

STATEWIDE KNOTWEED CONTROL PROGRAM

2009 Progress Report



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Cover Photo: Invasive knotweed on the East Fork Satsop River

Extreme care was used during the compilation of the map in this report to ensure accuracy. However, due to changes in data and the need to rely on outside sources of information, the Department of Agriculture cannot accept responsibility for errors or omissions, and, therefore there are no warranties which accompany this material. Original data were obtained from the Washington State Department of Ecology, Washington State Department of Natural Resources, and program cooperators.

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Executive Summary

Natives of Asia, the invasive knotweeds targeted by Washington's Statewide Knotweed Control Program include four perennial plant species that are commonly known as Japanese, giant, Bohemian, and Himalayan knotweed. The invasive knotweeds have been reported or documented in every county of Washington State, but recent geographic information systems model results suggest that these species currently occupy a small fraction of suitable habitats. If left untreated, the invasive knotweeds will likely spread to suitable areas that are currently unoccupied. Invasive knotweeds can alter riparian vegetation communities, disrupt nutrient cycling, negate riparian restoration efforts, affect the recreational use of watercourses, and decrease property values.

Since 2004, the Washington State Department of Agriculture (WSDA) has provided funding, coordination and other resources to county noxious weed control boards, tribal governments, and other organizations and agencies for the control of invasive knotweed. In 2009, the WSDA Knotweed Control Program budget was reduced from \$650,000 to \$470,000. This funding level allowed for the support of project activities in watersheds of 17 counties. Program cooperators leveraged state funding to bring approximately \$484,000 of additional local, non-governmental, and federal funding to these knotweed control projects.

With the combination of funds available, approximately 2,025 acres of knotweed were treated with integrated pest management techniques and project work occurred in 786.2 river miles for 1,377 landowners. To gauge the effectiveness of the treatment methods used in the control program, WSDA visited monitoring plots that have been treated by program cooperators using integrated pest management methods.

Compared to observations from 2005, annual herbicide treatments resulted in a 98% reduction in the number of stems per square foot at the program's monitoring plots. The knotweed that was present in the monitoring plots displayed a 91% reduction in stem height and an 85% reduction in stem diameter. This dramatic reduction is typical of results in project areas across the state, where many native plants have naturally returned to sites where they had previously been displaced by knotweed.

Recent budget reductions have resulted in the inability to perform follow-up treatments at many sites. If left untreated, there is evidence that the small amount of live knotweed present at treatment sites can return to their original level in three seasons, placing the site back on a path towards a monoculture of knotweed and subjecting the project area to the negative consequences of knotweed invasion.

WSDA will continue to support knotweed control as program funding allows, but further reductions in funding could require the abandonment of projects throughout the state and reduce support for remaining initiatives. This would result in the loss of progress toward long-term knotweed control, loss of employment opportunities, degradation of environmental quality, and the alteration of the sustainable ecological services of invaded sites.

Introduction

This is a progress report for the Statewide Knotweed Control Program carried out by the Washington State Department of Agriculture (WSDA) that describes the program framework, project selection process, budget, survey methods, treatment methods, and results for calendar year 2009.

The Plants

The invasive knotweed complex is comprised of four herbaceous perennial plant species from the buckwheat family (Polygonaceae) that are native to Asia. They are broadleaf plants that have green stems and swollen, reddish nodes (**Figure 1**). The plants were introduced to the United Kingdom and the United States as garden ornamentals. The four species are commonly referred to as Japanese, giant, Bohemian, and Himalayan knotweed, and are collectively referred to as knotweed in this report.

- **Japanese knotweed** (*Polygonum cuspidatum* Sieb. & Zucc.) The leaves of this plant are blunt at the base and sharply tapered at the tip (**Figure 2**). The stems of this plant usually grow to 7 feet tall. Stem diameters range from one-half to one inch.
- **Giant knotweed** (*P. sachalinense* Schmidt) This is the largest of the four invasive knotweed species. It has large heart shaped leaves (**Figure 2**), stems that can grow up to 12 feet tall, and stem diameters up to two inches.
- **Bohemian knotweed** (*P. x bohemicum* Chrtk & Chrtkova) This is the hybrid produced by giant and Japanese knotweed. Leaf shape, stem diameter, and stem heights are variable, but are usually within the range of the smaller Japanese knotweed and larger giant knotweed. It is the most common invasive knotweed species in Washington State.
- **Himalayan knotweed** (*P. polystachyum* Wall) has lance-shaped leaves that make it readily identifiable when compared to the other species (**Figure 2**). The stems of this plant usually



Figure 1. The green, bamboo-like stems of invasive knotweed.



Figure 2. Leaves of three species of knotweed. From left to right are the leaves of giant, Japanese, and Himalayan knotweed.

reach one half inch in diameter, and four to five feet in height. It is most common in the coastal areas of southwest Washington.

All four species are listed as Class B noxious weeds on the Washington State Noxious Weed List (WAC 16-750-011). Class B noxious weeds are designated for control in regions of Washington State where they are not yet widespread. In regions where Class B noxious weeds are abundant, mandatory control is decided at the county level. All four species are included in the Washington State noxious weed seed and plant quarantine list (WAC 16-752-610). Under this rule, it is illegal to transport, buy, sell, or trade any of the invasive knotweed species.

Invasive knotweeds have extensive underground rhizome and root systems. They thrive in moist soil or river cobble, in full or partial sunlight, and are most common along rivers, creeks, beaches, and disturbed areas. The aerial stems of knotweed emerge in spring and reach full height by early summer. The plants flower in late summer or early fall (*Figure 3*), and the aerial shoots die after the first frost. The dead shoots persist through the winter, and can remain standing for several years (*Figure 4*).



Figure 3. Flowering knotweed in Skamania County.



Figure 4. Dead aerial stems of knotweed on the East Fork Lewis River in Clark County.

The Problem

The invasive knotweeds are non-native plants that have been introduced to Washington State without any of the factors that keep their populations under control in their native range. Knotweed modifies the ecosystems it inhabits and is reported or documented in every county of Washington State. These plants are pioneer species and quickly colonize disturbed areas.

Knotweed alters riparian vegetation communities, disrupts nutrient cycling, negates riparian restoration efforts, affects the recreational use of watercourses, and decreases property values.

In the Pacific Northwest, knotweed spreads when roots and stems are moved by flowing water or human activities (**Figure 5**). Human activities include moving soil that contains knotweed plant material, mowing or cutting knotweed, or discarding knotweed plant material in vulnerable habitats.



Figure 5. (Left) Knotweed emerging from fragments in flood-deposited soil, and (Right) knotweed stems being transported downstream by flowing water.

Knotweed can negatively affect residential property, transportation infrastructure, and natural areas. Along right-of-ways, knotweed can grow through materials used for roadways causing the need for expensive repairs. Knotweed patches also pose potential sight-distance hazards to vehicle operators due to its rapid growth.

In river corridors, knotweed reproduces from fragments and seeds that travel downstream, affecting the gravel bars and riparian forests of entire river systems. Root and stem fragments as small as one inch can produce a new plant. As a result, one patch can be the source of many downstream populations. When these patches coalesce, they exclude all other vegetation.

Riparian areas are transitional habitats located between terrestrial and aquatic ecosystems such as lakes or rivers. Riparian areas provide shade, nutrients, and large woody debris to both aquatic and terrestrial ecosystems. These functions take many decades to recover once impacted. Over time, riparian areas that are occupied by early-successional native species such as alder, willow, and other shrubs, move toward a plant assemblage dominated by conifers.

At sites occupied by knotweed, both deciduous and coniferous trees exhibit decreased juvenile populations, decreasing the number of individuals available to replace mature trees. Failure to control knotweed at these sites will result in a monoculture of knotweed that excludes all beneficial riparian vegetation.



Figure 6. A knotweed-infested side channel and adjacent riparian forest of the Dickey River 2005 (National Park Service North Coast-Cascades Network EPMT) .

Figure 6 shows the knotweed infestation of the Dickey River in 2005. Knotweed had displaced most of the understory plants at this site and occupied any opening created by natural disturbance. Annual control efforts have greatly reduced the knotweed population present at this site, which has allowed native riparian plants to return.

The lack of juvenile tree species in knotweed-infested riparian forests could also result in a decrease in large trees available to fall into the stream channel. These large pieces of wood are important to the rivers and streams of the Pacific Northwest. Large woody debris creates pool habitats, retains spawning gravels, and provides cover for juvenile salmonids. The loss of large woody debris can disrupt natural processes, leading to a down-cutting of the stream bed, loss of side channel fish habitat, loss of pool habitat, decreased retention of spawning gravels, and decreased cover for juvenile salmonids and their prey.

Knotweed can affect aquatic invertebrates that are the basis of the aquatic food chain by disrupting or altering the quality and timing of leaf litter inputs. Invertebrates are the primary food source of juvenile fish species.

Substantial resources have been applied to the protection or restoration of riparian areas in Washington State for the benefit of fish, wildlife, and recreation. Many of these projects seek to reintroduce or protect riparian vegetation that is critical to self-sustaining ecological services of forests and streams. Knotweed infestations can ruin the sustainable benefits of these projects by out-competing the offspring of the native plantings and dominating the vegetation community in the long-term.

WSDA Knotweed Control Program

The WSDA Knotweed Control Program provides funding, coordination, and other resources to cooperators that conduct knotweed control projects. WSDA serves as a clearinghouse for knotweed control information and assists any group interested in knotweed control. WSDA also maintains a database of all known knotweed locations in the state.

WSDA works with groups throughout Washington State to identify knotweed, develop knotweed control projects, and secure grant funding. In order to minimize duplication of efforts by program cooperators, WSDA fulfills state-level environmental review requirements, coordinates Federal Clean Water Act permit requirements, provides public notification materials, and publishes required notices.

2009 Project Selection

In March 2009, WSDA facilitated a pre-proposal meeting in Olympia. This meeting gave stakeholders the opportunity to interact with representatives from organizations who are currently implementing knotweed control projects and provide input regarding the evaluation of project proposals. Representatives from county noxious weed control boards, county conservation districts, WSDA, and non-governmental organizations participated in the meeting.

Stakeholders recommended that WSDA support projects that:

- require funding to protect previous accomplishments
- cost-effectively control knotweed populations
- protect large, ecologically important areas

An internal review committee used these recommendations to evaluate project proposals. In 2009, thirty-five proposals requesting a total of \$1,133,000 were submitted. WSDA furnished support to 13 of these projects, allocating a total of \$352,734 for agreements and contracts.

Budget

The Washington State Department of Agriculture (WSDA) has administered a knotweed control program since 2004 when the Legislature provided an appropriation of \$500,000 per year for a pilot program in southwest Washington. In 2005, the program was expanded to address knotweed control statewide at a continued funding level of \$500,000. In 2007 and 2008, the budget was increased to \$650,000.

In 2009, the WSDA knotweed control program budget was \$470,000 (***Table 1***). WSDA allocated \$352,734 for contracts and agreements, \$26,000 for a centralized herbicide purchase, and \$91,266 for WSDA coordination. WSDA coordination expenses include agency

administration costs, salaries and benefits for the coordinator, legal and clerical support, equipment costs, printing, and other goods and services. This state funding was leveraged by program cooperators to secure an additional \$484,000 of local, tribal, non-governmental, and federal funding.

Table 1. Estimated budget activity for the 2010 fiscal year.

| Activity | Budget Expenditure | |
|--------------------|----------------------------------|-----------|
| Purchased Services | | \$352,734 |
| | 10,000 Years Institute | \$57,400 |
| | Clark County | \$55,240 |
| | Skamania County/Klickitat County | \$51,968 |
| | The Nature Conservancy (Skagit) | \$38,753 |
| | Clallam County/Jefferson County | \$36,984 |
| | Lewis County | \$34,558 |
| | King County | \$26,400 |
| | The Nature Conservancy (SW) | \$20,541 |
| | Snohomish County | \$8,969 |
| | Yakama Nation | \$7,431 |
| | Yakima County | \$5,125 |
| | Okanogan County | \$5,000 |
| | Cowlitz County | \$2,665 |
| | Whitman County | \$1,700 |
| Herbicide Purchase | | \$26,000 |
| WSDA Coordination | | \$91,266 |
| Total | | \$470,000 |

Survey and Treatment Methods

Program cooperators survey for knotweed by wading or boating streams and driving right-of-ways in each project area. The location of knotweed is documented, and this information is used to identify the ownership of affected parcels. Program cooperators secure permission from each landowner prior to the performance of any control activities. Most landowners are familiar with the negative impacts of knotweed and welcome the assistance provided by program cooperators.

Treatment methods are selected based on site and infestation characteristics according to integrated pest management (IPM) principles. An important IPM consideration for the program is the treatment of all known knotweed populations in the selected river corridor, starting at the

upstream source of the infestation and working in a downstream direction. This strategy helps to ensure that untreated knotweed plant material will not re-infest treatment sites as it moves downstream.

Treatments are conducted when the knotweed plants are actively growing. All program cooperators apply formulations of the systemic herbicides imazapyr or glyphosate, alone or in combination. Foliar delivery of herbicide was the primary treatment method used by project cooperators in 2009.

Program cooperators use herbicides that are registered for use in or near water in Washington State. WSDA requires that all herbicide applications be made under the supervision of a licensed applicator.

Results

In 2009, WSDA provided resources to the Yakama Nation, The Nature Conservancy (TNC), 10,000 Years Institute, and the noxious weed control boards of Clallam, Clark, Cowlitz, King, Lewis, Okanogan, Skamania, Snohomish, Whitman, and Yakima counties.

These cooperators implemented knotweed control projects in watersheds of 17 counties, including Clallam, Clark, Cowlitz, Grays Harbor, Jefferson, King, Klickitat, Lewis, Mason, Okanogan, Skagit, Skamania, Snohomish, Thurston, Whatcom, Whitman, and Yakima counties (**Figure 7**). The resources that are available to groups in Yakima, Klickitat, and Whitman counties allowed for the treatment of all known knotweed within each county.

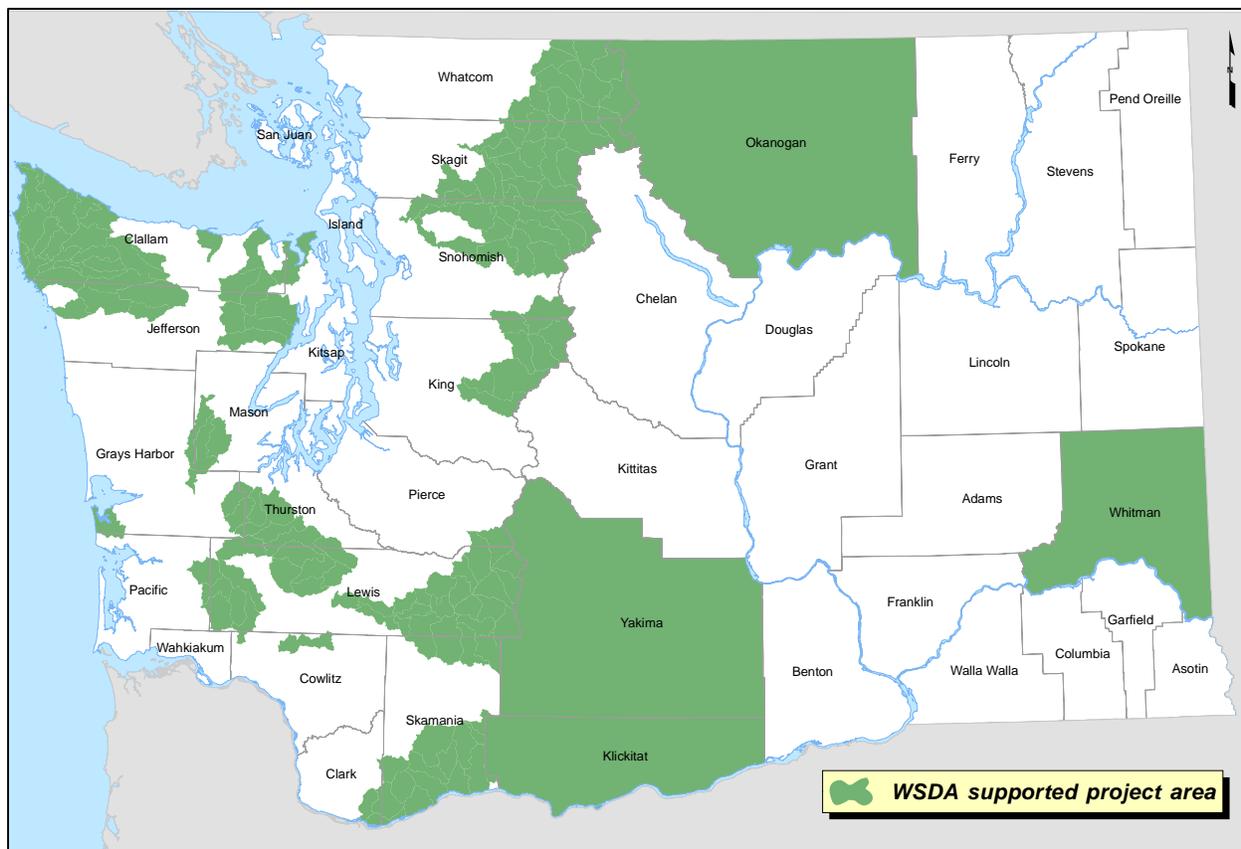


Figure 7. WSDA-supported project areas for 2009. Project area boundaries are delineated by Watershed Administrative Units where riparian knotweed control is the focus, and county boundaries where very low infestation levels allow program cooperators to survey for all known sites within the county. Watershed Administrative Unit boundaries were established in WAC 222-22-020.

WSDA continued to support on-going projects and, for the first time, provided resources to the Cowlitz County Noxious Weed Control Board for knotweed control in the Toutle Watershed. Cowlitz County surveyed the Toutle River and tributaries prior to 2009 and found that knotweed had not yet reached the riparian areas or gravel bars of the main river channel. Additionally, the knotweed in the project area was limited to three acres of an upland site. This site is very close to a tributary to the Toutle, and if left untreated would likely be the source of infestation for all suitable habitats in downstream areas.

Based on results of habitat suitability modeling performed by WSDA, there are approximately 42,000 acres of habitat suitable for knotweed colonization in the Toutle Watershed. The cost to control noxious weed populations increases rapidly if control activities are delayed. Therefore, the cost to treat 3 acres of upland knotweed in the Toutle Watershed in 2009 is significantly less than the cost of treating knotweed after it has expanded to all suitable habitats in the same project area.

Table 2. Results by region and program cooperator for the 2009 control season.

| Program Cooperator | Acres Treated | River Miles | Landowners Assisted |
|---------------------------------|----------------------|--------------------|----------------------------|
| 10,000 Years Institute | 0.03 | 12.5 | 8 |
| Clark County | 352.0 | 27.6 | 64 |
| Skamania County | 200.7 | 108.1 | 240 |
| The Nature Conservancy | 3.6 | 101 | 40 |
| Clallam County/Jefferson County | 1199.5 | 120 | 205 |
| Lewis County | 12.0 | 85.0 | 232 |
| King County | 116.9 | 40.3 | 139 |
| The Nature Conservancy | 6.5 | 196.5 | 113 |
| Snohomish County | 123.0 | 13.2 | 202 |
| Yakima County / Yakama Nation | 4.2 | 82 | 89 |
| Okanogan County | 4.0 | na | 31 |
| Cowlitz County | 3.0 | na | 4 |
| Whitman County | 0.1 | 0 | 10 |
| Total | 2,025.5 | 786.2 | 1,377 |

In most cases, program cooperators leveraged state funds to secure funding from other sources. If the state funding had not been available to program cooperators, the additional funding could not have been awarded, and work funded by state-leveraged resources would not have taken place. **Table 2** is a summary of the work performed by program cooperators in 2009 with all available funding.

WSDA uses three metrics to track the progress of each project. The river miles column includes survey, treatment, and monitoring activities. In cases where our projects are focused on the treatment of upland knotweed populations in order to prevent the infestation of the shorelines of rivers, the river miles measure does not apply.

Approximately 2,025 acres of knotweed were treated with IPM techniques in 2009. Project work occurred in 786.2 river miles for 1,377 landowners. Due to a budget reduction in 2009, WSDA was not able to provide resources to as many projects as in the past. There were 13 program cooperators in 2009 compared to 23 in 2008. As a result, there was a decrease in all three metrics compared to results of program activities for 2008.

Based on habitat modeling for invasive knotweed, only 0.3% of suitable habitat is currently occupied by knotweed in currently supported project areas. This suggests that the current expenditures for control are significantly less than the funding that will be required to protect the same project areas in the future.

Monitoring

WSDA uses monitoring plots to gauge the effectiveness of treatments used in the Knotweed Control Program. In 2009, WSDA staff visited plots in Pacific County, Skamania County, and Lewis County in southwest Washington between the months of July and September. In 2009, stem counts, stem heights, and stem diameters were recorded.

WSDA compared stem density (number of stems per square foot), stem height, and stem diameter measurements recorded in 2005 to measurements from 2009. All the monitoring plots have been treated each season since 2004. The difference between the measurements are calculated as a percent reduction, and used to evaluate the cumulative effects of treatments over the past five seasons. For all measurements, zero percent control represents no change compared to observations recorded in 2005, and 100% control translates to no knotweed at the site.

Across all sites, knotweed populations displayed a 98% reduction in the number of stems per square foot. The above ground growth that was present in the monitoring plots displayed a 91% reduction in stem height and an 85% reduction in stem diameter when compared to measurements recorded in 2005. All knotweed regrowth appeared to come from existing rhizomes or root crowns, and there were no seedlings present in 2009.

Natural recolonization of treatment sites by native or non-native plants was noted at all monitoring plots (**Figure 8**). These results suggest that the need to reestablish native vegetation at treatment sites depends on the vegetation that is present in the surrounding landscape.

Results observed at the monitoring plots are consistent with observations at project sites. Across the state, the knotweed populations that persist in project areas have fewer stems per acre and the knotweed that is present exhibits reduced stem height, stem diameter, and overall vigor. This has

allowed many native plants, including tree and shrub species, to colonize areas where they had previously been displaced by knotweed.



Figure 8. (Left) Monitoring plot in Lewis County, photo taken prior to herbicide treatment in 2004 (Right) Same monitoring plot, photo taken following five consecutive years of treatment.

Some program cooperators have observed knotweed growing at treatment sites where there had been no knotweed growth for two seasons; and there is evidence that, left untreated, the small amount of live knotweed present at treatment sites can return to its original level in three seasons. This phenomenon reinforces the need for project areas to be thoroughly re-surveyed and re-growth treated for several years.

Although there have been dramatic reductions in knotweed, program cooperators have not yet completely removed knotweed from any landscape-scale project area.

Biological Control Program

Dr. Fritzi Grevstad of the University of Washington has been working with an international group of scientists to develop a classical biological control program for the control of Japanese, giant, and Bohemian knotweed. In biological control, natural enemies from the weed's native range are introduced to provide long-term suppression of the plant population. Partners include the U.S. Forest Service Forest Health Technology Enterprise Team, Washington State Department of Agriculture, Oregon Department of Agriculture, Oregon State University, Cornell University, CABI- Biosciences United Kingdom, Washington State University Extension, Agri-Food Canada, and the BC Ministry of Forests.

Two natural enemies from knotweed's native range are currently being tested for use as biological control agents: a sap-sucking psyllid (*Aphalara itadori*) and a leaf and stem-feeding moth (*Ostrinia ovalipennis*). Biological Control Program partners have developed a test plant list of native and economically important species. Rigorous testing will be carried out using plants from the test list to help ensure that the insects will not feed on native or economically important non-target plant species in North America.

Results of a no-choice host specificity test show that the psyllid was largely host specific to the invasive knotweeds. Additional tests are being carried out to further assess the possibility of non-target impacts including host preference choice tests, impact assessments, and a test of the ability of the insect to persist on non-target plants for more than one generation.

Due to difficulties rearing *Ostrinia ovalipennis*, feeding trials were carried out on only one non-target plant. Larvae were able to feed and develop on the plant, but their growth was not vigorous and they were not able to pupate. The risk to this test plant depends on whether adult females will oviposit on the plant. Oviposition tests have yet to be performed. Other plants from the test list will be introduced after sufficient populations of *O. ovalipennis* have been reared.

Summary

The invasive knotweeds are non-native plants that have been introduced to Washington State without any of the factors that keep their populations under control in their native range. They modify the ecosystems they inhabit and have been reported or documented in every county of Washington State. These plants are pioneer species with the ability to quickly colonize disturbed areas and currently occupy a small fraction of suitable habitat in Washington. The invasive knotweeds have the ability to alter riparian vegetation communities, disrupt nutrient cycling, negate riparian restoration efforts, affect the recreational use of watercourses, and decrease property values.

Since 2004, the Washington State Department of Agriculture has provided resources to county noxious weed control boards, county conservation districts, tribal governments, the Washington State Parks and Recreation Commission, and three non-governmental organizations for landscape-scale knotweed control projects. WSDA has served as a clearinghouse for knotweed control information, and disseminated this information to any group interested in knotweed control. In order to minimize duplication of efforts by its program cooperators, WSDA fulfills state-level environmental review requirements, provides public notification materials, delivers technical training, and publishes required notices.

Our program cooperators have been successful at reducing the amount of knotweed growth in their project areas and minimizing the negative impacts of knotweed infestation. These reductions have allowed for the natural return of native plants to sites where they had previously been displaced by knotweed.

However, recent budget reductions have resulted in the discontinuation or contraction of many knotweed control projects and the inability to perform follow-up treatments at many sites. If left untreated, there is evidence that the small amount of live knotweed present at treatment sites can return to its original level in three seasons, placing the site back on a path towards a monoculture of knotweed and the exclusion of native plants.

WSDA will continue to support knotweed control as program funding allows, but further reductions in funding could require the abandonment of projects throughout the state and reduce support for remaining initiatives. This would result in the loss of progress toward long-term knotweed control, loss of employment opportunities, degradation of environmental quality, and the alteration of the sustainable ecological services of invaded sites.