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Invasive Plants in Corner Brook: Overview of Impacts, Control, and Management

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Partner Organization	City of Corner Brook https://www.cornerbrook.com/
Summary	Invasive plant species grow rapidly and tend to crowd out native species. These traits can harm biodiversity, terrain stability, sightlines, cultural values, and greenspace management. What are the most problematic invasive plant species in Corner Brook? What cost-effective options exist for managing them (especially Japanese Knotweed)? To address such questions, this report draws on a literature review and expert interviews, finding that there are many unknowns about the spread and potential harms of knotweed in Corner Brook. Still, short-term effects on road encroachment and possible long-term effects on biodiversity are concerning. Several management options are available, but each has its drawbacks. The conclusion categorizes current challenges along with a list of possible first-step solutions for how Corner Brook could address them (i.e., giving invasive species more consideration in City policy and planning; educating the public).

Note about EPILab

The Environmental Policy Innovation Lab (EPILab) is an initiative of the Environmental Policy Institute (EPI) at the Memorial University of Newfoundland's Grenfell Campus in Corner Brook, Newfoundland and Labrador, Canada. The lab is a space for innovation and collaboration around environmental policy thinking and research, which draws on the expertise of faculty members, postdoctoral researchers, and graduate students to address various research needs for mutual gain across EPI and its external partners.

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1. INTRODUCTION

In this report, we address the impact of invasive plants, a topic of interest to the City of Corner Brook. The City, which is located in the Canadian province of Newfoundland and Labrador (NL), seeks to expand its understanding of invasive plants. Areas of interest include presence and impacts within City boundaries as well as management, control, and removal options. There is a specific concern about an invasive plant called Japanese Knotweed (*Fallopia japonica*, or simply "knotweed" for this report – see Figure 1) found in numerous locations in and around Corner Brook. Knotweed's range is rapidly expanding, and the City is concerned about potential impacts on road visibility, trails, and erosion.

Figure 1. Photograph of Japanese Knotweed
(Source: Anneli Sato, Unedited, Creative Commons Attribution Share-Alike 3.0 License)

2. BACKGROUND ON INVASIVE PLANTS

According to the Government of Canada website on its Invasive Alien Species Strategy[1] : "Species that have become established in areas outside their natural range are defined as alien species. Generally, alien species do not pose a significant risk and many are even beneficial. However, some alien species spread rapidly, thus crowding out native organisms and causing significant harm to the environment, the economy and to society. Those are referred to as 'invasive alien species'".

Invasive species are plants and animals that spread from their native range into new habitats through human activities such as international trade (Westphal et al., 2008), tourism, and travel. Plant seeds and plant fragments can travel long distances on people's clothes, in the fur of domestic and wild animals, on ships and shipping containers, and in materials used for construction such as soil, gravel, sediment, and ship ballast (see the Government of Canada website[1] mentioned above). The agricultural and horticultural industries have also intentionally introduced alien plants. Invasive species often have a competitive advantage over native plants in the short term, in that they tend to adapt better to ecosystem disturbance from construction and development—and in the long term, in that they tend to adapt better to global environmental change and climate change (Groeneveld et al., 2014; Vardarman et al., 2018).

The Government of Canada website[1] goes on to state that invasive species are the second-leading cause of biodiversity loss worldwide, after habitat destruction.

According to the Canadian Council on Invasive Species[2], animal and plant invasive species create high costs for governments and businesses. Impacts include displacing native ecosystems, destroying habitats, spreading disease to non-invasive organisms, and harming economically important native species.

The Council, furthermore, says that estimated negative impacts of invasive species in Canada alone amount to tens of billions of dollars annually. For example, estimates of revenue lost yearly in the Canadian forestry and agriculture industries total about $7.5 billion. Rural and remote regions are particularly vulnerable to the spread of invasive species as they depend more on local natural resources.

3. RESEARCH METHODS AND QUESTIONS

The rest of this report conveys more specific information collected through two methods: a general literature review and informational interviews with local botanists, horticulturalists, and biologists. We invited five professionals to participate in semi-structured informational interviews, but ultimately only three interviews took place, lasting for about an hour each. These interviews were fact-finding endeavors focused on the professional knowledge of the interviewees and not their personal opinions. We cross-checked findings from the interviews with information available in the relevant literature.

[1] https://www.canada.ca/en/environment-climate-change/services/biodiversity/invasive-alien-species-strategy.html
[2] https://canadainvasives.ca/invasive-species/

The following research questions guided the methods:

- What kind of invasive plant species are present in Corner Brook?
- What problems and impacts are caused by these invasive species, especially knotweed?
- How can knotweed be managed, controlled, and eradicated?

4. STATUS AND IMPACTS OF INVASIVE PLANTS IN CORNER BROOK

One interviewee stated that cities are hotspots for invasive species; peer-reviewed literature also reflects this observation (i.e., Gaertner et al., 2017; Soltysiak & Brej, 2014). In cities, native ecosystems have been destroyed and displaced through the construction of roads and buildings. Construction sites and other disturbed sites, which lack the usual competition from native species, provide ideal conditions for invasive species to grow and spread (Cadotte et al., 2017).

Municipalities on the West Coast of Newfoundland, including Corner Brook, are home to a wide range of invasive plant species, including: Japanese Knotweed (*Fallopia japonica*), Norway Maple (*Acer platanoides*), Goutweed (*Aegopodium podagraria*), Phragmites (*Phragmites australis*), Purple Loosestrife (*Lythrum salicaria*), Mile-a-Minute (*Persicaria perfoliata*), Willow (*Salix*), Wild Parsnip (*Pastinaca sativa*), and others—according to the interviewees.

There was consensus among the interviewees that Newfoundland's harsh winters limit the spread of many invasive species. Two interviewees claimed that climate change might accelerate the spread of invasive plants in NL in the future. The peer-reviewed literature (i.e. Liu et al., 2017; Smith et al., 2012) has examined this potential effect of climate change and confirmed it for some invasive plants, such as Japanese Knotweed (Groeneveld et al., 2014).

While all invasive species impact biodiversity (see the background section above), interviewees stated that the measured impact is unclear for Newfoundland. Most of the island is not populated, and there is a great diversity of native plants that may outweigh the biodiversity impact of invasive species.

According to the interviewees, the most effective approach to limiting the damage caused by invasive species is preventing the initial introduction of new invasive organisms. Such prevention could come from citizen education initiatives and other policies that limit the introduction of new species—for example, through inspections at entry points and coordination across jurisdictions. Of course, many invasive plants are already present in Newfoundland.

4.1 Origin of Japanese Knotweed

The International Union for the Conservation of Nature[3] lists Japanese Knotweed as one of the top 100 worst invasive species. The plant was imported into the Americas in the 1800s as a horticultural novelty. Knotweed is exceptionally hardy, thriving in a wide range of soils (Anderson, 2012; Soltysiak & Brej, 2014) and climates (Anderson, 2012). It is an aggressive invader and rapidly outcompetes other plants (Anderson, 2012;

[3] http://www.iucngisd.org/gisd/species.php?sc=91

Soltysiak & Brej, 2014). Where knotweed has become dominant, it significantly reduces native plant and animal biodiversity (Maerz et al., 2005; Wilson et al., 2017) and causes extinctions of local species (Lavoie, 2017).

4.2 How Japanese Knotweed Spreads

Japanese Knotweed spreads by seed and, more commonly, clonal activity (Bailey et al., 2009; Gillies et al., 2016). Clonal activity means the plant's ability to generate entirely new plants from rhizomes (i.e., underground stems) and plant fragments. The clones are genetically identical to the parent plant (Bailey et al., 2009).

The competitive advantage of knotweed may come from several mechanisms. Possibilities include: allelopathy, which is the release of compounds into the soil that make it difficult for competing plants to grow (Dommanget et al., 2014; Murrell et al., 2011); a significant reduction in light penetrating to plants growing below the stems and leaves of knotweed (Siemens & Blossey, 2007); and changes in the nutrient cycle that limit nutrients available to competing plants (Parepa et al., 2019).

Japanese Knotweed prefers river-adjacent habitats, which are often disturbed by floods (Colleran & Goodall, 2014; Lavoie, 2017). Flood waters carry knotweed plant fragments to non-invaded areas, further expanding spread (Colleran & Goodall, 2014; Gillies et al., 2016). The species has a high salt tolerance, which enables it to invade ocean-adjacent habitats as well, such as salt marshes and coastal areas (Richards et al., 2008). Knotweed readily invades inland areas, including roadsides, railway tracks, waste dumps, and residential gardens (Soltysiak & Brej, 2014). The British Isles are an impressive example of knotweed expansion; Figure 2 demonstrates the extent of spread in Great Britain and is based on verified reports.

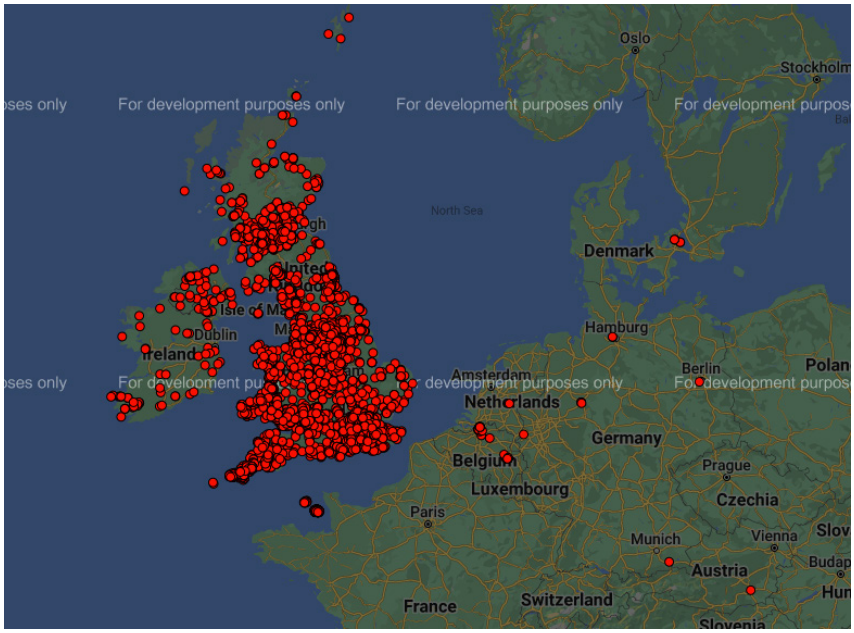

Figure 2. The Extent of Japanese Knotweed Spread in Great Britain (Source: https://www.planttracker.org.uk/map/knotweed)

4.3 Erosion

Lavoie (2017) argues that many government and other documents repeat assumptions about knotweed's plausible impacts. Such alleged impacts include increased erosion of streambanks, increased risks of flooding, and destruction of flood defense infrastructure. However, these impacts have not undergone rigorous study and documentation, and Lavoie (2017) recommends more research into the effect of knotweed on river habitats.

We asked interviewees about the impacts of knotweed, specifically whether they believed that the species causes soil erosion (i.e., its root network is shallow compared to other plant species, such as trees). However, they were doubtful that knotweed causes erosion. The roots of the plant, the interviewees suggested, are more likely to slow erosion. The literature review for this report identified studies, however, which confirm increased erosion due to the expansion of knotweed in river habitats (i.e., Arnold & Toran, 2018; Secor et al., 2013). Currently, the impacts of knotweed on erosion are unclear.

4.4 Damage to Buildings

There is anecdotal evidence that Japanese Knotweed causes structural damage; still, studies have so far failed to confirm damage to buildings or roads any greater than the structural damage caused by plants in general (Fennell et al., 2018). Japanese Knotweed may, on average, cause less damage than other woody plants (Fennell et al., 2018). However, knotweed can exacerbate minor structural damage when its roots grow into pre-existing cracks and fissures of walls and roads (Fennell et al., 2018).

4.5 Reductions in Native Biodiversity

Japanese Knotweed may significantly reduce native species diversity in river habitats (Seeney et al., 2019). There are impacts on tree growth and regeneration, mainly due to reduced light available to native plants and tree saplings (Aguilera et al., 2010; Urgenson et al., 2009). The displacement of native plant species in river habitats can have many consequences for rivers and streams, including an increase in streambank erosion, changes in nutrient cycling, and reduced availability of large woody debris (Aguilera et al., 2010; Urgenson et al., 2009). Large woody debris is essential for stream shape and flow, sediment transport in streams, and creating habitat for many aquatic organisms (Urgenson et al., 2009). Any jurisdiction that draws ecological benefits from rivers, streams, and wetlands should take note of knotweed's significant impacts on stream and wetland ecology.

4.6 Encroachment

The City of Corner Brook has identified encroachment on roads and trails as one of the most severe short-term impacts of Japanese Knotweed. Due to its tall stalks, broad leaves, and rapid spread, knotweed can grow right next to roads and trails, becoming obstructive even several meters from the ground. Trails may become reduced in width and generally obstructed for hikers. More importantly, encroachment can lead to a serious safety concern for road visibility. Nonetheless, neither the interviewees nor the academic literature explicitly identified the impact of encroachment.

Table 1 summarizes the impacts estimated by interviewees and the relevant literature. There does not appear to be much conclusive evidence for local erosion and building impacts. The reduction in native species and effects on freshwater systems may not be of concern to Corner Brook specifically. However, the extensive spread of knotweed in Great Britain suggests that the province as a whole should at least be cautious of the potential problem. Encroachment is certainly a challenge, but it has not been studied broadly.

Table 1. Impacts of Japanese Knotweed as Estimated by Interviewees and Literature

	Academic Literature	**Interviewees**
Erosion	documented in river habitats due to shallow root system	no
Damage to Buildings	not more than other species	not mentioned
Biodiversity	severe biodiversity impacts, including local extinction of native plant species, impacts on tree regeneration, and complete alteration of native ecosystems	has not been studied in NL
Encroachment	not mentioned	not mentioned

5. CONTROL AND MANAGEMENT OPTIONS FOR JAPANESE KNOTWEED

There was consensus across the interviewees and literature that the spread of knotweed is difficult to control and extremely challenging to eradicate once it becomes established on the landscape level. On the level of residential gardens, however, several strategies can effectively manage knotweed, including both mechanical and chemical approaches.

Control, management, and removal can involve chemical methods, mechanical methods, or a combination. In general, any efforts at removing an invasion must be pursued for several years (Seiger & Merchant, 1997), as many as five consecutive years to be successful (Middleton, 2014). Chemical approaches and mowing should be applied several times over a single year and followed up in consecutive years to show results (Seiger & Merchant, 1997).

5.1 Chemical Approaches

There is a range of chemical approaches available. Leaf spraying is possible, but stem injection of glyphosate (a common but controversial herbicide used by farmers) is considered the most effective (Delbart et al., 2012; Jones & Eastwood, 2019). The injection must reach the entire plant, particularly its underground rhizome, to be effective. Late summer injections have the greatest impact (Delbart et al., 2012). Single-year injections with glyphosate have shown limited success; injections have to be repeated for several years to increase the likelihood of removing stands entirely (Delbart et al., 2012).

However, glyphosate impacts many non-target organisms, including earthworms, fish, and crustaceans (Deepananda et al., 2011). In Belgium, for example, glyphosate application is prohibited near rivers (Delbart et al., 2012). Glyphosate is considered a probable carcinogen by the World Health Organization. This categorization has led to much controversy across the agricultural industry and environmental advocates, although more research is still needed (Kogevinas, 2019). Finally, several invasive plant species have developed resistance to glyphosate, becoming “superweeds” (Myint et al., 2012). Despite these concerns, the literature implies that chemical approaches are likely the most commonly used.

5.2 Mechanical Approaches

Mechanical methods are challenging because even small pieces of the rhizome and the stem have a high probability of sprouting again (Kidd, 2000). Any digging of roots or cutting of the above-ground parts therefore requires diligent collection and appropriate disposal of the resulting plant fragments. According to one interviewee, shredding the plant, followed by industrial-style composting under high temperatures, is required to destroy knotweed’s reproductive potential.

Some studies show that mowing can weaken knotweed rhizomes and slow expansion (Lavallée et al., 2019; Seiger & Merchant, 1997). Mowing should occur at least three times per year to have any effect, and six times a year to impact the below-ground parts of the plant (Lavallée et al., 2019). Mowing does not eliminate the plant entirely, and many years of treatment may be required (Lavallée et al., 2019). Cuttings must be disposed of properly

to prevent leftover stems and roots from forming new plants; any mower that disperses plant fragments is not suitable for this task. If done carelessly, mowing can enhance the spread of knotweed.

There is anecdotal evidence of using of goats and sheep to reduce the spread of knotweed. Goats and sheep consume the leaves and stems of the plant (Boehmer et al., 2006). There are few rigorous studies on the effectiveness of this control method, but it may be the most cost-efficient (Boehmer et al., 2006). As with other mechanical removal approaches, there is the possibility of unintentionally spreading the plant further. Another concern is that, in polluted sites, knotweed can absorb heavy metals at high rates (Soltysiak et al., 2011), which may poison the milk and meat of animals.

5.3 Follow-Up with Native Species Planting

Several studies show that replanting previously invaded areas with native species slows the re-entry and spread of knotweed (Dommanget et al., 2014; Skinner et al., 2012). Findings suggest that an approach drawing on mechanical control, chemical control, or a combination, followed by replanting native species, may be most effective (Koce, 2016; Skinner et al., 2012). Replanting native species has additional benefits, such as support for native birds and other animals, long-term protection for wetlands and rivers, and restoring the native ecosystem.

Unfortunately, the academic literature does not include many quantitative measures for the various approaches, because knotweed and its management are under-researched. At this point, grey literature may instead have more detail on removal methods and costs, although not verified by scholarly peer review. For example, a United Kingdom company, Knotweed Help[4], has a guide on removing Japanese Knotweed[5]. The guide includes information on several removal methods, identifies debunked methods, and estimates the cost of complete removal (chemical) from a typical residential property at about $4 681 CAD[6], with larger-scale removals (mechanical) starting at $10 923 CAD[7].

A straightforward comparison of the options may be difficult at this point, and any courses of action will likely require the support of more targeted research and perhaps formal cost-benefit analyses. Still, chemical approaches are probably the most common, and some limited anecdotal evidence suggests that goats and sheep may be the most cost-efficient. Table 2 provides a summary of possible control measures.

[4] https://www.knotweedhelp.com/
[5] https://www.knotweedhelp.com/japanese-knotweed-guide/getting-rid-of-knotweed/
[6] converted from 3 000 GBP (1 GBP = 1.56047 CAD; calculated on Jul 31 2022 through global currency converter xe.com)
[7] converted from 7 000 GBP (1 EUR = 1.56047 CAD; calculated on Jul 31 2022 through global currency converter xe.com)

Table 2. Control and Removal Options for Japanese Knotweed

	Type of Control	# of Applications	Drawbacks
Glyphosate	chemical	once in the summer and once in the fall	glyphosate kills aquatic organisms and has other potential risks
Mowing	mechanical	at least six cuts per year	does not eradicate the plant; meticulous capture and clean-up of plant fragments is required; risk of spreading knotweed further
Goats and Sheep	mechanical	several times per year	knotweed takes up heavy metals and thus may poison milk and meat
Plant Native Species	post-removal	repeated plantings depending on the species	N/A

6. CHALLENGES FOR CONTROL AND MANAGEMENT (PLUS POTENTIAL SOLUTIONS)

This section revisits the above challenges in detail, suggesting several potential solutions. We identify some promising approaches for starting to address the broader problem (i.e., cross-cutting solutions with a high estimated benefit and low estimated cost). There are two caveats to note. First, this list contains preliminary ideas that have not undergone any formal evaluation or planning process—those are perhaps matters for the City or future EPILab reports. In particular, we have not yet consulted the other organizations mentioned in some of the suggestions.

Second, our goal is to serve as an "honest broker" of possible policy approaches (Pielke Jr., 2007). We do not recommend or expect any particular course of action, but rather attempt to communicate the advantages and disadvantages of various options so that the partner organization is best equipped to make decisions on knotweed (and perhaps other invasive plant species).

6.1 Mapping and Impacts

According to interviewees, there are few maps of invasive species in Newfoundland and Labrador. Without mapping, it is difficult to understand the extent of the spread of Japanese Knotweed and

other invasive plant species within City boundaries, and their potential impact on local ecosystems and the built environment. Possible solutions to this problem include the following:

- The City could work with Grenfell Campus and the Western Environment Centre on mapping priority invasive plant species like Japanese Knotweed. Undergraduate and graduate students could be engaged in this activity for field credit or as graduate assistantships under the supervision of experienced botanists.

- A "citizen science" initiative could be established to encourage everyday citizens to submit sightings and geo-tagged photos of knotweed to a central database. The Canadian Forest Service could be an appropriate partner for such an initiative.

    - This would be similar to the PlantTracker map (see Figure 2 above).

- Mapping could support impact assessment and risk assessment.

- Publishable journal articles could result from this analysis. Because knotweed has been insufficiently studied (Lavoie, 2017), there is a need for articles on mapping, impact, and risk assessment, especially in Newfoundland. This potential output could help attract academic researchers to the partnership.

6.2 Cost and Time Investment

Removal and control of invasive plant species is costly and time-consuming.

- The City could partner with Grenfell Campus to arrange for graduate students to research available funding opportunities for invasive species removal. Government and private charitable foundations may offer support.

- The City could reach out to the Western Environment Centre to explore the possibility of engaging volunteers in invasive species removal as an outdoor social activity for residents, which could also involve teaching moments about native plants (and animals). Conservation biologists or botanists could train or supervise groups of volunteers to recognize and remove invasive species.

- Removal and control of invasive species in only the most problematic areas (e.g., where road visibility is affected) would be far more feasible than any attempts to manage them on a landscape level.

- The City could make a guide available to residents on the best low-tech ways to manage and eradicate Japanese Knotweed in their yards and neighborhoods, being careful to emphasize the counterproductive effects of careless management.

6.3 Valuing Ecosystems Services

The perception of invasive species by residents in Corner Brook is not yet well known. Do citizens know about the extent of the presence of invasive species in the City? Do they understand the potential impact of these species on native ecosystems? Would knowledge of the impacts of invasive plant species change the perception of these species among residents? Would enhanced knowledge support public action for removal and prevention?

- The City, perhaps in conjunction with the Western Environment Centre or EPILab, could conduct opinion assessment surveys, focus groups, or interviews with residents to improve understanding of residents' perception of invasive species. This work could also involve students and possibly lead to publishable articles (the potential for which, as above, may help attract academic researchers to the team).

6.4 Policy and Planning

The City could decide on a stance or perspective on invasive species (e.g., take no action, conduct additional research, or begin to pursue control and removal actions) and articulate it through available channels and citizen engagement opportunities.

- The City could include such an approach to invasive plant species in its short and long-term planning activities and documents.

- Planning documents could include thresholds. For example, if the initial response is to take no action, is there a threshold that would cause the City to act, such as the spread of knotweed into a particular wetland or stream or a certain extent of spread?

6.5 Prevention

Two interviewees stressed prevention as an optimal approach to addressing invasive species because, once established, they are generally difficult to eradicate. The interviewees pointed out that some invasive species are still being sold in the horticultural trade and planted in residential gardens, contributing to their spread.

- The City could reach out to the Western Environment Centre or EPILab to develop citizen education strategies. For example, seminars and workshops, fliers, and YouTube videos could provide information about the range of invasive species in Corner Brook, their impact, and ways to prevent spread.

- The City could consider collaborating with other municipalities in Atlantic Canada on early detection and prevention of the spread of new invasive species.

- The government of Newfoundland and Labrador could develop a strategy for invasive species prevention, control, and management. The City could communicate this possibility to the provincial government.

7. CONCLUSION: PROMISING APPROACHES FOR THE CITY OF CORNER BROOK

Corner Brook, NL is home to many invasive plant species. Harsh winters contain the spread of these plants, but their impact on the island is poorly understood. The invasive plant species growing in NL include Japanese Knotweed, one of the most aggressive plant invaders known to humans. Both control and management of knotweed pose significant challenges for public and private landowners. Chemical and mechanical control and removal approaches are available; however, they are costly, take time, have unintentional drawbacks, and may not eradicate the plant.

Considering the above list of possible solutions to the various challenges of managing invasive species like Japanese Knotweed, a few cross-cutting approaches seem to emerge for the City of Corner Brook. These strategies might make the most logical starting points for addressing the problem.

First, acknowledging and considering invasive species in City planning documents, or passing a general City policy on invasive species, would ensure that the matter stays on the agenda and create more opportunities for all solutions.

Second, a citizen education initiative could be simultaneously simple and comprehensive, cutting across several identified challenges with invasive species management. For example, the City could distribute a brief pamphlet on various invasive species, including: basic information on invasive species in the area, information on how to participate in a citizen science mapping initiative for knotweed, guidance on proper management and control of knotweed in residential yards, appeal to plant native species in residential yards, and an invitation to submit perceptions and opinions about invasive species. Possible partners for developing the pamphlet, and the opportunities within, might include EPILab, the Western Environment Centre, and the Canadian Forest Service.

These two starting points could provide a solid foundation for further initiatives. Any larger-scale efforts to control or eliminate Japanese Knotweed would require more targeted research or formal cost-benefit analyses. The City could pursue these subsequent approaches by itself or perhaps in collaboration with EPILab through future reports. Of course, we only intend for these strategies to be possible options for consideration, rather than recommendations, because the City is best equipped to understand its own priorities and resources.

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