Japanese Knotweed

(Fallopia japonica)

Best Management Practices in Ontario

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Invasive Species Centre

Ontario Invasive Plant Council

Ontario

Foreword

These Best Management Practices (BMPs) provide guidance for managing invasive Japanese Knotweed (*Fallopia japonica*) in Ontario. Funding and leadership for the production of this document was provided by the Ontario Ministry of Natural Resources (OMNR). The BMPs were developed by the Ontario Invasive Plant Council (OIPC), and its partners to facilitate the invasive plant control initiatives of individuals and organizations concerned with the protection of biodiversity, agricultural lands, infrastructure, crops and natural lands.

These BMPs are based on the most effective and environmentally safe control practices known from research and experience. They reflect current provincial and federal legislation regarding pesticide usage, habitat disturbance and species at risk protection. These BMPs are subject to change as legislation is updated or new research findings emerge. They are not intended to provide legal advice, and interested parties are advised to refer to the applicable legislation to address specific circumstances. Check the website of the Ontario Invasive Plant Council (www.ontarioinvasiveplants.ca) for updates.

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For more information on invasive plants in Ontario, visit www.ontario.ca/invasivespecies, www.ontarioinvasiveplants.ca, www.invadingspecies.com or www.invasivespeciescentre.ca

Front and back cover photo courtesy of Francine MacDonald.

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Japanese Knotweed.
Photo courtesy of Francine MacDonald.

Japanese Knotweed is listed as one of the world's top 100 invasive species.
Photo courtesy of Wasyl Bakowsky.

Introduction

Japanese Knotweed (*Fallopia japonica*) is an invasive, perennial herbaceous plant that is also known as Mexican Bamboo, Fleeceflower, Japanese Polygonum or Huzhang. The scientific names of *Polygonum cuspidatum* or *Reynoutria japonica* are also used. For the purposes of this document, this plant will be referred to as Japanese Knotweed, with the scientific name of *Fallopia japonica.*

This document has been developed to help guide the effective and consistent management of this invasive plant across Ontario. These BMPs emphasize prioritizing control efforts in areas where small populations of Japanese Knotweed are present, but have not yet become dominant. Secondary priorities should focus on invasion edges.

Japanese Knotweed is native to eastern Asia (Japan, Korea, China and Taiwan), where it is relatively uncommon and one of the first species to grow after eruptions or disturbance on volcanic slopes. It was introduced to North America as a horticultural plant in the late 19th century and was widely planted as an ornamental, for the purposes of erosion control, and as forage for livestock. It has escaped cultivation to become an aggressive invader in North America as well as Europe, Australia, and New Zealand. The first record of Japanese Knotweed in Ontario is from 1901, in Niagara Falls and is now reported in many locations throughout southern Ontario, and as far north as Thunder Bay.

Regarded as one of the world's top 100 invasive species by the Global Invasive Species Database, Japanese Knotweed can harm biodiversity, the economy and society. It forms dense thickets of bamboo-like vegetation that aggressively outcompete native plants, and negatively impacts wetland and riparian (water's edge) areas. Its extensive rhizome (root) system can cause major problems for public and private infrastructure.

Japanese Knotweed grows in a wide range of habitats including riparian areas, wetlands, roadsides, ditches, utility right of ways and fence lines. It is often found around old homesteads where it may have been originally planted as an ornamental. It spreads primarily along riparian areas or ditches where plant and rhizome fragments can be dispersed in moving water (i.e. along canals, beaches, streams and rivers). It can also be spread by moving machinery or equipment with soil containing plant parts (rhizomes). Seeds (if produced) are spread mainly by wind. Japanese Knotweed is available as an ornamental plant in Ontario, and can be spread to new areas from gardens.

Japanese Knotweed spreads primarily along riparian areas where it can be dispersed by moving water.
Photo courtesy of Ken Towle.

Description and Life History

Japanese Knotweed is a woody stemmed herbaceous perennial rhizomatous plant, and is a member of the Buckwheat (*Polygonaceae*) family. The family name of Polygonaceae is derived from the Greek words, "Poly" meaning many, and "goni" meaning knee or joint. Japanese Knotweed is also commonly referred to by the scientific name of *Polygonum cuspidatum* in North America and has a variety of common names. However, *Fallopia japonica* is the accepted scientific name listed by VASCAN (Database of Vascular Plants of Canada). In this document, the genus *Fallopia* and the common name of Japanese Knotweed are used.

Identification

Stems:

Japanese Knotweed has hollow, smooth, purple to green coloured stems up to 2.5cm (1") in diameter. The hollow jointed stems have reddish-brown solid nodes surrounded by a papery sheath (stipule), a trait unique to members of the buckwheat (*Polygonaceae*) family. The stems die back each fall and the dead stalks remain standing over the winter. Numerous new stems emerge in the spring (usually late March – early April in southern Ontario) from the over-wintering root system. The juvenile stems resemble asparagus (*Asparagus officinalis*) spears and are purplish in colour, fading to green as they mature. Japanese Knotweed grows rapidly; stems can grow up to 8 cm (3") per day. The plant can grow 1 m (3.2 ft) in height in three weeks, with the mature plant reaching full height by the end of July. This plant grows in large bamboo-like clumps, reaching heights of 1-3 m (3-10 ft).

Hollow, jointed stems have reddish brown solid nodes and look similar to bamboo.

Photo courtesy of Rod Krick.

Juvenile stems resemble asparagus and are purplish in colour.

Photo courtesy of Doug Thain.

Stalks die back each fall and remain standing.

Photo courtesy of Doug Thain.

Leaves:

Alternate leaves are oval to triangular with a pointed tip and flat base with a long stalk (petiole) arising from the stem. They are 10-17 cm (4-7") and 7-10 cm (3-4") wide and alternate along the stem in a distinctive zigzag pattern.

Leaves have a flat base and pointed tip.

Photo courtesy of Hayley Anderson.

Rhizomes:

Japanese Knotweed quickly develops large underground root systems (rhizomes) which account for two thirds of its total mass. These rhizomes are dark brown, with a bright orange interior. The rhizomes can extend more than 2 m (6 ft) deep and 14-18 m (45-59 ft) in length, and can spread outwards at a rate of about 50 cm/year (19") in optimal conditions. Due to this extensive underground biomass, Japanese Knotweed is a very persistent plant. Pieces of the stem or rhizome as small as 1 cm can produce new plants within 6 days if they are submerged in water. Buried rhizomes can regenerate from depths of up to 1 m, with 2 cm being optimal for regeneration.

Pieces of the stem or rhizome can produce new plants, as seen in this photo of improperly disposed soil with Knotweed fragments.

Photo courtesy of BC Ministry of Forests, Lands and Natural Resource Operations.

Flowers/Fruit:

Small, white-green flowers bloom in sprays near the end of the stem and in the leaf axils in late July or August. The flowers are produced in branching panicles (clusters). The panicles are usually longer than the closest leaves (this helps to distinguish Japanese Knotweed from other closely related species). The seeds are winged, triangular, shiny and very small. Seed production is not well studied in North America, and it is not known how often viable seeds are produced. The fruit is winged, which assists them in wind or water dispersal.

Japanese Knotweed is a dioecious plant, meaning there are male and female plants which require pollination to produce viable seeds. Much of the Japanese Knotweed that is present in North America is presumed to be a male-sterile clone (does not produce pollen) which reproduces and spreads mostly through rhizomes. However, these plants can produce viable seed which can germinate if pollinated by related invasive plants, Bohemian Knotweed (*Fallopia x bohemica*) or Giant Knotweed (*Fallopia sachalinensis*) which are also present in Ontario.

There are several horticultural varieties (cultivars) of Japanese Knotweed, which may have different characteristics based on their breeding. These include: 'Crimson Beauty' which has dark red flowers, 'Variegata', which has variegated leaves (leaves are multi-coloured or are edged in white), and 'Compactum' or Dwarf Japanese Knotweed which has been bred to grow smaller (up to 1 m in height). These cultivars can also be invasive. If they are pollinated by Japanese, Bohemian or Giant Knotweed populations they can produce seeds and will also reproduce vegetatively.

Japanese Knotweed has small, white-green flowers that bloom in sprays.

Photo courtesy of Sam Brinker.

Fruit is winged, which helps in seed dispersal.

Photo courtesy of Jil Swearingen, USDI National Park Service, Bugwood.org.

Japanese Knotweed 'Variegata' is a horticultural cultivar.

Photo courtesy of Missouri Botanical Garden.

Japanese Knotweed – Look-alikes

Giant Knotweed (*Fallopia sachalinensis*):

Native to northern Japan, it has been found in southern Ontario, mostly in the southeast (i.e. Leeds County, Ottawa-Carleton) and in the Niagara Region. Giant Knotweed was also introduced as an ornamental species, and can also be invasive.

Giant Knotweed has also been introduced to Ontario.

Photo courtesy of Wasyl Bakowsky.

Bohemian Knotweed (*Fallopia x bohemica*):

Bohemian Knotweed is a hybrid species of Japanese and Giant Knotweed. It is possible that it exists in Ontario, since both parent plants are present here, although it has not been reported. This hybrid plant may be more invasive/ aggressive than its parent plants by taking on the superior aspects of both, and it may also be more difficult to control. It has been reported in British Columbia, Quebec, Newfoundland and New Brunswick.

Bohemian Knotweed is a hybrid of Japanese and Giant Knotweed, it is possibly present in Ontario.

Photo courtesy of Robert Vidéki, Doronicum Kft., Bugwood.org.

Himalayan Knotweed (*Persicaria wallichii*):

Native to the Himalayan mountain region in Southern Asia. There are no known populations in Ontario; however it has been reported in British Columbia, Nova Scotia and Newfoundland.

Himalayan Knotweed has no known populations in Ontario.

Photo courtesy of Joseph M. DiTomaso, University of California - Davis, Bugwood.org.

	Japanese Knotweed (*Fallopia japonica*)	Giant Knotweed (*Fallopia sachalinensis*)	Bohemian Knotweed (*Fallopia × bohemica*)	Himalayan Knotweed (*Persicaria wallichii*)
	 Photo courtesy of Rod Krick.	 Photo courtesy of Tom Heutte, USDA Forest Service, Bugwood.org.	 Photo courtesy of Robert Vidéki, Doronicum Kft., Bugwood.org.	 Photo courtesy of David Earl Worthington
Height	1-3 m	2-4 m	2-3 m	Up to 2 m
Stem	Smooth and hollow; new stems are red to purplish in colour, turning green with reddish or purple specks, and then turn brown/grey in the winter and remain standing when dead	Smooth, hollow and light green, remain standing when dead	Reddish brown, stout, hollow, remain standing when dead	Red stems and leaf stalks, stems are hollow, remain standing when dead
Leaves	**Alternate** • 10-17 cm long, 7-10 cm wide • Oval to heart shaped with a flat base	**Alternate** • 15-40 cm long, 10-28 cm wide • Heart-shaped or "elephant ear", Wavy margin • Long thin hairs on the underside of the leaf (diagnostic feature)	**Alternate** • Up to 25cm long, up to 20 cm wide • Spade to heart- shaped • Long tapered leaf tips • Short and broad hairs on the underside of the leaf (diagnostic feature)	**Alternate** • Up to 20 cm long, up to 10cm wide • Long, thin leaves, • Can be mistaken for Himalayan Balsam (*Impatiens glandifulera*) – the leaves are very similar but are not serrated like Himalayan Balsam

Japanese Knotweed and its look-alikes (continued)

	Japanese Knotweed (*Fallopia japonica*)	**Giant Knotweed** (*Fallopia sachalinensis*)	**Bohemian Knotweed** (*Fallopia × bohemica*)	**Himalayan Knotweed** (*Persicaria wallichii*)
	 Photo courtesy of Rod Krick.	 Photo courtesy of Tom Heutte, USDA Forest Service, Bugwood.org.	 Photo courtesy of Robert Vidéki, Doronicum Kft., Bugwood.org.	 Photo courtesy of David Earl Worthington
Flower	• Blooms from July- September • Flowers are greenish-white and produced in upright clusters along the stem • Flower clusters are longer than the closest leaves	• Blooms from July-September • Flowers are greenish-white, and in clusters which are closer to the stems than in Japanese Knotweed • Flower clusters are shorter than nearest leaves	• Blooms from July-September • Flowers are greenish-white, produced in clusters on mid-size stalks (longer than bohemian knotweed, shorter than Japanese knotweed) • Flower clusters are mid-size or approximately the same length as nearest leaves	• Blooms from July-September • Flowers are pink to white in colour, occur in clusters
Fruit	Winged, triangular, shiny, very small	Winged, shiny, small and black	Winged, shiny, small and black	Smooth, small, 3 sided

Japanese Knotweed can grow in disturbed areas.
Photo courtesy of BC Ministry of Forests, Lands and Natural Resource.

Japanese Knotweed can grow in a variety of site conditions, including full sun.
Photo courtesy of Doug Thain.

Roads are one of the main geographic pathways for spread within Ontario.
Photo courtesy of Brett Dixon.

Habitat

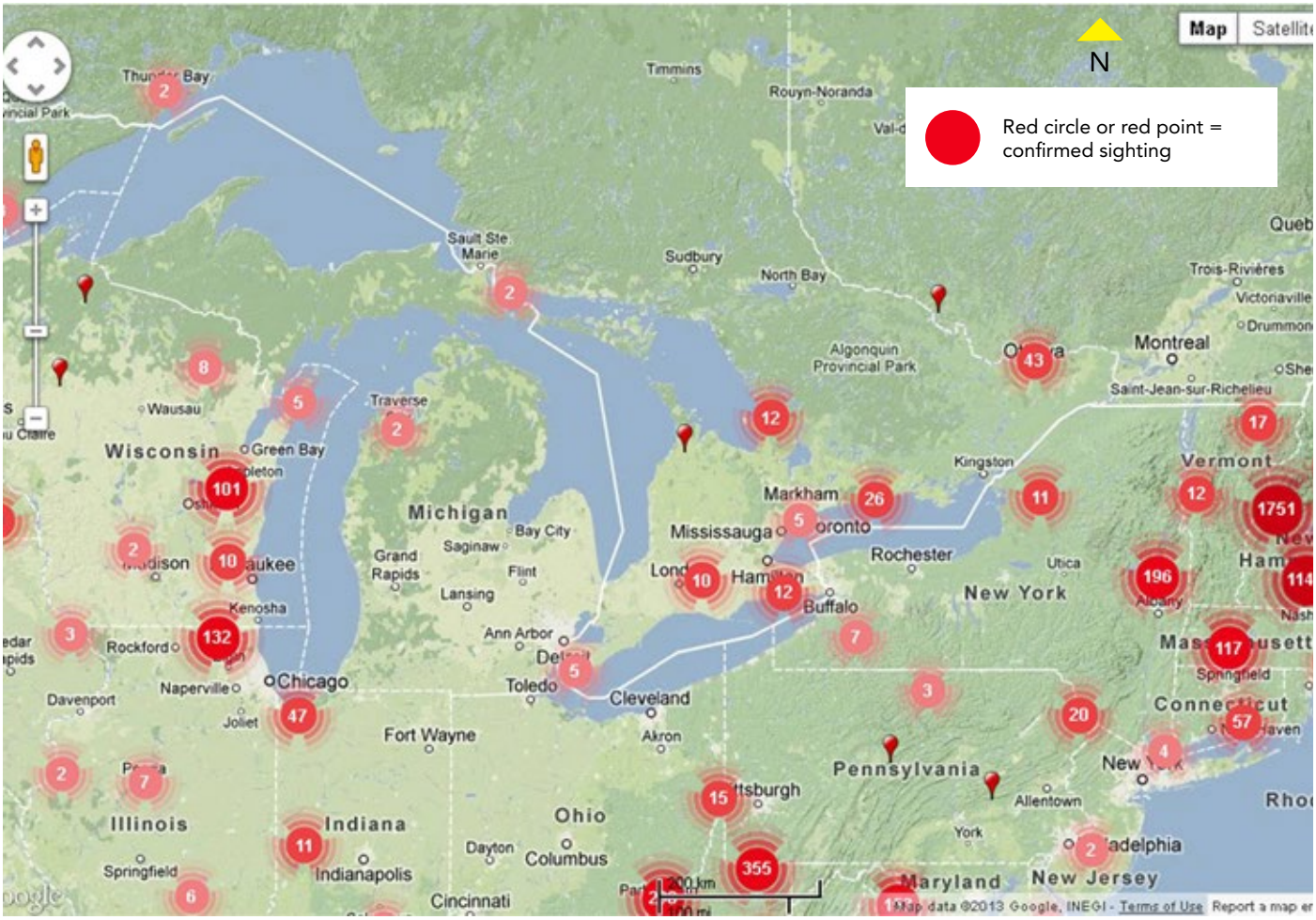
Japanese Knotweed grows most vigorously in full sunlight, preferring open exposed sites. It can also grow in deep shade in riparian zones. It prefers moist soils, like those in riparian or wetland areas; however it may also be found growing in disturbed areas along roadsides, rail-beds, old homesteads and along woodland/forest edges.

Japanese Knotweed can grow in a variety of site conditions. It is salt tolerant and able to survive in extreme climates (e.g. volcanic plains). It has been found growing in heavily polluted areas of Japan and in soils contaminated with heavy metals.

Distribution

In Ontario, Japanese Knotweed distribution is not well documented. The majority of sites have been reported in the last 10-20 years. There have been populations confirmed as far north as Thunder Bay and Sault Ste Marie (outside of the predicted ranges for its spread with the current climate and growing zones in Ontario). There are established populations across southern, central and eastern Ontario (in over 20 different municipalities). In Canada, the primary distribution is in Ontario, Quebec, and the Atlantic Provinces with isolated populations in Winnipeg, Manitoba and southern British Columbia. It is also widespread in the north-eastern United States and widespread in Europe. It is somewhat intolerant of persistent freezing conditions, and as a result, its spread may be confined to more southerly parts of Canada. However, as the climate warms it may be able to spread further north. Ontario should be prepared for Japanese Knotweed to spread within the Province as the average temperatures rise.

Road and railroad rights of way and waterways are the main geographic pathways for spread within Ontario. It is not known how prevalent it is in the horticultural industry. Road maintenance, forestry operations and construction activities may spread these plants further.



Japanese Knotweed Distribution Map courtesy of EDDMaps (www.eddmaps.org/ontario)

Impacts

Biodiversity

Japanese Knotweed can severely degrade the quality of wetland and riparian habitats where it becomes established. Dense thickets of Japanese Knotweed can reduce sunlight penetration by more than 90%, and its thick mats of dead and decaying vegetation in fall/spring prevent other plant species from growing, by shading them out. Studies done by Cornell University have found that knotweed negatively affects the diversity of vegetation, reducing native species groundcover within knotweed stands to 0%.

As a result of the reduced native plant biodiversity and lowered invertebrate densities, established Knotweed stands do not support the same levels of native amphibian, reptile, bird and mammal populations. For example, it has been shown that native Green Frog (*Rana clamitans*) presence is dramatically reduced in knotweed stands in riparian/wetland areas.

Although further study is needed, it is believed that Japanese Knotweed may have allelopathic properties. The roots contain unique compounds, which may alter soil chemistry or prohibit the growth of nearby native species.

Japanese Knotweed negatively affects the diversity of vegetation.

Photo courtesy of Randy Westbrooks, U.S. Geological Survey, Bugwood.org.

Infrastructure

This plant can significantly damage infrastructure. It is able to grow through concrete/asphalt up to 8 cm thick and building foundations. It is of particular concern in new housing developments. In the United Kingdom, developers must dispose of soil containing knotweed fragments at hazardous waste facilities.

Japanese Knotweed root systems, while strong, are not as dense as those of native plants, and do not hold soil as well. When Japanese Knotweed establishes along stream banks, the bank can become unstable and more vulnerable to erosion and flooding. Reductions in available soil (because of erosion) and space (because of the larger root/rhizome biomass) affect the ability of the stream bank to hold water during heavy rains.

Knotweed is able to grow through decks and building foundations as this photo showing Himalayan Knotweed demonstrates.

Photo courtesy of BC Ministry of Forests, Lands and Natural Resource Operations.

Recreation

Japanese Knotweed can block or interfere with access to water for activities such as canoeing, boating, angling and swimming.

Japanese Knotweed grows in dense stands which can impede access.

Photo courtesy of Freyja Whitten.

Regulatory tools

Federal

Japanese Knotweed is not a federally regulated plant species.

Provincial

Japanese Knotweed is not a regulated species in Ontario. In other parts of Canada, the provinces of Alberta and British Columbia have listed Japanese Knotweed and the other knotweeds on their provincial noxious weed lists.

Municipal – Property Standards Bylaw

A municipality can pass a property standards bylaw under the Building Code Act to address the presence of weeds deemed noxious or a threat to the environment or human health and safety. A municipality can also regulate Japanese Knotweed due to concerns for flooding and infrastructure damage.

Japanese Knotweed creates thick mats of dead and decaying vegetation.

Photo courtesy of Francine MacDonald.

Best Management Practices

Controlling Japanese Knotweed before it becomes locally established will reduce its impacts on biodiversity, the economy (e.g. infrastructure) and society.

It is important to use a control plan that incorporates integrated pest management principles. This means using existing knowledge about the pest species and its surrounding environment to prevent and fight infestations and may require more than one type of measure to be successful. It is also important to note that control measures for Japanese Knotweed can have a much higher success when heavily infested sites are re-planted with native species that are able to out-compete new growth.

Once Japanese Knotweed has been confirmed at a location, a control plan should be developed based on infestation size, site accessibility, potential for spread and the risk of environmental, economic or social impacts. Site specific conditions such as native plant diversity, wildlife usage and water table fluctuations should also be considered when developing control plans. A detailed inventory of each site is strongly recommended before starting control efforts to help ensure proper methods and timing are used to minimize negative impacts.

If confronted with an established infestation of Japanese Knotweed, land managers should first focus their efforts on preventing spread; by removing isolated plants and small populations (satellite infestations) outside the main infested area.

When action is taken early it can significantly reduce the cost of control. Many established Japanese Knotweed stands have required 5-10 years of active control to achieve eradication.

With large infestations and limited time and resources, control work can seem daunting. It is important to develop a feasible, long-term strategy.

The following BMPs can be used as a guide in the development of a control plan. A number of natural resource considerations should be applied prior to implementation of control plans, including species at risk and habitat disruption.

Natural Resource Considerations

You are responsible for ensuring that your project follows all relevant laws, including the Endangered Species Act (ESA). If protected species or habitats are present, an assessment of the potential effects of the control project could be required. Consult with your local MNR district office early in your control plans for advice. If controlling Japanese Knotweed in riparian areas, considerations may also be required for impacts to shoreline health.

When creating management plans, it is important to make the most of resources by prioritizing invasive species control. The following will help you to prioritize sites and areas within sites for control of Japanese Knotweed.

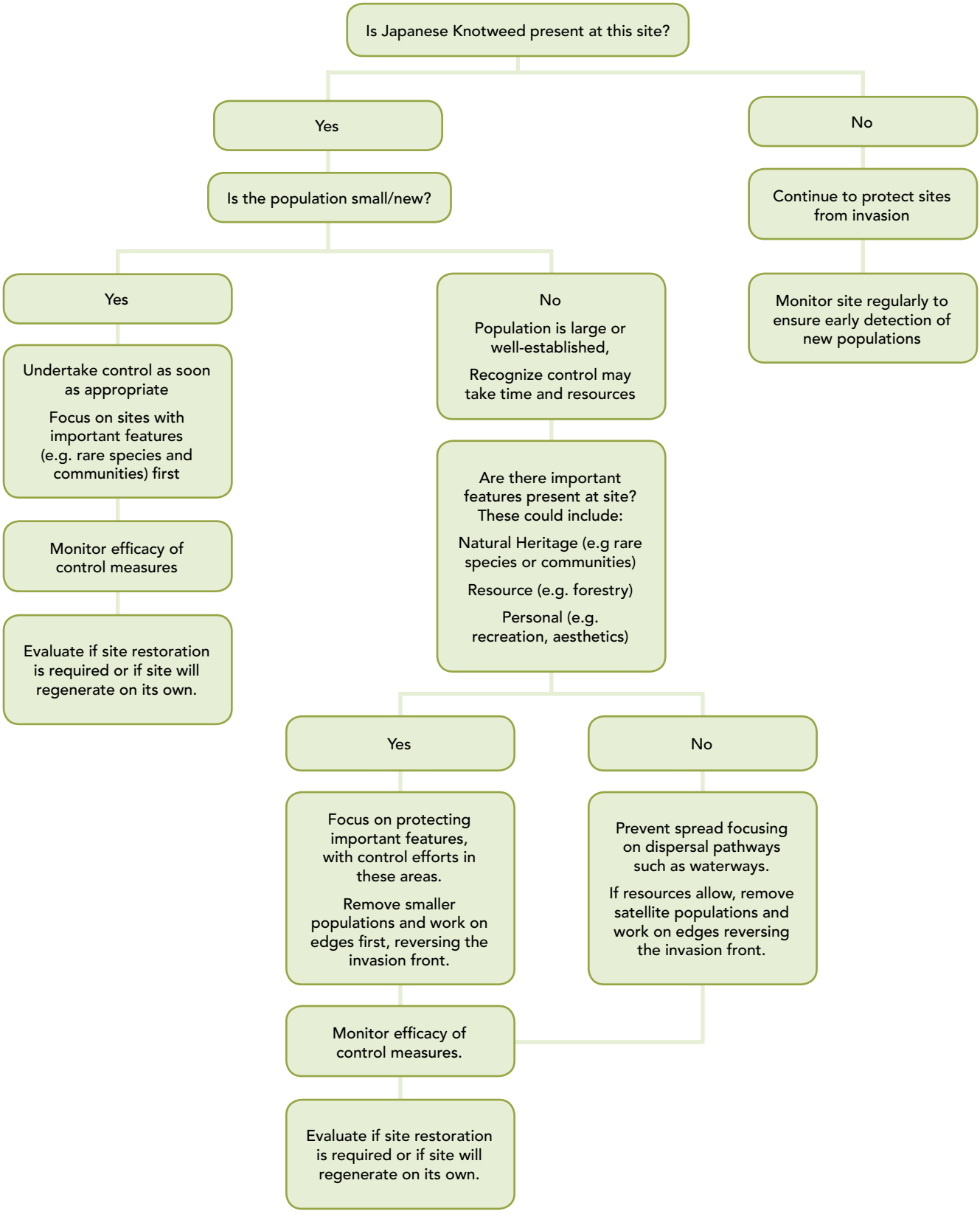
Setting Priorities

When creating management plans, it is important to make the most of resources by prioritizing invasive species control. The following will help you to prioritize sites and areas within sites for control of Japanese Knotweed.

It is important to prioritize sites for control.

Photo courtesy of Nanna Borcherdt, Sitka Conservation Society, Bugwood.org.

This flow chart can help land managers choose which site to first focus control efforts:



Site Prioritization

(This section modified from "The Landowners Guide to Managing and Controlling Invasive Plants, published by Credit Valley Conservation)

1. Protect areas where Japanese Knotweed is absent or just appearing.
2. Protect rare species and communities. These include federal, provincial, and regionally listed rare species.
3. Protect important habitats and land values (i.e. forestry, maple syrup production).
4. Cost and effort: Will the area where the Japanese Knotweed has invaded require restoration or can it be left to regenerate naturally? (Note – it is usually recommended to restore control areas to make them more resilient to future invasions.)

Prioritizing within a Control Area

1. Focus on large blocks of un-invaded areas and keep them free of invaders
2. Control small, younger, outlier (satellite) populations first
3. "Unfragment" the boundaries of invaded areas by removing outlying plants
4. Reverse the invasion, expand the un-invaded area outward

It is crucial to prioritize control by determining where the satellite populations are, and eradicating those before they join up with larger populations. Studies have shown that Japanese Knotweed has a lag time of 20-40 years after planting before it begins to expansively spread from founding populations.

Assessing Regeneration vs. Restoration

Consider the following factors:

- **Level of disturbance at the site**

What is the level of disturbance at site? Was it a heavily invaded site? (I.e. a lot of disturbance was caused when things were removed) Will it continue to be disturbed? (I.e. through trail use and management)

- **Invasive Species Biology**

What is the biology of the invasive species removed and is there a seed bank to consider?

- **Re-invasion Risk**

Are there invasive species in the area that could re-invade the site from certain pathways of introduction, such as nearby trails or watercourses?

- **Existing native vegetation**

What native vegetation is left? How long before it regenerates by itself? Does it need help?

Control Measures

Control measures must be continued for at least 5 years to ensure that the rhizome is depleted. Many of these measures, if only done once, will actually increase densities by stimulating growth through disturbance. If an area is cleared of Japanese Knotweed plants, it should be re-planted immediately with a cover crop or covered with leaves or mulch to prevent other invasive plants from germinating in the disturbed soil.

Manual Control

Mowing/Cutting:

Continual mowing or cutting of the stems with a brush mower at least once a month throughout the growing season will eventually weaken the rhizomes (this must be repeated for a minimum of 5 years). However, mowing/cutting is best used in tandem with another control method (i.e. chemical).

Digging:

Digging young plants (including rhizomes) can eradicate new or early infestations. Japanese Knotweed has a large and dense root system and will quickly re-sprout when pulled or dug if the roots are not completely removed. Using a restoration plan with this method will prevent additional invasive species from becoming established in areas disturbed by digging/ pulling efforts.

Excavation:

For large populations, full-scale excavation with heavy machinery has proven to be a method of quick eradication in the UK. This usually involves creating deep pits (more than 5 m deep) and excavating all soil up to 2 m deep that has been infested with Japanese Knotweed, then burying it in these pits which are lined with root barriers. As a last resort, if the Japanese Knotweed cannot be buried on-site, it is removed and brought to designated soil treatment areas at landfills.

Cultural Control

Grazing:

The young shoots of Japanese Knotweed are edible for livestock and horses when they first appear in the early spring. Grazing will not eradicate Japanese Knotweed but can suppress its growth and prevent spread. Once grazing is stopped (after the stems grow further and become woody, usually around July), the plants will continue to grow. This method is best used in combination with another control measure, such as chemical control.

Tarping:

Tarping refers to covering an invasive plant population with a dark material to block sunlight and "cook" the root system. Tarping is most effective when started in late spring and continued through the growing season and is a viable control method for medium to larger infestations. Tarping is not recommended in low light areas.

To tarp an area, first cut Japanese Knotweed stems, taking care not to spread any plant pieces to new areas. Next, cover the infested area with a dark coloured tarp or heavy material, loosely enough to allow some growth under the tarps as the Knotweed stems may break through the tarp if it is too tight. Make sure to tarp further out than the infestation as the rhizomes will spread outward to find light. Weed barriers used by landscapers or blue poly tarps are good options. Take care to weigh down the tarp material so it doesn't blow away, but be sure it is still receiving adequate sun exposure. Tent pegs work well as long as the ground isn't too rocky.

The tarp will need to be left in place for more than one growing season (up to 3 growing seasons) to ensure effective control. This method is very labour intensive. Monitor for plants growing from under the edges of the tarp (or through the tarp). Monitor rips/tears in the tarp as plants will continue to grow if there are rips/tears or any access to sunlight/air. This method may need to be done in conjunction with another method to ensure the entire patch is controlled. Since tarping essentially "cooks" the soil, mycorrhizae (beneficial soil fungi) may need to be added when re-planting. Re-planting the area with native vegetation once control measures are complete will help to suppress re-sprouting and assist in preventing new invaders from establishing.

Tarping done by Credit Valley Conservation.
Photo courtesy of Hayley Anderson.

Chemical Control

Herbicide Application

Herbicides must be applied in accordance with all label directions. For an up-to-date list of herbicides labelled for Japanese Knotweed control, visit the Pest Management Regulatory Agency's web site at www.pmra-arla.gc.ca. The Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA)'s **Publication 75, Guide to Weed Control** is an excellent reference for all aspects of weed control, and includes a section on invasive plant management. To determine if a federally registered herbicide is also classified for use in Ontario, visit http://app.ene.gov.on.ca/pepsis/.

Herbicide Timing

The best time to perform chemical control on Japanese Knotweed is from late May followed by another in early summer, and another in early July may be required for re-sprouts and any missed during the first application. Follow up application may be required. For established populations, chemical control is more effective when combined with mechanical control (cutting/mowing). Repeated cutting and allowing the plant to grow to full height between cuttings will weaken the root system. A systemic herbicide (e.g. glyphosate) applied when the plant has re-grown after multiple cuttings will be very effective. This process may need to be repeated for several years before a population is under control. Herbicides alone may be sufficient for isolated plants or new satellite populations.

Foliar Spray:

Refer to the label of the herbicide you are using for rates and instructions for foliar application.

Foliar spray done by Credit Valley Conservation.
Photo courtesy of Freyja Whitten.

Wick or wiper applications:

Some herbicides can be applied with wick or wiper applicators directly to the leaves of Japanese knotweed. This can be used in place of foliar spray if there are concerns over spray drift. Follow label instructions for the appropriate herbicide concentration and application methods.

Legislation governing pesticide use:

Anyone using a pesticide is responsible for complying with all federal and provincial legislation. Most non-domestic (i.e. commercial, restricted etc.) herbicides can only be applied by licensed exterminators. For more information, refer to the Ontario Pesticides Act and Ontario Regulation 63/09 (available on http://www.elaws.gov.on.ca), or contact the Ontario Ministry of the Environment (http://www.ene.gov.on.ca/environment).

The Ontario Pesticides Act and Ontario Regulation 63/09 provide natural resources, forestry and agricultural exceptions which may allow chemical control of invasive plants on your property. Other exceptions under the Act include golf courses, and for the promotion of public health and safety.

Natural Resources Exception

A 'natural resources' exception exists for the use of prohibited pesticides to manage, protect, establish or restore a natural resource. This exception allows the use of certain prohibited herbicides for control of invasive plants on your property provided your project meets specific conditions and you obtain the necessary approvals.

If your project meets the natural resources criteria specified in section 33 of Ontario Regulation 63/09 and includes the use of pesticides in accordance with Integrated Pest Management principles outlined in the BMP guide you will need to contact the Ontario Ministry of Natural Resources (www.ontario.ca) to obtain a written letter of opinion from the MNR Regional or Branch Director.

Forestry Exception

If Japanese Knotweed is within a forest*, chemical control may fall under the exception for forest management, and a letter of opinion may not be required. Class 9 pesticides can be used under the forestry* exception to protect trees from pests and to control competing vegetation.

*O. Reg. 63/09 defines "forest" and "forestry" as:

Forest means a treed area of land that is one hectare in size or larger and is not used for producing an agricultural crop as part of an agricultural operation.

Forestry means activities relating to any of the following: harvesting, renewing, maintaining or establishing a forest, protecting forest resources derived from a forest, and accessing a forest for these purposes.

Refer also to the Ministry of Environment's factsheet titled "Pesticides Act and Ontario Regulation 63/09 Private Land and Woodlot Owners April 2011" www.ene.gov.on.ca/stdprodconsume/groups/lr/@ene/@resources/documents/resource/stdprod_085367.pdf

Agriculture Exception

There is an exception for the use of Class 9 pesticides for uses related to agriculture by a farmer. This exception may apply to the control of Japanese Knotweed in agricultural fields or near farm operations.

A farmer is an individual who owns or operates an agricultural operation.

An agricultural operation is an agricultural, aquacultural or horticultural operation and includes:

- Growing, producing or raising farm animals
- Production of crops, including greenhouse crops, maple syrup, mushrooms, nursery stock, tobacco, trees and turf grass, and any additional agricultural crops
- Activities that are part of an agricultural operation such as maintenance of a shelterbelt for the purposes of the agricultural operation
- The production of wood from a farm woodlot, if at least one of the activities described earlier is carried out on the property where the farm woodlot is located.

Refer also to the Ministry of the Environment's factsheet titled "Pesticides Act and Ontario Regulation 63/09 Agriculture May 2011"
http://www.ene.gov.on.ca/stdprodconsume/groups/lr/@ene/@resources/documents/resource/stdprod_080128.pdf

Biological Control

Biological control is the use of an herbivore, predator, disease or other natural enemy to reduce established populations of invasive species. Most invasive species have no natural enemies in their new habitats. Biological control aims to re-establish an ecological balance between the invasive species and its natural enemies by selecting highly host-specific natural enemies from the country of origin, and moving them to the country where the invasive species is a problem. This is only done after extensive host-range testing in the country of origin or quarantine, to ensure that the potential biocontrol agent is host-specific to the targeted invasive species. This method has been used successfully for invasive plants in North America, including Purple Loosestrife (*Lythrum salicaria*), Leafy Spurge (*Euphorbia esula*), Diffuse Knapweed (*Centaurea diffusa*) and St John's Wort (*Hypericum perforatum*).

In its native range, Japanese Knotweed has many predators and pathogens which control its growth. Several of these predators and pathogens have been studied for use as a biological control. In the United Kingdom, two potential biological control agents (a leafspot fungus and a psyllid) have been identified and the psyllid (sap-sucking insect) has been released in quarantine areas for a 5 year field trial. Research is also ongoing in Canada and the United States to determine the feasibility of these biocontrol agents.

Biological Control agents are being researched.

Photo courtesy of John P Bailey, University of Leicester.

Disposal

Do Not Compost. All plant materials should be placed in thick black plastic bags. Seal the bags tightly and leave them in direct sunlight for about a week. Allow stems and rhizomes/roots to dry out thoroughly (for at least 1 week) before disposing of them. The best disposal for Japanese Knotweed plant pieces after drying is to burn them or send them to the landfill.

Control Measures Summary

Method	Population Characteristics	Purpose of Control	Notes
Digging	Small populations	Eradication	• Entire rhizome must be removed
Mowing/Cutting	Small to medium populations	Weaken rhizomes	• Must be repeated several times per season over several growing seasons
Tarping	Small to medium, dense infestations	Suppress growth and kill rhizomes	• Need to rehabilitate soil afterwards • Very labour intensive
Excavation	Large populations	Eradication	• Need to consider where excavated material will be disposed
Grazing	Large populations	Suppress growth, weaken plants	• Young shoots are edible for sheep, goats, cattle and horses. Goats may be most effective.
Chemical	Small to large/ established populations	Eradication or control to manageable levels	• Generally need multiple applications
Biological	Large/established, dense populations	Once a population is past manageable or treatable levels, often the only viable control option is biological control	

Choosing control measures based on size and density of infested area

Density of Infested Area	Size of the Infested Area			
	Isolated Plants	**Small (.1-.5ha)**	**Medium (.5-2ha)**	**Large (more than 2 ha)**
Low Density (1-50 plants or less than 10% cover)	• Chemical • Digging	• Chemical • Digging/ Pulling • Mowing/ Cutting	• Chemical • Digging/ Pulling • Mowing/ Cutting	• Chemical • Digging/Pulling • Mowing/Cutting
Medium Density (50-1000 plants or between 10% and 30% cover)		• Chemical • Digging/ Pulling • Mowing/ Cutting • Grazing	• Chemical • Tarping • Excavation • Grazing	• Chemical • Excavation • Grazing
High Density (more than 1000 plants or 30 – 100% cover)		• Chemical • Tarping • Excavation • Grazing	• Chemical • Tarping • Excavation • Grazing	• Chemical • Tarping • Excavation • Biological

Restoration

Restoration is a critical aspect of invasive plant management. Site restoration will result in a healthier ecosystem, which will be more resilient to future invasions. Monitor all restoration activities to ensure native species are becoming established, and continue removal of invasive plants that remain onsite.

Types of Restoration

During Control:

Mulching:

Mulching sites immediately after invasive species control (i.e. mechanical or chemical control of Japanese Knotweed) may aid in the recovery of native species and prevent immediate re-colonization by other invaders when the Knotweed dies back. Mulching reduces light availability, allowing more shade-tolerant native plant species to germinate and colonize the gaps left by the Knotweed removal.

Seeding:

Seeding an area with an annual cover crop or native plant species, immediately after management activities, may be necessary to prevent the establishment of new invasive species. This will give desirable native species the chance to establish themselves.

After Control:

Soil Rehabilitation:

Some invasive species alter soil chemistry (especially those that are potentially allelopathic, such as Japanese Knotweed). The soil may no longer support native plant species, and may in fact be better suited to other invaders moving in. Replenishing the mycorrhizae in the soil after all Japanese Knotweed control has been completed will help to reduce any potential allelopathic effects and restore soil conditions to encourage native species to re-grow. Growth of mycorrhizal fungi can be encouraged by using leaf mulch, logs and sticks (to provide food and protective cover for the fungi) and reducing soil compaction. Commercial mycorrhizal products are also available for purchase in Ontario.

Planting:

If there are invasive plants nearby which may colonize the control area, planting larger native species stock (potted etc) help them out-compete invasive seedlings. If planning on doing further management in subsequent years, wait until all management is complete prior to doing a large stock re-planting, as it may be difficult to distinguish between newly planted native species and invasive seedlings. When completing planting at control sites, it is important to consider if there has been earthworm impacts (little to no leaf litter), as well as light availability (have any trees recently been removed which have opened up the forest canopy?). These environmental changes should be taken into consideration when choosing plant species for restoration, as they will affect the growing and soil conditions. Also, additional management activities may disturb the newly planted materials, so it is best to postpone planting until all invasive plant control is complete.

Japanese Knotweed can change soil chemistry.

Photo courtesy of Jan Samanek, State Phytosanitary Administration, Bugwood.org.

Preventing the Spread

Everyone can help prevent the spread of Japanese Knotweed by following these tips:

☑ Report it.

If you think you see Japanese Knotweed, take a picture, record the location and contact the Invading Species Hotline to report it. For more information and guidance call the Invading Species Hotline at **1-800-563-7711** or visit www.invadingspecies.com or www.eddpmaps.org/ontario.

☑ Watch for it.

Learn what Japanese Knotweed looks like and then monitor hedges, property boundaries, riparian areas, fence lines and trails. Early detection of invasive plants can make it easier and cheaper to remove or control them.

☑ Stay on trails.

Avoid traveling off-trail and in areas known to have Japanese Knotweed or other invasive species.

☑ Stop the spread.

Inspect, clean and remove mud, seeds and plant parts from clothing, pets (and horses), vehicles (including bicycles), and equipment such as mowers and tools. Clean vehicles and equipment in an area where plant seeds or parts aren't likely to spread (e.g., wash vehicles in a driveway or at a car wash) before travelling to a new area.

☑ Keep it natural.

Try to avoid disturbing soil and never remove native plants from natural areas. This leaves the soil bare and vulnerable to invasive species.

☑ Use native species.

Try to use local native species in your garden. Don't plant Japanese Knotweed in your garden and if you have removed it, try to replant with native species. Don't transplant invasive species such as Japanese Knotweed. Encourage your local garden centre to sell non-invasive or native plants.

The OIPC has a booklet called "Grow Me Instead" which lists non-invasive or native plants for gardens. For the booklet, and a list of nurseries which sell these plants, visit:
www.ontarioinvasiveplants.ca

Tracking the Spread of Japanese Knotweed

Locations of Japanese Knotweed have been documented in many parts of Ontario. However, there are gaps in our understanding of its provincial distribution and the scale of its invasion in many locations.

Several reporting tools have been developed to assist the public and resource professionals to report sightings, track the spread, detect it early, and respond quickly. These include:

1) EDDMaps is an on-line reporting tool where users can view existing sightings of Japanese Knotweed and other invasive species in Ontario, and document their sightings. This tool, at www.eddmaps.org/ontario, is free to use.

2) The toll-free Invading Species Hotline (**1-800-563-7711**) and website (www.invadingspecies.com), which individuals can use to report sightings verbally or on-line.

If you think you have Japanese Knotweed on your property or if you see it in your community, please report it. You will be asked to send in photos of the leaf, stem and flower for identification.

Best Management Practices Documents Series

Common Buckthorn Best Management Practices for Ontario

Dog-strangling Vine Best Management Practices for Ontario

Garlic Mustard Best Management Practices for Ontario

Giant Hogweed Best Management Practices for Ontario

Phragmites (*Common Reed*) Best Management Practices for Ontario

Additional Publications from the Ontario Invasive Plant Council:

Clean Equipment Protocol for Industry

Compendium of Invasive Plant Management

Grow Me Instead! Beautiful Non-Invasive Plants for Your Garden, a guide for Southern Ontario

Grow Me Instead! Beautiful Non-Invasive Plants for Your Garden, a guide for Northern Ontario

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