

Invasive Plant Management Plan

FOR

Richmond Silver Maple Ostrich Fern Floodplain Forest
Richmond, Vermont

2010 - 2015



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The Nature Conservancy, the Richmond Land Trust and the Town of Richmond

*Prepared March 1, 2009, Updated December 2009, Approved by the Richmond Selectboard April 2010
Update recommended annually*

Project Partners

Organizations and agencies participating in the Richmond Floodplain Forest Restoration Project include:

- Richmond Land Trust (RLT)
- The Nature Conservancy
- Richmond Conservation Commission
- Richmond Trails Committee
- Vermont Youth Conservation Corp

...and many community members

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I. Introduction

A. Site Description

The Winooski River flows Northwest through Chittenden County into Lake Champlain. Between the Jonesville Bridge and the Richmond Bridge lies a four-mile stretch of river bordered by a silver maple-ostrich fern floodplain forest, a natural community that once dominated the banks of Vermont's major rivers. The Nongame and Natural Heritage Program of Vermont's Fish and Wildlife Department identifies Richmond's Floodplain Forest as the largest remaining on the upper Winooski and one of the highest quality examples remaining in Vermont.

The silver maple-ostrich fern floodplain forest natural community is described in the book "Wetland, Woodland, Wildland" by Elizabeth Thompson and Eric Sorenson. As the name suggests floodplain forests are inundated regularly by flood waters—in some years on multiple occasions. This regular flooding, particularly during the spring thaw when thick layers of river ice can be rafted up onto the riverbank, can cause significant disturbance within the floodplain. The trees and plants that typify floodplain forests have evolved strategies to thrive in this dynamic environment. The silver maple-ostrich fern floodplain forest is characterized by a closed canopy of silver maple (*Acer saccharinum*) and an understory of ostrich fern (*Pteris pensylvanica* aka *Mattucia struthiopteris*), with a scattering of nettles (*Urtica spp.*). There are several other tree species that occur in lower abundance here, including American elm (*Ulmus americana*), Hackberry (*Celtis occidentalis*), Boxelder (*Acer negundo*) and cottonwood (*Populus deltoides*), as well as a diversity of spring ephemerals (herbs that flower early in the spring before trees leaf-out).

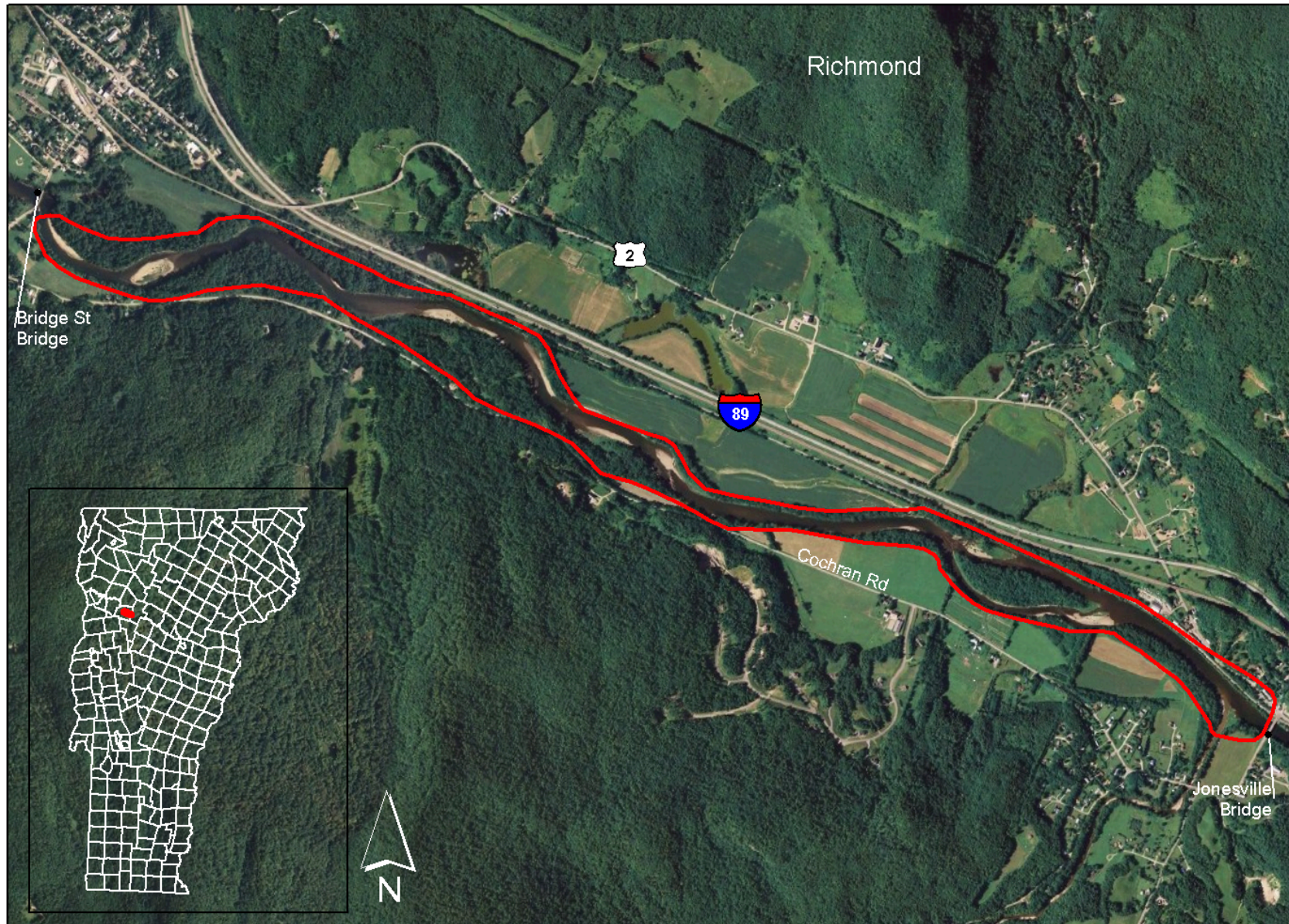
Cochran Road borders the forest on the southwest, and farm fields, Route 2, and Interstate 89 border the forest on the northeast. The Richmond Land Trust owns 35 acres and the Town of Richmond owns 33 acres on the South side of the river, The Nature Conservancy owns four acres on the South, and 19 acres on the North (Map 1: project area). The remainder of the forest in the project area is owned by private landowners. A recreation trail winds along the south side of the river and is used heavily by local residents for walking, biking, bird watching, and dog walking.

B. Site Purpose

Richmond Land Trust, The Nature Conservancy and the Town of Richmond preserved the lands within the project area for the following benefits:

- Conserve a unique natural community that once dominated the banks of Vermont's large rivers but is now found in few places in Vermont;
- Maintaining a corridor for wildlife moving between the forested uplands on both sides of the Winooski;
- Provide habitat for rare, threatened or endangered species, including the river cobble tiger beetle;
- Ensure the provision of ecosystem services such as floodwater retention, filtering of nutrients during rainstorms and flood events, and shading of riverbanks that provides habitat for fish and other animals;
- The Conservancy acquired its parcel to contribute an important component to the Chittenden County Uplands Project, a joint effort between several state and regional conservation organizations. The project aims to conserve the land between Mt. Mansfield State Park and Camels Hump State Park;
- Protect a treasured town asset that provides a natural area for recreation, fishing, and wildlife observation; and
- Protect an important part of the visual landscape for Winooski River and the Town of Richmond.

Richmond Floodplain Forest Restoration Project



The area bounded in red approximates project area boundaries.
Not all property owners within this area are participating in the Project.

The Conservancy, RLT, the Richmond Conservation Commission (RCC) and others are working together on the Floodplain Forest Restoration Project to protect this valuable resource for current and future generations. This document focuses solely on one component of the project: managing invasive plant species.

C. Desired Condition: Reduced Populations of Invasive Species

Silver maple-ostrich fern floodplain forests typically display a canopy of tall trees and a rich understory of herbaceous plants including ostrich ferns. Floodplain forests rarely have a mid-story shrub layer. This is in part due to the regular flooding, particularly during the spring thaw when large blocks of ice are rafted up onto shore, smashing the branches of woody shrubs. This leads to an open mid-story which hikers and other recreators find particularly inviting.

High quality floodplains are rich in wildlife. Turtles and leopard frogs move from the river to uplands to lay eggs, while mole salamanders, wood frogs and spring peepers typically move from terrestrial systems to vernal pools and wetlands to lay their eggs. Deer, bobcat, fox, moose and many small mammals both live and forage in the floodplain forest and use it as a corridor for travel to and from other habitats.

The desired condition for the floodplain forest begins with a well-vegetated riparian area/floodplain with a contiguous canopy of tall trees overhanging the river. The canopy shades the river, helping maintain cooler water that many native fish and amphibians require. This vegetation allows the floodplain to absorb powerful floodwaters, keeping the streambank relatively stable and filtering out sediments, nutrients and pollutants washed in from upstream. Without a healthy riparian area, floodwaters can cause significant erosion, radically reshaping the rivershores, washing phosphorous into the river and endangering local homes and other structures.

It is the goal of the project partners to maintain and restore the ecological integrity of Richmond's floodplain forest for the benefit of wildlife, water quality and other natural resources, local homeowners and Richmond residents of today and tomorrow. The greater the integrity of the floodplain forest, the more likely it will be able to provide a host of ecosystem services despite stressors such as Global Climate Change and encroachment by invasive plants.

To achieve this goal of maintaining and enhancing the ecological integrity of the floodplain forest, the project partners and local residents wish to reduce the density and number of non-native, invasive plants within the project area.

D. Current Condition

Currently, populations of several species of exotic invasive plants are now established in the project area. Collectively these species form the most significant threat to the ecological integrity of the project. Left unmanaged, they will out-compete native species—forcing some native out, reducing the ability of others to thrive, and triggering a host of other undesirable changes to the floodplain forest.

An invasive species is defined by the National Invasive Species Council as a species that is: 1) Non-native (or alien) to the ecosystem under consideration; and, 2) Whose introduction causes or is likely to cause economic or environmental harm or harm to human health. (Executive Order 13112; <http://www.invasivespecies.gov/>).

Invasive plant species—weeds—present include: Goutweed (*Aegopodium podagraria*) and Japanese knotweed (*Fallopia japonica*)—dominant in the understory in some areas. Garlic mustard (*Alliaria*

petiolata), Japanese barberry (*Berberis thunbergii*), Glossy buckthorn (*Frangula alnus*) Bush honeysuckles (*Lonicera spp.*) and Common buckthorn (*Rhamnus cathartica*), are scattered throughout the forest understory. Dame's Rocket, Moneywort, Chervil and Celandine are also present. A stand of common reed (*Phragmites australis*) persists in a wetland on the town-owned property on the South side of the river. Research has documented numerous problems caused by these species, including:

- *Hastening erosion:* Lacking a strong root structure, Japanese knotweed does a poor job of anchoring the riverbank. This can increase soil erosion, siltation and phosphorus runoff.
- *Replacing native species:* Japanese knotweed and goutweed grow so densely that they squeeze out and/or overshadow natives. Garlic mustard's roots exude a chemical that acts as a natural herbicide against other plants, and other plants can alter soil chemistry.
- *Disrupting the food chain:* Native wildlife often cannot feed on invasive plants. This is particularly true for insects, resulting in the loss of a critical food source for birds, fish and many other wildlife species. The berries of buckthorn and honeysuckle lack the proper combination of fats and lipids that allow for the absorption of nutrients. Though birds may be seen feeding on these berries, they are not building the energy reserves that will allow them to survive.
- *Increased risk of predation:* The branching patterns of honeysuckles invites nesting birds but their eggs and fledglings are more susceptible to predators such as raccoons.

E. Invasive Species Inventory

In the spring of 2008 the project partners and others collaborated to survey the Richmond floodplain forest within the project area for invasive exotic plants. Twenty volunteers were split into four teams that surveyed The Conservancy, RLT and most private properties on both sides of the river. Under the guidance of a team leader, volunteers recorded the location of infestations. A Richmond resident then used Geographic Information Systems (GIS) to develop a series of maps depicting infestations within the project area (Appendix A). Table 1 outlines the invasive species found:

Table 1: Invasive Species Inventory

Species	Location and Abundance
Japanese knotweed <i>Fallopia japonica</i>	Currently grows in both small and large patches in the project area, particularly where there are gaps in the overstory providing sunlight, such as along the forest edges, including the trail and river bank. An infestation where the Beeken Preserve meets the Town of Richmond property dominates the stream bank for hundreds of feet.
Garlic mustard <i>Alliaria petiolata</i>	Found in small patches on both sides of the river.
Goutweed <i>Aegopodium podagraria</i>	Carpets large patches of the understory of the in the project area. It occurs on all properties.
Common and Glossy Buckthorns <i>Rhamnus cathartica</i> and <i>Rhamnus frangula</i>	A few isolated infestations of these two species were identified, primarily on private property on the downstream end of the project area.
Common Reed <i>Phragmites australis</i>	A significant infestation of <i>Phragmites australis</i> exists at a wetland on the Richmond Town property. Small infestations were also identified on the south side of the river on the Richmond Town property and RLT Beeken Preserve
Honeysuckles <i>Lonicera morrowi</i> and <i>tatarica</i>	Honeysuckle infestations were identified on the east end of the RLT Lower Safford Preserve on the portion of the trail arcing back to Cochran Road. A well-established infestation occurs on the portion of

Species	Location and Abundance
	the Barlow property fronting the Huntington River. Additional infestations are relatively small and scattered on private property in the project area.
Japanese barberry <i>Berberis thunbergii</i>	This species is found as isolated plants, primarily along the southwest side of the RLT property, particularly in RLT's lower Safford preserve.
Dame's Rocket (<i>Hesperis matronalis</i>) and Moneywort (<i>Lysimachia nummularia</i>)	Currently found in small patches throughout the project area. A large patch is established along Cochran Road, east of the trailhead on The Conservancy property.

II. Invasive Species Management Prioritization And Timeline

The workplan described below will guide invasive species management efforts on RLT, TNC and Richmond Town lands in the project area for the next five years (2010-2015). At the end of this period, partners will assess progress made toward their goals. Due to the number of invasive species, and the density of several of these species, it will not be feasible to eliminate all occurrences of all invasive species from the project area. With steady work each year, however, many patches can be reduced or eliminated, further spread can be checked, new infestations can be prevented, and native species will be allowed to thrive.

The following section outlines the weed management plan. It includes a) An outline of *prioritization by species*; b) A *timeline of seasonal activities* that identifies when activities will take place, lists needed equipment, and staffing and/or volunteer needs; and, c) A *species by species summary of management options*. This information was developed using available research and The Conservancy's local experience managing invasive species.

This plan is currently designed to address the invasive plant control priorities of The Conservancy, RLT, and Richmond Town properties. Approximately ten private landowners also own properties within the project area. At this time, management on private lands is not included. In order for the plan to be effective invasives management on private lands will also need to be included. This document is meant as a starting point for discussion and planning, and will be updated after meetings with RLT and Richmond Conservation Commission. *It is recommended that the management partners work together to add a greater level of prioritization for **specific locations** for management of each species.*

A. Identifying Invasive Plant Management Priorities

Unfortunately, when working in an area heavily infested with invasive plants there is no one method that will completely eliminate each species. Management priorities are set with the goal of achieving greatest ecological benefit while minimizing the total, long-term workload and project costs. In order to determine which invasive species to work on, we must take into consideration several factors, including:

- **Ecological priorities:** Within the project area, protecting the streambank from erosion and maintaining the natural plant diversity typical of silver maple-ostrich fern floodplain forests are the highest priority.
- **Recreational Land Uses:** The trails are heavily used by residents who enjoy the trails and the views to the river. Therefore there are sections of the trail where the Richmond Land Trust,

Richmond Town, and The Conservancy should prioritize protecting the trail from being overgrown by honeysuckle, goutweed, and other invasive species.

- **Available Resources:** Project leaders should assess available and potential resources including funding, volunteers, expertise, and equipment as well long-term goals.
- **Invasive Management Techniques:** It can be easier, more cost effective, and more ecologically beneficial to manage certain species than others. In addition, there are a number of techniques for controlling invasives species, some more effective than others. Therefore it is important to make management decisions based on the ability to control one or more species, the techniques available at a specific site, and concerns for impact to native species. For example, goutweed infestations are dense and widespread in the project area. Removing goutweed using either mechanical processes (e.g., black plastic mulch) or with herbicide applications (the two most recommended methods) will kill unacceptably high numbers of the native plants that it grows beneath, therefore it is recommended that this be a lower priority for control.

These factors have been considered in this management plan. Each year, as work progresses and resources change, the year's work plan may shift slightly. However, consistent weed management targeting priority species in priority areas will offer the best results. It is also critical to keep in mind when mapping out the annual plan that invasive species management needs to become an ongoing management task along with trail maintenance.

B. Recommended Invasive Species Control Priorities within the Project Area

Based on the identified ecological and land-use priorities within the project area and the realities of invasive plant control (available resources and known techniques for plant control) identified immediately below, we recommend focusing control actions on the following:

- 1) The smaller patches of Japanese knotweed, the large patch at the mouth of the Huntington River and other selected medium-sized and larger patches, and the *Phragmites* stand on town property.
- 2) Woody stemmed species (honeysuckle, Japanese barberry and buckthorn) which have the highest feasibility of control, and have greater potential for negative impacts if left unchecked; and,
- 3) Remove new infestations of garlic mustard, goutweed and knotweed, particularly in high value areas.

Highest priority

Ecologically, the **highest priority in the project area is removal of Japanese knotweed (*Fallopia japonica*)**. Dense stands of knotweed make it nearly impossible for ferns or other herbaceous plants or tree seedlings to regenerate. Prioritization among Japanese knotweed patches within the project area will take some further consideration. It is often considered best to control the small patches of any invasive plant before they become large, and to save the largest patches for later. With a plant spread by floodwater such as Japanese knotweed, there is also the question of whether to start upstream and work downward to control the plant or to start with smallest patches wherever they occur. There are also patches of knotweed that completely obscure the view to the river. In certain areas, reducing the size of these patches may be a higher priority. Reducing these larger, more prominent patches can also serve to inspire the participation of local volunteers. *It is recommended that the priorities for the upcoming year's knotweed management be determined in a walk-through at the beginning of each growing season.*

Removal of *Phragmites* aka Common reed (*Phragmites australis*). A significant *Phragmites* infestation exists at a wetland on the Richmond Town property. *Phragmites* can alter the structure of local ecosystems, rendering them a monoculture. Thick rhizomal growth and the accumulation of litter from the aerial shoots prevent native plants becoming established. These monocultures have decreased value as wetland habitat for wildlife.

Removal of garlic mustard (*Alliaria petiolata*) is a high priority. This plant can grow in the shade, spreads quickly, and produces its own natural herbicide further reducing the ability of natives to grow. If it is not removed, each spring it will quickly spread throughout the forest. **Dame's rocket** is biennial (or perennial) mustard like Garlic mustard, but does not have the same "natural herbicide" effect on other plants. It would be possible to control Dame's rocket concurrently with garlic mustard control, but it is not recommended to control Dame's rocket separately for its own sake.

Moderate priority

The second-tier priority is systematic removal of woody plant species in the understory of the project area floodplain forest and the forested upland buffer. Left unchecked, Buckthorn, honeysuckle, and Japanese barberry will gradually begin to dominate the understory and prevent the growth of native perennials and regeneration of native canopy trees. Additionally, removal of woody plant species along the trail will provide an excellent educational opportunity to teach users about the need to identify and rapidly remove invasive species from their own gardens and from natural areas.

Lowest priority

Goutweed (*Aegopodium podagraria*) is incredibly invasive, and therefore it is tempting to try to eradicate this plant. However, goutweed is difficult to control, even in small patches with constant management (such as smothering). Smothering is not possible in an area that is regularly inundated with flooding, and the use of herbicides at the site would likely cause extensive kill of desirable native species. It also appears that ostrich fern stands are relatively healthy, even in the thicker patches of goutweed.

Moneywort is also virtually impossible to remove, and since it is a ground creeper that research has not yet identified as capable of crowding out other plants, it is probably of low ecological importance.

C. **Early Detection, Rapid Response**

Invasive plants will persist in this natural community. In order to prevent the further spread of existing invasive plants into uninfested area, and to manage the likely introduction of new species, it will be important to regularly monitor the site for new invasions. Specifically:

- Monitor areas that currently do not have goutweed. Volunteers could try to remove new plants as they appear.
- Monitor the lower section of the Huntington River below Cochran Road for Japanese knotweed and remove new infestations as they occur. Knotweed is currently found at the mouth, but not extensively further upstream in Richmond. Volunteer efforts should include removal of any new infestations from the tributary.
- Monitor for new populations of garlic mustard and pull immediately in the spring.
- Remove new woody stem species as they occur. They are much easier to pull and remove by hand when young than they are to remove later using herbicides.

D. Timeline of Seasonal Activities

Each year, there will be a two-pronged approach for seasonal management of invasive plants in the project area. First, the *invasive herbaceous species* of highest priority will be treated annually to reduce the size and number of populations. Second, **invasive woody species** within the forest understory will be removed or treated. Each year a distinct section of the forested buffer will be marked and treated; the size of each treatment area will depend on available resources, most importantly volunteer commitment. A detailed description of each of the seasonal activities is described in Table 2.

Table 2: Summary of Annual Weed Management Activities

<i>Season</i>	<i>Activity</i>	<i>Equipment</i>	<i>Time</i>
Early Spring (March through May):	<p>Garlic mustard and Dame's rocket pulling: Garlic mustard rosettes are one of the first plants to turn green in the spring and are therefore easy to identify. Volunteers will hand-pull plants, bag them in industrial sized garbage bags and haul them off-site. Once they are fully decomposed, they will be thrown away. After each workday, boots should be brushed off to prevent the spread of seeds. If there were a safe place to compost the plants that someone could keep an eye on, it would eliminate the expense of disposal in a landfill. The first pass through should happen as early in the spring as possible after the floodwaters recede, while the ostrich ferns are still curled up as fiddleheads, for better visibility and to avoid trampling the ferns.</p> <p>Woody invasive pulling: This is a great time for experienced volunteers to pull up honeysuckle, barberry and buckthorn seedlings since they're easy to see before the ferns unfurl. Seedlings can be hung in a tree to dry (no off-site disposal is needed).</p>	gloves, buckets, "contractor"-sized trash bags to collect and remove, "dandelion" diggers	At least four days of labor by 10 volunteers. 2 days for a first pass in March or April, 2 more days for a second pass in early May.
June – August	<p>Japanese Knotweed control: Knotweed is not easy to remove. Three methods of management are currently recommended. 1) For relatively small infestations that are easily accessible, cut Japanese knotweed the first week of every month Repeat each month for five years. 2) Apply a one time dose of herbicide to the cut stems in August. Due to the size of some infestation the proximity to the river, ensure that dosage will not exceed legal limits. 3) In areas that are too large or difficult to manage with volunteers, it is recommended that a contractor conduct a foliar application of glyphosate-based herbicide in August. At this point, TNC is not planning on pursuing a contractor. However, this option is open to RLT and may be more attractive if we were able to find a grant that both groups could apply for and use for this purpose.</p>	weed whacker, loppers, clippers, grass whip or scythe; herbicides, squeeze bottles, spray backpack	<p><i>Manual control of small patches:</i> 10 volunteers, 1 - 2 days of labor 4 times per year on each side of the river (total of 4 days of labor on each side of the river)</p> <p><i>Chemical control drip method:</i> 2-4 days of labor on each side of the river.</p> <p><i>Chemical control foliar spray of larger patches:</i> 1-2 days of contractor time.</p>
August	<p>Phragmites control: Before seed heads are fully formed, <i>Phragmites</i> can be controlled by clipping and dripping herbicide into the hollow stems or by using a foliar wipe. RLT is pursuing funding for a contractor. The exact method will be determined after a more careful assessment by an herbicide contractor in Winter/Spring</p>	Per herbicide applicator's recommendation	\$1500 - \$5000 k over 5 years;

<i>Season</i>	<i>Activity</i>	<i>Equipment</i>	<i>Time</i>
<i>September - November</i>	<p>Woody plant removal. Continue to hand-pull small stems; Cut larger woody plants and treat with herbicide using the cut stump method, applying a 20-25% concentration of glyphosate-based herbicide. <i>Year one:</i> TNC Staff or AmeriCorps members or volunteers chainsaw down larger shrubs and buckthorn trees to remove seed source. <i>Subsequent years:</i> Divide parcel up into 2-5 acre blocks and work on a given number of blocks per year, from the southern portion of the river where infestations are the heaviest, to the northern portion of the river.</p> <p>Early detection of new patches of garlic mustard: garlic mustard rosettes are often visible in the late fall after other vegetation has turned brown. This is a good time to identify new patches and flag for pulling the following spring.</p>	gloves, handsaws, chainsaws, herbicide, squeeze bottles, buckets to carry tools & herbicide in	2 - 5 volunteers, 1/2 day of labor per year. Staff certified herbicide applicator to supervise if using herbicides.
<i>Monitoring</i>	Annual walk along both sides of river by TNC and RLT staff & volunteers to map populations of invasive plants.	GPS, clipboards, maps.	1 day/year for 8 people,

III. Public Outreach and Education

Management of invasive plants in the floodplain forest project area will require the help of Richmond residents and other users of the river area. This offers a rich opportunity to educate local residents and land management professionals about invasive plant management. A thorough, well articulated plan developed by the project partners will ensure project success and encourages private and public land owners to adopt invasive plant control measures for use on their own properties.

Table 3 outlines public outreach and education objectives and activities to directly support the project as well as for spreading the message of invasive plant control beyond the immediate project area. The project partners use them as a starting point for the initial year. Like other pieces of this management plan, they will evolve as the project evolves.



It is recommended that the project partners secure a volunteer coordinator to manage the project.

Volunteer recruitment and management take persistence and continuity. The United Way has numerous tools for thinking about how to effectively manage a volunteer program. It also offers free or low-cost training sessions in volunteer management, and has a free service that matches volunteers with projects.

Table 3: Proposed Public Education and Outreach Activities

Objective & Tasks	Completion date	Lead Partner
Outreach and volunteer recruitment, training, support for invasive plant control activities over the next five years, This includes an annual celebration for all volunteers, complete with food, slideshow, and door prizes.	ongoing	RLT & all partners
Media outreach including radio spots, local newspaper articles, etc.	ongoing	RLT & all partners
Four public outreach workshops , designed to support volunteer efforts and increase the project's ecological impact. A: Local natural history focusing on silver maple-ostrich fern floodplain forest ecology, & the threat posed by invasive species B: Hands-on invasive species identification and removal workshop, to kick-off the volunteer season; C: Hands-on workshop for VYCC crew leaders teaching invasive species identification and removal D Workshop about landscaping for wildlife enhancement—focus on removing and replacing invasive species	8/2010	RLT/TNC
Develop and present a land manager's technical workshop (For land managers throughout the Champlain Basin, to share technical skills in invasives control, and how to implement a community weed management plan).	9/2010	RLT, TNC
Develop and present workshop and resources for Richmond road crews so that they adopt wise road management practices that reduce the spread of invasive species.	6/2010	RLT, TNC
Develop a local display on native and invasive plants to educate the public about landscaping with non-invasive plants: To be housed in a visible location in town during the spring planting season, and serve to educate people about alternative non-invasive species useful in landscaping year-round.	6/2010	RLT, TNC <i>(Consider developing with local school groups Master Gardeners; UVM)</i>
If necessary, develop re-vegetation plans and guidance materials	ongoing	RLT and TNC
Inspire 10 households to remove invasive species from their landscaping (with a focus on landowners in close proximity to RLT and TNC land?!)	Summer 2011	RLT
Update the invasive plant management plan covering all participating properties within the project area for all major weeds	Winter 2011/2012	TNC, RLT & Cons Comm
Maintenance and updating of GIS and inventory maps	Annually	Cons Comm

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V. APPENDICES

A. 2008 Invasive Plant Survey Maps

Insert maps #1-#6 here when converting the document to a pdf file.

B. Detailed Description & Recommended Control of Invasive Species on Richmond Floodplain Forest

Species & Priority Level	Description	Distribution & Threats	Mgmt Objectives	Management Options & Recommendation
<p>Japanese Knotweed <i>Fallopia japonica</i> or <i>Polygonum cuspidatum</i></p> <p><u>Priority level</u> HIGH</p>	<p>Japanese knotweed is a fast-growing, herbaceous perennial that grows three to seven or eight feet high & forms large, dense patches. The dispersal and spread of Japanese knotweed occurs largely through the spread and growth of rhizomes (roots), which may reach up to 45-50 feet in length. Spread is particularly high along riverbanks, where soil is loose and periodic flooding moves plant material down stream.</p>	<p><u>Distribution:</u> Heavy, especially on TNC land. In certain areas the plants form a 10-75 foot buffer from the river inland.</p> <p><u>Threats:</u> Knotweed spreads quickly through its rhizomes and without control will continue to invade all areas of the floodplain forest.</p>	<p>Control knotweed in the floodplain forest and prevent further spread.</p> <p>Allow no-net-increase in knotweed cover in the floodplain forest.</p>	<p><u>Manual control:</u> Each year, from June – September cut back knotweed. At first, this control can be done with loppers or garden shears. After several seasons, the plants will be less robust and the stalks are much thinner. When the plants are smaller, it is easier to cut them back with a scythe or grass whip. Take care and do not cut native plants that regenerate. This may require careful cutting with hand clippers around the native plants.</p> <p><u>Herbicide control:</u> Small patches: apply herbicide to cut stem in August; return following year to check for surviving sprouts. Large patches: In August conduct a foliar spray of knotweed using a 2% glyphosate solution that is approved for use near water. <i>(Because the infestation is so heavy, a combination of mechanical and herbicide treatment will be necessary on both RLT, Richmond Town, and TNC natural areas. Eventually, working with private landowners will be essential to long-term success of the project.)</i></p>
<p>Garlic Mustard <i>Alliaria petiolata</i></p> <p><u>Priority level</u> HIGH</p>	<p>Biennial herb of the mustard family (<i>Brassicaceae</i>). Seedlings emerge in spring and form basal rosettes. Flowers produced the following spring set seed by early-summer. Seeds are easily transported by picking and transport of plants, hiking boots, bike tires.</p>	<p><u>Distribution:</u> Small infestations found throughout the forest on both sides of river.</p> <p><u>Threats:</u> Garlic mustard invades forested communities and edge habitats. Spreads rapidly. Displaces native herbaceous species, often within ten years of establishment. It is allelopathic, exuding a chemical from its roots that prevents other plants from growing.</p>	<p>Prevent new infestations. Limit spread of existing invasions.</p> <p>Allow no-net-increase in garlic mustard cover in the floodplain forest.</p>	<p>The plant has no natural enemies in North America and is difficult to eradicate once established. The best and most effective control method is to prevent its initial establishment and control new populations early.</p> <p><u>Mechanical:</u> <i>Hand pulling</i> garlic mustard rosettes requires at least 2-5 years of management until the seed bank is depleted. Hand pulling provides the most effective control with minimal or no side effects (although in dense patches there's quite a bit of soil disturbance) but has a high labor cost. <i>Burning garlic mustard</i> with a portable propane weed torch has proved effective in fire-resistant communities and may be an option in this wetland area.</p> <p><u>Herbicide:</u> Herbicide application provides effective control at a lower labor cost but may negatively impact native species. To minimize possible impacts, the application can be done in late fall after several frosts when native plants have gone dormant. <i>Because the infestation in Richmond is relatively small, hand pulling each year is the most cost-effective option with the least environmental impacts. If the population expands rapidly, TNC and RLT may decide to begin spraying green garlic mustard rosettes in the fall with a glyphosate herbicide.</i></p>

<p>Common Reed <i>Phragmites australis</i></p> <p><u>Priority level:</u> HIGH</p>	<p>Common reed is an herbaceous, tall perennial wetland grass, up to 15 feet in height. It has stout stems, long leaves (up to 2 feet), and large feathery plumes of flowers. May spread by seed or rhizome growth, although a number of populations do not produce viable seed. To distinguish between the native and non-native variety of common reed, plants must be viewed during the growing season: native strains will have a red stalk at the base of each leaf while non-native varieties show a brownish-tan color.</p>	<p><u>Distribution:</u> One isolated patch on south side of river. <u>Threat:</u> Common reed can proliferate in wetlands, displacing a variety of other plant species. It is allelopathic, exuding a chemical from its roots that prevents other plants from growing. The resulting decrease in species richness may have negative impacts on the site's biological diversity, including the quality of shrub swamp habitat.</p>	<p>Eradicate <i>Phragmites</i> in the wetland.</p>	<p><u>Herbicide:</u> TNC's preferred method to control common reed occurring in small patches is hand-cutting followed by a glyphosate herbicide dripped into the cut stem. Repeated cutting before the end of July, when most of the plant's food reserves are located in the aerial portion of the plant, has successfully controlled common reed stands. Continuing this process for several years has contained and significantly reduced common reed stands in a number of sites in the northeast. Overall, cutting in conjunction with the use of a glyphosate herbicide has proven to be the most effective means of control, and results in minimal disturbance to wetlands. Rodeo is an herbicide that is licensed for use in wetlands. <i>RLT may also hire a contractor or make a donation to TNC to manage Phragmites on the site. The contractor may choose to conduct a stem wipe or foliar spray of glyphosate, depending upon the size and density of the mat. A state wetlands permit will be required for herbicide use on this portion of the RLTLand. Herbicide use increases costs, and will likely create a need for public education regarding safety concerns. However, because it is the most effective and efficient method, it is recommended.</i></p>
<p>Honeysuckle <i>Lonicera morrowii, tatarica, and x bella (a hybrid of the first two)</i></p> <p><u>Priority level</u> MODERATE</p>	<p>Bush honeysuckles are deciduous shrubs that range from a few feet to 16 feet in height. The branches are widely spreading. The opposite, simple leaves (downy in <i>morrowii</i>) are oval to oblong in shape. Honeysuckle flowers are typically white or pink, and yellow with age. The fruit is bright (one species has orange) colored berries that grow in pairs. Unlike the native honeysuckle (<i>Lonicera canadensis</i>, with solid white pith), non-native honeysuckle stems have brown pith that becomes hollow with age. Shrubby honeysuckles occur in abandoned fields and pastures, on wetland edges, and in forests, especially where soils are rich. They tolerate a wide range of soil moisture and light levels.</p>	<p><u>Distribution</u> Single plants and small infestations found throughout the forest.</p> <p><u>Threats</u> Honeysuckles can rapidly invade natural communities by forming a dense shrub layer that decreases light availability and prevents the regeneration of many native woody and herbaceous plants. Although they thrive in full or partial sun, honeysuckles are able to grow and persist beneath a closed forest canopy. Honeysuckles spread vegetatively and sexually through fruits that are readily spread by birds and small mammals. Songbird nests built in honeysuckle experience higher predation than those in native shrubs.</p>	<p>Control honeysuckle in the floodplain forest and prevent further spread.</p> <p>Allow no-net-increase in honeysuckle cover in the floodplain forest.</p> <p><i>Left uncontrolled, the smaller patches in the floodplain forest will continue to expand.</i></p>	<p><u>Whole-plant removal.</u> Hand-pull small stems. For larger stems, use a weed wrench. This treatment removes the roots and ensures that treated individuals will not re-sprout. However, soil disturbance and increased light availability may enable new seeds to sprout. In addition, most weed wrenches cannot accommodate plants with a stem diameter greater than 2.5 inches, and they are less effective for multi-stemmed shrubs such as honeysuckle.</p> <p><u>Stem cutting followed by covering the stump.</u> This treatment removes plants without disturbing the soil. For best results, stems should be cut after spring leaf out and again in the fall because honeysuckle can re-sprout vigorously. Stems should be cut close to the ground surface. Cover the stump with burlap or plastic & tie securely. Shrub removal may increase light availability, releasing honeysuckle seedlings in the area or allowing new seeds to sprout.</p> <p><u>Stem cutting followed by application of glyphosate herbicide.</u> Herbicide application kills the roots and prevents re-sprouting from the stump. Apply an appropriate herbicide in the summer or fall after cutting the shrub.</p> <p><i>It is recommended to clear out the small infestations quickly, using a combination of hand pulling seedlings & cut stump treatment (either covering or herbiciding the stump). Herbicide use will increase cost, and will likely create a need for public education regarding safety concerns. However, because it is an effective method, it is recommended.</i></p>

<p>Common Buckthorn (<i>Rhamnus cathartica</i>) & Glossy Buckthorn (<i>Rhamnus frangula</i>) <u>Priority level</u> MODERATE</p>	<p>Deciduous shrub or small tree that reaches up to 20 feet high. Smooth, dull or shiny green, sub-oppositely arranged leaves persist well into the fall, and twigs are often tipped with short, weak thorns. Prefers neutral or alkaline soils, and does not grow well in dense shade. Buckthorn produces prolific fruits, spreading its seeds with the help of birds & wildlife.</p>	<p><u>Distribution:</u> Single plants and small infestations found throughout the forest. <u>Threats:</u> Buckthorns readily invade natural areas, establish dense, even-aged thickets that crowd or shade out native plants. It increases nitrogen in soils resulting in a change in the species composition of soil microfauna.</p>	<p>Same as above</p>	<p>Same options and recommendations as for honeysuckle (see above, plus girdling, see below.) Girdling. Girdling is a quick and easy method that results in slow tree death with minimal soil disturbance and alteration of the light regime. This method does not work when there are multiple trunks growing closely together. Herbicide may be applied to the girdle to decrease re-sprouting.</p>
<p>Japanese barberry (<i>Berberis thunbergii</i>) Common barberry (<i>Berberis vulgaris</i>) (not found in the project area but would be treated similarly if found) <u>Priority level</u> MODERATE</p>	<p>Thorny, deciduous shrub that grows 2-10 feet in height. Flowers from mid-April to May & produces edible red berries that are persistent on the stems throughout winter. Used as a landscaping plant. Birds & mammals feed on berries, dispersing viable seeds throughout large area. Tolerant of dense shade conditions.</p>	<p><u>Distribution</u> Single plants and small infestations found throughout the forest. <u>Threats</u> Barberry readily invades natural areas, establishing dense thorny thickets that shade out native plants, excludes wildlife. Due to greater protective cover, more mice are present. They are alternative hosts for deer ticks, and therefore it has been shown that in large populations of barberry, there can be a greater incidence of Lyme disease.</p>	<p>Same as above</p>	<p>Same options and recommendations as for honeysuckle (see above). However, it's not feasible to use the stem cutting and cover stump approach with barberry because it has many, many small stems.... impossible to cover them all. Likewise, the weed wrench may not be effective due to the multiple stems. It is recommended to use the cut stump treatment with herbicide application.</p>
<p>Dame's rocket (<i>Hesperis matronalis</i>) <u>Priority level:</u> MEDIUM in certain locations and when done in conjunction with garlic mustard pulling</p>	<p>Herbaceous biennial (sometimes perennial) in the mustard family. Produces four petaled pink/lavender/white flowers. This plant is often confused with garden phlox, which has five petals.</p>	<p><u>Threats:</u> Dame's rocket spreads quickly and becomes dense in floodplain forests. Has the ability to crowd out native species.</p>	<p>Reduce spread into new areas. Same as above.</p>	<p>Mechanical: Uproot the plants and bag them for removal as seeds can continue to ripen even if plant is pulled and set in a pile to compost. Treat like garlic mustard. However, uprooting may cause a lot of soil disturbance since the root system can be fairly large. Do not uproot when there are dense mats. Chemical: Treat in the fall when leaves are still green but native plants have become dormant. Use a glyphosate spray on the rosette. Recommendation: Hand pull and bag plants.</p>

<p>Goutweed (<i>Aegopodium podagraria</i>)</p> <p>Priority level: LOW</p>	<p>Vigorous perennial with numerous rhizomes. Leaves divided into three groups of three leaflets. Can be variegated or entirely green. In July, produces a 2-3 foot stem with an umbrella-shaped flower on top, much like a Queen Anne's Lace. May not flower in shady areas.</p>	<p>Distribution: Heavy infestations found throughout the forest on both sides of the river. In most areas forms a dense carpet beneath the ostrich fern.</p> <p>Threats: Forms dense mat that prevents native plants from regenerating. Highly competitive in shady environment. Reproduces rapidly by rhizomes.</p>	<p>Reduce spread of goutweed into un-infested areas.</p> <p><i>Goutweed is notoriously difficult to manage. In much of the floodplain forest, removal will not be possible</i></p>	<p>Mechanical: The only mechanical option that has proved effective is to smother the plants by putting several layers of black plastic, rugs, or tarps over the area. This will of course kill native plants as well, but in areas with few native plants this could be a viable option.</p> <p>Herbicide: Glyphosate can be applied to the plant, but it is not always effective. The potential collateral damage to native herbaceous plants is very high, especially in a floodplain forest where Ostrich fern is one of the primary species found in the natural community.</p> <p><i>In areas that do not yet have goutweed, new invasions can be prevented by hand pulling and foliar application of herbicide.</i></p>
<p>Moneywort (<i>Lysmachia nummularia</i>)</p> <p>Priority level LOW</p>	<p>Moneywort is an herbaceous perennial that forms a low, ground-covering mat. Its creeping stems are smooth with opposite, round leaves that are 1-3 cm long. In mid-summer, it forms solitary flowers in the leaf axils that are yellow with red spots. Though it produces small seeds borne in capsules, the seeds are not viable. It spreads vegetatively. Native to Europe and Southwest Asia, it is found in eastern Canada and the United States, as well as several western States. It prefers, and poses the biggest threat to, wet meadows and floodplain forests.</p>	<p>Distribution <u>Creates dense understory mat throughout much of the forest. Thus far relatively small patches persist.</u></p> <p>Threats <u>Moneywort forms dense, ground-covering mats that may have the ability to prevent the recruitment of native seedlings and herbaceous species.</u></p>	<p>Test the feasibility of eradication of moneywort through a pilot study. Based on pilot study, determine if moneywort eradication is possible at this site and if so, modify the weed mgmt plan to include moneywort control in the future.</p>	<p><u>There is little research available about how to control moneywort. Mechanical treatment does not work because plants break off from the root, leaving the root to re-sprout. Herbicide treatments would kill nearby native plants.</u></p> <p><u>At this point, moneywort management is not recommended.</u></p>

C. Recommendations for Further Research

The following sites are quality references for referencing management options.

- <http://www.vtinvasiveplants.org>
The Vermont Invasive Exotic Plant Committee (VEIPC) website - Includes information about VEIPC activities, as well as a “Gallery of Invaders”, useful for identifying individual species and tips on management techniques.
- <http://tncinvasives.ucdavis.edu>
The Conservancy’s “Invasives on the Web” - Includes invasive species fact sheets, information on controlling invasives and a wide variety of invasive exotic species information.
- <http://www.vermontagriculture.com/invasive.htm>
The Vermont Department of Agriculture - Explains the Vermont plant quarantine rule and provides its entire text.
- www.nps.gov/plants/alien/factmain.htm
Plant Conservation Alliance - Illustrated, easy-to-read fact sheets on invasive alien plants with native ranges, plant descriptions, ecological threats, U.S. distributions & habitats, background of introductions, plant reproduction & dispersal, management approaches, alternative native plants, and other useful information.

D. Developing Bid Specifications for Contracting Invasive Plant Control Support

A thorough guide to developing bid specifications invasive plant control, covering establishing goals, identifying and prioritizing species, outlining tasks, contractor requirements and types of contracts can be found at <http://www.invasiveplantcontrol.com/>.

E. Invasive Plant Fact Sheets