City of Coquitlam

Invasive Plant
Management Strategy

Coquitlam

City of Coquitlam Invasive Plant Management Strategy



Prepared for:

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TABLE OF CONTENTS

List of Figures

List of Tables

PART 1 – PURPOSE, STRUCTURE, AND PRINCIPLES

1.1 Statement of Purpose

The purpose of the Invasive Plant Management Strategy is to (1) guide the City of Coquitlam's management of invasive plants in publicly-owned parks and natural areas; and (2) to facilitate the management of invasive plants on private lands in the City. The overall goal is to prevent, reduce, or mitigate the effects of invasive plants on conservation, aesthetic, and recreation values of publicly-owned parks and natural areas in the City of Coquitlam.

1.2 Structure

This strategy is divided into seven parts:

Part 1 summarizes the purpose, structure, and management principles of the Invasive Plant Management Strategy, and provides definitions for key terms.

Part 2 provides an introduction to invasive plant issues in the City of Coquitlam.

Part 3 provides direction on the strategic management of invasive plants.

Part 4 outlines on-the-ground control and restoration methods for invasive plants.

Part 5 discusses the role of monitoring and adaptive management.

Part 6 discusses education and collaboration activities.

Part 7 provides recommendations.

1.3 Management Principles

The strategy is built on six principles that were developed by the Invasive Plant Steering Committee:

Principle 1: Use an integrated approach to managing invasive plants.

- The Invasive Plant Management Strategy is to be aligned with the principles of sustainability, integrating social, environmental and economic factors with a view to the long-term.
- An integrated approach includes prevention, community education, monitoring and evaluation.
- Adopt an Integrated Pest Management approach and utilize herbicides only when the benefits outweigh the costs and risks.

Principle 2: Save your best first.

- Priorities should focus on the most valuable habitats such as riparian areas and wetlands. Generally, areas that are part of a connected system are more valuable than isolated patches.
- Focus on Prevention and Early detection and Rapid Response as the first management strategies.

Principle 3: Maximize benefits to park and natural areas values.

- Work to achieve 'best bang for the buck' recognizing soft and hard economic costs.

Principle 4: Emphasize leadership and partnerships.

- The City is to lead by example and recognizes that a partnership approach is essential to the success of this program.
- Support existing energies. Some neighbourhood initiatives may not be the highest priority but it is important to take advantage of community interest.
- Implicit in a "Partnership Approach" is valuing and supporting volunteers to build the community's capacity to deal with invasive plants.

Principle 5: Increase awareness and knowledge through education and outreach.

- Recognize that the level of awareness and knowledge about invasive plants is variable.
- Use multiple methods of communication to reach a range of audiences including the lay public, city staff, professionals, and stewards.
- Recognize that control, restoration, and monitoring projects are an important component of both education and outreach during the early stage of invasive plant management.

Principle 6: Use monitoring and adaptive management.

- Adopt adaptive management principles where new research and pilot testing is utilized, results are evaluated, and management approaches adapt accordingly.
- Keep current and share information regionally.

1.4 Definitions

Alien Plants. Alien plants include all taxa (species and varieties) whose presence in Greater Vancouver is due to intentional or accidental introduction by human activity since European settlement began in 1827 (synonyms: non-native, exotic, non-indigenous species).

Invasive Plants. Invasive plants are a small group of rapidly spreading alien plants that become both regionally common and locally abundant and have the potential to cause changes to the composition, structure, and function of native ecosystems through competition or ecosystem effects (from GVRD Parks, 2005).

Invasive Plant Impact. Impact of invasive plants is generally related to distribution (rare to widespread) and abundance (sparse to dense). Plants that are both abundant and widespread generally have a higher impact than plants that are rare and sparse.

Invasive Plant Control. Control encompasses a range of activities whose combined goal is to eradicate, remove, or reduce invasive plants through physical, chemical, or biological means. A successful control strategy prevents the continued invasion or spread of an invasive plant, and in some cases, eradicates it entirely from a given area.

Restoration and Recovery. Restoration and recovery are activities to recreate healthy, sustainable plant communities that are generally composed of native plants. In the context of this report, restoration is a post-control activity that re-introduces native or desirable plants to the site and limits the re-establishment of invasive plants.

Adaptive Management. Adaptive management is a process for improving management policies and practices by learning from the successes and failures of programs and projects.

Monitoring. Monitoring is the repeated collection of measurements to define changes over time. Monitoring is a key component of adaptive management.

Prevention. In the context of invasive plant management, prevention encompasses measures to restrict invasive plant from establishing to new areas.

Early Detection and Rapid Response (ED/RR). ED/RR is a two part management strategy that emphasizes the identification and eradication of invasive species before they become widespread and abundant, or where eradication is not possible, control and confinement to prevent further spread.

Confinement. Confinement is a management strategy that attempts to prevent the further expansion of invasive plant populations by targeting the outer edge of their range or limiting them to a specific area. For example, it may be possible to prevent the spread of some species east of the Coquitlam River using EE/RR strategies.

PART 2 – INVASIVE PLANT ISSUES

2.1 Background

Invasive plants are recognized as a major component of urbanization-related change in parks and other natural areas in the City of Coquitlam. Invasive plants are considered a subset of the larger group of alien plants that are distinguished by their potential to cause ecological or economic harm. The effects of invasive plants include loss of habitat for native species, systemic change to ecological processes, aesthetic changes, reduced human access in natural areas, increased vegetation management costs, and human health risks. Unlike other forms of landscape-scale change associated with urbanization such as forest loss, their effects are often subtle and incremental. Populations of many invasive plant species develop slowly and only become highly visible during later stages of invasion.

A 2006 inventory of invasive plants in 420 ha of parks and natural areas in the City of Coquitlam for Coquitlam Parks and Leisure Services found the following:

1) Invasive plants are widespread throughout the City of Coquitlam and appear to be a ubiquitous component of urbanization in the city. Approximately 17% (72.3 ha) of the 418.2 ha of City-owned lands that were inventoried had at least one invasive plant present.

2) Measured using total cover in areas assessed, the most abundant invasive plants were: Himalayan blackberry 21.6 ha (5.2% of 418.2 ha assessed); English ivy 6.6 ha (1.6%);

yellow lamium 5.6 ha (1.3%), reed canary grass 2.0 ha (0.5%), knotweed 1.0 ha (0.2%), morning glory 1.0 ha (0.2%), Scotch broom 0.9 ha (0.2%), vinca 0.5 ha (0.1%), policeman's helmet 0.4 ha (0.1%), small flowered touch-me-not 0.2 ha (0.1%), purple loosestrife 0.0 ha (0%), and giant hogweed 0.0 ha (0%).

3) Himalayan blackberry, English ivy, and yellow lamium were substantially more abundant than any other species. Himalayan blackberry accounted for more than half (54%) of all invasive plants measured in the inventory.

4) Invasive plants are much more common in natural areas in the older, developed community areas in the Southwest (total cover 14.8%) and Town Centre (14.1%). The Northeast had only 2.9% and the Northwest (Westwood Plateau) had 2.5%.

5) Invasive plant abundance varies by habitat type. All invasive plants were much less common in coniferous forest than in mixed or deciduous forest. Himalayan blackberry was most common in shrublands. None of the species showed a clear association with wetlands except for policeman's helmet and reed canary grass. There were too few wetlands inventoried to provide an accurate estimate of invasive plants in this habitat type.

6) Terrestrial and riparian areas support a similar abundance of invasive plants. However, there are differences in the distribution and abundance of specific invasive plants. Reed canary grass, knotweed, policeman's helmet, and small flowered touch-me-knot are more abundant in riparian areas, while yellow lamium, Scotch broom, and morning glory are less abundant. Himalayan blackberry was not substantially more abundant in riparian areas.

7) All invasive plants were between three and 23 times more abundant along forest edges than in interior forest. The prevalence of invasive plants in edge forest reflects both dispersal patterns and the availability of resources (light, water, and soil) for establishment and growth.

8) English ivy, yellow lamium, and vinca were more than twice as common adjacent to residential areas than non-residential areas such as schools and roads. Himalayan blackberry, reed canary grass, and Scotch broom followed the opposite pattern and were more abundant along non-residential edges.

9) The shade tolerant understorey species that originate in gardens were clearly associated with garden waste dump sites: English ivy cover occupied 5.3% of the area around dump sites versus 1.7% of comparable habitats without dump sites, yellow lamium occupied 10.1% vs. 1.3%, knotweed occupied 0.7% vs. 0.2%, and vinca occupied 0.5% vs. 0.1%. These results support general observations that garden waste dumping is a major source of invasive plants to natural areas.

10) English holly, cherry-laurel, and common laurel were noted sporadically throughout the study sites but were rarely abundant. Laurel species and English holly were most abundant in the dry Douglas-fir forest in Glen Park.

11) Giant hogweed is not abundant or common in the City of Coquitlam. Only two or three small populations were recorded and it was never abundant enough to be mapped as a polygon. It occurs sporadically near the Brunette River, Nelson Creek, and Como Creek, and was also recorded at one site on the Eagle Ridge right-of-way. Similarly, purple

loosestrife, often common in some freshwater wetlands, was very rare in the study area. Small populations were recorded in wetlands in Coquitlam River Park.

12) Non-native species that were noted during the field assessment but not mapped include herb-robert *(Geranium robertianum)*, creeping buttercup *(Ranunculus repens)*, and Alleghany blackberry *(Rubus allegheniensis)*. Alleghany blackberry was observed along Victoria Drive, just east of Freemont Park.

13) Non-native species that are invasive in other parts of Greater Vancouver but were rare in the study area include daphne-laurel *(Daphne laureola)*, hop *(Humulus lupulus)*, traveller's joy *(Clematis vitalba)*, and goutweed *(Aegopodium podagraria)*. All were observed in the study area but were never abundant. This may reflect their relatively recent introduction.

2.2 Invasive Plants of Concern in Coquitlam

Table 1 lists the plants that are considered invasive in parks and natural areas in the City of Coquitlam. The list is not in order of priority, however, the first five species are considered to have the most detrimental impact to conservation and other park values.

Table 1. Invasive plants in the City of Coquitlam.

Common Name	Species Name
Himalayan blackberry	*Rubus armeniacus* (syn. *Rubus discolor)*
English ivy	*Hedera helix* and *Helix hibernica* (and varieties)
yellow lamium (syn. yellow archangel)	*Lamiastrum galeobdolon* (syn. *Lamium galeobdolon)*
reed canary grass	*Phalaris arundinacea*
knotweed species (syn. false-bamboo)	*Fallopia* species and hybrids (syn. *Polygonum* spp.)
English holly	*Ilex aquifolium*
cherry-laurel	*Prunus laurocerasus*
spurge-laurel (syn. daphne-laurel)	*Daphne laureola*
common periwinkle (syn.vinca)	*Vinca minor*
common hop	*Humulus lupulus*
clematis (syn. traveller's joy)	*Clematis vitalba*
Himalayan jewelweed (syn. policeman's helmet)	*Impatiens glandulifera*
small flowered touch-me-not	*Impatiens parviflora*
common morning-glory (syn. hedge bindweed)	*Convolvulus sepium*
common tansy	*Tanacetum vulgare*
giant hogweed (syn. giant cow-parsnip)	*Heracleum mantegazzianum*
purple loosestrife	*Lythrum salicaria*
yellow-flag iris	*Iris pseudacorus*

2.3 Effects of Invasive Plants on Parks and Natural Areas

Invasive plants pose six key threats to ecological or recreation values in parks and natural areas in the City of Coquitlam (modified from GVRD, 2005):

1) Competitive displacement of native plants. Invasive plants monopolize resources such as light, moisture, and soil nutrients that are required by native plants to establish and grow. Where abundant, some invasive species displace native species by depriving them of access to these resources. However, this likely only occurs in sites with very dense growth (either of single invasive species or groups of invasive species).

2) Increased park management costs. Invasive plants increase park management costs through either increased resource management planning (e.g., project management, park plans, monitoring, etc) and the operational cost of maintaining vegetation communities (e.g., mowing, pruning, weeding).

3) Homogenization of regionally distinct plant communities. Invasive plants reduce plant community distinctiveness and lead to the loss of unique plant communities. Conspicuous invasive species, such as purple loosestrife and yellow flag iris, reduce the value of parks for some users because they are associated with loss of naturalness.

4) Changes to ecosystem functions or dynamics. Ecosystem effects encompass systematic changes to productivity, disturbance, energy transfer, and other ecological processes on which plant communities depend. An example from

Coquitlam is the dense growth of Himalayan blackberry in many urban stream corridors which prevents the establishment of riparian trees.

5) Hybridization and genetic effects. Hybridization is the risk that the genes from invasive plants will mix with closely related native species. Generally, hybridization only occurs between different varieties of the same species or between species in the same genus. Non-native lupine species may hybridize with streambank lupine *(Lupinus rivularis)*, which is an endangered species found in Coquitlam.

6) Risks to human health. Few invasive plants pose risks to human health, particularly in the context of park use or maintenance in the City of Coquitlam. Species that may pose health concerns include: giant hogweed (dermatitis from toxic sap), daphne-laurel (toxic sap), English holly (toxic berries), cherry-laurel (toxic berries), and Himalayan blackberry (scratches and punctures from thorns).

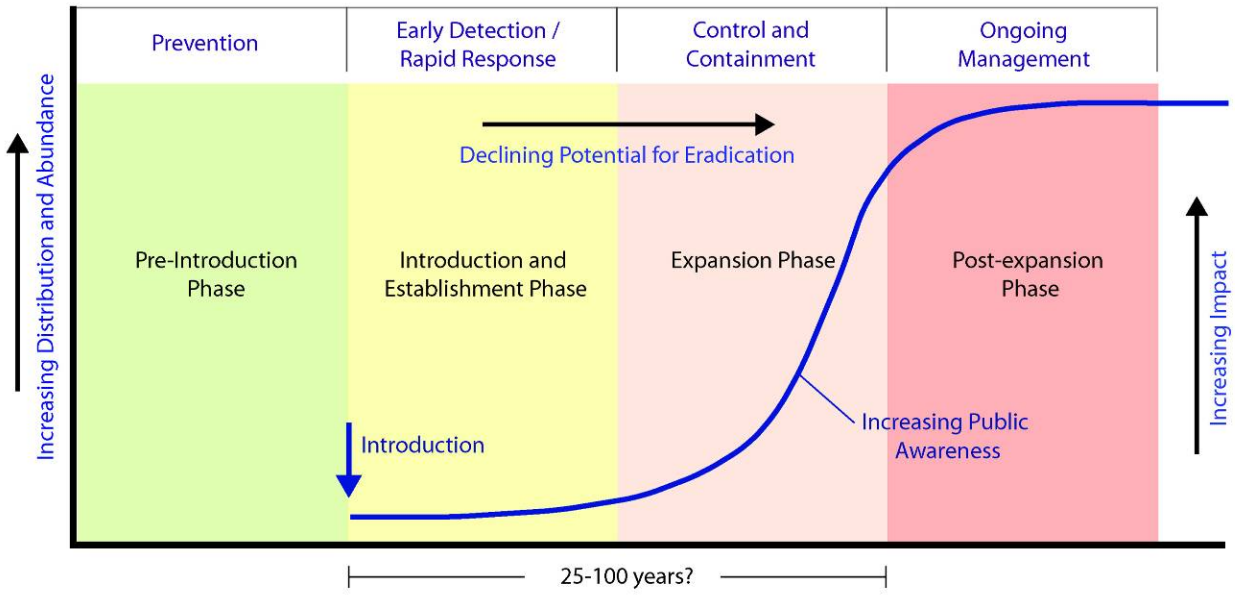
PART 3 – STRATEGIC MANAGEMENT

Invasion is a temporally and spatially dynamic process as invasive plant populations expand both locally and regionally over time. The invasion process can be divided into four phases, each with a different management focus (see table below and Figure 1):

Invasion Phase	**Management Focus**
Pre-introduction Phase	Prevention
Introduction and Establishment Phase	Early detection and rapid response
Expansion Phase	Control and containment
Post-expansion Phase	Ongoing management

The *Pre-introduction Phase* begins before an invasive plant is introduced and focuses on activities to prevent introduction from occurring, such as education, monitoring, and restrictions on the use or movement of specific plants. However, if prevention is unsuccessful, invasive plants are able to establish, an *Introduction and Establishment Phase* begins. During this phase, invasive plants occur as isolated and sparse populations at or near the point of introduction and early detection and rapid response is the most effective management strategy. Eradication is feasible at this stage. The *Introduction and Establishment Phase* may be prolonged and some species take over 50 years before population growth begins to accelerate. In the *Expansion Phase,* invasive plant populations expand rapidly and eradication becomes increasingly difficult. Confinement, where invasive plant populations are prevented from expanding by targeting populations at the outer boundary of population expansion, can still be undertaken during the control phase. The final phase is the *Post-expansion Phase,* when invasive plants are widespread and abundant across the landscape and ongoing control activities must be implemented to reduce impact; eradication or confinement is impossible. Species such as Himalayan blackberry are in the *Post-expansion Phase.*

Figure 1. Generalized invasion process and management phases.



3.1 Prevention

The most effective way to reduce the effect of invasive plants is to prevent them from establishing. However, most of the invasive plants that are considered invasive in the Pacific Northwest are already established in the City of Coquitlam, which reduces the effectiveness of prevention strategies in stopping new introductions. However, prevention can also be effective in reducing establishment of existing invasive plants to new areas of the city. For example, Westwood Plateau and Northeast Coquitlam have fewer infestations of English ivy than older residential areas. Prevention, particularly focusing on the use of ivy in residential gardens, can reduce or slow the invasion of ivy into these neighbourhoods. Prevention is also important because species that are not currently considered invasive may become a problem in the future, particularly with climate change.

Strategic Action:

1) Use education and voluntary restrictions on availability to prevent the establishment of new invasive plants or new plant populations through purposeful movement of plants or plant parts.

2) Use the development review process to restrict or prevent the use of known invasive plants, particularly English ivy and yellow lamium, in new landscaped areas.

3) Use information from other jurisdictions in the Pacific Northwest to identify emerging invasive plants before they establish in the City of Coquitlam.

4) Giant hogweed is rare in the City of Coquitlam and management should focus both on prevention of new populations through garden use and eradication through an early detection and rapid response strategy.

5) Use communication and education (see Communication Plan; Section 6.3) as the primary tool for preventing the introduction and distribution of invasive plants.

6) Monitor the distribution of emerging invasive plants every 3-5 years to assess the effectiveness of prevention actions (see Monitoring; Section 5.1).

3.2 Early Detection and Rapid Response

Early detection and rapid response (ED/RR) is the focus of invasive plant management in many jurisdictions because it is cost effective and successful. Sites with small and/or recent invasive plant introductions have the best potential for successful eradication. Success, however, depends on two distinct activities that can be difficult to combine.

First, the early detection component requires knowledge of an invasive plant before it establishes; this is often based on information from other areas with similar environmental conditions. For example, plants that are invasive in maritime areas of western Europe are often invasive in coastal BC. As well, ED/RR requires on-the-ground monitoring by professionals or experienced volunteers who are able to identify the plant. Taxonomic confusion and the lack of qualified observers can reduce effectiveness. Finally, it requires mapping and data management to make observations usable to those responsible for control activities.

Second, rapid response measures use established control and restoration measures to eradicate small populations of new invasive plants. Overall success of this component is limited by the effectiveness of the specific control method. Success also depends on having adequate resources to respond to invasive plant populations before they expand.

Action:

1) Develop a Watch List of plants likely to be invasive in Coquitlam if introduced, or are at initial stages of invasion when eradication is possible. The preliminary watch list should include Giant hogweed *(Heracleum mantegazzianum)* – rare in southwest and south central Coquitlam; spurge-laurel (syn. Daphne-laurel) *(Daphne laureola)* – dry forests; butterfly bush *(Buddleja davidii)* – dry rocky soils and gravel bars; red maple *(Acer rubrum)* – urban forests; Allegheny blackberry *(Rubus allegheniensis)* – may be invasive, found in Partington area; Himalayan knotweed *(Polygonum polystachum)* – forms dense clumps, may be invasive; and carpet burweed *(Soliva sessilis)* – lawns and golf courses.

2) Use community-based monitoring ("report-a-plant") to identify and track emerging invasive species. This should include providing identification and mapping information, or initial development of a web-based tool for managing information. The City of Coquitlam should manage collected data in a GIS system.

3) Designate funds for eradicating small populations of giant hogweed, Japanese knotweed, and other emerging invasive plants.

4) Sites on the outer edge of population expansion (including upstream sites) should be a priority because their control will limit further invasion. This is considered a confinement strategy.

3.3 Management Priorities for Established Invasive Plants

Priorities for established (rather than emerging) invasive plants in the City of Coquitlam are based on: (1) ecological value or sensitivity of the affected habitat; (2) the impact (existing or potential) of the invasive plant on park values; (3) the feasibility of control; and (4) community interests.

Specific control and restoration activities in the City of Coquitlam should focus on six invasive plants in different habitat conditions:

1) **Large monotypic thickets of Himalayan blackberry**, particularly in non-forested riparian shrublands.

2) **English ivy in forest habitats**. This should include removing small populations before they establish and spread in the Northwest and Northeast and preventing ivy growth on tree trunks and canopies in large, established populations.

3) **Yellow lamium in forest habitats.** Yellow lamium is less of a problem than English ivy because it does not grow on tree trunks and canopies and does not generally disperse by seed. Populations establish vegetatively, mainly from garden waste dumping. However, yellow lamium appears to be becoming much more abundant in many areas of Greater Vancouver and can form dense understorey stands.

4) **Reed canary grass in wetlands and non-forested riparian zones** such as lower Como Creek and on DeBoville Dykes, and the created wetlands in Coquitlam River Park.

5) **Giant hogweed in any habitat.** This species is rare in Southwest Coquitlam but is beginning to spread in the Maillardville area. The City of Coquitlam has used a early detection and rapid response strategy to attempt to eradicate the species from the City of Coquitlam. This strategy should be continued using root cutting or herbicide (glyphosate) use as the primary treatments. The City of Coquitlam should also work with the City of Burnaby to identify cross-border dispersal of giant hogweed.

6) **Japanese knotweed (and other knotweeds) in riparian areas (forest, shrublands)** from which it can spread. Japanese knotweed disperses through waterborne movement of root fragments and removing populations within or near stream channels should be undertaken before upslope removal. It may rarely disperse using seeds. It is less of a problem in non-riparian areas provided it is not flail-mowed and the soil is not disturbed, which can promote spread.

Action:

1) Sites in upstream riparian areas should be a priority if they have the potential to disperse downstream. Many species (e.g., Japanese knotweed, giant hogweed, policeman's helmet) disperse along streams and rivers through water movement. Control strategies should initially focus on source populations at the most upstream point in the watershed to prevent re-establishment.

2) Sites with well-established monocultures of Himalayan blackberry, reed canary grass, and/or Japanese knotweed usually have reduced ecological values and are suitable for broad-scale removal techniques such as mowing, tilling, mulching, or (where suitable) herbicide use.

3) Demonstration projects in high profile parks or other accessible areas are important for testing techniques and promoting invasive plant management.

4) Sites with high community interest should be considered a higher priority. Community involvement is essential for successful invasive species management; the selection of priority sites should include community participation and interest.

PART 4 – CONTROL AND RESTORATION METHODS

Control and restoration are different components of an overall process to reduce the impact of invasive plants in parks and natural areas in the City of Coquitlam. Their combined goal is to remove invasive plants from parks and other City-owned properties and replace them with native or non-invasive plants. The desired plant community in natural areas is one that is appropriate for the site's environmental conditions, maintains or increases ecological function, recreation use, and aesthetic value, and is also low-maintenance and self-sustaining. It is generally composed of native plants.

Control methods for invasive plants include:

1) Cutting (manual or mechanical) of above ground stems, branches, and leaves by mowing, pruning, brush-cutting, or grazing;
2) Soil and root removal (manual or mechanical) such as tilling or excavation;
3) Surface covering such as mulching to act as physical barrier to plant growth;
4) Biological control such as the introduction of herbivorous insects or fungal pathogens; and,
5) Herbicide application such as spraying or injecting.

Restoration methods include:

1) Natural colonization or succession (including introducing physical features to promote succession);
2) Seeding of desirable grasses, forbs, or trees;
3) Replanting of container grown trees and shrubs; and
4) Planting of live-cuttings.

The effectiveness of the range of control methods for eleven invasive plants is presented in Table 2. Table 3 summarizes the timing of control methods and Table 4 provides an estimate of the length of the control phase. More specific information on control and restoration methods for the six priority invasive plants is provided in the following sections.

Table 2. Summary of effectiveness of common control methods for invasive plants of concern in parks and natural areas of the City of Coquitlam. The effectiveness of each control method is rated on a scale of 0–3, with 0 being ineffective and 3 demonstrating proven effectiveness. Boxes designated with an -1 indicates treatments that may worsen the infestation by increasing seed germination or dispersing root fragments. An asterisk (*) indicates control methods which are generally inappropriate for the type of habitat in which the species is found (e.g., forested areas cannot be mowed). The terms "n/a" means *not applicable* and "n/i" mean *no information*. Green boxes indicate control methods that are effective (rated 2 or 3).

Control Method	Himalayan Blackberry	English Ivy	Yellow Lamium	Japanese Knotweed (+ others)	Vinca	Morning Glory	Purple Loose-strife	Scotch Broom	Police-man's Helmet	Reed Canary Grass	Giant Hogweed
1. Cutting of Stems, Branches, and Leaves (not including roots)											
Mowing	2	1*	0*	-1	0	1	1*	1	3	1	1
Pruning	2	3[i]	0	0	0	0	1[k]	1	0	0	1[k]
Raking	n/a	1	1	n/a	1	1	n/a	n/a	1	0	0
Brushcutting	2	1*	0	-1	0	0	0*	1	3	0	1
Grazing[a]	2*	n/i*	n/i*	n/i*	n/i*	n/i*	n/i*	n/i*	n/i*	2*	2*
2. Root and/or Soil Removal (generally following cutting)											
Root pulling[b]	1	2	2	0	2	2	2	3	2	0	0
Root cutting	1	1	1	-1	1	2	n/a	1	0	n/a	3
Tilling	2	1*	1*	-1*	1	2	2*	-1	1	2	2
Excavating[c]	3	2*	2*	3	2*	2	2*	2	2	2	3
3. Surface Covering (in combination with cutting or tilling)											
Woodchips[d]	2	n/i*	1	0	n/i*	1	0	1	0	0	1
Geotextile	2	n/i*	n/i*	2	n/i*	2	0	0	0	2	2
Biosolids[e]	n/i	n/i	n/i	n/i	n/i	n/i	n/i	1	n/i	n/i	n/i
Imported soil[f]	0	0	0	0	0	0	0	0	1	0	0
4. Biological Controls											
Insect pest	n/a	n/a	n/a	n/a	n/a	n/a	3[j]	n/a	n/a	n/a	n/a
Fungal pest	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
5. Herbicide Application											
Spraying[g]	3	1	2	2*	0	2	2*	2	3*	2*	3
Stem injection[h]	n/a	n/a	n/a	3[l]	n/a	n/a	n/a	n/a	n/a	n/a	3

Notes: [a]pigs, cattle, goats, sheep; [b]by hand; [c]excavation of both roots and surrounding soil; deciduous or mixed chips approx. 30 cm in depth; [e]organic material from sewage treatment; [f]clean soil (30 cm deep) free of seeds and roots; [g]back-pack applicator using glyphosate (Roundup); [h]injection of glyphosate into the stem using specialized equipment; [i]removal from trees only; [j]introduction and maintenance of *Galerucella* beetles; [k]prevents flower development; [l]depends on the age of knotweed plants (established plants may be difficult to kill with herbicides).

Table 3. Recommended timing for prescribed control methods (by month). In most cases, work is recommended during the growing season when plants are visible and have put energy into leaf and flower development. The early growing season is recommended for some species such as Scotch broom to prevent the dispersal of seed. Use of glyphosate (a chemical herbicide) is recommended in the early part of the growing season. Bird nesting may occur in many habitats between April and July, and removal of vegetation should be avoided during this period.

Control Method	Himalayan Blackberry	English Ivy	Yellow Lamium	Knotweed	Vinca	Morning Glory	Purple Loose-strife	Scotch Broom	Police-man's Helmet	Reed Canary Grass	Giant Hogweed
1. Cutting of Stems, Branches, and Leaves (not including roots)											
Mowing	May-Sept	n/a	n/a	May-Sept[b]	n/a	May-Sept	May-Sept	May-June[a]	May-June[a]	May-June[a]	May-June[a]
Pruning	May-Sept	n/a	n/a	May-Sept[b]	n/a	n/a	May-Sept	May-June[a]	n/a	n/a	May-June[a]
Raking	n/a	All year	n/a	n/a	All year	May-Sept	n/a	n/a	May	n/a	0
Brushcutting	May-Sept	n/a	n/a	n/a	n/a	n/a	n/a	May-June[a]	May-June[a]	n/a	May-June[a]
Grazing	May-Sept	n/i*	n/i*	n/i*	n/i*	n/i*	n/a	n/i*	n/i*	May-June[a]	May-Sept
2. Root and/or Soil Removal (generally after cutting)											
Root pulling	May-Sept	All year	All year	n/a	All year	May-Sept	May-June[a]	Dec-June[c]	May-June[a]	n/a	n/a
Root cutting	May-Sept	All year	All year	n/a	All year	May-Sept	n/a	n/a	n/a	n/a	Apr-June
Tilling	May-Sept	All year	All year	n/a	All year	May-Sept	n/a	n/a	May-June[a]	May-Aug	Apr-June
Excavating	All year	All year	All year	All year	All year	May-Sept	May-June[a]	All year	Apr-Aug	May-Aug	Apr-Aug
3. Surface Covering (in combination with cutting or tilling)											
Woodchips	Feb-Sept	n/a	n/a	All year	n/a	May-Sept	n/a	May-June	n/a	n/a	n/a
Geotextile	Feb-Sept	n/a	n/a	All year	n/a	All year	n/a	n/a	n/a	All year	All year
Biosolids	n/a	n/a	n/a	n/a	n/a	n/a	n/a	May-June	n/a	n/a	n/a
Imported soil	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	Apr-May	n/a	n/a
4. Biological Controls											
Insect pest	n/a	n/a	n/a	n/a	n/a	n/a	All year[e]	n/a	n/a	n/a	n/a
Fungal pest	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
5. Herbicide Application											
Spraying	May-June or Sept-Oct	Feb-Mar	Feb-Jun	May-June[d]	n/a	Apr-June	May-Aug	Mar-June	Apr-June	May-Aug	May
Stem injection	n/a	n/a	n/a	May-June Aug-Sept[d]	n/a	n/a	n/a	n/a	n/a	n/a	May

Notes: [a]before seeds have formed; [b]mowing or pruning must be accompanied by removal of stems from the site to prevent resprouting or collection and on-site mulching/composting during hot weather; [c]Scotch broom can be pulled at any time of the year except when seeds are present (to prevent dispersal); [d]herbicide use after cutting and 1 m high regrowth; [e]repeated introductions of *Galarucella* may be required for successful establishment (or re-establishment).

Table 4. Estimated length of control phase (in years) before restoration (replanting) can begin. These estimates are very general and do not reflect site-specific issues such as the intensity of the control method (e.g., mowing frequency), seed-bank, or the amount of root energy (age of infestation). Many sites will require monitoring and some level of maintenance in perpetuity.

Control Method	Himalayan Blackberry	English Ivy	Yellow Lamium	Knotweed	Vinca	Morning Glory	Purple Loose-strife	Scotch Broom	Police-man's Helmet	Reed Canary Grass	Giant Hogweed
1. Cutting of Stems, Branches, and Leaves (not including roots)											
Mowing	2-5 yrs	n/a	n/a	n/a	n/a	1-3 yrs	2-5 yrs	2-5 yrs	1-2 yrs	2-5 yrs	2-5 yrs
Pruning	2-5 yrs	n/a	n/a	n/a	n/a	n/a	ongoing	1-3 yrs	n/a	n/a	ongoing
Raking	n/a	2-5 yrs	2-5 yrs	n/a	2-5 yrs	1-3 yrs	n/a	n/a	1-2 yrs	n/a	n/a
Brushcutting	2-5 yrs	n/a	n/a	n/a	n/a	n/a	n/a	1-3 yrs	1-2 yrs	n/a	2-5 yrs
Grazing	2-5 yrs	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	2-5 yrs	2-5 yrs
2. Root and/or Soil Removal (generally after cutting)											
Root pulling	1-3 yrs	2-5 yrs	2-5 yrs	n/a	2-5 yrs	1-2 yrs	ongoing	1-5 yrs	1-2 yrs	n/a	n/a
Root cutting	1-3 yrs	2-5 yrs	2-5 yrs	n/a	2-5 yrs	1-2 yrs	n/a	n/a	n/a	n/a	1-3 yrs
Tilling	1-3 yrs	2-5 yrs	2-5 yrs	n/a	2-5 yrs	1-2 yrs	n/a	n/a	1-2 yrs	1-2 yrs	1-3 yrs
Excavating	1-3 yrs	1-2 yrs	1-2 yrs	1-2 yrs	1-2 yrs	1-2 yrs	1-2 yrs	1-2 yrs	1-2 yrs	1-2 yrs	1-2 yrs
3. Surface Covering (in combination with cutting or tilling)											
Woodchips	1-3 yrs	n/a	n/a	n/a	n/a	1-2 yrs	n/a	1-5 yrs	n/a	n/a	n/a
Geotextile	1-2 yrs	n/a	n/a	>5 yrs	n/a	1-2 yrs	n/a	n/a	n/a	1-3 yrs	1-3 yrs
Biosolids	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1-3 yrs	n/a	n/a	n/a
Imported soil	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1-2 yrs	n/a	n/a
4. Biological Controls											
Insect pest	n/a	n/a	n/a	n/a	n/a	n/a	ongoing	n/a	n/a	n/a	n/a
Fungal pest	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
5. Herbicide Application[g]											
Spraying	1-2 yrs	1-3 yrs	1-2 yrs	1-5 yrs	n/a	1 yr	1-5 yrs	1-5 yrs	1-2 yrs	1-2 yrs	1-3 yrs
Stem injection	n/a	n/a	n/a	1-5 yrs	n/a	n/a	n/a	n/a	n/a	n/a	1-3 yrs

4.1 Appropriate Invasive Plant Control Methods

Invasive plant control can be a highly interventionist activity which requires cutting, pulling, digging, or the use of herbicides to kill or damage vegetation. It can be in conflict with the values of some park users, and if done inappropriately, can impact other park values.

Action:

1) Review and update the information on control and restoration methods that are appropriate for different situations in the City of Coquitlam.

2) The City's existing IPM policy should guide the use of herbicides for invasive plant management. They should only be applied by qualified professionals and, if required, with appropriate permits in place.

3) Work with DFO and MOE to develop best management practices for invasive plant management in riparian areas, including the appropriate use of mowing, brush cutting, herbicide application, grazing, and mulching. Notification requirements for invasive plant management projects should also be discussed.

4) Avoid vegetation clearing work in the bird nesting season between April 1 and July 31, unless nest searches are undertaken.

5) Consult with the local community and stewardship groups if large scale vegetation management projects are planned. The potential negative effects of invasive plants on park values, including wildlife habitat, should be emphasized. It should also be stressed that given the extent of Himalayan blackberry in the City, opportunities for blackberry picking will remain extensive.

PART 5 – MONITORING AND ADAPTIVE MANAGEMENT

5.1 Monitoring

Monitoring is the repeated collection of measurements to assess changes over time. In the context of invasive plant management it encompasses: (1) measurements to track changes in invasive plant distribution and abundance on a city-wide, watershed, or habitat basis; and, (2) activities to measure the success of control and restoration activities at a specific site. Site-scale monitoring programs are critical to measure the success of invasive plant management projects. Most invasive plants are persistent and difficult to control and monitoring for several years may be required to ensure control methods are appropriate, restoration plantings are successful, and to guide maintenance activities. Monitoring will also help identify unforeseen responses to the control method and therefore must be conducted with adaptive management in mind. In order for adaptive management to work, alternative management options must exist.

Action:

1) Use monitoring to track the invasion of emerging invasive plants and contribute to early detection / rapid response activities. Initially, use giant hogweed as a test for a "plant watch" because it is conspicuous, easily identified, with a high level of public interest and concern because of its risk to human health through dermatitis.

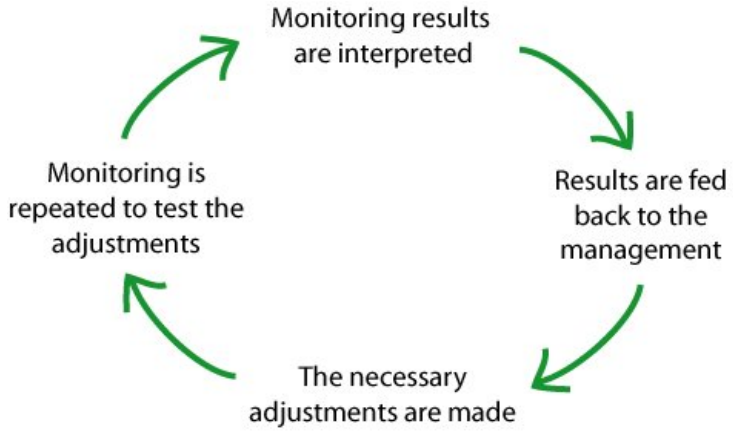
2) Monitor the distribution and abundance of invasive plants on a City-wise basis. The 2006 invasive plant survey should be repeated in 3–5 years to measure the change in invasive plant abundance and distribution.

3) Monitor the effectiveness of control methods and projects. More information is needed on the success of different control and restoration methods to guide future projects. The City should use informal or formal monitoring methods such as photodocumentation and vegetation surveys (e.g., measurements at fixed plots, transects) to measure plant community characteristics. Effective testing often requires a rigourous research design and statistical analysis, but useful results can be achieved through repeated site visits to review project success.

4) Monitor City-wide efforts to control invasive plants. The City should compile, on an annual basis, a summary of invasive plant management projects including their location, scope, lead organization, and, where appropriate, some measure of success (e.g., number of square meters treated). Stewardship groups and other NGOs undertaking invasive plant management projects in Coquitlam parks should be required to submit project details to City of Coquitlam parks staff.

5.2 Adaptive Management

In the context of the Invasive Plant Management Strategy, adaptive management should be considered a semi-formal process to integrate the lessons learned into future decisions. The figure below shows the general steps. Adaptive management is especially important during the initial stages of the strategy's implementation when control and restoration methods are being tested.



Source: www.forestbiodiversityinbc.ca

Action:

1) Require brief post-implementation reports or monitoring programs for all invasive plant management projects; reports should clearly document project successes and failures. Photodocumentation should also be required.

2) Provide a forum for the dissemination of information on project effectiveness. This could include making monitoring results available on a website, developing a summary document that collates results, initiating workshops to review results in combination with a field tour of successful and unsuccessful sites.

PART 6 – EDUCATION AND COLLABORATION

6.1 Roles and Partners

Successful invasive plant management in the City of Coquitlam will require the involvement of a broad range of participants and partners. Table 5 summarizes the potential roles of each of these groups in invasive plant management in the City of Coquitlam and Table 6 indicates their participation in different management phases.

Table 5. Roles of participants and partners in invasive plant management in the City of Coquitlam.

Participant / Partner	Role
City of Coquitlam	Overall responsibility for managing invasive plants in publicly-owned parks and natural areas; facilitation of invasive plant management on private lands through education and outreach; initiating regulation (if appropriate) of invasive plants; funding internal and external invasive plant management projects; monitoring or collation of monitoring and mapping; developing policies and strategic plans; integrating invasive plant management into polices and initiatives including OCP and the ESA strategy.
City of Coquitlam Parks (urban forestry)	Lead department role in the coordination of invasive plant management on public lands; review of internal and external projects; effectiveness monitoring; internal and external communication and outreach activities including staff training.
City of Coquitlam Parks (operations)	Planning and implementation of control projects; formal or informal monitoring of project effectiveness; support for stewardship projects; implementation of best management practices for plant and soil use or movement and plant and soil disposal.
City of Coquitlam Planning	Review of development applications to avoid or restrict the use of invasive plants; integrating invasive plant management into policies and initiatives including OCP and the ESA strategy.
City of Coquitlam Engineering	Use of best management practices through materials (soil) management and revegetation during construction; incorporation of invasive plant issues into transportation and stormwater plans.
Metro Vancouver (GVRD)	Facilitation of collaborative invasive plant management between municipalities; management of invasive plants in regional parks; coordination of invasive plants as part of regional biodiversity planning; development of regional standards for mapping and

	monitoring.
Government Ministries or Agencies (MOTH, MAFF, MOE, DFO and CFIA)	Management of invasive plants on some public lands (e.g., highways); support of invasive plant management through enabling legislation; financial resources; education; direction on best management practices to protect other environmental values (fish and wildlife); regulation of noxious weeds.
Coquitlam First Nation	Management of invasive plants on Coquitlam First Nation's lands; participation in partnerships with the City and others.
Stewardship Groups and Conservation Organizations (stream, watershed, or park stewards)	Planning and implementation of appropriate projects on public-lands; maintenance and monitoring of existing projects; informal research or participation in research; participation in strategic planning; community education and outreach.
Greater Vancouver Invasive Plant Council (GVIPC)	Semi-formal coordination of invasive plant management in the Greater Vancouver area through education, outreach, and research; emphasis on collaborative management and capacity building.
Developers	Management of invasive plants on greenfield and redevelopment sites; removal of existing infestations during development activities, including infestations in newly designated parks; ensuring best management practices (soils, plant selection) for invasive plant management are followed by professionals and construction staff; proper disposal of waste material.
Professionals (landscape architects, landscape designers, architects, engineers, planners, and biologists)	Participating in strategic or operational management of invasive plants on public and private lands including project management, design, implementation, monitoring, and research.
Professional Organizations	Provision of voluntary or regulatory codes of practice for invasive plant management; education and outreach to members; best management practices or standards such as landscape standard.
Academics and Researchers	Technical assistance in the effective control and monitoring of invasive plants; addressing research questions such as biocontrol methods; technical outreach (conferences, workshops, etc).
Nurseries and Plant Suppliers	Voluntary or regulated control of the availability and sale of invasive plants; education of buyers; provision of suitable alternatives; management of soil and plant waste.
Landscape Contractors (construction and maintenance)	Consultation with designers to avoid the use of invasive plants; use of inspected plant material and soil; proper disposal of waste material to prevent dispersal.
Utility Companies	Management of invasive plants on utility corridors and control of dispersal vectors to prevent movement of invasive plants into parks and natural areas.
Park Neighbours	Respecting park boundaries and no dumping signs; preventing the movement of invasive plants from private lands to parks and natural areas; supporting or assisting in invasive plant management projects in parks.
General Public	Supporting and participating in invasive plant management initiatives throughout the City.

Table 6. Roles of participants and partners in different components of invasive plant management in the City of Coquitlam.

Participant / Partner	Prevention	Early Detection	Strategic Management	Operational Management	Restoration and Recovery
City of Coquitlam	X	X	X	X	X
City of Coquitlam Parks (urban forestry)	X	X	X	X	X
City of Coquitlam Parks (operations)	X	X	X	X	X
City of Coquitlam Planning	X		X		
City of Coquitlam Engineering	X		X		
Metro Vancouver	X		X		
Government Ministries or Agencies	X		X		
Coquitlam First Nation	X	X	X	X	X
Stewardship Groups and Conservation Organizations	X	X		X	X
Greater Vancouver Invasive Plant Council	X		X		
Developers	X	X	X	X	X
Professional	X		X	X	X
Professional Organizations	X				
Academics and Researchers	X		X		
Nurseries and Plant Suppliers	X				
Landscape Contractors	X	X		X	X
Utility Companies	X		X	X	X
Park Neighbours	X	X			X
General Public	X	X			X

6.2 Collaboration

Because invasive plants know no boundaries and move across municipal borders, and between public and private lands, effective management requires collaboration. This includes sharing information and experience, coordinating strategic planning, and co-funding projects. Workshops, conferences, and meetings are an important part of collaboration.

Action:

1) Provide a forum for the dissemination of information on invasive plant management. This could include making monitoring results available on a website, developing a summary document that collates the results of control projects, and initiating workshops to review results in combination with a field tour of successful and unsuccessful projects.

2) Establish a Working Group, consisting of staff and community representatives, to provide advice on invasive plant management in the City of Coquitlam.

3) The City of Coquitlam should continue to support the work of the Greater Vancouver

Invasive Plant Council (GVIPC).

4) The City should support research activities on invasive plant management by providing sites for student or faculty research, as well as encouraging staff to initiate or participate in research projects.

6.3 Education and Communication

During the initial stages of implementation of the Invasive Plant Management Strategy, education and communication are critical for increasing awareness, building momentum, and increasing capacity. It is important to remember that invasive plants are a relatively recent concern, and that awareness levels vary widely.

Action:

1) Develop a Communication Plan to guide education and communication activities. The plan should be action-oriented and the implementation of one or more innovative communication projects should be included in the plan's development.

2) Staff training should be undertaken to: (1) increase awareness amongst professional staff in parks, engineering, and planning who are not familiar with invasive plant issues; and (2) provide technical training to park planning and operations staff directly involved in invasive plant management. Informal field tours are recommended for both groups.

3) Landowners adjacent to parks and natural areas should be the focus of public education. Further landowner contact that builds on the letter and information provided to householders in various areas of the City in Spring 2007 should be undertaken as part of the Communication Plan.

PART 7 – RECOMMENDATIONS

The following priorities are recommended for 2008 (see Table 7):

1) Initiate the development of a Communication Plan for invasive plant management for the City. The plan should identify effective print and web methods for momentum building during the initial stages of invasive plant management. A minimum of one component of the Communication Plan should be implemented such as website development, landowner target package, or other media.

2) Coordinate and support volunteer-based control and restoration projects through technical assistance, on-the-ground support, and financial assistance.

3) Continue to monitor invasive plants on a City-wide basis to track changes to overall distribution and abundance, as well as use site-scale monitoring to evaluate the effectiveness of control and restoration methods.

4) Investigate policy options for invasive plant management based on enabling provincial

legislation and municipal precedents.

5) Develop a database and associated GIS-based mapping to track invasive plant management projects in the City as an initial component of a web-based management tool.

6) Develop a pilot project for early detection and rapid response using giant hogweed as a test species. This should include development of a community-based “plant watch” system with reporting requirements, GIS data compilation, and staff trained in the control of small populations of giant hogweed. This pilot project would build on the existing work in eradicating this species in southwest and southcentral Coquitlam, and would test the effectiveness of community-based monitoring for invasive plant detection and mapping.

Table 7. Summary of Invasive Plant Management Strategy recommendations.

No.	Short Term	Prevention	Early Detection Rapid Response	Mgt	Restoration
1	Integrate the Como Creek Watershed invasive plant study results into this Strategy.			✓	✓
2	Track costs associated with each Strategic Action in order to improve budget allocations and resource requirements in future years.			✓	✓
3	Include invasive plant reporting during trail maintenance and inspection work.	✓	✓		
4	Develop a community-based and potentially web-based 'plant watch' program and tool to elicit reports of small infestations of giant hogweed, Japanese knotweed, yellow lamium, English ivy and other plants of concern in natural areas and parks.		✓		
5	Provide an internal awareness and training session for Parks, Engineering and other staff.	✓	✓		
6	Review and strengthen the existing messaging regarding the threat to public health safety with regards to giant hogweed.	✓	✓		
7	Continue to support volunteer-based control and restoration projects through technical assistance, on-the-ground support, and financial assistance.			✓	✓
8	Use the development review process to restrict or prevent the use of known invasive plants, particularly English ivy and yellow lamium, in new landscaped areas.	✓			

No.	Short Term	Prevention	Early Detection Rapid Response	Mgt	Restoration
9	Designate funds for eradicating small populations of giant hogweed, Japanese knotweed, and other emerging invasive plants.		✓		
10	Focus on headwaters to reduce invasive plant dispersal through water movement. Coquitlam River, Hoy Creek, Scott Creek, Hyde Creek and Como Creek have been identified as priority watersheds.		✓		
11	Require brief post-implementation reports as part of monitoring programs for all invasive plant management projects; reports should clearly document project successes and failures. Photo documentation should also be required.			✓	
12	Establish an Invasive Plant Committee of staff and community interests to provide advice on invasive plant management in the City of Coquitlam.	✓		✓	
13	Develop a Volunteer Management Plan to ensure volunteer projects are supported and acknowledged, and also to maximize the effectiveness of volunteer-based stewardship	✓		✓	
14	Develop a Monitoring Program to track invasive plant populations and evaluate the effectiveness of management projects.			✓	
15	Develop a Communication Plan to guide education and communication activities.	✓	✓	✓	

No.	Medium Term	Prevention	Early Detection Rapid Response	Mgt	Restoration
16	Investigate policy options for invasive plant management based on enabling provincial legislation and municipal precedents. For Example: Strengthen requirements in Development Permit guidelines for reporting and managing invasive plants by private developers in environmentally sensitive lands.	✓			
7	Use information from other jurisdictions in the Pacific Northwest to identify emerging invasive plants before they establish in the City of Coquitlam.	✓			
18	Develop a Watch List of plants likely to be invasive in Coquitlam if introduced, or are at initial stages of invasion when eradication is possible. The preliminary watch list should include giant hogweed *(Heracleum mantegazzianum)*; spurge-laurel (syn. Daphne-laurel) *(Daphne laureola)*; butterfly bush *(Buddleja davidii)*; red maple *(Acer rubrum)*; Allegheny blackberry *(Rubus allegheniensis)*; Himalayan knotweed *(Polygonum polystachum)*; and carpet burweed *(Soliva sessilis)*.	✓			
19	Review and update the information on control and restoration methods that are appropriate for different situations in the City of Coquitlam such as riparian areas.			✓	
20	Work with DFO and MOE to develop best management practices for invasive plant management in riparian areas, including the appropriate use of mowing, brush cutting, herbicide application, and mulching. Notification requirements for invasive plant management projects should also be discussed.			✓	
21	Monitor the distribution and abundance of invasive plants on a City-wide basis. The 2006 invasive plant survey should be repeated in 3 to 5 years to measure the change in invasive plant abundance and distribution.			✓	

No.	Medium Term	Prevention	Early Detection Rapid Response	Mgt	Restoration
22	Provide a forum for the dissemination of information on project effectiveness. This could include making monitoring results available on a website, developing a summary document that collates results, initiating an annual workshop to review results in combination with a field tour of successful and unsuccessful sites.			✓	
23	Develop staff training opportunities on regular basis to: (1) increase awareness amongst professional staff in parks, engineering, and planning that are not familiar with invasive plant issues; and (2) provide technical training the park planning and operations staff that are directly involved in invasive plant management. Informal field tours are recommended for both groups.	✓	✓	✓	✓
24	Landowners adjacent to parks and natural areas should be the focus of public education. Further landowner contact that builds on the letter and information provided in Spring 2007 should be developed as part of the communication plan.	✓			
25	Continue to work with GVIPC, BCSLA, BCLNA and nursery growers on consumer education and alternatives to potential invasive ornamental plants.	✓			