

BRIEFING NOTE FOR INFORMATION

DATE: December 16, 2019

PREPARED FOR: Honourable Doug Donaldson, Minister of Forests, Lands, Natural Resource Operations and Rural Development

ISSUE: FPInnovations' Glyphosate Use in BC Forestry, Review Report

BACKGROUND:

- Glyphosate is an herbicide used by forest managers to reduce broadleaf competition of conifer plantations to assist achievement of free-to-grow status.
- Glyphosate use is a controversial issue with the public, particularly related to recent claims of habitat impacts and the decline in moose populations.
- In spring 2019, the Office of the Chief Forester (OCF) initiated a review of glyphosate use in provincial forests to help inform future policy development and research needs.
- A small steering committee comprised of staff from Forests, Lands, Natural Resource Operations and Rural Development (FLNRORD) and Environment and Climate Change (ENV) was established to define the scope/scale and oversee the review.
- FPInnovations (FPI) was contracted to assess current peer reviewed forest science and best practices related to glyphosate use primarily in the context of the current value-set that applies to forest management throughout BC (e.g., biodiversity, First Nations, climate change, soil and water, etc.).
- This note provides a brief summary of FPI's report and sets out next steps, including internal and external communication.

DISCUSSION:

- Based on an initial assessment of the ~50-page report (ref. Appendix 1), FPI reports that the risk of glyphosate and its metabolites¹ on the environment is minimal when the herbicide is applied according to the product instructions (label). Further, it confirms that species richness and diversity of flora and fauna remain in the range of natural variation, and that any changes to these communities when glyphosate is used is transient.
- Glyphosate is one of many vegetation management tools available to forest managers. Glyphosate, while very cost-effective, is declining in use relative to the forested area harvested each year. In 2018, ~ 11,000 hectares of Crown land in BC were treated with glyphosate representing 7 percent of the Crown area harvested that year, most of which was in the Omineca Forest Region.
- Further, the FPI report also indicates that contrary to current public perceptions, the data indicates that parts of BC have shown a significant increase in mixed deciduous stands over the years due to previous harvesting activity; even in stands that have been previously treated with glyphosate. Deciduous trees still account for 15-20 percent of the stems per hectare at free growing.

¹ A metabolite refers to the product that remains after a chemical has broken down, digested or otherwise processed.

- The FPI report also makes a series of recommendations related to opportunities to improve research and data; particularly with respect to glyphosate persistence in plants, impact on soil micro-organisms, wildlife forage and fire behaviour.
- The FPI report also includes recommendations related to the opportunities to improve two-way communication with First Nations and the public related to glyphosate use.

NEXT STEPS:

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Attachments:

1. Briefing note "*Summary of FPIInnovations Glyphosate Review Report*" (CLIFF 252256).
2. Review of Glyphosate Use in BC Forestry (FPI, Dec. 11, 2019).

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| | Initials | Date |
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| MO | | |
| DMO | | |
| ADM | DN | December 19, 2019 |
| ED | SB | December 16, 2019 |
| Program Dir/Mgr. | SH | December 13, 2019 |

BRIEFING NOTE FOR INFORMATION

DATE: December 12, 2019

PREPARED FOR: Diane Nicholls, Assistant Deputy Minister, Chief Forester, Minister of Forests, Lands, Natural Resource Operations and Rural Development

ISSUE: Summary of FPInnovations Glyphosate Review Report

BACKGROUND:

- Glyphosate is an herbicide used by the forest sector to reduce broadleaf competition with conifer plantations in order to assist in the achievement of free-to-grow status.
- In spring 2019, the Office of the Chief Forester (OCF) initiated a review of glyphosate use in provincial forests to help inform future policy development and research needs.
- A small steering committee was established to define the scope/scale and oversee the review.
- FPInnovations (FPI) was awarded a \$75,000¹ consulting services contract to assess current peer-reviewed forest science and best practices related to glyphosate use in the context of, but not necessarily limited to:
 - The current value-set that applies to forest management throughout BC;
 - Where and why forest managers use glyphosate, how it relates to the current value-set e.g., carbon, First Nations (FN), wildlife, and wildlife habitat, and alternative vegetation management approaches;
 - Document the uncertainties and assumptions related to forestry-related glyphosate use; and
 - How glyphosate use supports the overarching objective of promoting the establishment of healthy and diverse forests.
- This note provides a summary of highlights, key findings and recommendations set out in FPI's report. Subsequent notes will address potential next steps, including internal and external communication.

HIGHLIGHTS, KEY FINDINGS AND RECOMMENDATIONS:

General/Background

- Glyphosate-based herbicides are the most widely used in the world due to their cost, effectiveness, and safety.
- The effects of glyphosate on human health have been extensively reviewed by international regulatory agencies, including Health Canada, with the conclusion generally being that exposure to glyphosate does not pose a carcinogenic or genotoxic risk to humans.
- Several factors can be considered to inform the use of glyphosate in forestry applications in BC, including:
 - Effective and targeted vegetation control to achieve plantation survival and achievement of the free growing objective (i.e., sustainable timber supply);

¹ Subsequently increased to \$82,500.

- Cost-effectiveness relative to alternative treatment options;
- Ability to control resprouting of perennial competitive vegetation;
- Persistence in the natural environment through time (NB. biodegradation profile appears to vary in different ecosystem types);
- Toxicity to non-target flora and fauna in surrounding environment; and
- Potential trade-offs across non-timber objectives.

Regulation and Use

- Health Canada's Pest Management Regulatory Agency (PMRA) is responsible for regulating pesticide use in Canada. The PMRA re-approved glyphosate for use in Canada in 2017. After objections were raised regarding the re-approval, the PMRA issued a supplementary statement in which it concluded that the objections could not be scientifically supported.
- The BC Ministry of Environment and Climate Change (ENV) regulates the sale and use of pesticides in BC under the *Integrated Pest Management Act*. Large scale use of pesticides requires the proponent to prepare and adhere to a Pest Management Plan.
- Notwithstanding its effectiveness as a silvicultural tool, glyphosate is also used to help manage invasive species. Of the 1,593 hectares treated with herbicides for control of invasive species under the BC provincial jurisdictions of highways, forests, and parks agencies in 2018, 8 percent of the area was treated using glyphosate.
- Data from this ministry's RESULTS application program shows that:
 - Roughly 11,000 hectares of Crown land was treated with glyphosate in 2018 with 86 percent sprayed aerially and 14 percent sprayed via ground-based methods;
 - Most of the spraying of glyphosate occurred in the Omineca Natural Resource Region (73 percent) followed by the Northeast Region (11 percent); and
 - Smaller amounts of glyphosate use also occurred in the Thompson-Okanagan and South Coast Regions.
 - The reasons for the high use of aerial application in the Omineca Region were not explicitly reviewed.
- The area sprayed has declined from an average of 13,802 hectares for the last five years and higher historical levels. The area sprayed in 2018 was 0.044 percent of the 25 million hectares available for harvesting in BC, and 0.44 percent of the tenured area on Crown land that has an outstanding reforestation obligation.
- The proportion of area harvested that has had any kind of vegetation control treatment has decreased from 18 percent to 14 percent over the last 10 years.
- In contrast to agriculture and other common land uses where areas are sprayed repeatedly, glyphosate in forestry is typically applied once or occasionally twice in a rotation.
- Glyphosate treatments may target a wide variety of vegetation complexes ranging from grasses and herbaceous vegetation to shrubs and broadleaf species, but are most commonly used in the Sub-Boreal Spruce biogeoclimatic zone targeting trembling aspen, mixed shrub, fireweed, and wet alder.

Treatment Costs

- Glyphosate treatment costs vary widely but are typically at least half that of manual methods (e.g., \$300-\$500/hectare vs. \$700-\$1,200/hectare). The differential cost of using manual methods vs. glyphosate for silviculture is currently estimated to \$15 million/year based upon 11,000 hectares treated provincially exclusive of timber productivity losses.

Biodiversity

- One of the primary public concerns regarding the use of glyphosate in forestry is the perception that by using it to control competition of broadleaf species such as trembling aspen, broadleaves are being eliminated from the landscape. These claims are not supported when analysing the level of deciduous components at free-growing, or the increase in mixed deciduous stands over time as a result of forest management.
- A 2008 review of species diversity pre- and post-harvest in BC found that the amount of deciduous mixed stands at free growing increased from 2,811 hectares before harvest to 55,614 hectares in the Northern Interior Forest Region for all reporting periods. Similarly, in the Southern Interior Forest Region, deciduous mixed stands increased from 1,202 hectares before harvest to 37,268 hectares at free growing, a 3,000 percent increase. Analysis further suggests that aspen stocking recovers after glyphosate spraying and may in fact be increasing over time with forest management activities.
- Studies found that species richness and diversity of non-target vascular plants was not negatively affected when measured 5-12 years after glyphosate application. Studies also found that while glyphosate reduced cover of herbaceous vegetation right after application, abundance and diversity recovered to pre-treatment levels as soon as one to two years after treatment. In many cases, herbaceous vegetation abundance, diversity, and richness increased as a result of decreased dominance of the shrub and deciduous layer and recovery from the forest floor seed bank. Further, while glyphosate tends to result in a larger initial reduction of a wider range of species, brushing alternatives such as manual brushing has similar effects on plant communities, albeit at a higher treatment cost.
- Plants that survive glyphosate treatment may show altered phenotypes and metabolic actions due to the phytotoxicity of glyphosate and its breakdown product, aminomethylphosphonic acid (AMPA). New research findings suggest that these effects may persist for long periods, as glyphosate has been found to persist in low levels in some surviving perennial forest plants for at least one year. Glyphosate/AMPA residues were found primarily in root systems, as plants isolated glyphosate to resist mortality; however, some translocation into shoots and fruit was observed in select plants.

Aquatic Organisms

- Amphibian populations are declining around the world and chemical contaminants released to aquatic environments have been listed as a threat. Studies have shown direct effects of chronic glyphosate exposures on fish, amphibians, invertebrates, and other components of the ecosystem. However, field studies have not been able to replicate these toxicity effects under typical glyphosate application rates and conditions. Further, numerous whole ecosystem field experiments in Canada have shown no direct effects on larval amphibian survival, growth, or development, the expression of genes related to larval development, or juvenile amphibian survival. This is likely due to the short exposure duration and rapid sorption of the herbicide to sediment and other organic surfaces within the wetlands.
- A field study in coastal BC found temporary stress effects and minor mortality in caged Coho salmon smolt post glyphosate application. However, no acute mortality, changes in over-winter mortality, growth rate or change in use of the tributary were observed for resident Coho.

Similarly, no effects on growth, behaviour, or histopathology of gill and liver of resident rainbow trout were found after a two-month exposure of herbicide in a separate tank experiment. While these studies investigated the effects of glyphosate application directly over aquatic ecosystems, integrated pest management regulations in BC mandate the use of no-treatment pesticide-free zones around water features, dry streams, and classified wetlands, further reducing the risk of negative effects on aquatic ecosystems.

Wildlife

- Several studies on the direct acute toxicity effects of glyphosate on small mammals, large mammals and birds have found risk quotients below the level of concern with typical field application rates. However, some uncertainty remains regarding the effects of long-term chronic exposure of low levels of glyphosate to wildlife through glyphosate persistence in forage.
- Moose populations have been declining in several regions of BC, and forage availability and quality has been flagged as a potential contributing cause to this decline.
- Glyphosate treatment has been found to reduce wildlife forage availability in the short term, reducing moose use of glyphosate-treated area for the first few years after treatment. However, the long-term impact of glyphosate use on habitat selection by moose is not well understood. Further, some studies even show that by 7 to 11 years post treatment, moose seem to favour treated areas over controls, although these impacts must also be considered in relation to the area treated annually and its distribution over the landscape. The effects of glyphosate's chelating² properties on forage quality and nutrient availability are also poorly understood.

Soil and Water Quality

- Glyphosate is largely immobilized in the soil and then dissipates via microbial degradation. One of the compounds released during the microbial breakdown process – AMPA – is adsorbed to soils and biodegraded. However, AMPA is considered to be a mild phytotoxin with relatively unknown long-term consequences on soil organisms and plants.
- The mandated use of no-treatment pesticide-free zones around water features, the strong sorption to upper soil layers, and the rapid uptake by plants minimize the risk of glyphosate entering aquatic ecosystems. Field studies have consistently shown low probability and magnitude of inputs into aquatic ecosystems when buffers and typical mitigation actions are undertaken.

Climate Change

- Vegetation management can affect carbon sequestration due to its impact on structure and stand productivity. When used to control herbaceous or shrub vegetation for example, it allows the establishment of a woody crop, delivering immediate carbon sequestration benefits in the woody biomass and coarse woody debris pools. When competing species are aspen or other deciduous species however, more carbon may be fixed by the stand if a deciduous component is left on site, although this effect varies with site and species.

² Chelation is a type of bonding of ions and molecules to metal ions. It involves the formation or presence of two or more separate coordinate bonds between a polydentate ligand and a single central atom. These ligands are called chelants, chelators, chelating agents, or sequestering agents.

Wildfire

- Fires in deciduous stands are usually slower moving surface fires which are easier to suppress than crown fires.
- The Canadian Forest Fire Behaviour Prediction system indicates that deciduous stands exhibit the least aggressive fire behaviour, followed by leafless deciduous or leaf-on mixed wood stands.
- Amongst deciduous trees, poplars show the most fire resistance. In one study, researchers estimate broadleaf forests to remain next to inflammable even as drought conditions worsen, in stark contrast to coniferous forests.
- The effect of fire behaviour from deciduous vegetation treated with glyphosate is not well documented. It is expected that the fire hazard in treated dead stems following treatment either manually or chemically would be very high.

First Nations

- Some FNs across BC have expressed concern over the use of glyphosate in forests related to plants that are traditionally gathered for food or medicinal purposes, and which are killed directly by glyphosate or are considered contaminated.

Public Use

- Forest managers are faced with mounting public pressure over the safety of glyphosate use.
- Some recreational forest users are concerned about the application of glyphosate in the forest and its impacts to human health from being exposed to herbicides while hunting, fishing, berry picking, mushroom picking, firewood cutting, camping or hiking. The PMRA's review on glyphosate has addressed many of these concerns and concluded that when used according to the label, glyphosate poses no risk to human health.
- There is currently no evidence that suggests that glyphosate application can cause game meat contamination, as glyphosate has not been shown to accumulate in animal tissues.
- Recent research on glyphosate persistence in some edible and medicinal plants and berries did find low yet unexpected levels of glyphosate, primarily localized in roots but sometimes found in shoot and fruit tissue.
- Better communication of the relevant science, including the persistence of low levels of glyphosate in some perennial forest plants, between forest managers and recreational users, can help address key public concerns.

Timber Supply

- Vegetation control in some cases is necessary to suppress competing vegetation and allow crop trees to become established and grow unimpeded. This unimpeded growth of conifers maximizes timber supply in the long term, and the economic benefit derived from forests.
- Glyphosate is cost-effective vs. manual vegetation control methods.
- Relying on manual methods only for vegetation management would greatly increase reforestation costs and may result in an increase in non-satisfactorily restocked area with

direct consequences on timber supply. This is compounded by the fact that some of the most productive growing sites are the most challenging to reforest due to brush competition.

Conclusions

- Glyphosate is one of a number of vegetation management tools available to forest managers and is the most cost-effective way to manage competing vegetation to promote plantation survival, meet free growing obligations to ensure stand productivity and a sustainable timber supply into the future.
- A review of current inventory data shows that stands that have been treated with glyphosate retain 15-21 percent deciduous components at free growing, and that the area comprised of deciduous-mixed stands has been increasing over time as a result of forest management activities in general.
- Field studies have shown that the risk of glyphosate and its metabolites on the environment is minimal when applied according to the label. Studies suggest that species richness and diversity of plant communities, small and large mammals (with the exception of moose), songbirds, and invertebrates remain within the range of natural variation and that changes to communities tend to be transient.
- Some knowledge gaps were identified in the literature, specifically pertaining to poorly understood effects on soil microorganisms, glyphosate's chelating effects on soil and plant nutrients, and glyphosate persistence in plants that survive treatment. More research is still needed to understand some of the more nuanced impacts glyphosate may have at the site level. Forest managers must recognize and manage for these uncertainties. Better communication of current practices, research findings, and known sources of uncertainty regarding the use of glyphosate in forests is also needed.
- While more research is recommended on the identified knowledge gaps, the use of glyphosate needs to be further considered within the context of the amount of area treated, the short time scale of site-level effects, and the mosaic of treated and non-treated areas that exist at the stand- and landscape-levels. Many of the public's concerns and challenges faced by our forests today, such as increasing wildfire risk and declining moose populations, can be better served by better linkages between site and landscape level planning that allow other non-timber values to be prioritized where needed.

Recommendations

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Attachments: Review of Glyphosate Use in BC Forestry (FPI, Dec. 11, 2019).

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| Program Dir/Mgr. | SH | December 12, 2019 |

From: [FLNR eApprovals](#)
To: [Silverio, Lisa FLNR:EX](#); [Purdy, Sandra FLNR:EX](#); [Jones, Tristan FLNR:EX](#)
Subject: NOTIFICATION - eApprovals Item ID: 4173 - Item Forwarded - - Due 12/24/2019
Date: Monday, December 23, 2019 10:02:05 AM

Purdy, Sandra FLNR:EX [Assignee] forwarded an eApprovals item to Donaldson, Doug for action

Comment: Glyphosate Review Report and Info Note for your review.

#: 252744

Title: 252744 BNI MIN FPInnovations Glyphosate Review Report XREF 252256

Full Name:

Due Date: 12/24/2019

Category: Briefing Note - Information Note

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