

In the western boreal, wetlands form significant parts of the wildland-urban interface and wildland-industry interface and are often older than their historic natural range of variation, but are rarely targeted for proactive wildfire risk management.[1] This is primarily due to widely held assumptions that all wetlands are wildfire refugia, a focus on avoiding wetland disturbance (and potential regulatory barriers associated with any disturbance), a lack of knowledge of the mitigation techniques that could be effective and appropriate in wetlands, and a lack of clarity with respect to who is responsible for managing wetland fire risk on crown land.

There is a growing understanding that **some wetland types, primarily forested organic wetlands, are susceptible to high-intensity burns, characterized by severe smoldering combustion and substantial carbon losses.** As awareness of the potential risks grows, so does the need for techniques that effectively manage fuel loads to reduce wildfire risk and severity in wetlands (***Factsheets #8***).[1]

This factsheet provides an overview of the current state of knowledge of managing wetlands for fire risk. These approaches should be considered alongside Indigenous fire stewardship (***Facsheet #10***). The purpose of this factsheet is to increase awareness of the need for fuel management in some wetlands, the types of techniques being explored, and how these techniques may differ from uplands. For example, fuel management in uplands has focused on managing above ground fuel, but that is insufficient in organic wetlands where sub-surface fuel is the primary risk factor.[2] This information is important to consider when taking a whole landscape approach to ecosystem based management.

Need for Wetland Fuel Management

Managing fuel loads in wetlands can help reduce the amount of above ground fuel available and restore the hydrological and vegetation conditions that make wetlands more resistant and resilient to fire (***Factsheet #8***).

Driven by historic fire suppression, climate change, and land use change, there are more older and drier wetlands than historic patterns suggest. These conditions have increased the risk of fire ignition, severity, intensity, and season length.[1] This in turn increases potential effects to other ecological values, severe wetland fires can:

- Release significant amounts of carbon into the atmosphere from below-ground carbon stores;
- Transition a burned wetland to a different wetland type, or an upland ecosystem, altering wetland functions such as water resources, habitat, or presence of culturally important species;
- Propogate fire to adjacent areas contributing to significant fire events and putting at communities, infrastructure, and resources (e.g., timber) at risk and over-winter fire in peat soils; and,
- Potentially release legacy metals into the air and water systems.[1]

Fuel Management Treatments in Wetlands

Wildfire in wetlands is managed using a combination of fuel management treatments (passive suppression) and extinguishing fire once detected (active suppression). Wetland management in wetlands must adress both above-ground and below-ground fuel sources. Table 1 provides an overview of passive suppression techniques that are being trialed in wetlands. Current research focuses on treed organic wetlands because these wetland types pose the greatest fire risk on the landscape to due the large amount of subsurface fuels (peat) available to burn when dry and their sensitivity to climate and land use change.

Treatment Type	Description	Considerations
Prescribed Burns	Deliberately setting fires under controlled conditions to reduce excessive fuel loading on the landscape.	Appropriateness and success as a management tool depends on the size of the area, season, and hazard conditions. Because of these factors, perscribed burning is not appropriate in many circumstances, but can be extremely effective when it is. Incorporating Indigenous Knowledge and cultural burning practices can enhance the effectiveness, increase biodiversity, and promote ecological resilience (***Factsheet #10***).
Thinning	Selectively removes vegetation to decrease fuel loads and reduce fire intensity and rate of spread.[2]	While shown to be effective in upland forests, evidence shows that thinning does not reduce the rate of spread or fire intensity in treed organic wetlands. Reducing the canopy cover in wetlands results in drier surface fuels due to greater wind and sun exposure.[2] Thinning did show to reduce the intensity of burn, and reduced canopy do suggest that thinning practices may support active suppression.[2]
Mulching	Mechanically shredding surface fuels and trees, reducing crown bulk density and ladder fuels.[1,3]	Mulching can maintain peat moisture content and reduce evaporation from the moss surface, further aiding fire prevention and control.[1,4,5] Mulching also required thinning above-ground biomass, but unlike thinning alone, the mulch results in beneficial outcomes such as *Sphagnum* moss establishment due to increased sun availability and increased soil moisture content.[6]
Compression	Mechanically compressing moss and peat layers to maintain soil moisture.[6]	Manual compression of peat soils from machinery has shown increased moisture retention capabilities, and the vertical transport of water to the ground surface has been shown to reduce the depth of burn and potential for smouldering.[3,8,9] By compressing the soil, the peat bulk density increases, which could result in increased carbon loss if soils were to burn in future unknown conditions.

Table 1. Wetland fuel management techniques and considerations in application.

Challenges for Implementing Fuel Management Techniques in Wetlands

Implementing effective fuel management techniques in wetlands is challenging due to their distinctecology and need for specialized approaches for fire management. Socio-economic, political, and economic factors can compound these challenges (Table 2).

Ecological	Wetlands pose unique challenges for implementing fuel management techniques due to their complex hydrology and deep organic soils (organic wetlands). Their unique ecology means that upland fuel management techniques may not be directly applicable and research is needed to develop techniques tailored to wetlands. As well, techniques that are effective in one wetland type (e.g., treed fen) may not be effective in another wetland type (e.g., treed swamp).
Socioeconomic	Determining who is responsible for funding and leading fuel management in wetlands is a significant obstacle. Divergent stakeholder interests, economic constraints, and varying community engagement levels contribute to the complexity of decision-making and implementation processes.
Economic	Developing and executing fuel management techniques requires substantial financial and time investment and there is no immediate offset to the cost (e.g., fuel management in uplands may provide some merchantable timber). The remote locations of many wetlands in the western boreal also presents financial and logistical barriers for implementing fuel management practices.
Political	Policy and regulatory frameworks governing wetlands restrict disturbances and permission for fuel management may require additional steps. Techniques perceived as risky, such as prescribed burning, face additional regulatory barriers.
Risk	Similar to uplands, wetlands most in need of fuel management may also be too risky for some fuel management techniques such as prescribed burning as there can be a heightened potential for fire escape and rapid spread under high-hazard conditions.[7]

Table 2. Challenges associated with implementing peatland fuel management techniques.

PELICAN MOUNTAIN RESEARCH SITE

The Pelican Mountain Research Site near Slave Lake, Alberta is a partnership between Alberta Wildfire and FPInnovations to evaluate the effects of various fuel management techniques. The research site is predominantly bog and fen ecosystems with black spruce cover and the partnership is supported by multiple wetland research affiliations. Wetland focused projects such as WILDPHIRE utilize the site to test novel wetland fuel treatments.

Resources:

- Canadian Forest Fire Behaviour Prediction (FBP System)
- Natural Resources Canada National Guide for Wildland-Urban Interface Fires (2021)
- Canada Wildfire Burn - P3 Model
- Mortelmans, J., Felsberg, A., De Lannoy, G. J., Veraverbeke, S., Field, R. D., Andela, N., & Bechtold, M. (2024). Improving the fire weather index system for peatlands using peat-specific hydrological input data. Natural Hazards and Earth System Sciences, 24(2), 445-464.
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7.Hvenegaard, S., Refai, R., Mackinnon, B., & Benson, M. (2020). Fuel Amendment as a Forest Fuel Removal Treatment: Exploratory Trials in Black Spruce Fuels at the Fort Providence Wildfire Experimental Site.