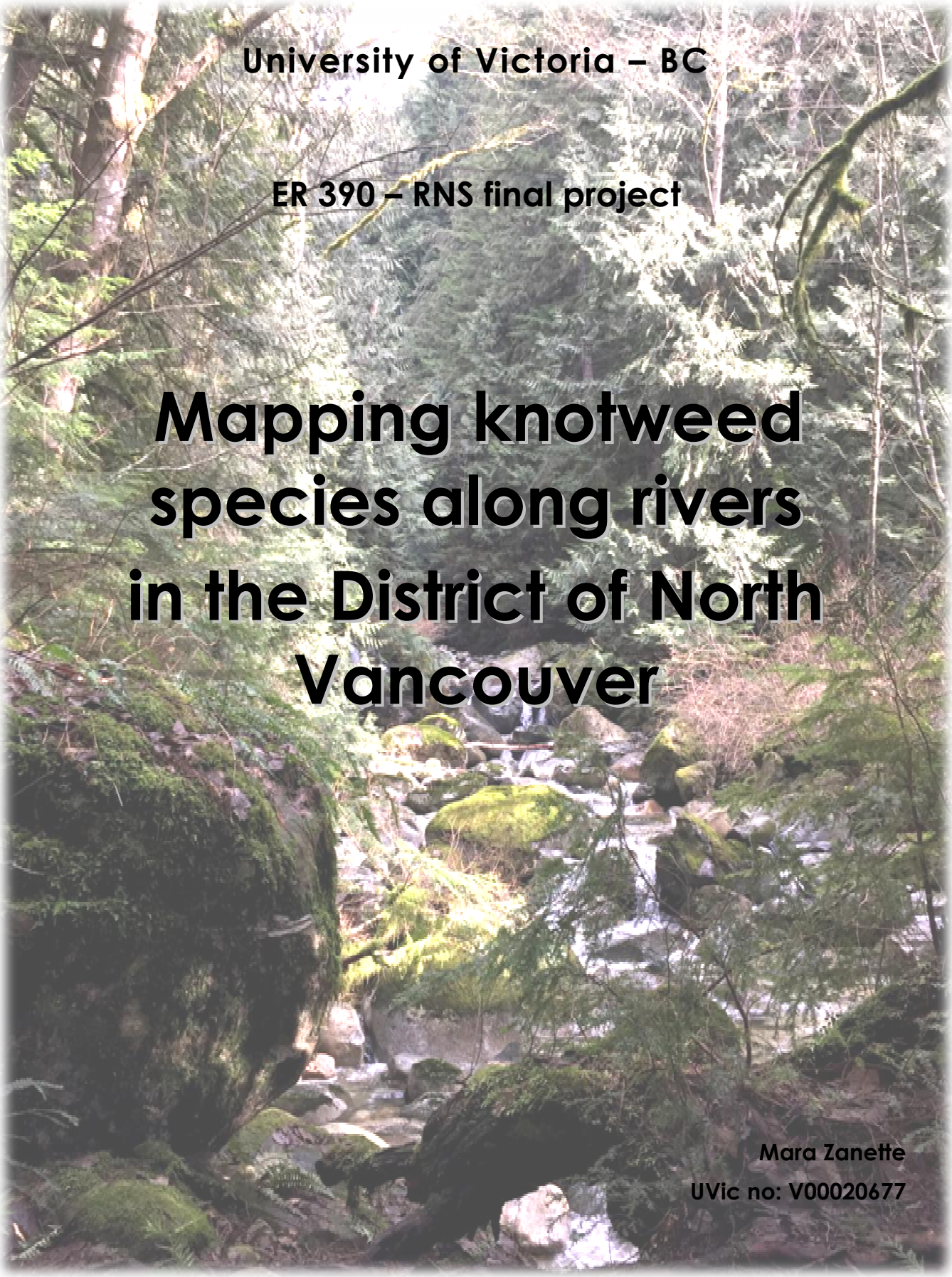

University of Victoria – BC

ER 390 – RNS final project

Mapping knotweed species along rivers in the District of North Vancouver

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UVic no: V00020677

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1 ACKNOWLEDGEMENTS

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Least but not last a special thanks to my family, my friends and my partner who supported me along this wonderful journey.

2 ABSTRACT

Invasive plants reproduce rapidly and spread aggressively, dominating natural areas and altering biological communities; between these, knotweed spp. are one of the 100 worst invasive species. To help manage, prevent, treat and control invasive plants the District of North Vancouver (DNV) prepared the Invasive Plant Management Strategy (IPMS).

One of the objectives of the IPMS is to develop and maintain an invasive plant inventory that provides the information required to make informed decisions regarding invasive plant management. To gather the information needed for a knotweed spp. inventory I used the protocol established by the Invasive Alien Plant Program (IAPP). The result was a map of the actual presence of knotweed spp. along DNV rivers.

The map shows a reduction of knotweed spp. presence along Mosquito creek and MacKay creek, however some upper part of these creek are still overrun by knotweed spp. The greatest occurrences were detected in the lower part of Lynn river and in a spot along Capilano river.

Future challenges will be how to deal with knotweed spp. close to river where glyphosate cannot be used, however classical biological control are now been tested in UK and US with excellent results.

3 INTRODUCTION

3.1 Purpose and Objectives

The purpose of this project is mapping knotweed species and their spreading along six rivers situated in the District of North Vancouver (DNV). The following objectives allow achieving this goal:

- Recording location and abundance of knotweed species along DNV's rivers;
- Gathering together all information collected in an Excel spreadsheet and in a GIS map;
- Comparing results with historical data.

Moreover the project allows updating the inventory of knotweed species. Through the inventory, areas at risk of spreading and areas invaded by species are monitored. Map of knotweed spp. allows keeping them under control: spatial data on plant abundance and distribution provides the information required to make informed decisions regarding invasive plant management (Steele, Coulthard, & Page, 2015).

3.2 Invasive plants

Invasive plants are plants that are not native to a specific place, in our case British Columbia, and the ecosystem in which they are present. Free from the pests that keep them in check in their native ranges, invasive plants reproduce rapidly and spread aggressively, dominating natural areas and altering biological communities (Range Branch - Ministry of Forests and Range, 2010). They produce significant:

- Social impacts: Invasive plants can impact human health and aesthetic values and interfere with recreation opportunities;
- Ecological impacts: Invasive plants can devastate native ecosystems, forming dense monocultures that outcompete or exclude native flora and fauna;
- Economic impacts: Invasive plants are associated with wide ranging economic impacts across a range of sectors in Canada (Steele et al., 2015).

Invasive plants can spread in several different ways: horticultural activities, improper disposal of waste, soil transfer, water movement, wind, and by 'hitching a ride' on vehicles, boats, bikes, people, animals and birds. In most cases successful treatment of an infestation will require repeated manual removals over multiple years (Steele et al., 2015). Invasions by exotic plant species are considered as a major threat for the conservation of biodiversity. Their impacts alarm both ecologists and land managers.

In particular, riparian ecosystems are highly invaded by exotic plants. They provide various ecosystem services including stream temperature moderation, nutrient control, and bank stabilization. However, as riparian ecosystems are frequently disturbed habitats and subjected to high exotic propagule pressure, they are extremely sensitive to plant invasions (Dommanget, Spiegelberger, Cavaillé, & Evette, 2013).

3.3 Knotweed species

Nowadays in British Columbia four knotweed species are present: Japanese knotweed (*Fallopia japonica*), Giant knotweed (*Fallopia sachalenensis*), Bohemian knotweed (*Fallopia x bohemica*), and Himalayan knotweed (*Polygonum polystachyum*). All four

species are similar in appearance, biology, impacts, and distribution (Invasive Species Council of British Columbia, 2016). Knotweeds are one of the 100 worst invasive species as identified by the International Union for Conservation of Nature (IUCN) and a top-ten invasive species for eradication in BC (Invasive Species Council of British Columbia, 2016).

The provinces of Alberta and British Columbia have listed Japanese knotweed and the other knotweeds on their provincial noxious weed lists (Anderson, 2012).

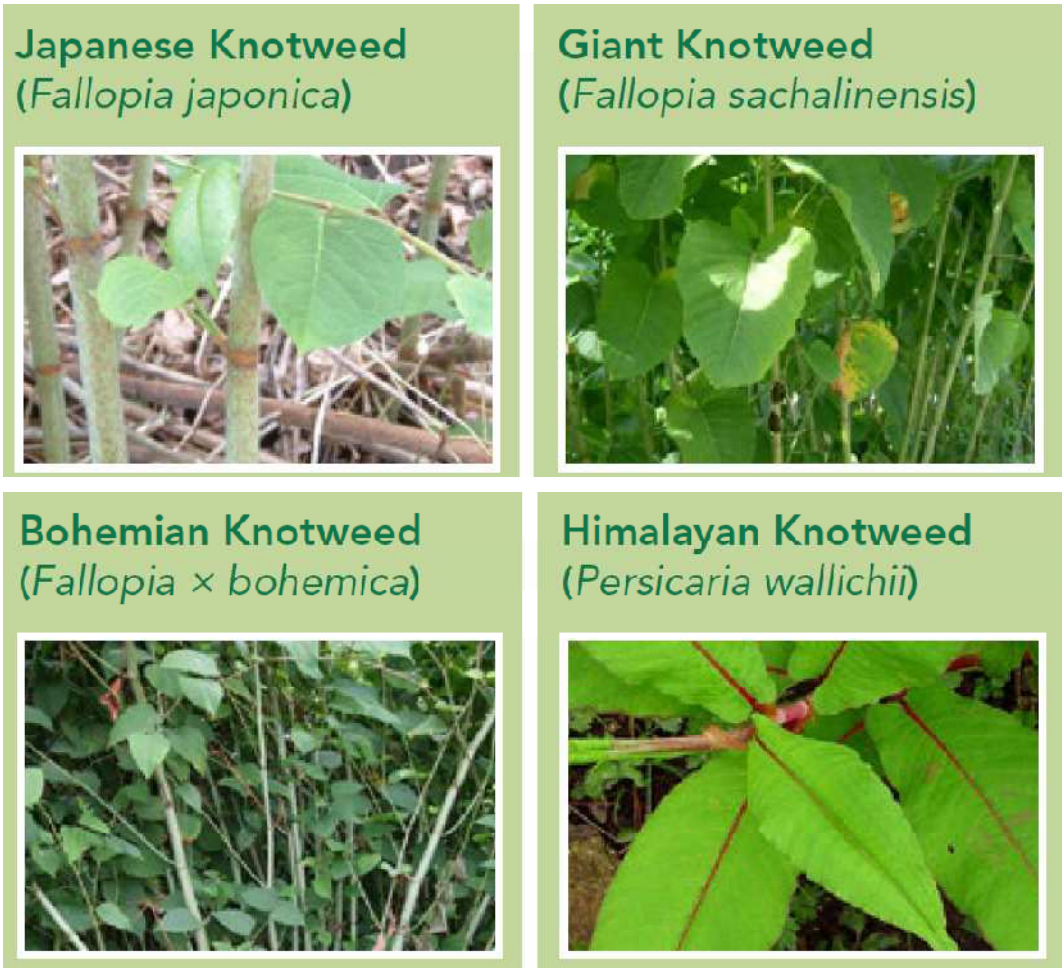


Figure 1 – The four knotweed species present in BC (Anderson, 2012)

Knotweed spp. were introduced to North America from Japan during the late 19th century and they have spread throughout much of North America with the greatest infestations in the Pacific Northwest, the north-eastern United States, and eastern Canada (Grevstad et al., 2013).

Japanese knotweed is an herbaceous perennial that can reach heights of 3 m or more (Skinner, Van Der Grinten, & Gover, 2012). The plant grows rapidly and the stems can grow up to 8 cm per day. The stems die back each fall and the dead stalks remain standing over the winter (Figure 2 and Figure 3) while numerous new stems emerge in the spring (Anderson, 2012). Japanese knotweed quickly develops large underground root systems which account for two thirds of its total mass. The rhizomes can extend more than 2 m deep and 14-18 m in length, and can spread outwards at a rate of about 50 cm/year in optimal conditions. Due to this extensive underground biomass, Japanese knotweed is a very persistent plant, moreover pieces of the stem or rhizome as small as 1 cm can produce new plants within 6 days if they are submerged in water (Anderson, 2012).

Japanese knotweed grows most vigorously in full sunlight, preferring open exposed sites, however it can also grow in deep shade in riparian zones, preferring 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 or forest edges (Anderson, 2012). Natural dispersal involves transportation of rhizome and stem fragments along watercourses. However, human activities, such as the conveyance of contaminated soil for construction and transportation of stems and rhizomes as garden waste, play an important role in the long-distance dispersal of the species (Delbart et al., 2012).

Figure 2 – Dead stalk of Japanese knotweed along Lynn river (Ph. Mara Zanette)

Figure 3 – Dead stalk of Japanese knotweed with remain of flowers along Lynn river (Ph. Mara Zanette)

Infestations are extremely difficult to manage and over time native plant diversity and abundance diminish when an ecosystem becomes dominated by knotweed spp. Correlated with this change in plant diversity is a total reduction in invertebrate abundance and species richness (Rudenko & Hulting, 2010).

Knotweed spp. can increase the risk of soil erosion and the bank instability and they are not recognize by wildlife as food or for cover (Hallworth, 2011), and they are very resilient to chemical control (Rudenko & Hulting, 2010). Moreover knotweed spp. can significantly damage infrastructure, in fact they are able to grow through concrete or asphalt up to 8 cm thick (Anderson, 2012).

The plant is somewhat intolerant of persistent freezing conditions, and as a result, its spread is confined to more southerly parts of Canada; however, as the climate warms it may be able to spread further north (Anderson, 2012).

Restoring habitats dominated by these exotic species requires a better understanding of the importance of abiotic factors controlling the invasive knotweeds performance. As knotweeds spp. are pioneer species in their native range and as it has been shown that they rarely dominate in mature forests in their exotic range (Dommanget et al., 2013).

Since this project took place between November and March for me it was impossible to recognize the different knotweed spp. (Japanese knotweed, Giant knotweed, Bohemian

knotweed, and Himalayan knotweed). For this reason all data collected are referred to knotweed spp.

3.4 District of North Vancouver's Invasive Plant Management Strategy

The Invasive Plant Management Strategy (IPMS) provide a comprehensive framework to help manage, prevent, treat, and control invasive plants on both public and private land, using approaches that are consistent with regional and international best practices. It act as a living document that is updated continually through an adaptive management approach (Steele et al., 2015).

The IPMS aims to provide a framework and policy for strategic management of invasive plants in the District to meet five goals:

1. AWARENESS: Effectively communicate why invasive plants are a problem;
2. PREVENTION: Prevent new invasive plants from establishing and spreading;
3. DETECTION: Detect where invasive plants are growing early and accurately;
4. TREATMENT: Control invasive plants safely and effectively;
5. RESTORATION: Restore natural habitat affected by invasive plants (Steele et al., 2015)

Even if the DNV has been actively managing invasive plants on public land since 1998, more than two dozen species of non-native, invasive plants are still present and established in the District (listed in Table 1). Eradication of all invasive plants is not realistic, feasible or necessary; however, invasive plants require management when they have the potential to cause significant social, ecological and economic impacts (Steele et al., 2015), such as seen in chapter 3.2.

Common Name	Scientific Name	General Impact
English ivy	*Hedera helix*	Ecological, infrastructure
Himalayan blackberry	*Rubus armenicus*	Ecological, recreation
Lamium (yellow archangel)	*Lamium galeobdolon*	Ecological
Knotweed species	*Primarily Fallopia japonica and Fallopia x bohemica*	Ecological, infrastructure
Spurge laurel (daphne laurel)	*Daphne laureola*	Ecological, human health
English holly	*Ilex aquifolium*	Ecological, recreation
Cherry laurel	*Prunus laurocerasus*	Ecological
Periwinkle	*Vinca minor*	Ecological
Scotch broom	*Cytisus scoparius*	Ecological
Policeman's helmet (Himalayan balsam)	*Impatiens glandulifera*	Ecological
Goutweed (bishop's weed)	*Aegopodium podgaria*	Ecological
Saltmeadow cordgrass	*Spartina patens*	Ecological
Giant hogweed	*Heracleum mantegazzianum*	Ecological, human health, recreation

Table 1 – Most common invasive plant species found in the District and their general impact. Species are listed from highest to lowest abundance (Steele et al., 2015)

One of the objectives of the IPMS is to develop and maintain an invasive plant inventory because spatial data on plant abundance and distribution provides the information required to make informed decisions regarding invasive plant management (Steele et al.,

2015). An invasive plant inventory consists of a general review of the species being investigated and the collection of detailed information about the species, such as the physical characteristics of the site, and its location and distribution across the landscape. It may also include proposed treatment activities (Range Branch - Ministry of Forests and Range, 2010)

A consistent and comprehensive inventory can provide the following advantages:

- Spatial data collected is standardised and includes information on species, location and abundance (area, density);
- The data can be used to identify problematic locations for invasive plant introduction, prioritize treatments and direct operations;
- Abundance and dispersal patterns can be analyzed and later used to determine containment lines for high risk species, monitor treatment efficacy, and measure progress towards treatment goals;
- Data can help in tracking change overtime to measure success of treatment (Steele et al., 2015);
- Regular surveillance can also identify new invaders and help ensure effective implementation of early detection and rapid response programs (Range Branch - Ministry of Forests and Range, 2010).

Knotweed spp. have significant economic and ecological impacts. Ecologically, the plant is aggressive and outcompetes native species as well as degrades soil stability along river banks. Economically, it is costly to treat, destroys hard infrastructure and can even severely degrade property values (Steele et al., 2015). For these reasons the IPMS recognize the knotweed spp. as an "high risk species" with a top priority for control and the following treatment approaches are been identified:

- Treat all infestations occurring outside of park natural areas (e.g. road allowances, boulevards, mowed areas, landscaped areas, etc);
- Begin systematic treatment of park natural area from the top end of riparian corridors and moving downstream, prioritizing sensitive ecosystems;
- Collaborate on treatment projects with other public land owners (Steele et al., 2015).

3.5 The Invasive Alien Plant Program

In this project to gather the information regarding knotweed spp. I used the protocol established by the Invasive Alien Plant Program (IAPP) of the BC Government.

The IAPP application promotes effective communication, collaboration, and planning of invasive plant programs in British Columbia. It is composed of two modules: a database that houses inventory, treatment, monitoring, biocontrol agent dispersal, and planning information; and an interactive mapping component that displays the information (Range Branch - Ministry of Forests and Range, 2017). By sharing invasive plant information through a centralized database, agencies involved in invasive plant management are able to plan and coordinate their activities, optimize the use of their resources, avoid duplication of efforts, and record plans for future surveys and treatments. This is important, as there are many agencies performing invasive plant management on the land base, and their activities can overlap and possibly conflict (Range Branch - Ministry of Forests and Range, 2010).

The IAPP map allows highlighting of previously inventoried invasive plant species within a given area of interest and it can provide detailed lists of sites that have been previously inventoried (Figure 4) (Range Branch - Ministry of Forests and Range, 2010).

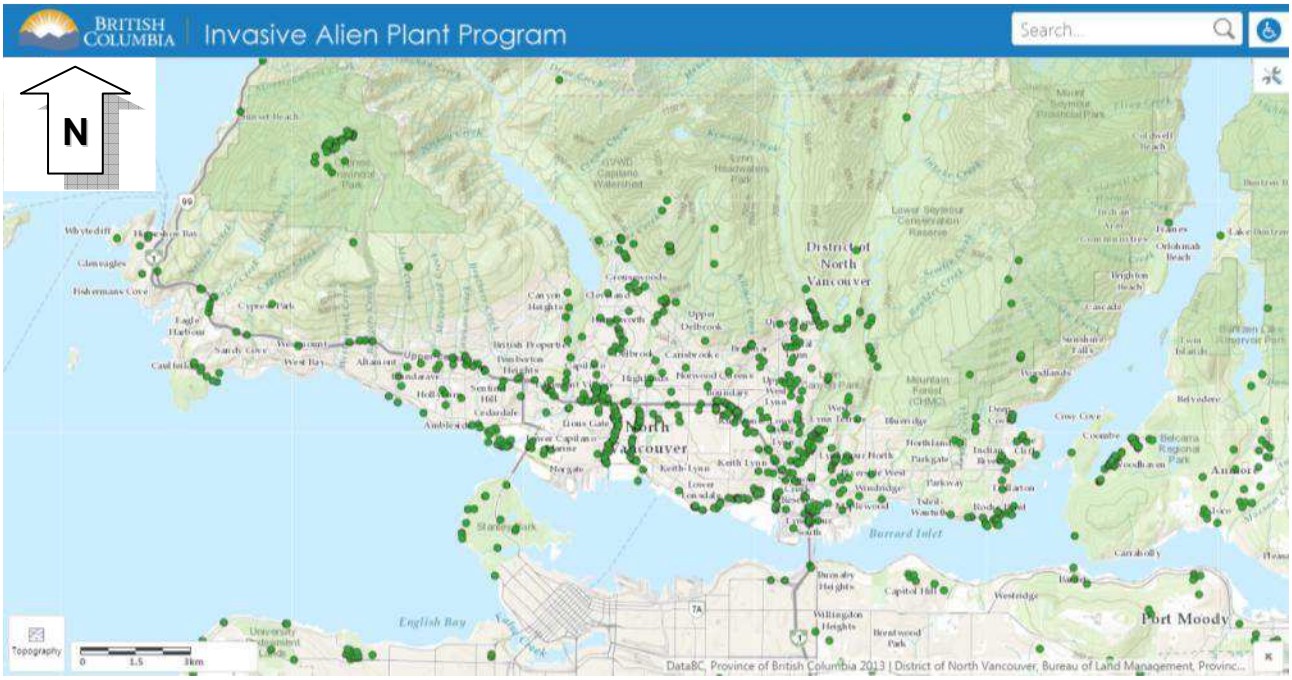


Figure 4 – The IAPP map and in green the sites where Japanese knotweed is been detected (Image from Range Branch - Ministry of Forests and Range (2017))

4 THE STUDY AREA

The project is carried out along some of the creeks and rivers in the District of North Vancouver (Figure 5). All rivers are situated inside the District and precisely in the UTM Zone 10, map n. 092G035 (GeoBC of Ministry of Forests, Lands, 2016). From east to west, the studied rivers are the following:

- Lynn River;
- Wagg Creek;
- Thain Creek;
- Mosquito Creek;
- MacKay Creek;
- Capilano River.

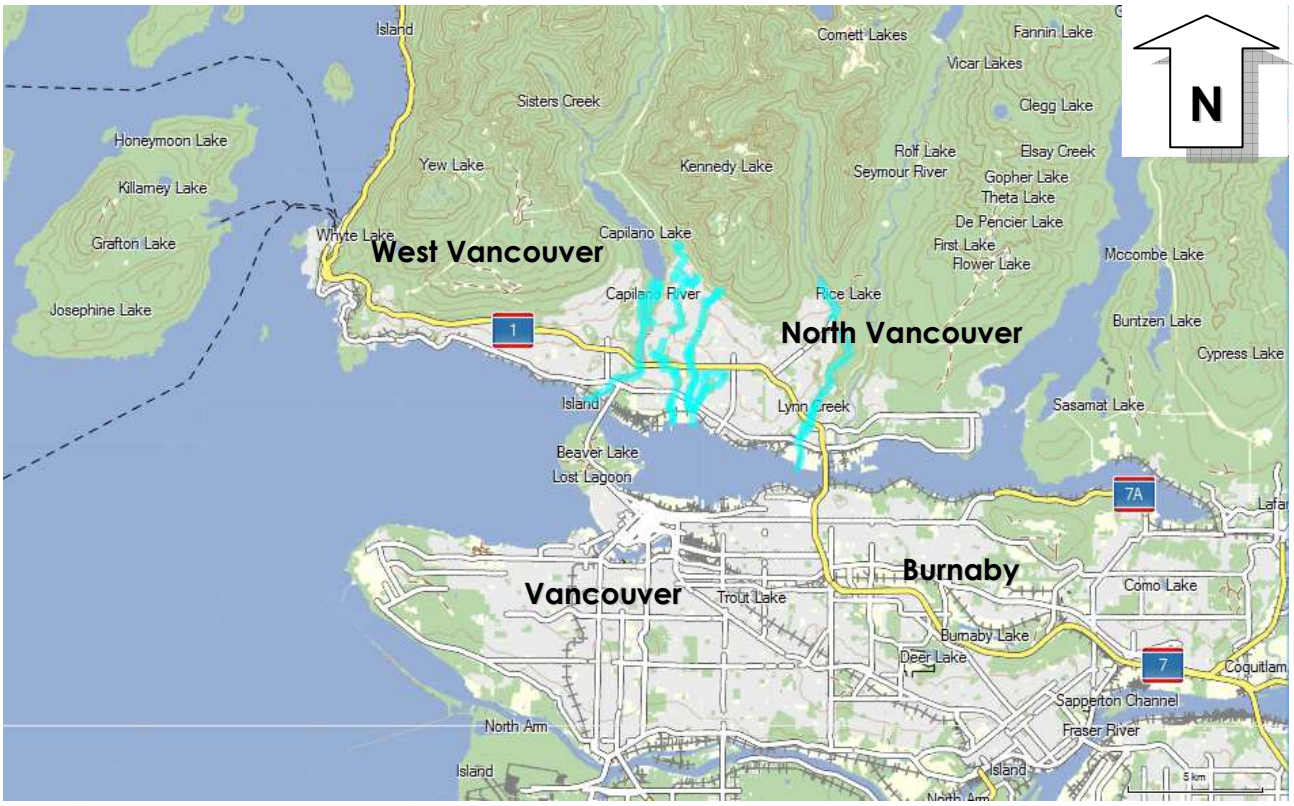


Figure 5 – Location of the studied rivers, in cyan the walked tracks (Image from MapSource)

The lower part of these rivers are mainly in an urban context with several human pressures coming from the surrounding, whereas the upper part of Mosquito creek and Lynn river present a more natural environment.

Rivers are within the Georgia depression ecoprovince and the Fraser Lowland (FRL) Ecosection. In particular they are within the Coastal Western Hemlock, Dry Maritime (CWHdm) biogeoclimatic zone. Some of them have the upper part in the Coastal Western Hemlock, Very Wet Maritime Submontane (CWHvm1) biogeoclimatic zone; however the study area is within the CWHdm biogeoclimatic zone (Figure 6).

The CWH zone occurs at low to middle elevations mostly west of the coastal mountains, along the entire British Columbia coast and on into both Alaska and Washington/Oregon. It penetrates the coastal mountain barrier somewhat in major river valleys, especially along the Fraser and Skeena rivers. The CWH occupies elevations from sea level to 900 m on windward slopes in the south and mid-coast (1050 m on leeward slopes), and to 300 m in the north. It is, on average, the rainiest biogeoclimatic zone in British Columbia (J Pojar, Klinka, & Demarchi, 1991).

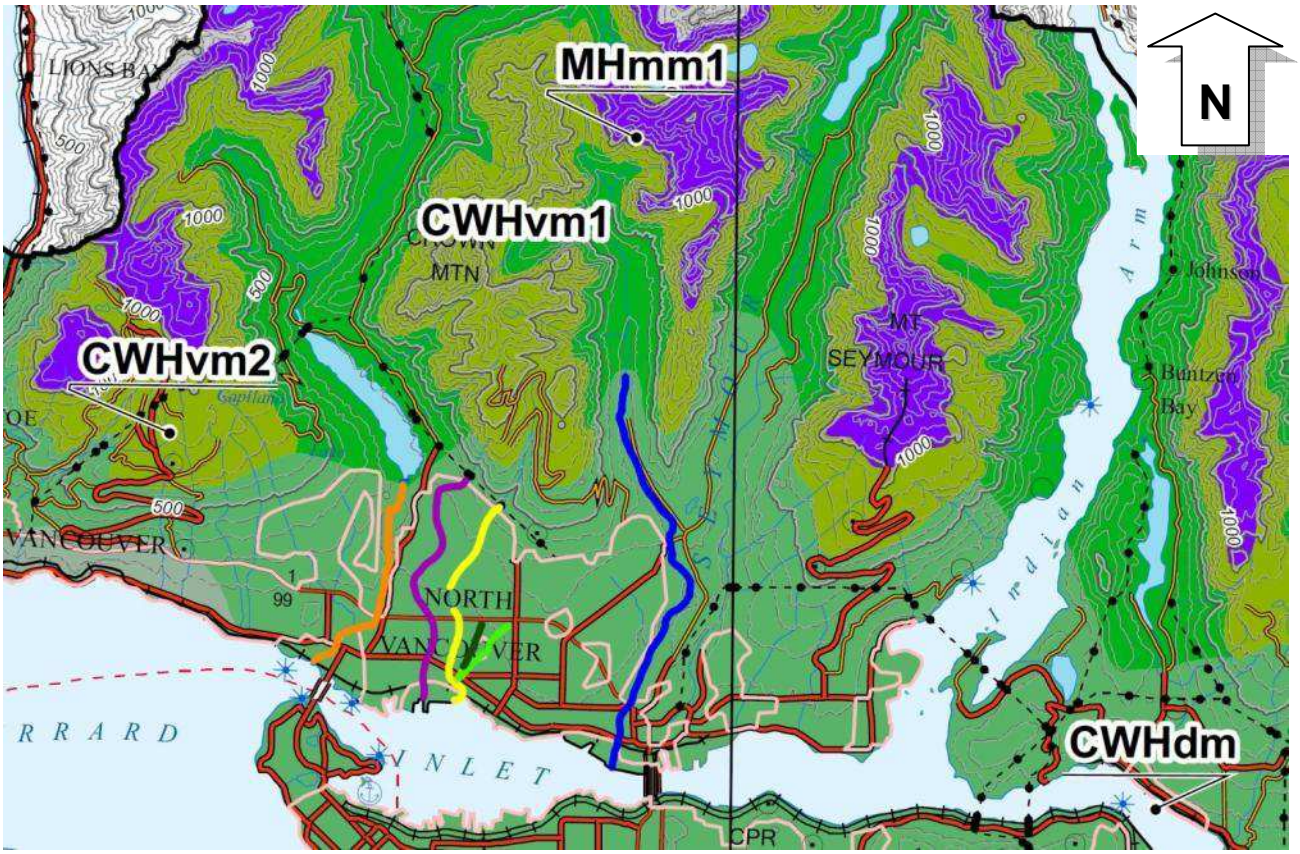


Figure 6 – Biogeoclimatic Ecosystem Classification and locations of monitored rivers (the pink lines are the builtup area while the dotted lines are the tansmission line power. The studied area for each river is market with the following colors: in blue Lynn river, in yellow Mosquito creek, in light green Wagg creek, in dark green Thain creek, in purple MacKay creek and in orange Capilano river (Modified from B.C. Government, 2014)

However in the CWHdm subzone the climate has warm, relatively dry summers and moist, mild winters with little snowfall. The growing seasons are long, and feature only minor water deficits on zonal sites. The forests are dominated by Douglas-fir, western redcedar and western hemlock, while the major understorey species include salal, red huckleberry, *Hylocomium splendens*, *Kindbergia oregana*, *Rhytidiadelphus loreus*, and *Plagiothecium undulatum* (Green & Klinka, 1994).

5 METHODS

The methods I used to collect and analyze information are:

1. Field visits from November 2016 to March 2017;
2. Mapping of knotweed spp. was done walking along rivers. I started from the mouth of the river and I recorded the coordinate for each site with knotweed spp., according to the IAPP reference guide (Range Branch - Ministry of Forests and Range, 2010) and I marked it with a waypoint in the GPS unit. Generally I proceeded toward the spring until there were no more signs of knotweed spp. or until it was impossible to go further ahead;
3. Fill the IAPP Site & Invasive Plant Survey Record (APPENDIX A) and take photos for each point;
4. All data are gathered and collected in a single excel spreadsheet (APPENDIX C) that allows an analysis of distribution and density frequency;

5. Data are compared with data collected in the IAPP webpage (Range Branch - Ministry of Forests and Range, 2017) using a GIS software (Figure 8).

The tools I used to collect and analyze these information are:

- Garmin GPSmap 62s;
- Binocular;
- Camera, measuring tape, notebook;
- Plants of Coastal British Columbia (Jim Pojar et al., 2004);
- Software MapSource from Garmin;
- GIS software (ArcGIS);
- For soil information I used direct observation and data available on Hectares BC (2016);
- Literatures and webpages review (see references for more details).

5.1 The IAPP Site & Invasive Plant Survey Record

In this project to gather information about knotweed spp. I followed the standards set by IAPP for their inventories of invasive species. The information was recorded on the "IAPP Site & Invasive Plant Inventory Record" form (APPENDIX A); an example of the filled forms is in Figure 7.

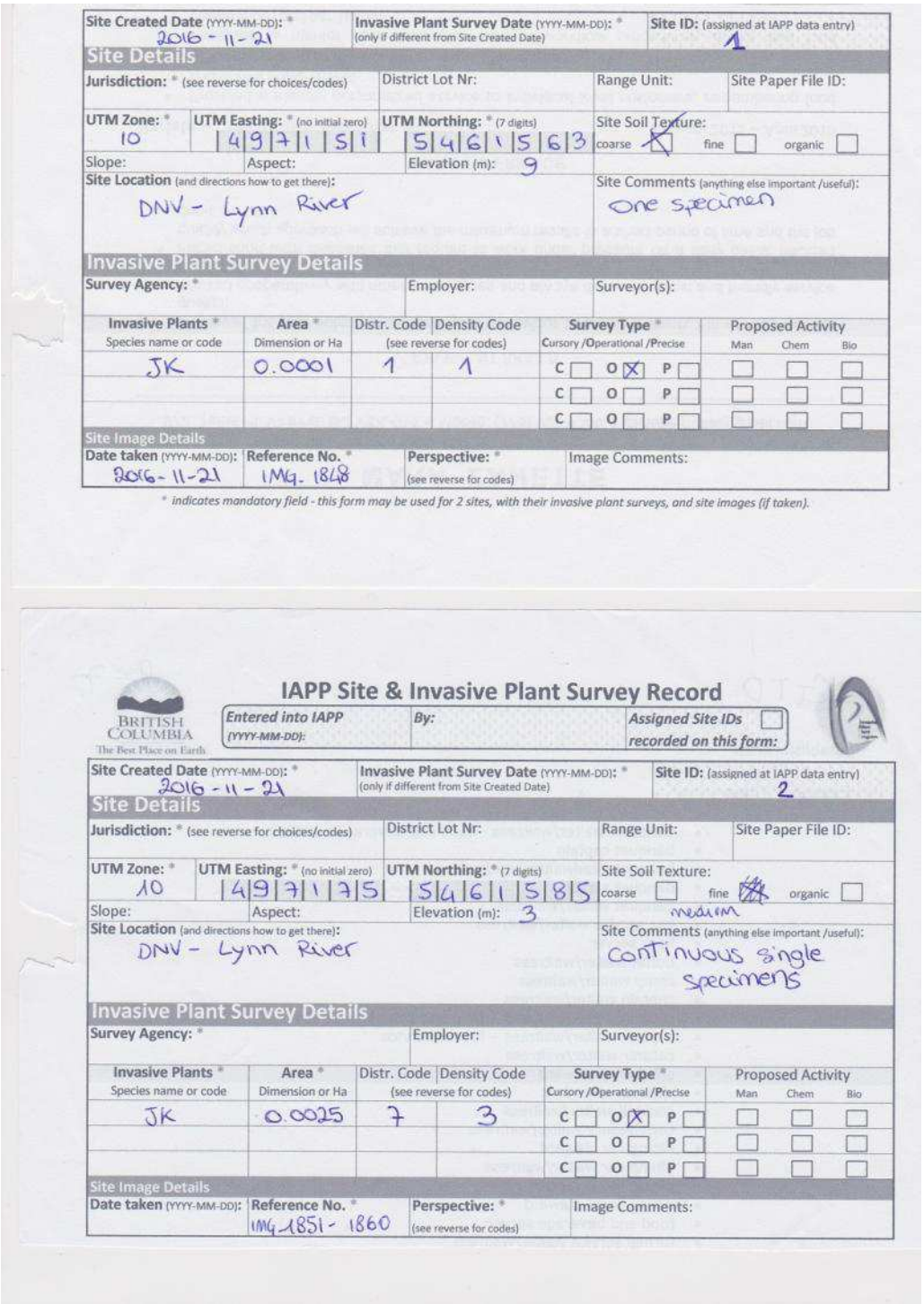
I pursued indications for the "operational standard" approach. This approach provides a systematic way to acquire accurate inventory data that can later be used for different analyses (Range Branch - Ministry of Forests and Range, 2010). For the "operational standard", the field required to be filled are the following:

- invasive plant species,
- GPS coordinates,
- area,
- comments,
- site location,
- digital polygon for infestations larger than 0.2 ha,
- distribution code,
- density code.

For each form I also attached information of matching photos, but it is also possible to fill the form with information about proposed activities (chemical, biological or mechanical treatments).

The GPS location was taken at the centre of the infestation (where possible, some of them were impossible to reach since they were situated inside the river or on the opposite bank) using the NAD 83 datum. The area occupied by knotweed spp. was recorded with measuring tape, however in several sites was a visual estimation.

Continuous invasive plant occurrences with less than a 100-m gap between plants are recorded as one site. Occurrences over 100 m apart with no target species between them are recorded as separate sites as indicate in the IAPP guide.



Site Created Date (YYYY-MM-DD): * 2016 - 11 - 21 | Invasive Plant Survey Date (YYYY-MM-DD): * (only if different from Site Created Date) | Site ID: (assigned at IAPP data entry) 1

Site Details

Jurisdiction: * (see reverse for choices/codes) | District Lot Nr: | Range Unit: | Site Paper File ID:

UTM Zone: * 10 | UTM Easting: * (no initial zero) 497151 | UTM Northing: * (7 digits) 5461563 | Site Soil Texture: coarse [X] fine [ ] organic [ ]

Slope: | Aspect: | Elevation (m): 9

Site Location (and directions how to get there): DNV - Lynn River

Site Comments (anything else important /useful): One specimen

Invasive Plant Survey Details

Survey Agency: * | Employer: | Surveyor(s):

Invasive Plants * Species name or code	Area * Dimension or Ha	Distr. Code (see reverse for codes)	Density Code (see reverse for codes)	Survey Type * Cursory /Operational /Precise	Proposed Activity Man	Chem	Bio
JK	0.0001	1	1	C [ ] O [X] P [ ]	[ ]	[ ]	[ ]
				C [ ] O [ ] P [ ]	[ ]	[ ]	[ ]
				C [ ] O [ ] P [ ]	[ ]	[ ]	[ ]

Site Image Details

Date taken (YYYY-MM-DD): 2016-11-21 | Reference No. * IMG_1848 | Perspective: * (see reverse for codes) | Image Comments:

* indicates mandatory field - this form may be used for 2 sites, with their invasive plant surveys, and site images (if taken).

BRITISH COLUMBIA The Best Place on Earth

IAPP Site & Invasive Plant Survey Record

Entered into IAPP (YYYY-MM-DD): | By: | Assigned Site IDs recorded on this form: [ ]

Site Created Date (YYYY-MM-DD): * 2016 - 11 - 21 | Invasive Plant Survey Date (YYYY-MM-DD): * (only if different from Site Created Date) | Site ID: (assigned at IAPP data entry) 2

Site Details

Jurisdiction: * (see reverse for choices/codes) | District Lot Nr: | Range Unit: | Site Paper File ID:

UTM Zone: * 10 | UTM Easting: * (no initial zero) 497175 | UTM Northing: * (7 digits) 5461585 | Site Soil Texture: coarse [ ] fine [X] organic [ ] medium

Slope: | Aspect: | Elevation (m): 3

Site Location (and directions how to get there): DNV - Lynn River

Site Comments (anything else important /useful): Continuous single specimens

Invasive Plant Survey Details

Survey Agency: * | Employer: | Surveyor(s):

Invasive Plants * Species name or code	Area * Dimension or Ha	Distr. Code (see reverse for codes)	Density Code (see reverse for codes)	Survey Type * Cursory /Operational /Precise	Proposed Activity Man	Chem	Bio
JK	0.0025	7	3	C [ ] O [X] P [ ]	[ ]	[ ]	[ ]
				C [ ] O [ ] P [ ]	[ ]	[ ]	[ ]
				C [ ] O [ ] P [ ]	[ ]	[ ]	[ ]

Site Image Details

Date taken (YYYY-MM-DD): | Reference No. * IMG_1851 - 1860 | Perspective: * (see reverse for codes) | Image Comments:

Figure 7 – Filled forms for the first two points

Finally all data collected with the forms are summarized in a spreadsheet (APPENDIX C) mainly because it is easier to manage, but also because in the IAPP webpage, online forms and data access, are to be previously authorized. These data can also be manage and analyze using a GIS software. The result is a map that allow a simple and easy visualization of different years of monitoring.

6 RESULTS

Data collected during my monitoring and data from the IAPP map (Figure 4) are showed in Figure 8. For the IAPP data I considered only sites close to rivers; these data are generally been collected between 2009 and 2014.

The actual spread of knotweed spp. is undoubtedly different from the one recorded in the IAPP map, with only few sites corresponding in coordinates. The overall estimated area occupied by knotweed spp. along the almost 60 walked kilometers of rivers is 0.47 ha.

Generally knotweed species were found in several sporadically occurring individuals, while single occurrence and, at the opposite, continuous occurrence were rare. The most represented density category was a medium density: several sites presented a density between 2-5 plants/m^2, additionally sites with an high density (6-10 plants/m^2) where well represented as well.

Knotweed spp. were mainly found in coarse texture soil (e.g. sand, cobbles, gravel - water drains quickly) followed by a medium texture soil (loamy or silty soil - water takes longer to drain).

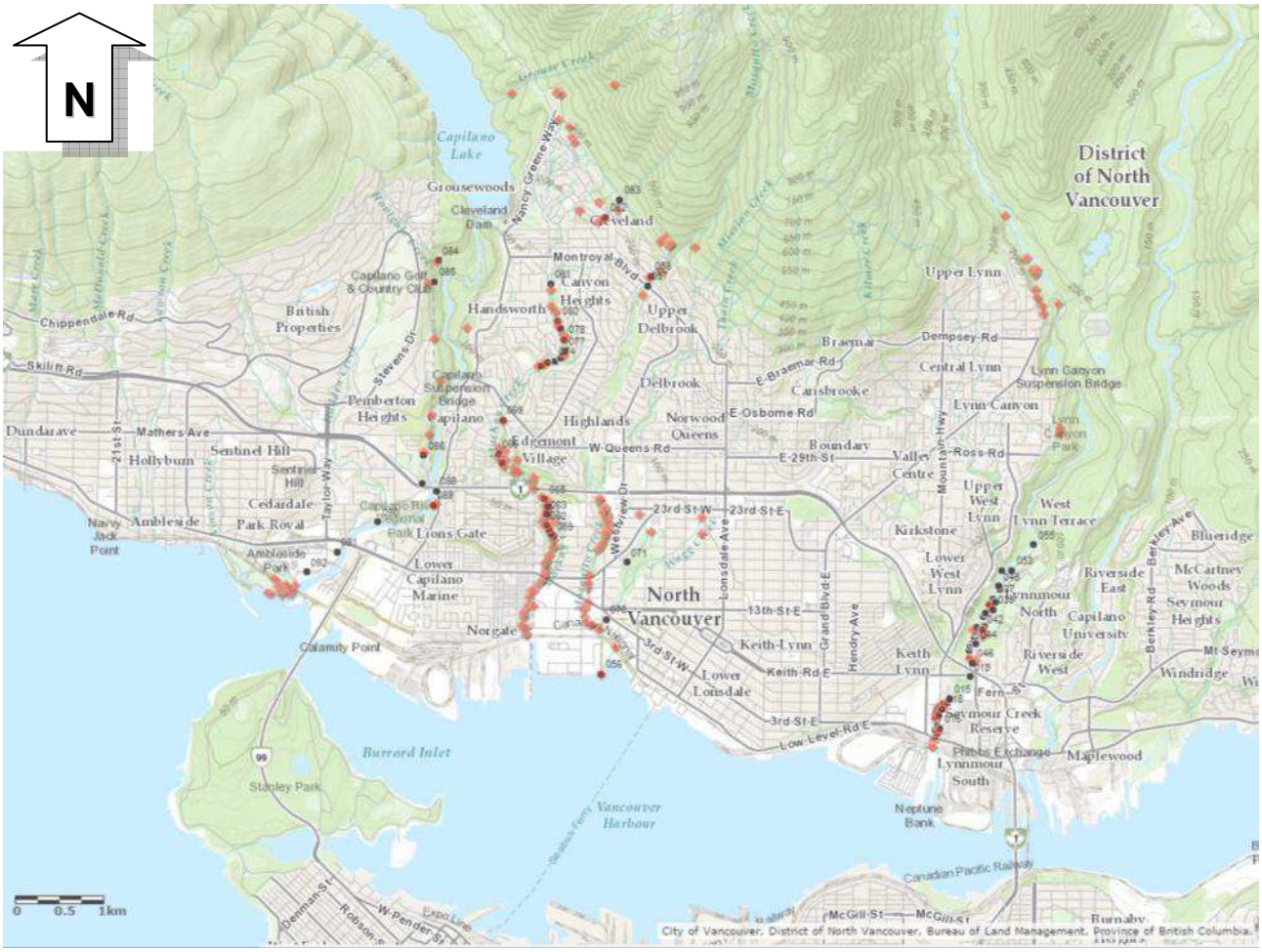


Figure 8 – Distribution map of knotweed spp. comparison between IAPP data (in red) and my monitoring (black point) (image create using ArcGIS by ESRI)

In the lower part of Lynn river (after the confluence of Hasting creek) I found more knotweed spp. that the one recorded in the IAPP map, especially close to the Inter river park. Here the bare slopes near the river were mostly occupied by knotweed spp. (Figure 9), instead in the IAPP map Japanese knotweed is recorded at the top of the slope.

Figure 9 – Photo taken at point n. 39 along Lynn river (Ph. Mara Zanette)

On the other hand, on the upper part of the river close to Lynn Canyon Ecology Centre I was not able to find any knotweed spp., probably due to the impossibility to distinguish single or small occurrence in the middle of a dense understory.

The mainly differences between my monitoring and the IAPP map were found in Mosquito and McKay creek. Both creeks presented recent restoration work and no trace of knotweed spp. were found (Figure 10 and Figure 11).

It was impossible to confirm the presence of the knotweed spp. in the upper part of Mosquito creek due to a block of the path for police investigation (CBC News, 2017).

Figure 10 – Mosquito creek, close to Larson Road (Ph. Mara Zanette)

Figure 11 – McKay creek, close to Marine Drive (Ph. Mara Zanette)

Figure 12 – Clump along McKay creek, site n. 83 (Ph. Mara Zanette)

The lower part of McKay creek does not present anymore knotweed spp., however the upper part still present it in several part of the creek. Moreover one big clump was recorded more north of the last point detected in the IAPP map (Figure 12).

The IAPP map recorded some knotweed spp. close to Grouse Mountain gondola. These sites were not spotted anymore. Furthermore it was impossible to check Capilano river in the part north to Capilano lake, since the area is restricted for the Capilano watershed.

The part between Capilano lake dam and Capilano suspension bridge was impossible to check due to very steep canyon, whereas several specimens were found along the lower part of Capilano river, with a continuous occurrence just south of Park Royal mall.

Several plants were found inside the river bed (Figure 14 and Figure 15) where they are subject to flow and inundation with an high probability to be moved downward.

Figure 13 – Conituous dense occurence just south of Park Royal mall, site n. 92 (Ph. Mara Zanette)

Figure 14 – Single clamp in Lynn river, site n. 7 (Ph. Mara Zanette)

Figure 15 – Clamps in Capilano river, site n. 89 (Ph. Mara Zanette)

7 DISCUSSION

The map created with ArcGIS (Figure 8 and APPENDIX B for more detail) allows an immediate visualization where knotweed spp. are located and where their concentration is higher. Knotweed spp. inventory have been successful in showing that the IAPP data need to be updated more constantly, since rivers are ecosystem in constantly change and the same knotweed spp. could be easily moved elsewhere. However the IAPP webpage provide a wonderful tool to compare and keep track of invasive species, to coordinate treatments and thus not waste resource.

The approach identify by IPMS (chapter 3.4) is the best way to deal with knotweed spp.; that is: begin a systematic treatment of park natural area from the top end of riparian corridors and moving downstream, prioritizing sensitive ecosystems and treat all infestations occurring outside of park natural areas (Steele et al., 2015). Consequently in my opinion the actual need is to limit the upper invasion of rivers and the larger infestation along bare slopes (sites n. 39 and n. 53 along Lynn river and n. 86 along Capilano river). In this latter case restoration projects can be started after treatments, to provide shade with native plants and thus limit the recolonization from knotweed spp.

The time of the year (November - March) in which I collected the data was appropriate to detect big clumps or isolate individual, however it was almost impossible find single specimens where the understory was dense and thick.

As previously mentioned, the mainly differences respect the IAPP map were found in Mosquito creek and McKay creek: both creeks presented recent restoration work and no trace of knotweed spp. This trend seem to be confirmed by the 2016 update of the Invasive Plant Management Strategy, in which a reduction of 71% of knotweed spp. were recorded (Negenman, 2016).

Finally dense and continuous occurrences of knotweed spp. were mainly found in disturbed sites such as open slopes (sites n. 39, n. 53 and n. 86), where light availability is high and thus knotweed spp. can grow rapidly in dense and continuous canopy.

8 RECOMMENDATIONS

The 2016 inventory update of the Invasive Plants Managements Plans of DNV shows a major reduction in abundance and distribution of knotweed spp. (71% reduction). However in riparian zones glyphosate (even used in the stem injection) cannot be used within 1m of the high water mark, which has resulted in continued spread of untreated knotweed (Negenman, 2016). Now the effort should be concentrated in contain and eradicate knotweed spp. inside rivers, in their upper parts (and going downward), and where it forms dense and continuous canopy.

In sites located at a distance greater than 1 m the articles reviewed (Rudenko & Hulting (2010) and Claeson & Bisson (2013) suggested to use glyphosate to contain knotweed spp., in particular Rudenko & Hulting (2010) suggested that glyphosate applied at 4.21 kg ae/ha is the most cost effective treatment option for knotweed spp. However different treatments are needed to completely eradicate the species. They also suggested that restoration to ecologically desirable species may increase the resilience of sites to future infestations (Rudenko & Hulting, 2010).

Beerling (1991) and Dommanget et al. (2013) confirmed that light availability is a major factor in the spread of knotweed spp., thus restore slopes and disturbed sites after treatments seem a key factor to reduce and maybe avoid recolonization of knotweed spp. Maintain dense plant cover combined with periodic removal of plant shoots, either by defoliation or spot herbicide treatments, are necessary for effective long-term control of Japanese knotweed (Skinner et al., 2012); moreover species diversity can enhance invasion resistance by reducing resource availability (Skinner et al., 2012).

In highly disturbed riparian areas, especially along large streams, active reintroduction of native plant species may help promote recovery and prevent exotic plant reinvasions. In addition, planting larger native plants appropriate to floodplain riparian settings can provide shade, potentially weakening shade-intolerant exotic seedlings while supporting shade-tolerant native species (Claeson & Bisson, 2013).

Now the major challenge remains how to control knotweed spp. inside and in proximity of rivers, since glyphosate cannot be used. Moreover the widespread use of chemical control is economically unsustainable and can lead to environmental harm with an increased risk of herbicide resistance (Kurose et al., 2015). However some alternative are been tested: classical biological control has the potential to provide widespread and sustained reduction in knotweed abundance at a very low cost (Grevstad et al., 2013).

Grevstad et al. (2013) examined the suitability of two populations (one from Kyushu and the other from Hokkaido) of the psyllid *Aphalara itadori*. Both populations were capable of halting knotweed plant growth and reducing both above and below ground biomass by more than 50% in just 50 days. Moreover, the psyllids caused mortality of several of the plants during this period. Both were found to be specialized to knotweeds, with only very low occurrence of development on a small number of related non-target plant species (Grevstad et al., 2013).

Mass releases of this agent at selected sites in the UK were initiated in 2011 (Kurose et al., 2015). In 2012, host range screening was completed for A. itadori and a permit to import the psyllid into Canada was submitted to the Canadian Food Inspection Agency in October 2012. The agent has been permitted for release and Agriculture and Agri-Food Canada is at a very early research stage (Invasive Species Council of British Columbia, 2016)

Another classical biological control is the leaf-spot pathogen *Mycosphaerella polygoni-cuspidati* that caused severe damage to J. knotweed. When sentinel knotweed plants from the UK were placed amongst naturally-infected field populations of *F. japonica*, disease incidence and severity were highest. The Mycosphaerella leaf-spot fungus is currently undergoing evaluation for its suitability as a potential classical biological control agent of J. knotweed in the UK(Kurose et al., 2015).

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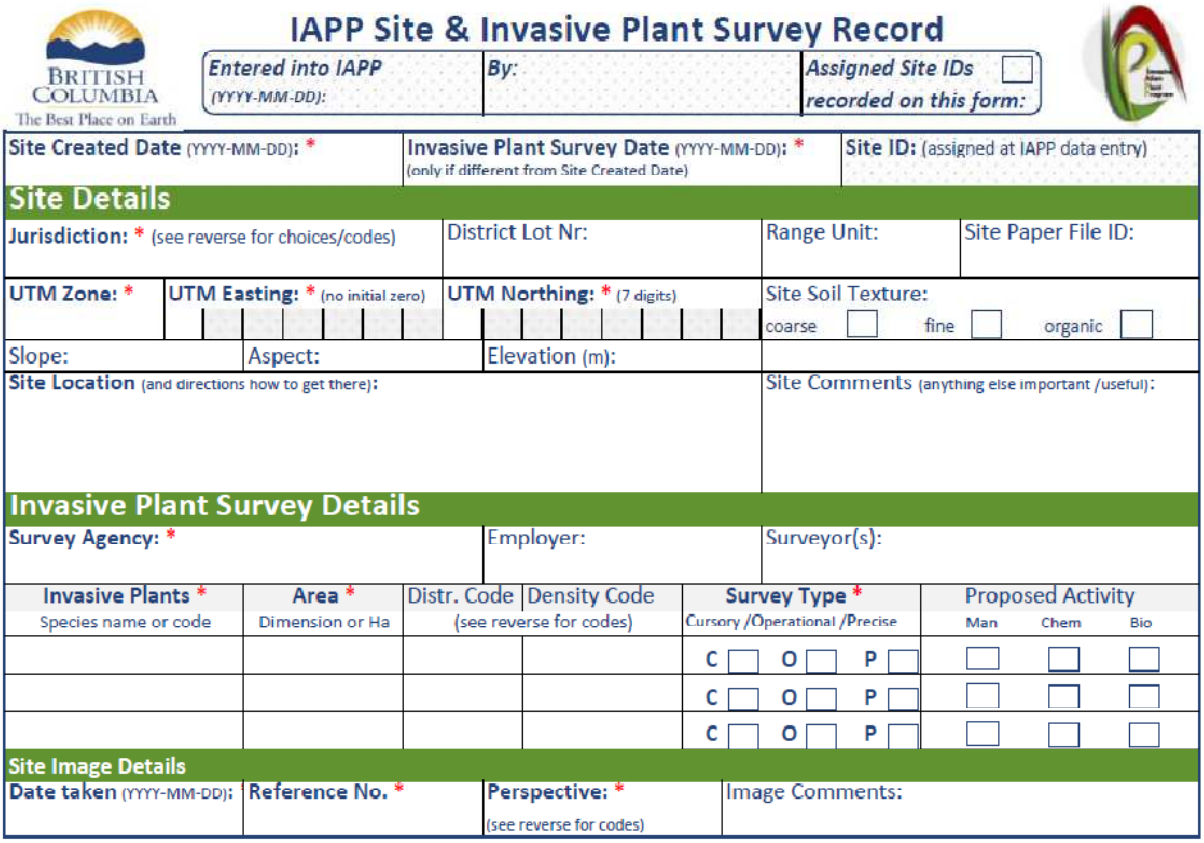
10 APPENDIX A

IAPP Site & Invasive Plant Survey Record



IAPP Site & Invasive Plant Survey Record

BRITISH COLUMBIA
The Best Place on Earth

Entered into IAPP (YYYY-MM-DD):	By:	Assigned Site IDs ☐ recorded on this form:

Site Created Date (YYYY-MM-DD): *	Invasive Plant Survey Date (YYYY-MM-DD): * (only if different from Site Created Date)	Site ID: (assigned at IAPP data entry)

Site Details

Jurisdiction: * (see reverse for choices/codes)	District Lot Nr:	Range Unit:	Site Paper File ID:

UTM Zone: *	UTM Easting: * (no initial zero)	UTM Northing: * (7 digits)	Site Soil Texture: coarse ☐ fine ☐ organic ☐

Slope:	Aspect:	Elevation (m):	

Site Location (and directions how to get there):	Site Comments (anything else important /useful):

Invasive Plant Survey Details

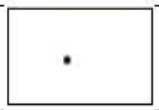
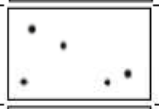
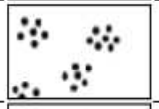
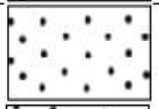
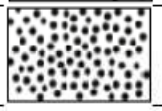
Survey Agency: *	Employer:	Surveyor(s):

Invasive Plants * Species name or code	Area * Dimension or Ha	Distr. Code (see reverse for codes)	Density Code (see reverse for codes)	Survey Type * Cursory /Operational /Precise	Proposed Activity Man	Chem	Bio
				C ☐ O ☐ P ☐	☐	☐	☐
				C ☐ O ☐ P ☐	☐	☐	☐
				C ☐ O ☐ P ☐	☐	☐	☐

Site Image Details

Date taken (YYYY-MM-DD):	Reference No. *	Perspective: * (see reverse for codes)	Image Comments:

Some commonly used codes in IAPP:

Distribution Code		
Code	Reference	Description
1		Rare individual, a single occurrence
2		Few sporadically occurring individuals
3		Single patch or clump of a species
4		Several sporadically occurring individuals
5		A few patches or clumps of a species
6		Several well-spaced patches or clumps of a species
7		Continuous uniform occurrence of well-spaced individuals
8		Continuous occurrence of a species with a few gaps in the distribution
9		Continuous dense occurrence of a species

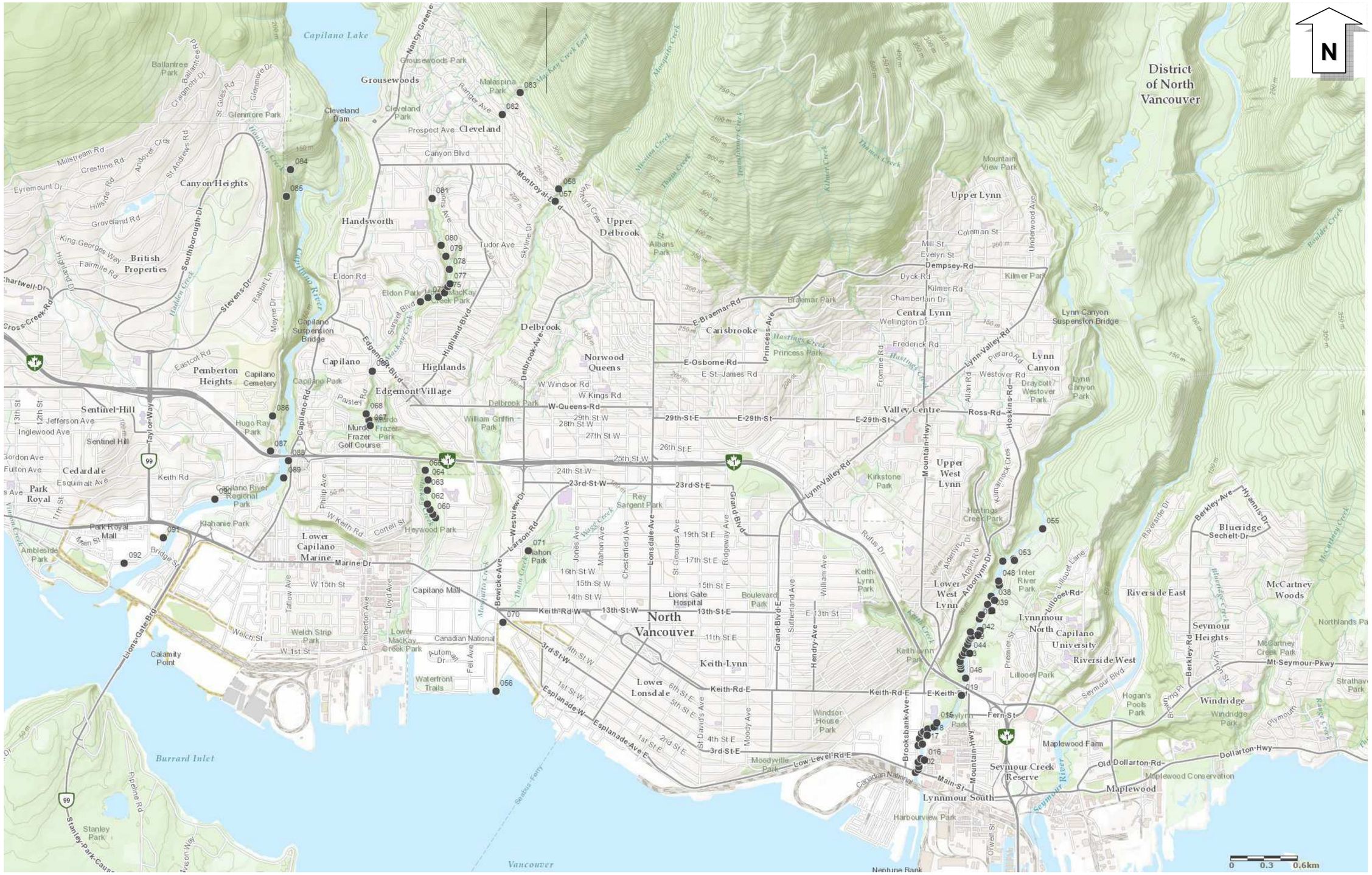
Density Code		
Code	Reference	Description
1	Low	≤ 1 plant/m^2
2	Medium	2-5 plants/m^2
3	High	6-10 plants/m^2
4	Dense	> 10 plants/m^2

Jurisdiction Codes	
MFR	Ministry of Forests and Range
AH	Alaska Highway
HYDR	BC Hydro
BCR	BC Rail
BCTC	British Columbia Transmission Corp.
BNSF	Burlington Northern Santa Fe
CNR	CN Rail
CPR	CP Rail
DND	Department of National Defense
GL	Grazing Lease
FN	First Nations Reserves
MN	Mining Companies
MOT	Ministry of Transportation and Infrastructure
MOE	Ministry of Environment - *except Provincial Parks*
MOP	Municipality owned land
PIPE	Oil and Gas Companies
PNG	Pacific Northern Gas
PCAN	Parks Canada
P	Private Land
PP	Provincial Parks
MRD	Regional District owned land
TEL	Telus
TER	Terasen Gas Inc.
TRP	TransCanada Pipelines
WF	Westcoast Energy Inc.

* *indicates mandatory field - this form may be used for 2 sites, with their invasive plant surveys, and site images (if taken).*

11 APPENDIX B

Distribution map of knotweed species along the monitored rivers (image create using ArcGIS by ESRI)



12 APPENDIX C

Spreadsheet with collected data

SiteID	Site_Created_Date	UTM_Zone	UTM_Easting	UTM_Northing	Soil_Texture_Code	Soil_Texture_description	Genus_code	Species_code	Common_name	Estimated_Area	Distribution_Code	Distribution_description	Density_Code	Density_Description	Plant_Comments	ID_image
1	21/11/2016	10	497151	5461563	1	Coarse	FALL	JAP	Japanese knotweed	0.0001	1	rare individual, a single occurrence	1	Low (<= 1 plant/m2)	One specimen	IMG_1848
2	21/11/2016	10	497175	5461585	1	Coarse	FALL	JAP	Japanese knotweed	0.003	7	continuous uniform occurrence of well-spaced individuals	3	High (6-10 plants/m2)	Continuous single specimens	IMG_1851-1860
4	21/11/2016	10	497184	5461614	1	Coarse	FALL	JAP	Japanese knotweed	0.0001	3	single patch or clump of a species	3	High (6-10 plants/m2)	Single bunch	IMG_1861
5	21/11/2016	10	497176	5461654	2	Medium	FALL	JAP	Japanese knotweed	0.001	4	several sporadically occurring individuals	2	Medium (2-5 plants/m2)	Several single specimens	IMG_1863 IMG_1865
7	21/11/2016	10	497202	5461687	1	Coarse	FALL	JAP	Japanese knotweed	0.0003	5	a few patches or clumps of a species	4	Dense (>10 plants/m2)	Few clumps	IMG_1867 IMG_1869 IMG_1871 IMG_1875
9	21/11/2016	10	497177	5461803	1	Coarse	FALL	JAP	Japanese knotweed	0.0005	4	several sporadically occurring individuals	3	High (6-10 plants/m2)	Single specimens along the river	IMG_1877 IMG_1878
10	21/11/2016	10	497191	5461866	1	Coarse	FALL	JAP	Japanese knotweed	0.0002	4	several sporadically occurring individuals	2	Medium (2-5 plants/m2)	Single specimens	IMG_1882
11	21/11/2016	10	497207	5461914	3	Fine	FALL	JAP	Japanese knotweed	0.0015	8	continuous occurrence of a species with a few gaps in the distribution	4	Dense (>10 plants/m2)	Dense continuous occurrence	IMG_1884 IMG_1887
12	21/11/2016	10	497228	5461930	3	Fine	FALL	JAP	Japanese knotweed	0.0002	4	several sporadically occurring individuals	2	Medium (2-5 plants/m2)	Several single specimens	IMG_1888
13	21/11/2016	10	497265	5461956	1	Coarse	FALL	JAP	Japanese knotweed	0.0015	4	several sporadically occurring individuals	2	Medium (2-5 plants/m2)	On the little island inside the river	IMG_1890 IMG_1893 IMG_1895
14	21/11/2016	10	497316	5461971	1	Coarse	FALL	JAP	Japanese knotweed	0.0001	3	single patch or clump of a species	4	Dense (>10 plants/m2)	Single clump	IMG_1899
15	21/11/2016	10	497344	5462009	3	Fine	FALL	JAP	Japanese knotweed	0.006	4	several sporadically occurring individuals	2	Medium (2-5 plants/m2)	Several single specimens	IMG_1900 IMG_1903
16	21/11/2016	10	497230	5461673	2	Medium	FALL	JAP	Japanese knotweed	0.001	9	continuous dense occurrence of a species	4	Dense (>10 plants/m2)	One big clumps with continuous dense occurrence of single specimens	IMG_1908-10 IMG_1912 IMG_1913
17	21/11/2016	10	497215	5461815	1	Coarse	FALL	JAP	Japanese knotweed	0.0001	3	single patch or clump of a species	3	High (6-10 plants/m2)	Single bunch	IMG_1916
18	21/11/2016	10	497257	5461895	2	Medium	FALL	JAP	Japanese knotweed	0.0004	2	few sporadically occurring individuals	2	Medium (2-5 plants/m2)	Few single specimens	IMG_1922 IMG_1923 IMG_1926
19	21/11/2016	10	497569	5462259	1	Coarse	FALL	JAP	Japanese knotweed	0.0003	2	few sporadically occurring individuals	2	Medium (2-5 plants/m2)	Few single specimens below the bridge	IMG_1931
20	14/01/2017	10	497560	5462497	3	Fine	FALL	JAP	Japanese knotweed	0.0002	3	single patch or clump of a species	4	Dense (>10 plants/m2)	Bunch of plants behind the power line in an open space	IMG_2115 IMG_2117 IMG_2118
21	14/01/2017	10	497563	5462527	2	Medium	FALL	JAP	Japanese knotweed	0.0005	4	several sporadically occurring individuals	4	Dense (>10 plants/m2)	Samples along the trail	IMG_2119 IMG_2122
22	14/01/2017	10	497559	5462546	2	Medium	FALL	JAP	Japanese knotweed	0.0008	4	several sporadically occurring individuals	4	Dense (>10 plants/m2)	Several single specimen between the two paths	IMG_2123 IMG_2124 IMG_2125
23	14/01/2017	10	497558	5462564	2	Medium	FALL	JAP	Japanese knotweed	0.0004	7	continuous uniform occurrence of well-spaced individuals	4	Dense (>10 plants/m2)	Several single specimen between the two paths, some are going down toward the river	IMG_2126 IMG_2127 IMG_2128 IMG_2129
24	14/01/2017	10	497574	5462616	1	Coarse	FALL	JAP	Japanese knotweed	0.0002	2	few sporadically occurring individuals	2	Medium (2-5 plants/m2)	Few single specimen inside the river in a island	IMG_2130
26	14/01/2017	10	497597	5462641	1	Coarse	FALL	JAP	Japanese knotweed	0.005	4	several sporadically occurring individuals	2	Medium (2-5 plants/m2)	Singles specimen scattered in the gravel island inside the river	IMG_2131 IMG_2133 IMG_2134 IMG_2135 IMG_2136 IMG_2138
28	14/01/2017	10	497609	5462674	1	Coarse	FALL	JAP	Japanese knotweed	0.0001	3	single patch or clump of a species	4	Dense (>10 plants/m2)	Single clump	IMG_2142 IMG_2144 IMG_2147
29	14/01/2017	10	497623	5462718	1	Coarse	FALL	JAP	Japanese knotweed	0.0015	6	several well-spaced patches or clumps of a species	3	High (6-10 plants/m2)	Several single specimens with some bunches	IMG_2149 IMG_2150

																IMG_2151
30	14/01/2017	10	497639	5462756	1	Coarse	FALL	JAP	Japanese knotweed	0.0001	2	few sporadically occurring individuals	2	Medium (2-5 plants/m2)	Few single small specimens plus some at the beginning of the island	IMG_2152 IMG_2156
31	14/01/2017	10	497650	5462773	1	Coarse	FALL	JAP	Japanese knotweed	0.0008	4	several sporadically occurring individuals	2	Medium (2-5 plants/m2)	Singles specimens along the river bank	IMG_2157 IMG_2158
32	14/01/2017	10	497661	5462796	1	Coarse	FALL	JAP	Japanese knotweed	0.0001	5	a few patches or clumps of a species	2	Medium (2-5 plants/m2)	A bunch at the top of the river bank	IMG_2162
33	14/01/2017	10	497651	5462830	2	Medium	FALL	JAP	Japanese knotweed	0.01	8	continuous occurrence of a species with a few gaps in the distribution	4	Dense (>10 plants/m2)	A lot of specimen close to a building along the path	IMG_2163 IMG_2165
34	14/01/2017	10	497729	5462946	1	Coarse	FALL	JAP	Japanese knotweed	0.002	4	several sporadically occurring individuals	2	Medium (2-5 plants/m2)	Some bunches along the rive	IMG_2166 IMG_2167
35	14/01/2017	10	497752	5462987	1	Coarse	FALL	JAP	Japanese knotweed	0.0002	5	a few patches or clumps of a species	2	Medium (2-5 plants/m2)	Some bunches along the river	IMG_2168 IMG_2169
36	14/01/2017	10	497805	5463082	1	Coarse	FALL	JAP	Japanese knotweed	0.0003	2	few sporadically occurring individuals	2	Medium (2-5 plants/m2)	Few single specimen along river	IMG_2171
37	14/01/2017	10	497841	5463154	1	Coarse	FALL	JAP	Japanese knotweed	0.0002	2	few sporadically occurring individuals	2	Medium (2-5 plants/m2)	Few single specimens	IMG_2172 IMG_2173
38	14/01/2017	10	497867	5463114	1	Coarse	FALL	JAP	Japanese knotweed	0.0008	4	several sporadically occurring individuals	3	High (6-10 plants/m2)	Some single specimens along the river bank, close to the walking bridge	IMG_2174
39	14/01/2017	10	497841	5463026	1	Coarse	FALL	JAP	Japanese knotweed	0.003	6	several well-spaced patches or clumps of a species	3	High (6-10 plants/m2)	Several bunches on open slope (no trees), close to the street, close to the river	IMG_2176 IMG_2178 IMG_2181
41	14/01/2017	10	497736	5462842	1	Coarse	FALL	JAP	Japanese knotweed	0.0003	5	a few patches or clumps of a species	2	Medium (2-5 plants/m2)	Big clumps in the river	IMG_2182 IMG_2184 IMG_2185
42	14/01/2017	10	497717	5462804	1	Coarse	FALL	JAP	Japanese knotweed	0.0015	6	several well-spaced patches or clumps of a species	3	High (6-10 plants/m2)	On the slope, close to a fenced area, 2 big bunches plus other single specimens	IMG_2183 IMG_2186 IMG_2187
44	14/01/2017	10	497642	5462637	1	Coarse	FALL	JAP	Japanese knotweed	0.0001	2	few sporadically occurring individuals	2	Medium (2-5 plants/m2)	Some single specimen	IMG_2188
46	14/01/2017	10	497605	5462414	1	Coarse	FALL	JAP	Japanese knotweed	0.007	2	few sporadically occurring individuals	2	Medium (2-5 plants/m2)	Few scattered young specimens along the river. Some more on the upper river bank	IMG_2192 IMG_2194
47	14/01/2017	10	497914	5463257	1	Coarse	FALL	JAP	Japanese knotweed	0.0002	2	few sporadically occurring individuals	2	Medium (2-5 plants/m2)	Fes single specimens	IMG_2196 IMG_2197
48	14/01/2017	10	497905	5463291	1	Coarse	FALL	JAP	Japanese knotweed	0.0002	5	a few patches or clumps of a species	2	Medium (2-5 plants/m2)	Few bunch in the island inside the river	IMG_2198 IMG_2199
50	14/01/2017	10	497944	5463471	1	Coarse	FALL	JAP	Japanese knotweed	0.005	4	several sporadically occurring individuals	3	High (6-10 plants/m2)	Several single specimens on the other side of the river bank	IMG_2200 IMG_2201 IMG_2202
52	14/01/2017	10	498043	5463489	1	Coarse	FALL	JAP	Japanese knotweed	0.0004	5	a few patches or clumps of a species	4	Dense (>10 plants/m2)	Three big bunches just next to the road	IMG_2205
53	14/01/2017	10	498051	5463477	1	Coarse	FALL	JAP	Japanese knotweed	0.15	6	several well-spaced patches or clumps of a species	3	High (6-10 plants/m2)	Several specimen along the slope	IMG_2204 IMG_2206
55	14/01/2017	10	498303	5463765	1	Coarse	FALL	JAP	Japanese knotweed	0.001	6	several well-spaced patches or clumps of a species	2	Medium (2-5 plants/m2)	Several clumps inside the river (around 20 m from the riverbank)	IMG_2207 IMG_2208 IMG_2209 IMG_2210 IMG_2211
	-															
56	18/02/2017	10	493347	5462298	1	Coarse	FALL	JAP	Japanese knotweed	0.0001	2	few sporadically occurring individuals	2	Medium (2-5 plants/m2)	A couples of plants on the other side of the river	IMG_2335 IMG_2336
57	23/02/2017	10	493887	5466723	1	Coarse	FALL	JAP	Japanese knotweed	0.0004	4	several sporadically occurring individuals	3	High (6-10 plants/m2)	On the other side of the river, several plant on 2 x 2 m2	IMG_2376
58	23/02/2017	10	493920	5466835	1	Coarse	FALL	JAP	Japanese knotweed	0.0002	4	several sporadically occurring individuals	3	High (6-10 plants/m2)	On the side of a road, two different spots close to each other	IMG_2377 IMG_2378 IMG_2379
59	23/02/2017	10	492796	5463869	1	Coarse	FALL	JAP	Japanese knotweed	0.0003	5	a few patches or clumps of a species	3	High (6-10 plants/m2)	Few specimens on the other side of the river, 3 small bunches	IMG_2395 IMG_2396
60	23/02/2017	10	492777	5463898	2	Medium	FALL	JAP	Japanese knotweed	0.0006	4	several sporadically occurring individuals	2	Medium (2-5 plants/m2)	Several specimens along the river, generally 5-10 m from each other	IMG_2397
61	23/02/2017	10	492750	5463944	1	Coarse	FALL	JAP	Japanese knotweed	0.0001	4	several sporadically occurring individuals	3	High (6-10 plants/m2)	Several specimens	IMG_2398
62	23/02/2017	10	492723	5463993	1	Coarse	FALL	JAP	Japanese knotweed	0.0008	4	several sporadically occurring individuals	2	Medium (2-5 plants/m2)	Just below a small power line, on both side of the river	IMG_2399 IMG_2400

63	23/02/2017	10	492724	5464119	1	Coarse	FALL	JAP	Japanese knotweed	0.002	4	several sporadically occurring individuals	2	Medium (2-5 plants/m2)	Singles specimens for around 5-10 m	IMG_2401
64	23/02/2017	10	492732	5464211	2	Medium	FALL	JAP	Japanese knotweed	0.0001	3	single patch or clump of a species	2	Medium (2-5 plants/m2)	After the small bridge, just 4 singles specimens	IMG_2402
65	23/02/2017	10	492703	5464294	1	Coarse	FALL	JAP	Japanese knotweed	0.01	8	continuous occurrence of a species with a few gaps in the distribution	4	Dense (>10 plants/m2)	A lots in both side of the river, it continues up on both side	IMG_2403 IMG_2404 IMG_2405
66	23/02/2017	10	492198	5464751	2	Medium	FALL	JAP	Japanese knotweed	0.0006	4	several sporadically occurring individuals	2	Medium (2-5 plants/m2)	Probable treatment	IMG_2406 IMG_2407
67	23/02/2017	10	492208	5464701	2	Medium	FALL	JAP	Japanese knotweed	0.0001	3	single patch or clump of a species	2	Medium (2-5 plants/m2)	Six single specimens	IMG_2408
68	23/02/2017	10	492171	5464807	1	Coarse	FALL	JAP	Japanese knotweed	0.0001	3	single patch or clump of a species	4	Dense (>10 plants/m2)	One clump	IMG_2409
69	23/02/2017	10	492225	5465195	1	Coarse	FALL	JAP	Japanese knotweed	0.0001	2	few sporadically occurring individuals	2	Medium (2-5 plants/m2)	Eight single specimen	IMG_2410
70	24/02/2017	10	493407	5462919	2	Medium	FALL	JAP	Japanese knotweed	0.05	6	several well-spaced patches or clumps of a species	3	High (6-10 plants/m2)	A lots, just between a house and the river	IMG_2414 IMG_2416 IMG_2417 IMG_2420
71	24/02/2017	10	493644	5463569	2	Medium	FALL	JAP	Japanese knotweed	0.001	6	several well-spaced patches or clumps of a species	2	Medium (2-5 plants/m2)	Other side of the river, slope with few specimens in groups	IMG_2426 IMG_2428 IMG_2430
72	25/02/2017	10	492667	5465819	1	Coarse	FALL	JAP	Japanese knotweed	0.0004	4	several sporadically occurring individuals	3	High (6-10 plants/m2)	Few specimens in the other side of the river	IMG_2437
73	25/02/2017	10	492736	5465857	1	Coarse	FALL	JAP	Japanese knotweed	0.0003	5	a few patches or clumps of a species	2	Medium (2-5 plants/m2)		IMG_2438
74	25/02/2017	10	492825	5465865	1	Coarse	FALL	JAP	Japanese knotweed	0.00001	1	rare individual, a single occurrence	1	Low (<= 1 plant/m2)	One single specimen	IMG_2439
75	25/02/2017	10	492883	5465902	1	Coarse	FALL	JAP	Japanese knotweed	0.0006	4	several sporadically occurring individuals	3	High (6-10 plants/m2)	Lots of single specimens	IMG_2440 IMG_2441 IMG_2442
76	25/02/2017	10	492917	5465956	1	Coarse	FALL	JAP	Japanese knotweed	0.001	7	continuous uniform occurrence of well-spaced individuals	4	Dense (>10 plants/m2)	Lots of single and clumps	IMG_2444 IMG_2445 IMG_2446
77	25/02/2017	10	492934	5465980	2	Medium	FALL	JAP	Japanese knotweed	0.001	8	continuous occurrence of a species with a few gaps in the distribution	4	Dense (>10 plants/m2)	Lots of single and clumps	IMG_2448 IMG_2449 IMG_2451 IMG_2453 IMG_2454 IMG_2456
78	25/02/2017	10	492928	5466113	1	Coarse	FALL	JAP	Japanese knotweed	0.0007	7	continuous uniform occurrence of well-spaced individuals	3	High (6-10 plants/m2)	On the other side of the river, around 20 m from the point	IMG_2457
79	25/02/2017	10	492895	5466232	1	Coarse	FALL	JAP	Japanese knotweed	0.0005	4	several sporadically occurring individuals	2	Medium (2-5 plants/m2)	Single specimens	IMG_2459
80	25/02/2017	10	492853	5466327	1	Coarse	FALL	JAP	Japanese knotweed	0.0004	4	several sporadically occurring individuals	2	Medium (2-5 plants/m2)	Single specimens	IMG_2460 IMG_2462
81	25/02/2017	10	492772	5466751	1	Coarse	FALL	JAP	Japanese knotweed	0.0001	3	single patch or clump of a species	4	Dense (>10 plants/m2)	Next to house	IMG_2466
82	25/02/2017	10	493408	5467509	1	Coarse	FALL	JAP	Japanese knotweed	0.0003	5	a few patches or clumps of a species	3	High (6-10 plants/m2)	Few clumps	IMG_2468
83	25/02/2017	10	493569	5467705	1	Coarse	FALL	JAP	Japanese knotweed	0.0001	3	single patch or clump of a species	4	Dense (>10 plants/m2)	Single clump	IMG_2470 IMG_2471
84	01/03/2017	10	491491	5467017	1	Coarse	FALL	JAP	Japanese knotweed	0.0004	2	few sporadically occurring individuals	2	Medium (2-5 plants/m2)	Few groups with 5 individuals stems	IMG_2492 IMG_2493 IMG_2494 IMG_2496
85	01/03/2017	10	491447	5466774	1	Coarse	FALL	JAP	Japanese knotweed	0.0001	2	few sporadically occurring individuals	2	Medium (2-5 plants/m2)	Some alone specimens	IMG_2498 IMG_2499 IMG_2500
86	01/03/2017	10	491322	5464790	1	Coarse	FALL	JAP	Japanese knotweed	0.15	9	continuous dense occurrence of a species	4	Dense (>10 plants/m2)	Huge amount, all the slope for around 50-60 m, close to a site where a treatment was done in June 2016	IMG_2514 IMG_2516 IMG_2518 IMG_2519
87	01/03/2017	10	491305	5464470	1	Coarse	FALL	JAP	Japanese knotweed	0.003	7	continuous uniform occurrence of well-spaced individuals	3	High (6-10 plants/m2)	A lot of single specimens	IMG_2522 IMG_2524
88	01/03/2017	10	491464	5464386	1	Coarse	FALL	JAP	Japanese knotweed	0.0001	3	single patch or clump of a species	3	High (6-10 plants/m2)	One big chunk in the middle of the river	IMG_2526

89	01/03/2017	10	491423	5464229	1	Coarse	FALL	JAP	Japanese knotweed	0.0004	5	a few patches or clumps of a species	3	High (6-10 plants/m2)	Chunks in the middle of the river bed	IMG_2527 IMG_2528
90	01/03/2017	10	490797	5464037	1	Coarse	FALL	JAP	Japanese knotweed	0.0005	5	a few patches or clumps of a species	3	High (6-10 plants/m2)	Chunks in the middle of the river bed	IMG_2530 IMG_2532
91	01/03/2017	10	490326	5463692	1	Coarse	FALL	JAP	Japanese knotweed	0.0003	2	few sporadically occurring individuals	2	Medium (2-5 plants/m2)	Some specimens along the river, not many	IMG_2535 IMG_2537 IMG_2539
92	01/03/2017	10	489975	5463464	1	Coarse	FALL	JAP	Japanese knotweed	0.04	8	continuous occurrence of a species with a few gaps in the distribution	4	Dense (>10 plants/m2)	A lot starting close to the river up to the park beside the mall	IMG_2540 IMG_2543 IMG_2545 IMG_2547 IMG_2548 IMG_2550
									TOTAL AREA:	0.47491						

LEGEND

Soil_Texture_Code	Soil_Texture_description
1	Coarse (e.g. Sand, cobbles, gravel - Water drains quickly)
2	Medium (Loamy or silty soil - Water takes longer to drain)
3	Fine (e.g. Clay - Compact soil that holds water)
4	Organic (Dark soil with organic material)

Density_Code	Density_Description
1	Low (<= 1 plant/m2)
2	Medium (2-5 plants/m2)
3	High (6-10 plants/m2)
4	Dense (>10 plants/m2)

Distribution_Code	Distribution_description
1	rare individual, a single occurrence
2	few sporadically occurring individuals
3	single patch or clump of a species
4	several sporadically occurring individuals
5	a few patches or clumps of a species
6	several well-spaced patches or clumps of a species
7	continuous uniform occurrence of well-spaced individuals
8	continuous occurrence of a species with a few gaps in the distribution
9	continuous dense occurrence of a species

Color legend

Lynn river
Mosquito creek
MacKay creek
Wagg creek
Thain creek
Capilano river