The Lamprey River Japanese Knotweed Control Project

A Summary of Progress, 2009

LAMPREY RIVER ADVISORY COMMITTEE &

LAMPREY RIVER WATERSHED ASSOCIATION

Introduction

In 2008, The Lamprey River Advisory Committee (LRAC) and Lamprey River Watershed Association (LRWA) joined forces to begin control of the invasive plant Japanese Knotweed along the banks of the Lamprey River. These groups are committed to maximizing the extent of long-term control of knotweed throughout the Lamprey River Watershed.

This report summarizes activities and findings from 2009. It is put together in four chapters, each overviewing a specific part of the project:

1. Evaluation of the effectiveness of treatment in 2008 and comparison of using an early season cut versus not.
2. A visual documentation of effectiveness of control
3. An evaluation of herbicide impact on non-target plants
4. A prioritization model for knotweed control in the Lamprey River stream corridor and future project directions.

Funding for this project was provided by the Lamprey River Advisory Committee and the NH Department of Agriculture's Integrated Pest Management Program.

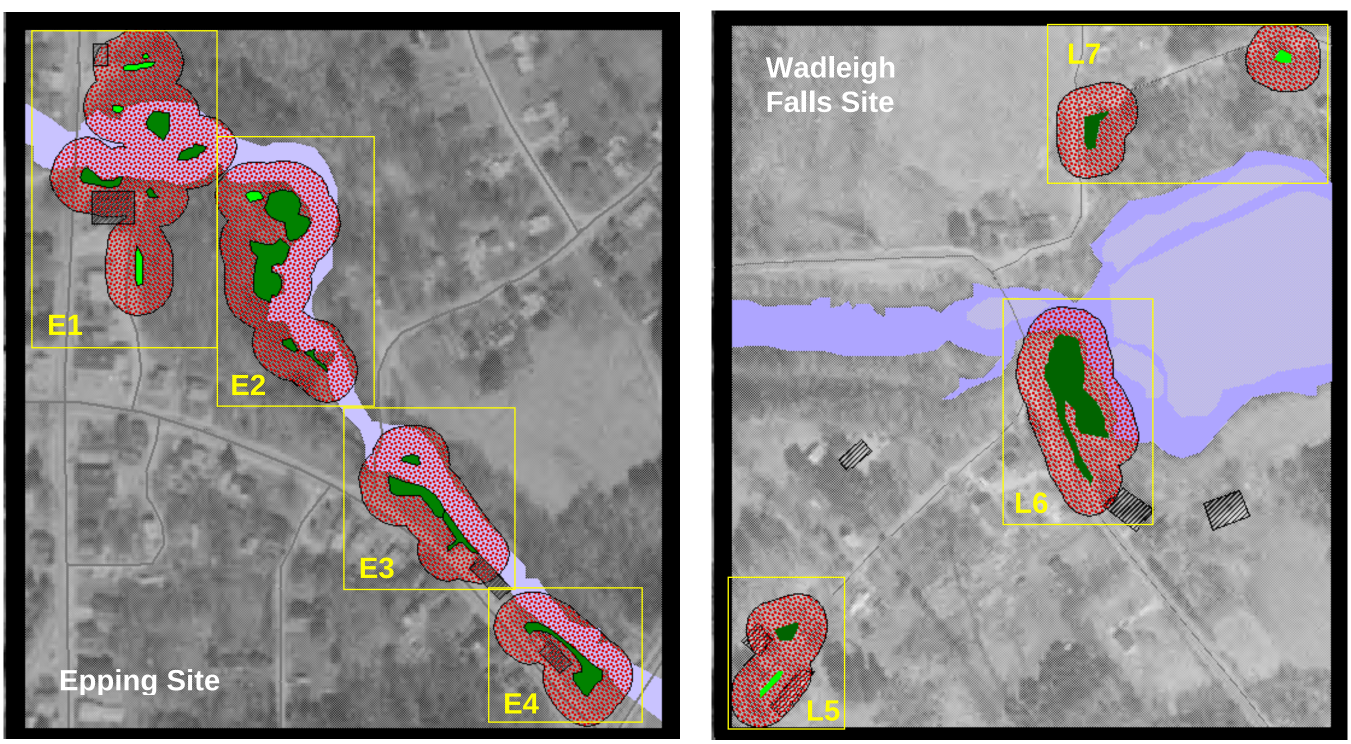
Sincerest thanks to all the volunteers, landowners, and technical experts that have contributed to this project.

1. Assessment of Japanese knotweed density and vigor one year after treatment with herbicide and comparison of a mid-season cut in effectiveness of control.

Background:
To assess the effectiveness of an herbicide application on the control of Japanese knotweed, stand density and vigor were measured. The data is compared to that from a year ago that assessed the same parameters before any control took place.

All stands of Japanese knotweed included in this pilot project were treated with the same herbicide application. Areas within a 10 foot buffer of the Lamprey River were stem-injected with “Aquamaster“ and all other areas were treated with a foliar application of “Habitat”. A range of well established and newly established stands under shady and bright light conditions were cut mid way through the growing season to see if this aided in the effectiveness of the herbicide application. About half the knotweed was left uncut to offer a comparison to the “coppicing” technique.

Monitoring Method:
The study area was divided into groups of knotweed stands that are unlikely to be connected by underground tuber due to their distance apart. These discrete populations are shown as “E1” to “L7” in the diagram below. Within each of these separate populations, at least three monitoring plots were sampled. Monitoring plots consisted of one meter square quadrants randomly placed in a stand. Within each plot, stand density was measured by counting the number of knotweed stems, and vigor was assessed by recording the height and stem diameter of the five tallest plants. This technique replicates the methods used in a 2006 of knotweed control methods at Parker River National Wildlife Refuge so allows direct comparison of results (Whitaker and Pau, 2006).

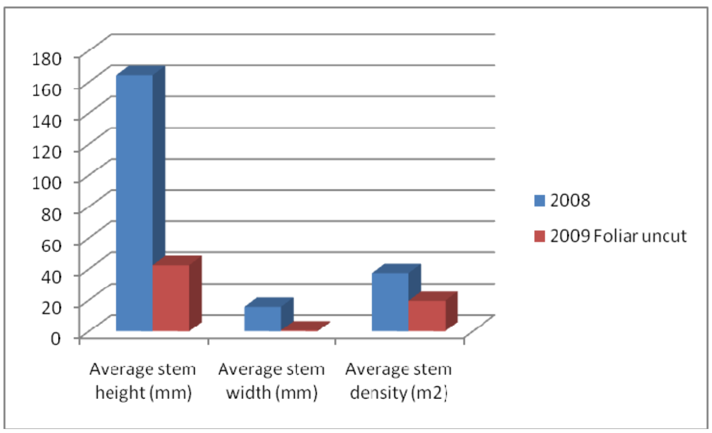


Legend
Well established Japanese knotweed stand
Recently introduced, not yet established Japanese knotweed stand
65 foot buffer around each knotweed stand

Results:

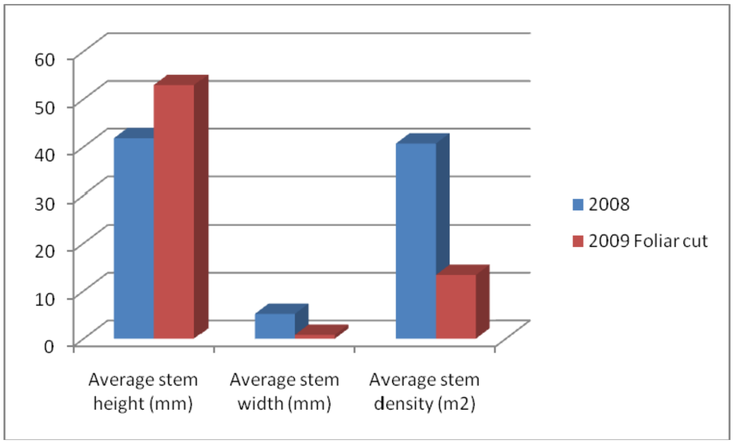
Uncut knotweed stands
As seen in the table and figure below, areas of uncut knotweed that were treated by both foliar and stem-injection herbicide decreased in both vigor and density compared to the untreated stands. Both the foliar and stem injection techniques decreased stem density by almost 50%. However, the stem injection was less effective than the foliar application at decreasing stand vigor. Although knotweed stems in a 10 foot strip buffering the Lamprey River were only a quarter of the width of pre-treatment values, the stems, on average, were almost the same height as before treatment.

SUMMARY UNCUT KNOTWEED	2008	Foliar	Stem injection
Average stem height (mm)	164	42	131
Average stem width (mm)	16	1	4
Average stem density (m2)	37	19	17



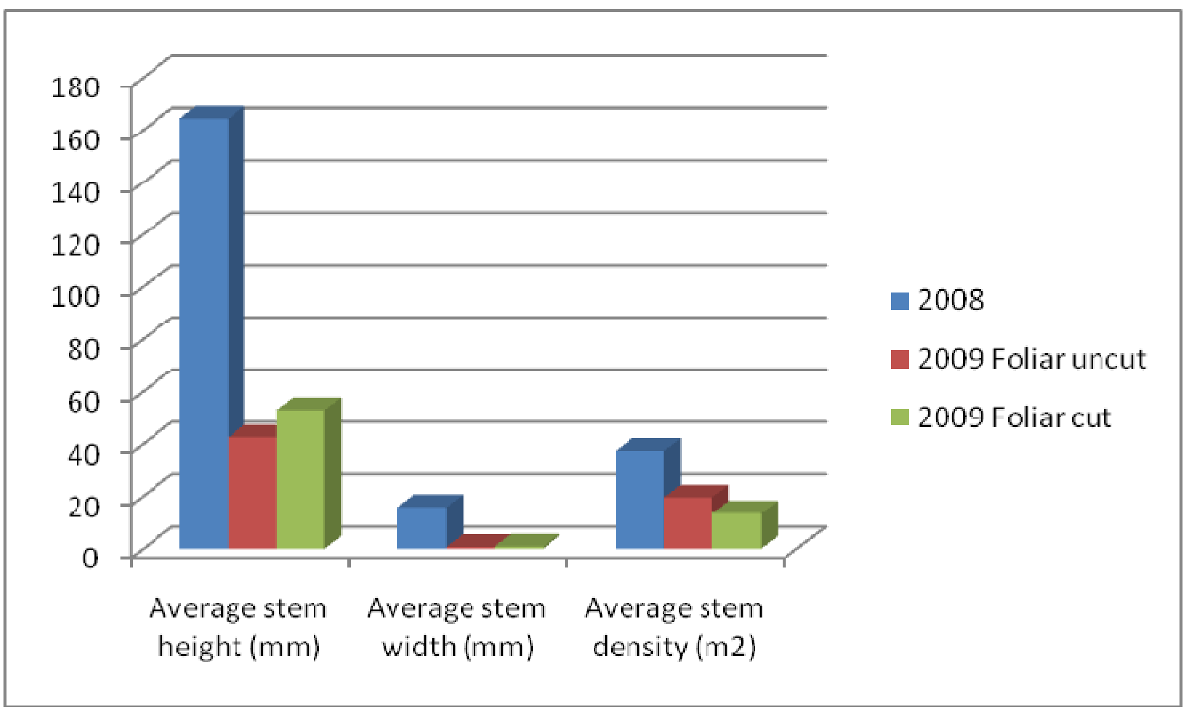
Cut knotweed stands
At the time of measurement, knotweed that had been cut mid season had partially regrown to short, multiple stemmed plants. No knotweed stands that were cut were treated with the stem injection method as stems diameters were too small. As seen in the table and figure below, areas of cut knotweed that were treated by foliar herbicide decreased in both vigor and density compared to the untreated stands in 2008. Stem density was over a third less and stem width was about 20% less. Stem height was greater as knotweed had had a full year to grow compared to the approximate month when measurements were made in 2008.

SUMMARY CUT KNOTWEED	2008	Foliar	Stem injection
Average stem height (mm)	42	53	none cut
Average stem width (mm)	5	1	none cut
Average stem density (m2)	41	13	none cut



This pilot study was designed to compare the effectiveness of a foliar herbicide application in areas of knotweed that underwent a mid-season cutting to areas that were not cut. In the table and graph below, it can be seen that cut areas moderately decreased the density of knotweed compared to uncut areas, but did not decrease knotweed vigor compared to uncut areas.

SUMMARY CUT VERSUS UNCUT KNOTWEED	2008	2009 Foliar uncut	2009 Foliar cut
Average stem height (mm)	164	42	53
Average stem width (mm)	16	1	1
Average stem density (m2)	37	19	13



The slight increase in the effectiveness of knotweed control when a mid-season cut is used is likely outweighed by the risk that cutting knotweed may spread stem fragments that have the potential to start a knotweed colony in new areas. The cutting method has the potential to have small stem fragments fall into the river and potentially start new colonies downstream. Also, transportation off site, even though covered by a tarpaulin has potential for stem fragments to disperse along roadways.

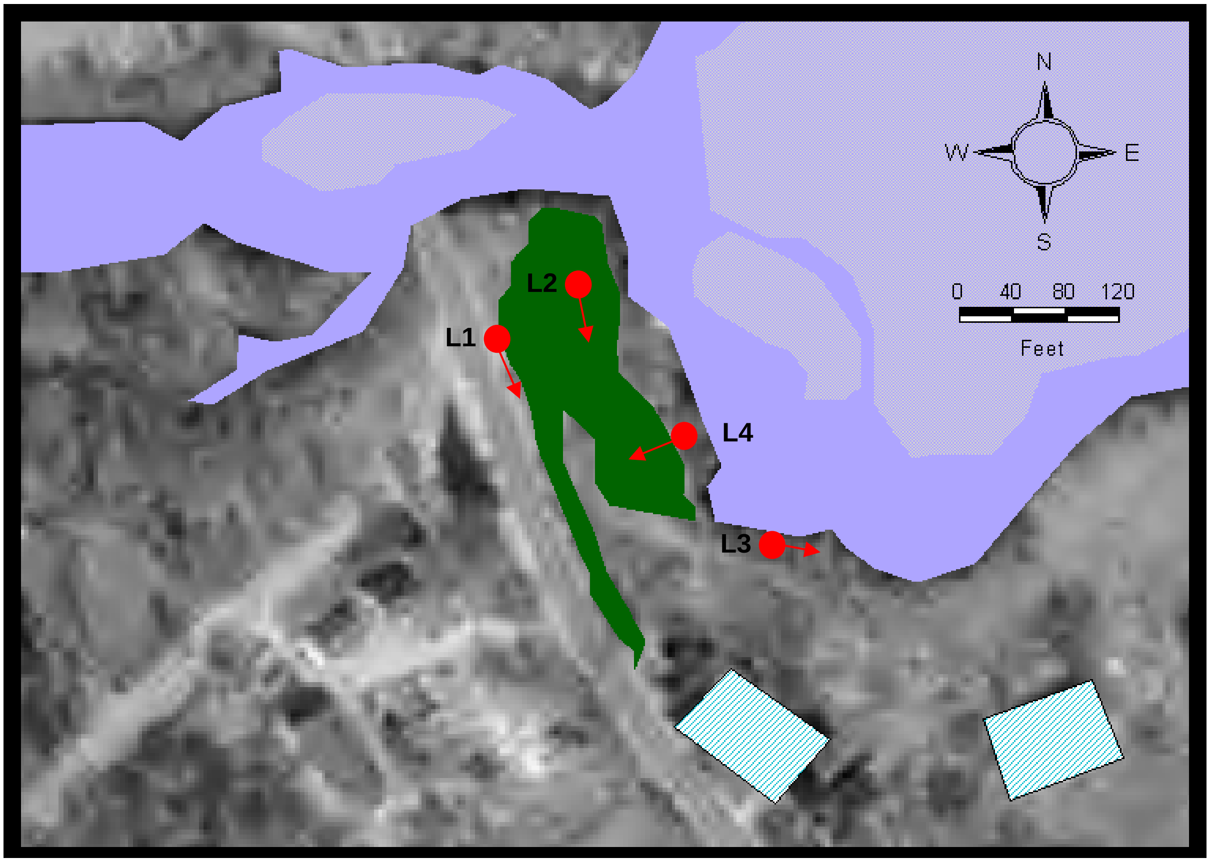
Reference:

Whitaker, C. and N. Pau, 2006. 2006 Annual Report: Japanese knotweed project Parker River National Widlife Refuge Newburyport, MA.

2. Visual Documentation of the Lamprey River Knotweed Control Project Pilot Sites. A comparison of progress between 2008 and 2009.

All photos were taken on September the 10th. The photos on the left were taken in 2008 and can be compared to conditions in 2009.

Lee Photo points:



<table>
<tr><td>Photo point #: L1</td><td rowspan="3">
</td></tr>
<tr><td>Date: 10-Sept</td></tr>
<tr><td>Description:

End of guardrail looking SSE along road. This stand was cut mid season in 2008.</td></tr>
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Photo point #: **L2**

Date: 10-Sept

Description:

Along path from road to water, looking roughly south..

Photo point #: **L3**

Date: 10-Sept

Description:

Newly established stand.

Photo point #: **L4**

Date: 10-Sept

Description:

A dodder species growing on Japanese knotweed. A close-up is inset.

Epping Photo points:

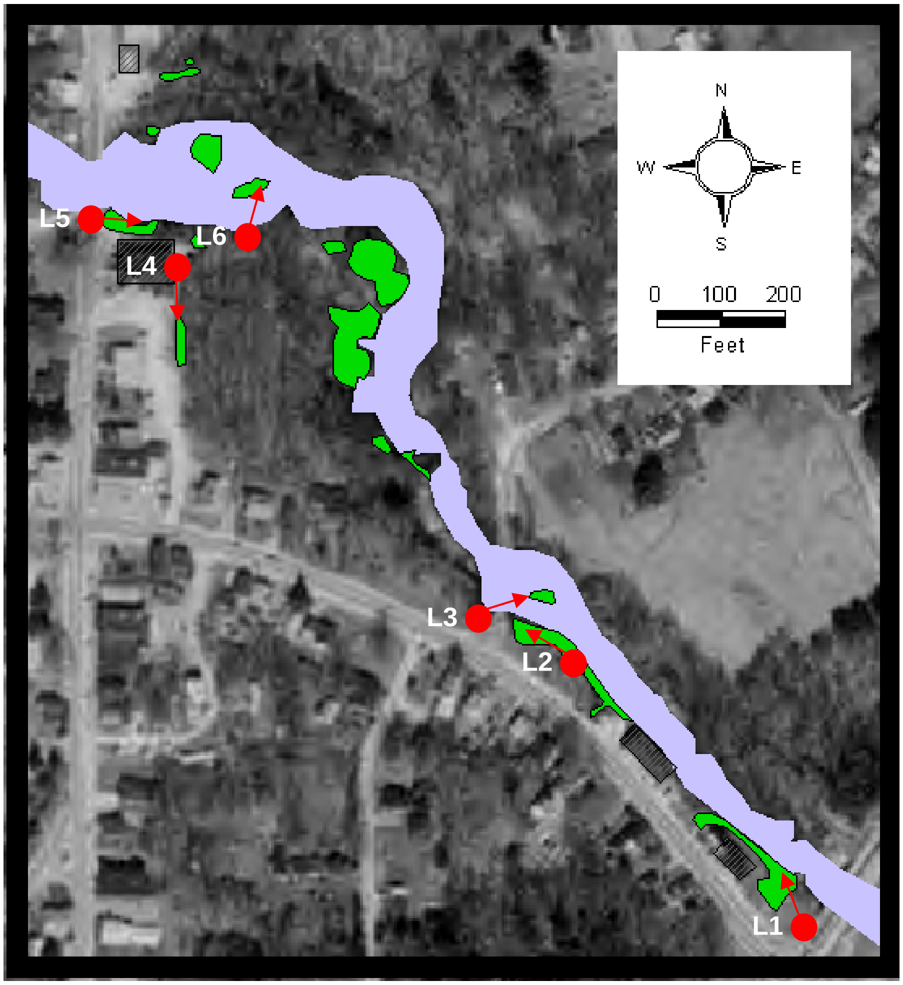


Photo point #: **L1**		
Date: 10-Sept		
Description: Taken at end of guard rail at the intersection of Route 125 and Water Street.		

Photo point #: **L2**

Date: 10-Sept

Description:

At Mirriam Jackson park, facing NE. The bridge can be seen in the background.

Photo point #: **L3**

Date: 10-Sept

Description:

Knotweed on an island. Taken from the south east corner of the bridge guard rail.

Photo point #: **L4**

Date: 10-Sept

Description:

Taken standing next to the second window of the Town Hall basement from the parking lot, Facing due south.

Photo point #: **L5** Date: 10-Sept Description: Looking along the river standing on the Main Street bridge at the base of the Lamprey River sign.	

Photo point #: **L6** Date: 10-Sept Description: Standing on the river bank facing NE.	

3. Assessment of non-target impacts of pesticide application on knotweed stands in Epping and Lee NH, 2008.

2008 Pesticide Application Details:

Two types of treatment took place on knotweed stands in 2008. All knotweed stems within 10 feet of the mean high water mark of the Lamprey River were stem-injected with the glyphosate product "AquaMaster" at an application rate of 5ml per stem and formulation amount of 53.8% (5.4lb/US gallon). Areas of knotweed outside of this 10 foot buffer to the Lamprey River were treated with a foliar spray of the imazapyr herbicide "Habitat" using backpack sprayers. Application rate of Habitat was 5-20 gallons per acre with a formulation amount of 28.7% (2lb/US gallon).

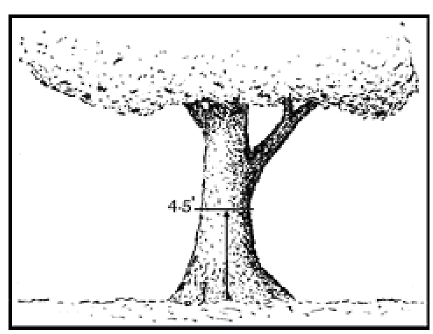
As noted in the pesticide permit, and advised to do so on the EPA label for this product, Habitat was applied using large droplet size to prevent drift. Application was made at a low height above the plant, in low relative humidity, when wind speeds were low. Commercially licensed applicators stood with their backs to the river and directed sprayer nozzles away from the river. Herbicides were mixed off site and equipment was required to be cleaned off site. Both Habitat and AquaMaster are labeled for aquatic situations. In Lee, 5 stands of knotweed were treated totaling about 0.6 acres. In Epping, 16 stands of knotweed were treated, totaling about 0.77 acres.

Non-Target Woody Vegetation Response:

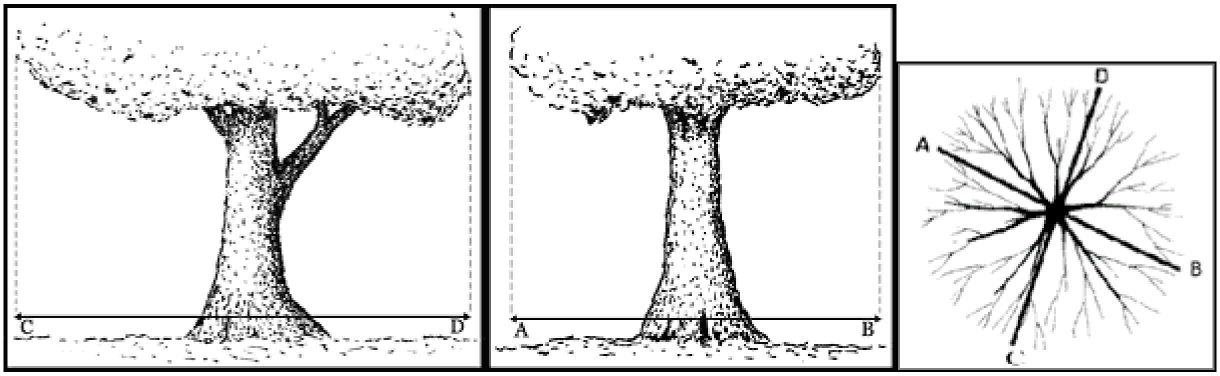
1. Assessment
In the spring of 2009, it was noticed that several trees and shrubs located within the knotweed stands had either been killed or severely stressed. On 11 June a group of guest experts, including Dr Tom Lee (Associate Professor of Forest Ecology at the University of New Hampshire), Fred Borman (UNH Cooperative Extension Rockingham County Forester), and Doug Cygan (Invasive Species Coordinator, NH State Department of Agriculture) were invited to the site and probable causes of non-target impacts were discussed. Florence Peterson, Forest Health Specialist with the United States Forest Service, has visited these sites and also been consulted. Expert opinion is that the trees were likely to have been impacted by the herbicide Habitat through the process of root grafting. When several plants grow near each other, some species' roots can come in contact in the soil and graft together. This is an advantage as it allows plants to share nutrient and water resources. However, the process of root grafting can also allow the passage of disease, for example Dutch Elm disease, or in this case, the passage of herbicide to non-target species.

A quantative assessment of impacts was completed on 27 June 2009 and is detailed below. This is an extremely conservative estimate of herbicide impact. Any trees that showed signs of rot or decay were not included in this assessment as there is potential they could have been impacted prior to 2008 by causes unrelated to the herbicide application. For example, there is a hickory and cherry tree along the road at the Wadleigh Falls site that show significant decay so were clearly dead prior to herbicide application. Each tree or shrub was identified to species, diameter at breast height (dbh) measured and canopy extent assessed.

Dbh (diameter at breast height) was measured at 4 ½ feet above ground level in inches.



Average Crown Spread was calculated by measuring the widest crown spread, that is the greatest distance between any two points along the drip line of the tree. A second measurement was taken at 90 degrees to the first, and average crown spread was calculated by averaging the two measurements for each tree.



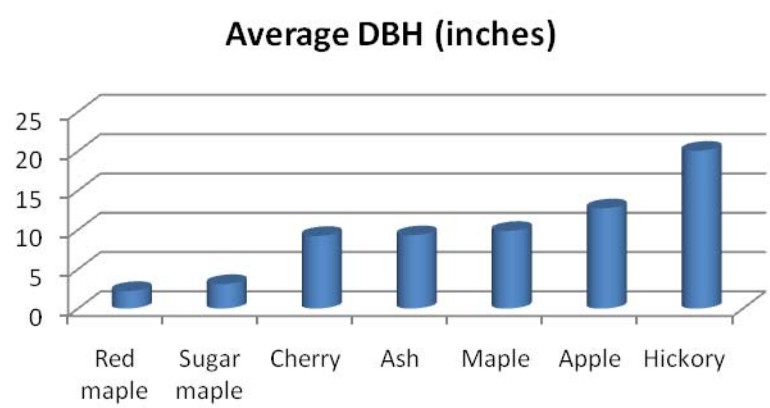
Fred Borman bored selected trees at the Lee site to determine if they had been dead prior to the herbicide application. The spatial relationship of impacted trees and details of measurements are shown in Appendix 1.

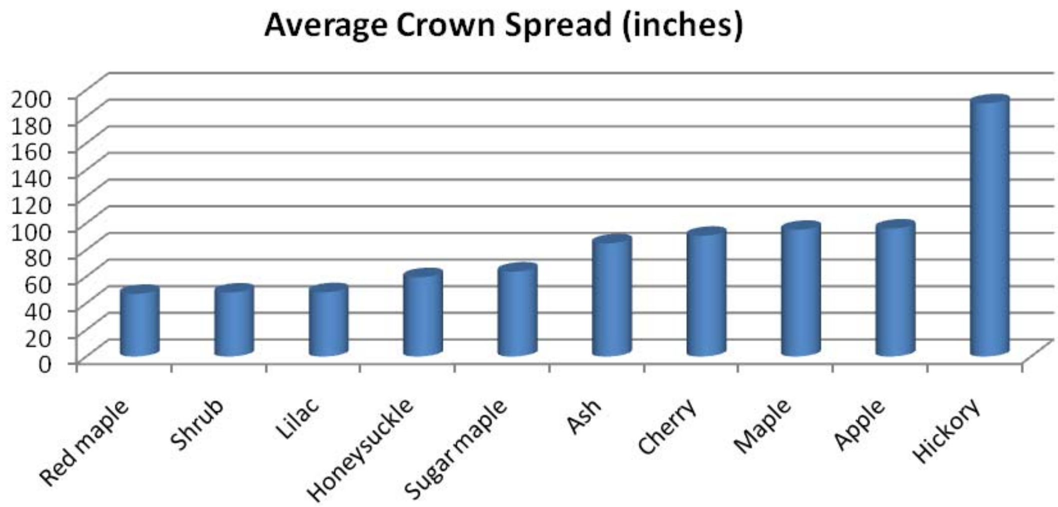
2. Results Summary

This conservative assessment found 22 trees and 3 shrubs to be impacted at Lee and 3 trees and 3 shrubs impacted at the Epping site. Ash trees were the most common species affected, with cherry and sugar maple also heavily impacted.

Species	Number of Individuals Affected
Ash	7
Cherry	6
Sugar maple	6
Honeysuckle	2
Lilac	3
Hickory	1
Red maple	1
Other	4

A wide range of sizes of tree (1 to 29 inches dbh and 4 to 190 inch canopy spread) were impacted. The average dbh of all woody species impacted was 7.8 inches and the average crown spread for all species impacted was 74.7 inches. The largest trees impacted were hickory. The average size for each species is shown in the following two charts:



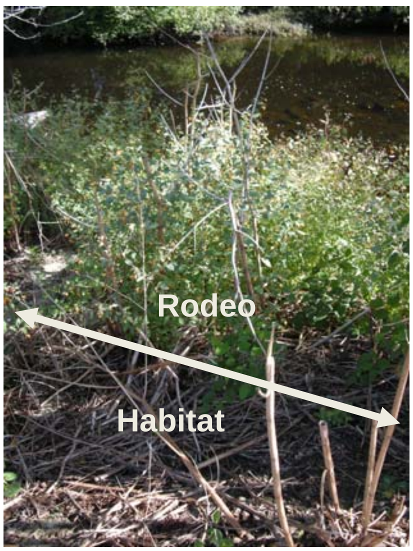


Trees in the middle of large knotweed stands seemed most likely to be impacted. No tree in small knotweed stands (0.015 acres or less) seem to have been negatively impacted by herbicide application.

Town	Knotweed Stand Size with non-target impacts (acres)
Lee	0.014
Lee	0.191
Lee	0.024
Epping	0.061
Epping	0.046
Epping	0.040

Increment cores taken indicated that the trees had been growing at a slow but steady pace of about 8 rings to the inch for the past few years, including last year, prior to the knotweed control.

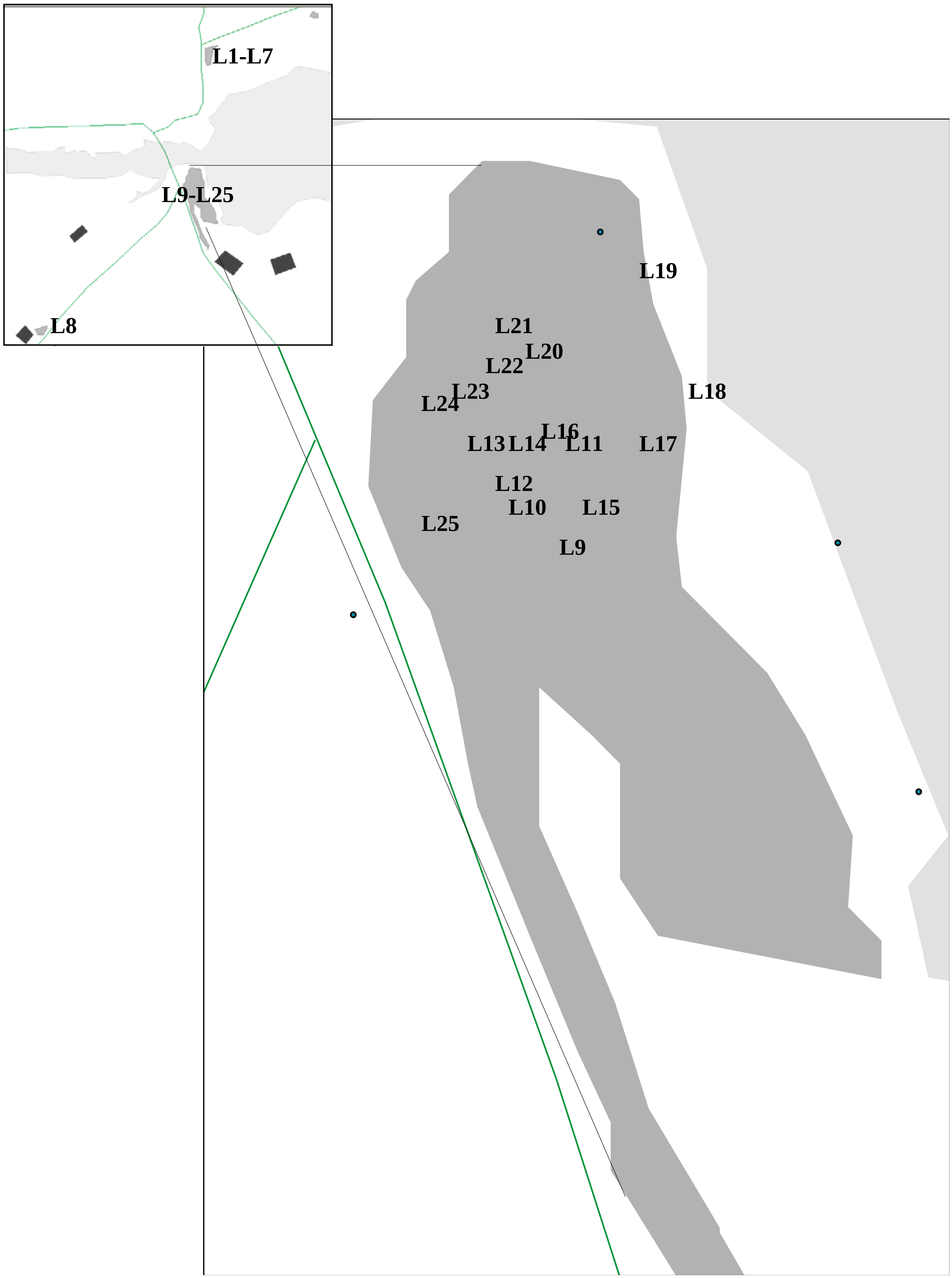
As of 27 June several trees were beginning to sprout malformed and stunted leaves. As of 01 September several trees continued to recover, the malformed leaves grew larger. We are hopeful that over time most trees may recover. However, several of the shrubs show absolutely no signs of life.



The difference between plant regrowth in areas treated with Rodeo (top of photo) and those treated with Habitat (lower portion of photo).

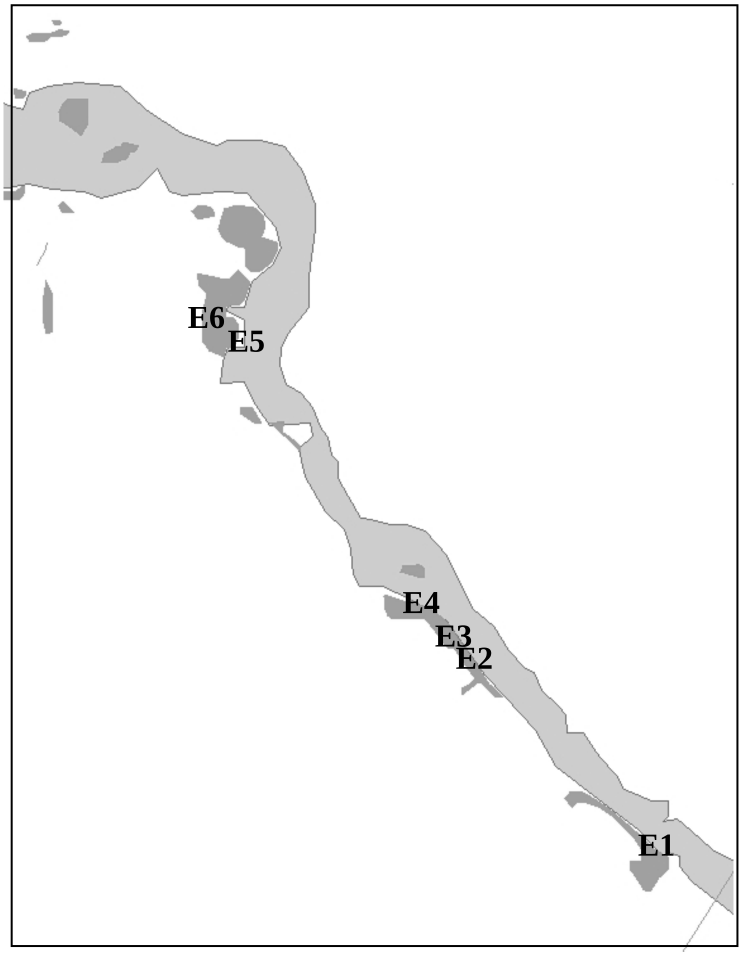
Appendix 1: Detailed Results

Lee: Location of impacted non-target species



Tree Code	Species	DBH	Average Crown Spread	Notes
L1	Sugar maple	3	50	
L2	Sugar maple	3	40	
L3	Sugar maple	4	90	
L4	Cherry	9	61	
L5	Sugar maple	4	86	
L6	Apple	13	96	
L7	Maple	10	95	
L8	Lilac (removed)	-	-	
L9	Cherry	7	53	A few leaves remain
L10	Honeysuckle	-	52	18 July. Malformed leaves are beginning to sprout.
L11	Cherry	10	140	
L12	Red maple	2	47	Main stem looks dead but beginning to stump sprout
L13	Sugar maple	2	53	
L14	Ash	3	79	
L15	Lilac	-	47	
L16	Unknown sapling	1	16	
L17	Ash	11	180	
L18	Sugar maple	-	-	Multi-stemmed. On water's edge. Stress may be due to something other than herbicide application
L19	Cherry	14	120	Double-stemmed
L20	Hickory	20	190	Double-stemmed
L21	Ash	4	105	
L22	Cherry	3	45	
L23	Ash	4	65	
L24	Ash	4	73	
L25	Cherry	13	125	

Epping: Location of impacted non-target species



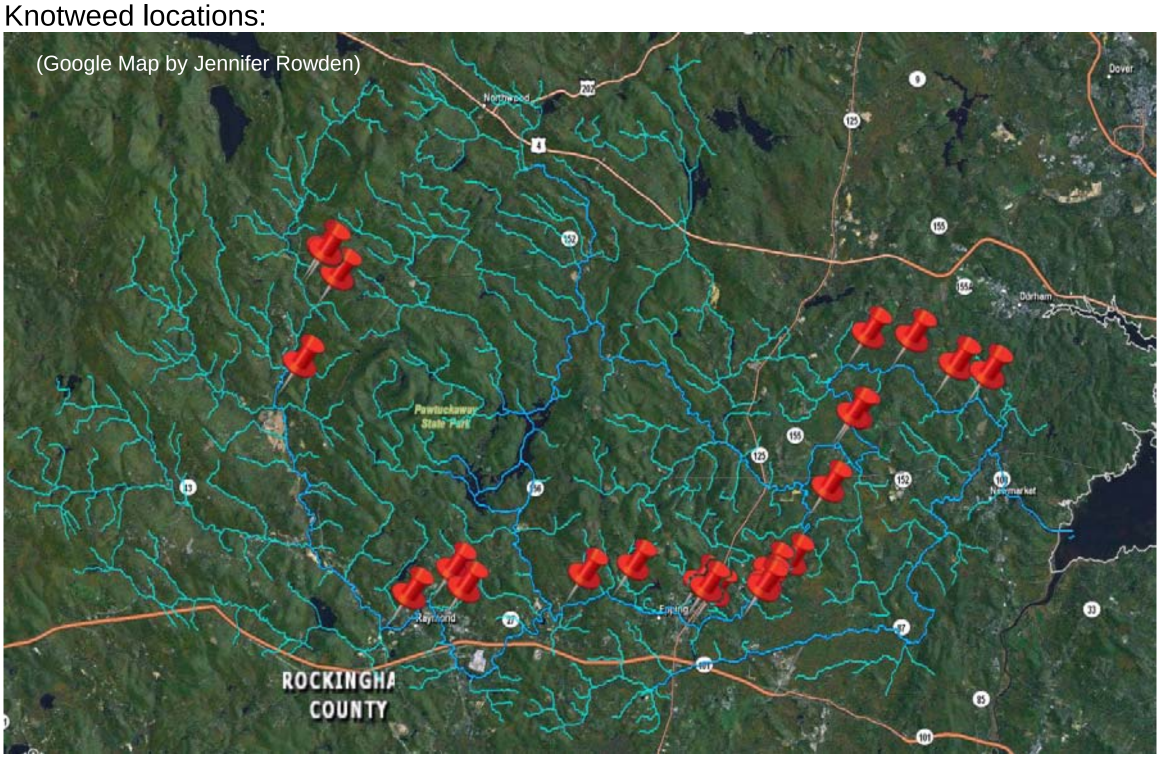
Tree Code	Species	DBH	Average Crown Spread	Notes
E1	Ash	11	82	Located at interface of foliar and stem-injection application methods. Three stemmed each of similar dbh.
E2	Lilac	-	50	Shrub
E3	Shrub	-	48	Multi-stemmed
E4	Honeysuckle	-	67	Shrub
E5	Sapling	5	4	
E6	Ash	29	11	Floodplain forest

4. Prioritization of Japanese Knotweed Control along the Lamprey River Corridor, a River-length Approach.

Goal:
In order to attempt long-term eradication of Japanese knotweed within the Lamprey River watershed, a strategic plan using the locations of all knotweed stands within the watershed needs to be constructed and a long-term education campaign developed to prevent reinfestations occurring. This comprehensive goal can be approached in several stages, with areas of particular ecological sensitivity being prioritized. The goal of this document is to summarize a strategic prioritization model for knotweed control along the Lamprey River banks and its immediate river corridor.

Background:
In 2008, a corps of volunteers assessed various parameters of ecological health along the entire length of the Lamprey River. This “Streamwalk” monitoring program was coordinated by the Lamprey River Watershed Association. As part of the assessment, locations of Japanese knotweed were noted.

Knotweed locations:



The Streamwalk data was provided as the above “jpeg” image. Twenty three knotweed populations of unknown size were recorded along the 47 mile river. Knotweed is a creeping perennial with an extensive rhizome system that allows new knotweed shoots to sprout at least 23 feet and possibly as far as 65 feet from its parent population (Murray McHugh 2006). No identified knotweed population was closer than 65 feet to another so each population can be treated as isolated. If any populations were closer then 65 feet, control of these stands would need to take place concurrently to prevent reinfestation via underground tuber. The two stands in closest proximity are the two closest to the river headwaters. When the image above was translated into a GIS environment, these stands were measured as being separated by a distance of at least 450 feet.

Prioritization Model:
The parameters in the following table were included in the prioritization model of which order to control knotweed stands in. They are based on factors affecting knotweed growth and the potential of each stand to spread and establish knotweed stands in new areas. A total score for each stand was developed by assessing the individual score for each of these parameters listed below and totaling for each stand (see Appendix 1).

Parameter	Weight factor	Rationale
Distance from headwaters	Stand order from headwaters x 2 (the stand furthest upstream would have a score of 2, the stand furthest downstream a score of 46.	The further upstream a stand is located, the longer the stretch of river that can be infected with knotweed fragments. Just 2mm of stem are enough to establish a whole new colony.
Knotweed located immediately downstream of a dam	10	These are areas of turbulent water most likely to result in stream bank erosion during flood periods and have the potential to break off knotweed fragments and transport to new areas downstream. DES has a water velocity model for the Lamprey which could be used to refine this scoring further.
Close proximity to road	5	This is a proxy for areas that may be mowed. Data likely to be made more accurate with field truthing.
Cleared / open areas	5	From UNH's GRANIT 2001 landuse GIS data layer. Another proxy for areas that may be mowed. Data likely to be made more accurate with field truthing.
Urban	1	From UNH's GRANIT 2001 landuse GIS data layer. Not always true, but in general stands in an urban environment will have an increased likelihood of disturbance over rural areas since more human activities are associated.
Conservation land	1	Not always the case, but land that has been thought important enough to conserve in perpetuity may have greater ecological integrity than other areas not conserved. Data likely to be made more accurate with field truthing.
Non forested area	0.5	From UNH's GRANIT 2001 landuse GIS data layer and aerial photographs. A proxy for stands of knotweed not growing under forest canopy. Stands in full sunlight are lightly to have increased vigor over those in shade.
Parcel over 5 acres	0.5	Education of a single owner of a large parcel of land will hopefully maximize the geographic area that is kept knotweed free. Data likely to be made more accurate with field truthing.

Caveat!
Most handheld GPS units collect data with an accuracy of plus or minus 15 meters (+/- 49 feet) in an open field environment. Signal bounce under forest canopy, from hills, and buildings makes this distance greater. Because of this, parameters shaded in blue in the table above are likely to have their accuracy improved by field-truthing. However, since we are working at a river-length scale this should not be an issue for the most important, and so heavily weighted parameters, meaning this model should be fairly robust using the current information we have. Detailed field-truthing would be time consuming and likely to leave most of the prioritizations unchanged. However, once a stand has been selected for control, field-truthing is necessary to accurately identify location on town tax maps and other fine scale modifications

Prioritization Results:
A group of four stands in Deerfield are a clear priority for control. Located closest to the Lamprey headwaters, these have potential for fragments of knotweed to drift down stream and start new colonies along almost three quarters of the entire river length. Control of these stands would allow approximately the first 14 miles of river corridor to be knotweed free.

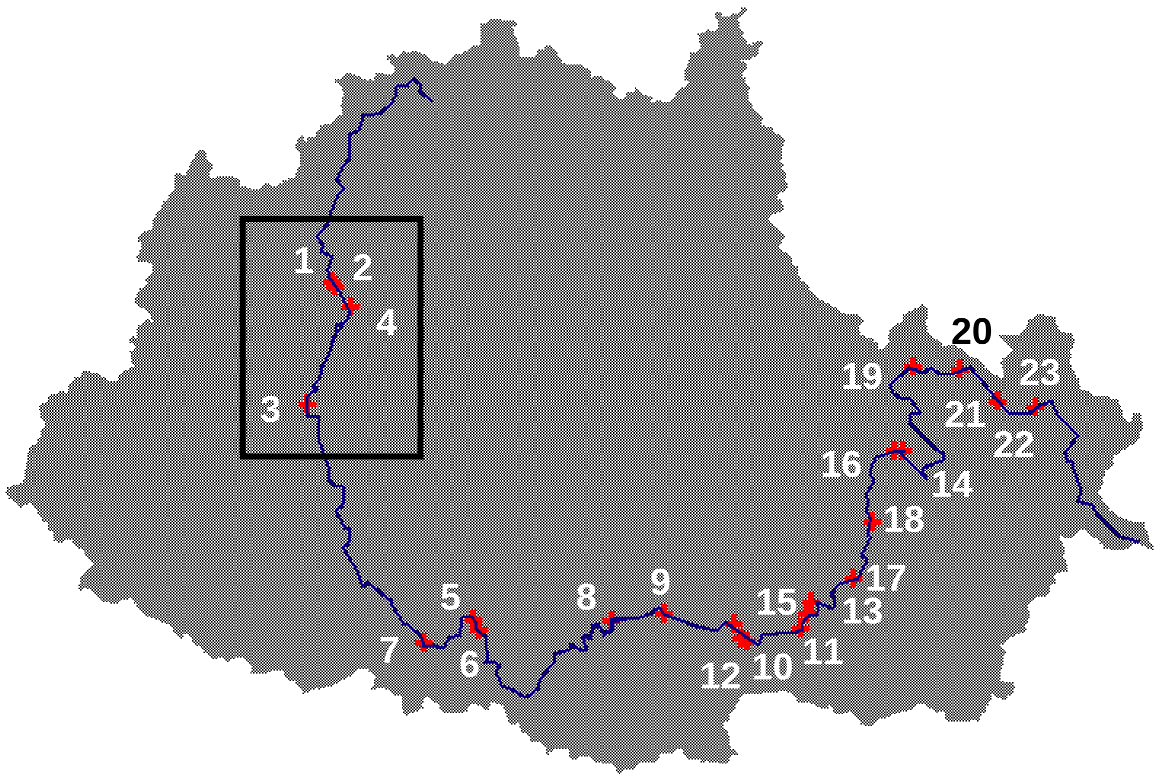
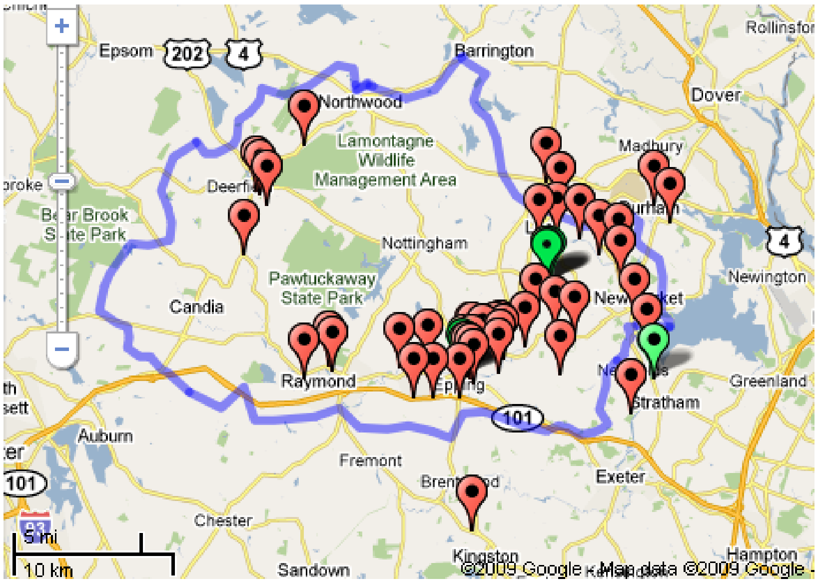


Figure 1. Location and prioritization score of knotweed stands along the Lamprey River. The lower the score, the greater the priority for that stand to be controlled to prevent further infestations occurring.

Future Direction:
It is planned that a watershed-wide strategy and restoration plan will be developed once the locations of a good proportion of knotweed stands have been mapped.

WE NEED YOUR HELP!
Any interested person is encouraged to participate in this mapping project. We rely on your help to document as much knotweed as possible. Stand information can be entered online at http://www.lampreyriver.org/ or http://www.lrwa-nh.org/. Please help add to our database and watch our knowledge of knotweed in the Lamprey River watershed grow and our chances of controlling this invasive plant increase. *Thank you!*

The watershed-wide mapping project was piloted in 2009 in partnership with the National Parks Service, the company "Vertices", and several wonderful volunteer "knotweed watchers" who added stand locations and other information online. A summary of our state of knowledge to date is depicted in the "Google Map" below:



Key:

Knotweed reported

Knotweed treated

The blue line is the boundary of the Lamprey River watershed.

Over the next few years, once the distribution of knotweed has been mapped as extensively as possible, key strategies for its control will be identified. Outreach programs will be developed, with barriers to effective control identified, and solutions found. Finally, strategies to prevent future infestations of knotweed will be implemented with the goal of keeping the Lamprey River stream corridor, and its watershed relatively knotweed free. This strategies have already begun to be developed.

Reference:

Murray McHugh, J. 2006. A review of literature and field practices focused on the management and control of invasive knotweed (*Polygonum cuspidatum, P. sachalinense, P. polystachyum* and hybrids). TNC Southern Lake Champlain Valley Program, West Haven, VT.

Appendix 1: Detail of Prioritization Model

Proximity to Headwaters	Conservation Land?	On Road?	Parcel Size	Dam	Cleared	Urban	Forest	Score	Priority
1	No	Yes	0	Yes	No	No	No	57	1
2	No	Yes	2	Yes	No	No	No	55	2
3	No	No	13	No	No	No	Yes	43	4
4	No	Yes	0	No	No	No	No	46	3
5	No	No	10	No	No	No	No	39	7
6	No	Yes	0	No	Yes	No	No	42	5
7	No	No	19	No	Yes	No	No	40	6
8	Yes	No	70	Yes	No	No	Yes	39	8
9	Yes	No	115	No	No	No	Yes	32	9
10	No	No	1	No	No	No	No	29	12
11	No	No	5	No	Yes	No	No	32	10
12	No	No	41	No	Yes	No	No	30	11
13	No	No	108	No	No	No	Yes	23	15
14	No	Yes	1	No	No	Yes	No	27	13
15	No	No	29	No	No	No	Yes	19	17
16	No	No	48	No	No	No	Yes	17	18
17	No	No	10	No	Yes	No	No	20	16
18	No	Yes	13	No	Yes	No	No	23	14
19	No	No	2	No	No	No	Yes	10	19
20	No	No	54	No	No	No	Yes	9	20
21	No	No	2	No	No	No	No	7	21
22	No	No	0	No	No	No	No	5	22
23	Yes	No	0	No	No	No	No	4	23