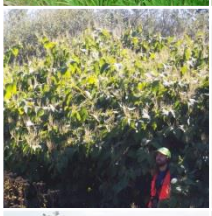
2015

Clackamas River Invasive Species Management Plan

A collaborative effort by the Clackamas River Invasive Species Partnership to prioritize and manage invasive species and associated restoration efforts in the Clackamas River Basin.



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Prepared on behalf of the Clackamas River Invasive Species Partnership
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Executive Summary

The Clackamas River Invasive Species Partnership (CRISP) was formed collaboratively by the Clackamas River Basin Council, the Clackamas Soil and Water Conservation District, and Metro to develop the *Clackamas River Invasive Species Management Plan* in order to prioritize and manage invasive species and associated restoration efforts in the Clackamas River Basin. Through the implementation of this plan, the CRISP will:

- Develop and maintain a coalition of federal, state, regional, and local partners to prioritize and coordinate invasive plant control and revegetation efforts throughout the basin;
- Secure new and sustainable sources of funding to implement and maintain these efforts;
- Align local and regional policies to support implementation of plan goals;
- Promote a culture among public and private land owners within the basin that recognizes the need to actively manage invasive plants and enhance natural areas;
- Identify and prioritize sub-watersheds, natural areas, and important habitats for protection and enhancement;
- Develop an invasive plant treatment strategy that identifies and prioritizes specific actions for managing invasive species through the consolidation of existing efforts and resources.
- Prevent the introduction or spread of new invasive species, reduce the distribution and cover of priority invasive species, and restore priority natural areas currently infested with common, priority, or new invasive species;
- Outline a strategy to use limited resources to accomplish measureable, impactful, and lasting improvements within the basin.

The *Clackamas River Invasive Species Management Plan* presents both a long-term, basin-wide framework for controlling invasive species and a near-term strategy that is intended to help focus limited resources on the geographies and initiatives where they can have the greatest impact. This plan is intended to be iterative, and will be adapted and adjusted to changing priorities, partnerships, and conditions within the Clackamas River Basin.

The plan is not intended to capture or direct all invasive plant control activities within the Clackamas River Basin. Local site conditions and restoration goals amongst CRISP partners necessitates unique management approaches at the property or site level. The *Clackamas River Invasive Species Management Plan* is instead focused on creating commonalities between projects, and helping to focus available resources that can affect meaningful change at the landscape level through collective action.

The first section of the *Clackamas River Invasive Species Management Plan* gives an overview of the human history, land and water use patterns, habitat conditions, and community values that informed the development of this plan.

Section 2 defines the term invasive species as used in the context of this report and provides an overview of the impacts that invasive species have on habitat, water quality, agriculture, forestry, and economics within the basin.

Section 3 summarizes the existing invasive species control and restoration efforts in the basin and proposes a framework of invasive species control strategies to be employed across the basin.

In section 4, the *Clackamas River Invasive Species Management Plan* describes the known invasive species populations in the basin and their prioritization for control based on a variety of biological attributes.

Section 5 analyzes land use patterns and habitat values in order to organize and prioritize specific sub-basins, and groups of sub basins for control and restoration actions.

Section 6 characterizes the four priority sub-basin target areas, including known invasive species populations, existing patches of high quality habitat, and potential priority initiatives in each of the areas.

Section 7 consolidates the highest priority basin-specific initiatives into a 10-year strategy to be implemented by the stakeholders.

Section 8 discusses regulatory and political initiatives that could significantly improve the effectiveness of the stakeholders' on-the-ground efforts.

Section 9 provides estimates of the financial resources needed to implement the 10-year strategy and gives insights in how to close the budget gap.

Section 10 summarizes the *Clackamas River Invasive Species Management Plan*'s recommendations and lays out the steps that are necessary for successful implementation.

The wide diversity of land management agencies and organizations that are invested in restoring the Clackamas River Basin presents both an opportunity and a challenge. Control of invasive species and restoration of habitat are long-term processes even when conducted on a small scale. Scaling these processes up to encompass the whole of the Clackamas Basin will require a long-term commitment from agencies, non-profits, and private landowners to work towards common goals. Partners within the Clackamas River Basin will need to look beyond jurisdictional boundaries and be strategic in their allocation of available resources. Successful implementation of the *Clackamas River Invasive Species Management Plan* will also depend on partners staying engaged in specific restoration and control activities while working cooperatively to accomplish long-term goals.

Section 1: *Overview of the Clackamas River Basin*

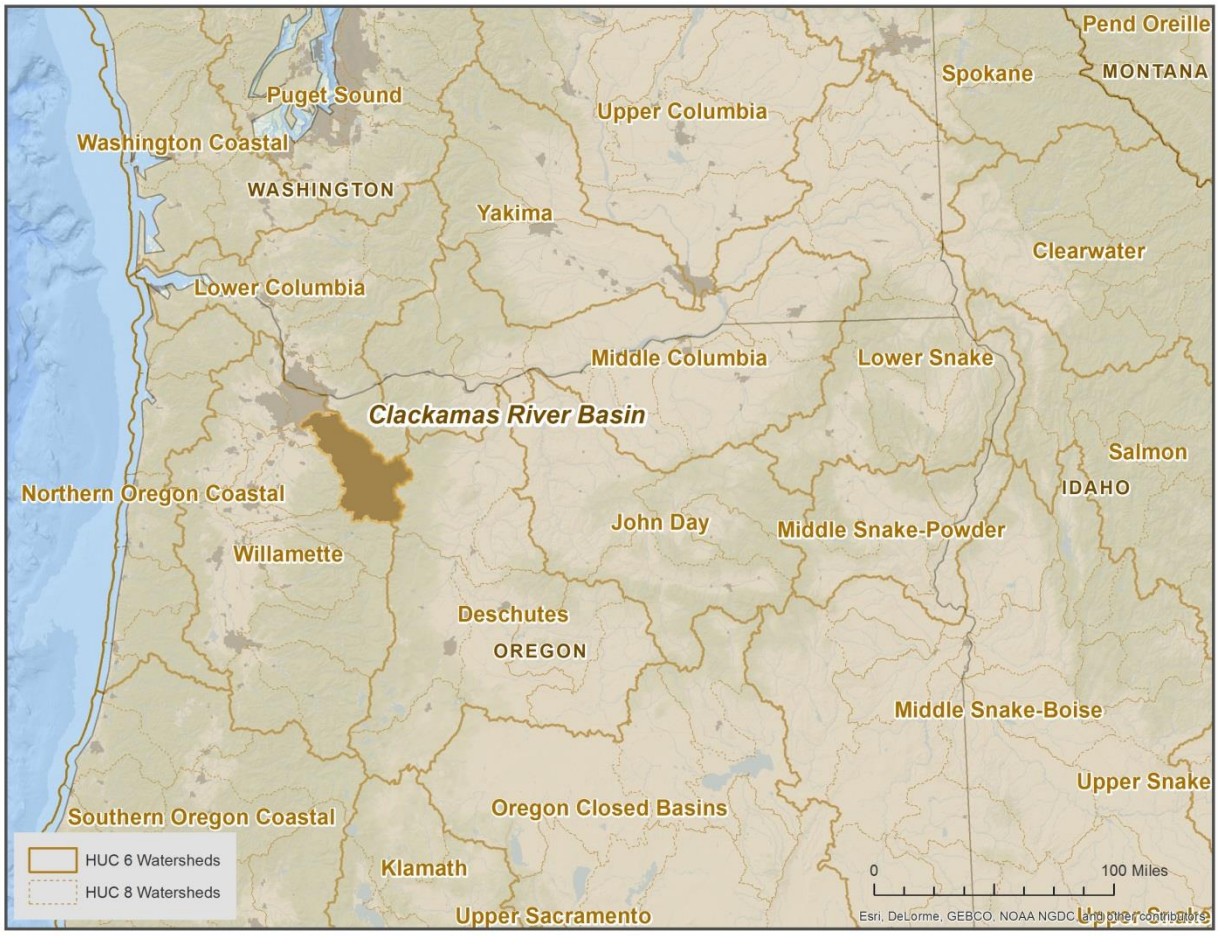


Figure 1.0 – Location of the Clackamas Basin

The 600,700-acre Clackamas River Basin is made up of 72% publicly owned land, 3% tribally owned land, and 25% privately owned land. The Clackamas River flows 82 miles from its headwaters in the Mt. Hood National Forest to its confluence with the Willamette River just downstream of Willamette Falls. The Clackamas River descends from an elevation of 6,000 feet down to 12 feet at its confluence. The basin provides water to more than 300,000 people and contains three large dams that provide electricity, water storage, and flood control.

The Clackamas River Basin has been populated by humans for at least 8,000 years (Burtchard *et al*. 1993)[1]. Until the mid-1800s the primary inhabitants of the basin were Native Americans from the Clackamas tribes. In the early 1800s the basin was estimated to have approximately 1,800 Native American inhabitants, and this was after their populations had been devastated by diseases introduced by European Americans. They lived in as many as 11 villages spread out from the mouth of the river to

[1] Burtchard, G. C. D. R. Werth, S. L. Snyder. 1993. Clackamas wild and scenic river cultural resource inventory project. International Archaeological Research Institute.

as far upstream as the present-day town of Estacada (Taylor 1999)[2] Archaeological evidence suggests that the basin's original inhabitants maintained a subsistence lifestyle, characterized by hunting game, gathering edible plants, and fishing. Early European-American settlers characterized the habitats of the Clackamas basin as a mixed coniferous and deciduous forest with numerous patches of prairie and hazelnut groves. The latter two plant communities were likely the result of intentional burning and clearing by native people in order to propagate hazelnut and camas as food sources and to facilitate game hunting (Woodard 1974)[3]

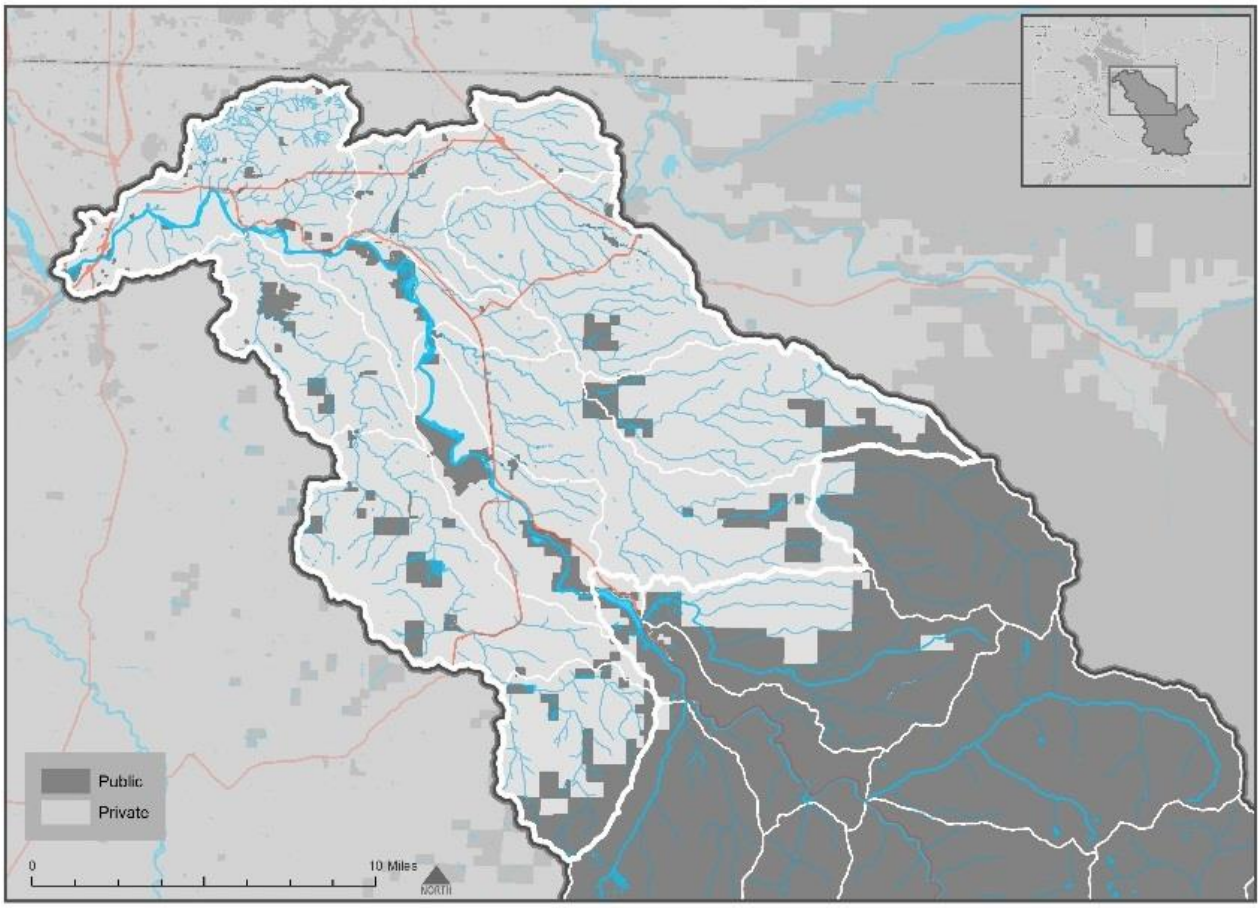


Figure 1.1 – Public vs. Private Ownership *(Map by Jeff Lesh, Clackamas SWCD)*

Present-day habitation and land-use patterns in the basin, while denser and more intensive, likely resemble the patterns found before European-American settlers arrived in the area. Historically, there were several larger Native American settlements near the mouth of the river, a handful of additional communities were scattered along the river upstream as far as the present-day town of Estacada, and the mountainous portions of the watershed were relatively uninhabited (Woodard 1974)[3]. Today, the

[2] Taylor, B. 1999. Salmon and steelhead runs and related events of the Clackamas River basin – A historical perspective. Portland General Electric, Portland, Oregon.

[3] Woodward, J. A. 1974. Salmon, Slaves, and Grizzly Bears: The Prehistoric Antecedents and Ethnohistory of Clackamas Indian Culture, Ph.D. Dissertation, Univ. of Oregon: Eugene, OR.

mountainous upper watershed is still largely wild and uninhabited. The area's steep mountainous terrain is used for forestry and recreation purposes. The lower watershed transitions from sparsely populated and rural to densely populated and urbanized as the river flows from Estacada to its confluence with the Willamette River. These areas generally have more moderate terrain and contain a complex mosaic of land uses including agriculture, industrial use, forestry, conservation, and urban/rural residential tracts.

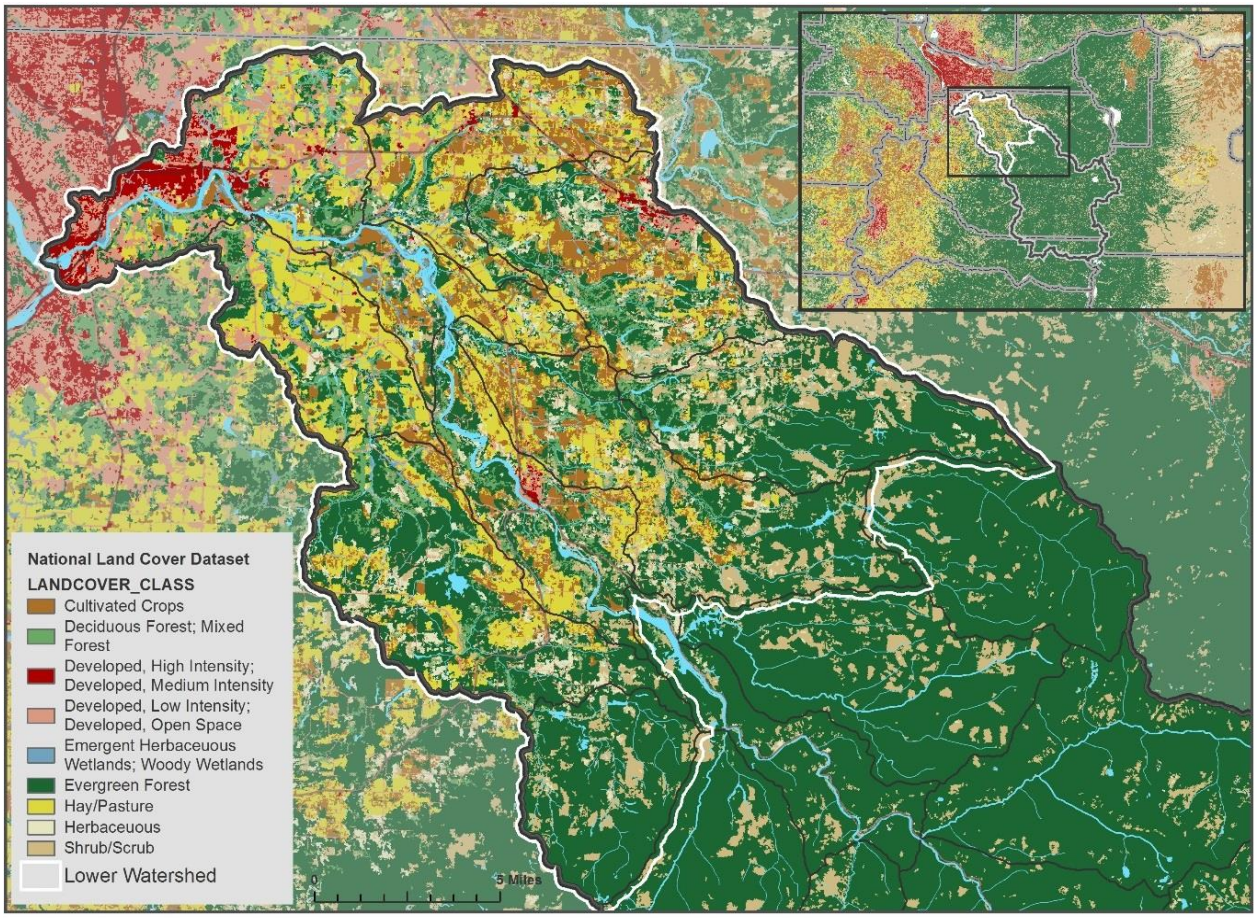


Figure 1.2- Land Use in the Clackamas Basin *(Map by Jeff Lesh, Clackamas SWCD)*

Section 2: Invasive Species- Defining the problem

The Clackamas River Basin has been actively managed by people since they arrived in the basin. Clearing forests, burning fields, propagating food crops and building long-term settlements are activities that Native Americans conducted in the basin for millennia before the arrival of European Americans in the mid-19th century. In the last 150 years, European-Americans have transformed the lower basin from the mostly pastoral setting they found when first settling here, to the urban/suburban condition we have today. As the human population in the Clackamas Basin has grown, so has the intensity of land management. Today, one of the most noticeable ecological side effects of these land uses is the reduced abundance of native species and the increased abundance of invasive species.

Native species are defined as those species that were likely to be present in the area before European American settlers arrived. Invasive species are defined as those species that are non-native and whose aggressive growth habit allows them to spread quickly and cause harm to the environment, agriculture, and the economy and, in turn, people. Many invasive species were intentionally introduced by European American settlers as landscaping plants, food crops, or for other human uses. In general, those areas in the basin that have seen more intensive land management and manipulation have a greater diversity and abundance of invasive species. Invasive species, if left unchecked, can have a deeply negative impact on the environment, the economy, and on society in general. Over time, invasive species simplify plant communities, replacing complex systems of native trees, shrubs, and herbaceous plants with a monoculture of a few non-native plants. The impact of this biological simplification can be far reaching.

The Impact of Invasive Species

Watershed Health

Invasive species can impact watershed health by reducing water quality, canopy cover, and stream bank stability. When an invasive species replaces a native riparian forest, the reduced canopy cover and root diversity can cause water temperatures to rise and can increase the rate at which rainwater percolates through the soil and enters the stream. This can make streams more prone to flooding and incision and, in turn, increase turbidity and reduce bank stability.

Biodiversity

When a few invasive species replace a broad diversity of native trees, shrubs, and herbaceous plants, the value of the habitat is severely reduced. Native plants provide shelter, food, and structure that animal species depend on for survival. As floristic diversity is reduced at a site, so, too, is faunal diversity. Invasive species have been partially or wholly responsible for the decline of 42% of threatened and endangered species (Pimentel *et al*. 2005)[4]

Tree Cover

The native forest canopy provides the lowest cost, most sustainable form of temperature regulation, storm water interception, and wind buffering available. These ecosystem services make our communities more livable, more sustainable, and more attractive. However, throughout the Clackamas

[4] Pimentel, D, R. Zuniga, D.Morrison. 2005. Update on the environmental and economic costs associated with alien-invasive species in the United States. *Ecological Economics* **52**:273– 288.

Basin, hundreds of acres of forest are being or have been replaced or compromised by invasive species such as English ivy (*Hedera helix*), old man's beard (*Clematis vitalba*), Himalayan blackberry (*Rubus bifrons*), and Japanese knotweed (*Fallopia japonica*).

Soil Health

Some invasive plants can alter soil chemistry by releasing chemicals into the soil through their roots, or by dropping leaves onto the surrounding environment. These chemicals can prevent seeds of desirable species from germinating and can reduce their growth and survival. For example, in places where garlic mustard (*Alliaria petiolata*) has become heavily established, few if any other species are now able to grow. Garlic mustard is now spreading rapidly to colonize new areas.

Figure 2.0- Invasive Knotweed Replacing a Riparian Forest in Deep Creek. ***(Photo by CRBC Staff.)***

Agriculture and Forestry

Invasive plants are estimated to reduce the annual productivity of the United States agricultural sector by 12% (Pimentel 2009)[5]. For many farmers, controlling invasive species in their fields can be one of the most time consuming and expensive aspects of producing a crop. The additional labor costs and

[5] Pimentel, D. 2009. Environmental and Economic Costs of the Application of Pesticides Primarily in the United States. Integrated Pest Management: Innovation-Development Process. pp 89-111. Springer Netherlands.

chemical application costs associated with controlling invasive species on farms results in higher costs to consumers. Similarly, the cost of conducting forestry activities is greatly increased the need to control invasive species after harvesting trees until the new crop is established. Failure to control invasive species on farms and in forest settings can lead to crop loss or can require expensive intervention to prevent crop loss.

Economics and Society

Invasive species are calculated to cause approximately $120 billion in losses and control costs to the nation's economy each year (Pimentel 2005)[4]. These losses impact society both directly and indirectly. They reduce productivity and increase costs on both the farm and in the forest. They reduce water quality and increase the need for costly infrastructure to clean and manage both storm water and drinking water. They reduce the diversity of species that inhabit our landscapes, sometimes requiring costly intervention in order to prevent species from becoming threatened or endangered. Invasive species can reduce the value of land and inhibit how landowners utilize their land. Invasive species also reduce the resilience of our communities, making them more susceptible to storms, power outages, flooding, heat waves, and landslides.

Invasive species are impacting the Clackamas River Basin in the same ways they are impacting the rest of the nation. Community resilience and livability have been reduced. Habitat, water quality and biological diversity are diminished. Farming, forestry and other economic activities are losing significant productivity due to invasive species. But, most importantly, the diversity and abundance of invasive species in the Clackamas Basin continue to increase rapidly. Aggressive new invaders are being found each year, and the distribution and abundance of existing invasive species continues to grow. This increase can only result in greater costs to society, greater losses in productivity for farms, forests, and businesses, and reduced biological diversity and habitat quality for future generations.

Section 3: Taking Stock

In January 2015, in order to elicit partner participation and input, the Clackamas River Basin Council, the Clackamas Soil and Water Conservation District, and Metro developed and sent out a survey to the Technical Advisory Group participants including staff from:

- 4-County CWMA
- Bureau of Land Management
- Clackamas County Parks
- Clackamas County Water Environment Services
- Clackamas River Basin Council
- Clackamas Soil and Water Conservation District
- Metro
- Natural Resources Conservation Service
- North Clackamas Parks and Recreation District
- Oregon Department of Agriculture
- Oregon Department of Fish and Wildlife
- Oregon Department of Forestry
- Oregon Department of Transportation
- Oregon Parks and Recreation Department
- Oregon State Marine Board
- Oregon State University Extension
- Portland General Electric
- Tribal representatives
- United States Forest Service
- United States Geological Survey

The goal of the survey was to better understand where stakeholders were currently engaged in the basin, what kinds of activities they were engaged in, and how they could collectively begin to plan, prioritize, and coordinate future activities. Thirteen individuals filled out the survey, and a follow-up meeting was organized to review the results. From the survey and meeting, attendees developed a broad understanding of the current state of invasive species management in the basin, identified gaps in management efforts, clarified where stakeholder priorities overlapped and diverged, and identified the components that would be needed to make a successful invasive species management plan for the Clackamas River Basin.

3.0 Survey Results

Current Efforts to Address Invasive Species

When asked to categorize their current efforts to address invasive species, 77% of respondents were treating invasive species; 69% were doing survey and monitoring work, site based restoration, and/or providing partner support; 23% were conducting outreach and education; and 46% were providing funding. These figures indicate that the majority of staff time and funding in the basin is currently going to on-the-ground efforts.

Where We Are Currently Working

When asked where they focused their invasive species efforts, 62% of respondents selected public lands, 38% selected lands owned or managed by their employer, 8% selected lands adjacent to lands owned or managed by their employer, and 15% selected private lands. Overall, survey participants indicated that their funding and resources were being highly focused on public lands and on their agencies' own landholdings.

How We Prioritize

Of the survey respondents, 77% said they prioritized weed control and restoration actions on a site-by-site basis, 53% prioritized by the weed species, 31% said that their actions were determined by a

strategic plan, and 23% said they worked where they could get funding to work. Many survey participants indicated that they were prioritizing actions as opportunities presented themselves rather than through a long-term strategic plan.

What We Prioritize

The five most commonly treated invasive species among all of the respondents were English ivy (*Hedera helix*), false brome (*Brachypodium sylvaticum*), Himalayan blackberry (*Rubus bifrons*), Japanese knotweed (*Fallopia japonica*) and Scotch broom (*Cytisus scoparius*). When asked which species are the highest priorities for control efforts, respondents selected Japanese knotweed (*Fallopia japonica*), garlic mustard (*Alliaria petiolata*), false brome (*Brachypodium sylvaticum*), orange hawkweed (*Heiracium auranticum*) , and giant hogweed (*Heracleum mantegazzianum*).

Many of the species most commonly treated by survey participants were also among the most widespread and pervasive in the basin. Meanwhile, many infestations of high priority invasive species went untreated in the basin. This dichotomy indicates a high potential for improving the implementation of treatment through prioritization and coordination of actions to maximize control efforts within the Clackamas River Basin.

Priority Sub-Watersheds

When asked to prioritize specific sub-basins for control and prevention efforts, an equal number of respondents ranked the upper basins as high of a priority as the lower basins within the watershed. During the follow-up meeting, attendees determined that different areas of the basin were a priority for different kinds of actions. The more pristine upper watershed was selected for prevention, survey, and limited control activities, while the lower watershed was selected for more active control and restoration activities.

Data Collection

The vast majority of the respondents collect data on invasive species that they find in the watershed, yet there was no single place where the majority of attendees reported their information. Data are being collected on a broad diversity of species lists using broadly different methodologies. Statewide databases such as *Oregon iMapInvasives* (http://imapinvasives.org/orimi/map/), and *Oregon Weedmapper* (http://www.weedmapper.org/) were cited by several participants' survey results, indicating that no single database existed for all participants. As a result, it is clear that no single participant had a clear idea of the full scope and severity of mapped invasive species infestations across the basin.

What Is Missing

Over the course of the discussions, three primary gaps were identified. The first was a well-defined and clearly rationalized plan for prioritizing actions in the basin. The second was a paucity of available resources. Nearly every partner reiterated the need for additional funding and better use of existing funding in order to make meaningful impacts towards restoring habitat and reducing the threat of invasive species in the basin. The third gap identified was a general sense that partners were not really aware of what each other were doing in the basin. While some partners worked together on specific projects, no venue existed for documenting and sharing partners' efforts with one another.

Plan Goals

From the meeting, it became clear that CRISP's primary objectives should be to address these missing organizational, funding, and communications gaps. Specifically, CRISP needs to:

- Articulate a rational plan that prioritizes strategic actions across the basin;
- Serve as a fundraising tool for focusing funding on the highest priority actions; and
- Establish and maintain a venue for communicating and reporting partner activities.

3.1- Existing Efforts in the Basin

As a follow-up to the survey and meeting, the partners submitted geographic data defining project areas where they were actively engaged. This information was assembled into a single map showing the locations and types of projects on which partners were working (*Figure 3.0*).

Survey and Mapping Programs

In the Clackamas River Basin numerous partners are working to survey and map invasive species. The Clackamas Soil and Water Conservation District (CSWCD) runs the WeedWise program, which conducts invasive species surveying and mapping on both public and private lands. Clackamas SWCD has taken a lead role in compiling and analyzing data collected by private landowners and other agencies and organizations. As part of its Shade Our Streams program, the Clackamas River Basin Council surveys and maps invasive species on privately owned riparian lands. In addition to these efforts, the Bureau of Land Management, Clackamas County Parks, Water Environment Services, Metro, Oregon Department of Agriculture, Portland General Electric, North Clackamas Parks and Recreation District, Oregon Parks and Recreation Department and the U.S. Forest Service survey and map invasive species on their own properties or properties they manage.

Early Detection and Rapid Response Programs

Early Detection and Rapid Response (EDRR) programs train volunteers, staff, and members of the public to survey for particularly damaging weed species in areas where they are rare or not known to exist. The intent of an EDRR program is to prevent establishment of high priority weeds by eliminating populations before they grow too large and costly to prevent eradication. Two complimentary EDRR programs currently exist in the basin. Clackamas SWCD leads a program in cooperation with the 4-County Cooperative Weed Management Area and offers multiple trainings each year to interested organizations and citizen groups. The U.S. Forest Service-Mt. Hood National Forest also offers an annual training in cooperation with Oregon Department of Agriculture to train employees and the general public. Both programs report sightings through the Oregon Invasives Hotline (http://oregoninvasiveshotline.org/), which simplifies coordination between the partner organizations.

Invasive Species Control Programs

A wide variety of weed control programs exist in the basin. Some programs, like those managed by Clackamas SWCD and ODA, target specific weeds wherever they exist. Other programs target lands owned or managed by the responsible agency. These programs include BLM, Clackamas County Roads Department, Metro, ODOT, PGE, and the USFS.

Active Restoration Programs in the Basin

Significant restoration efforts have been ongoing in the Clackamas Basin for decades. Restoration initiatives include, but are not limited to, large-scale instream restoration, fish passage barrier removal,

stream meandering, prairie and oak savannah restoration, wetland restoration, riparian forest restoration initiatives, and upland forest restoration initiatives. Active restoration initiatives are being led by Clackamas County Parks, Clackamas SWCD, CRBC through its Shade Our Streams initiative, Oregon State Parks, Metro, and the Rock Creek Partnership (jointly implemented by WES, Friends of Trees, SOLVE, and CRBC).

Sources of Funding for the Basin

There is a diversity of funding sources for survey, control, and restoration initiatives currently being directed towards the Clackamas River Basin. The Clackamas Soil and Water Conservation District provides resources for on-the-ground weed control for priority weed species as well as for funding for restoration initiatives. PGE, which funds the Shade Our Streams program, supports revegetation, instream-restoration initiatives, invasive species survey and control efforts, and other initiatives associated with its dam operations. Metro, manages the Nature in Neighborhoods grant program, and assists partners when projects positively impact Metro restoration efforts. The Oregon Watershed Enhancement Board provides funding for in-stream and reforestation projects around the state. WES funds the Rock Creek Partnership and other stream shading and water quality initiatives. Other sources of funding include the Oregon State Weed Board grant to control invasive species and the Natural Resource Conservation Service (NRCS) restoration assistance to private landowners.

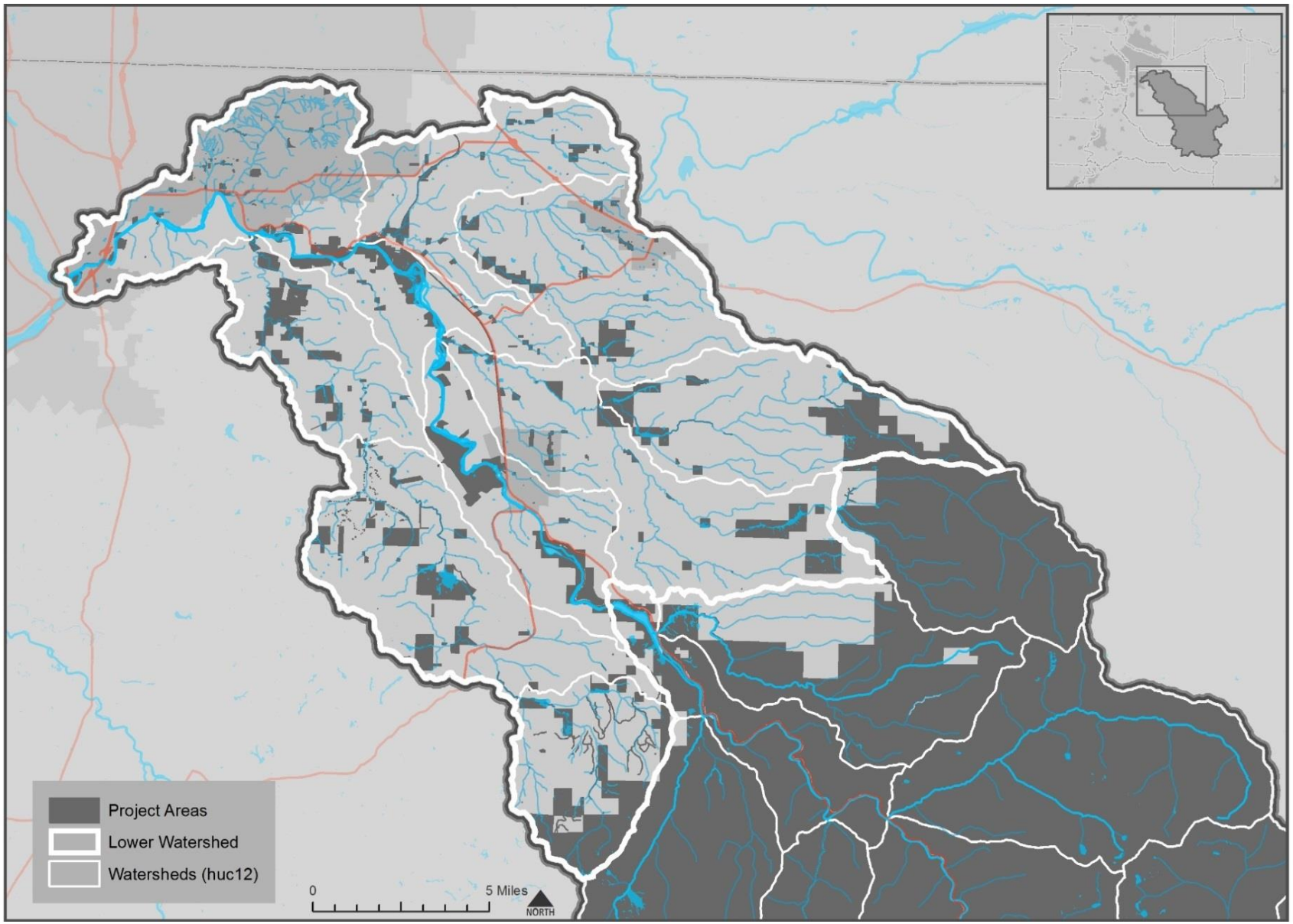


Figure 3.0- Location of reported partner projects. *(Map by Jeff Lesh, Clackamas SWCD)*

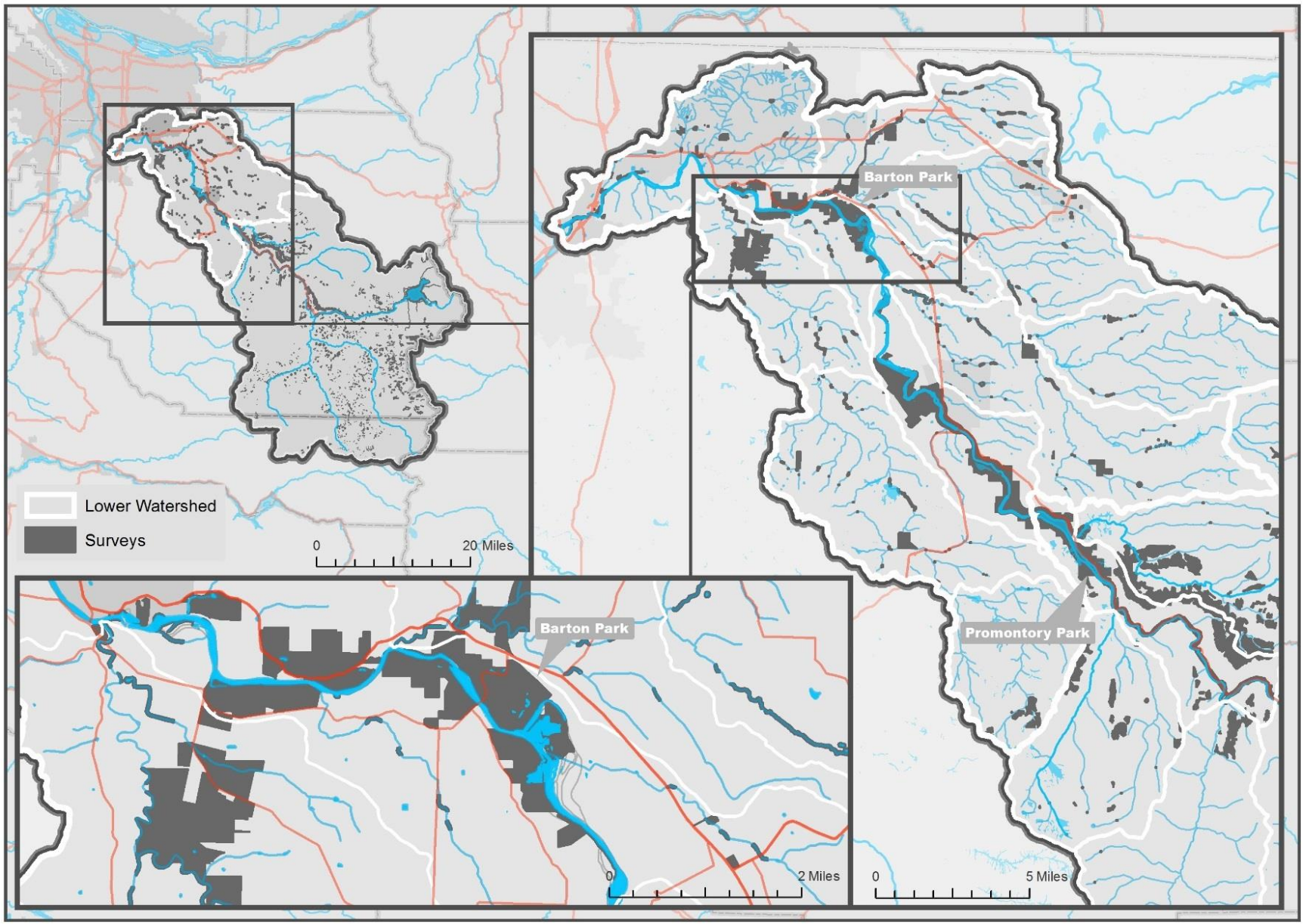


Figure 3.1 – Documented Invasive Species Survey Locations *(Map by Jeff Lesh, Clackamas SWCD)*

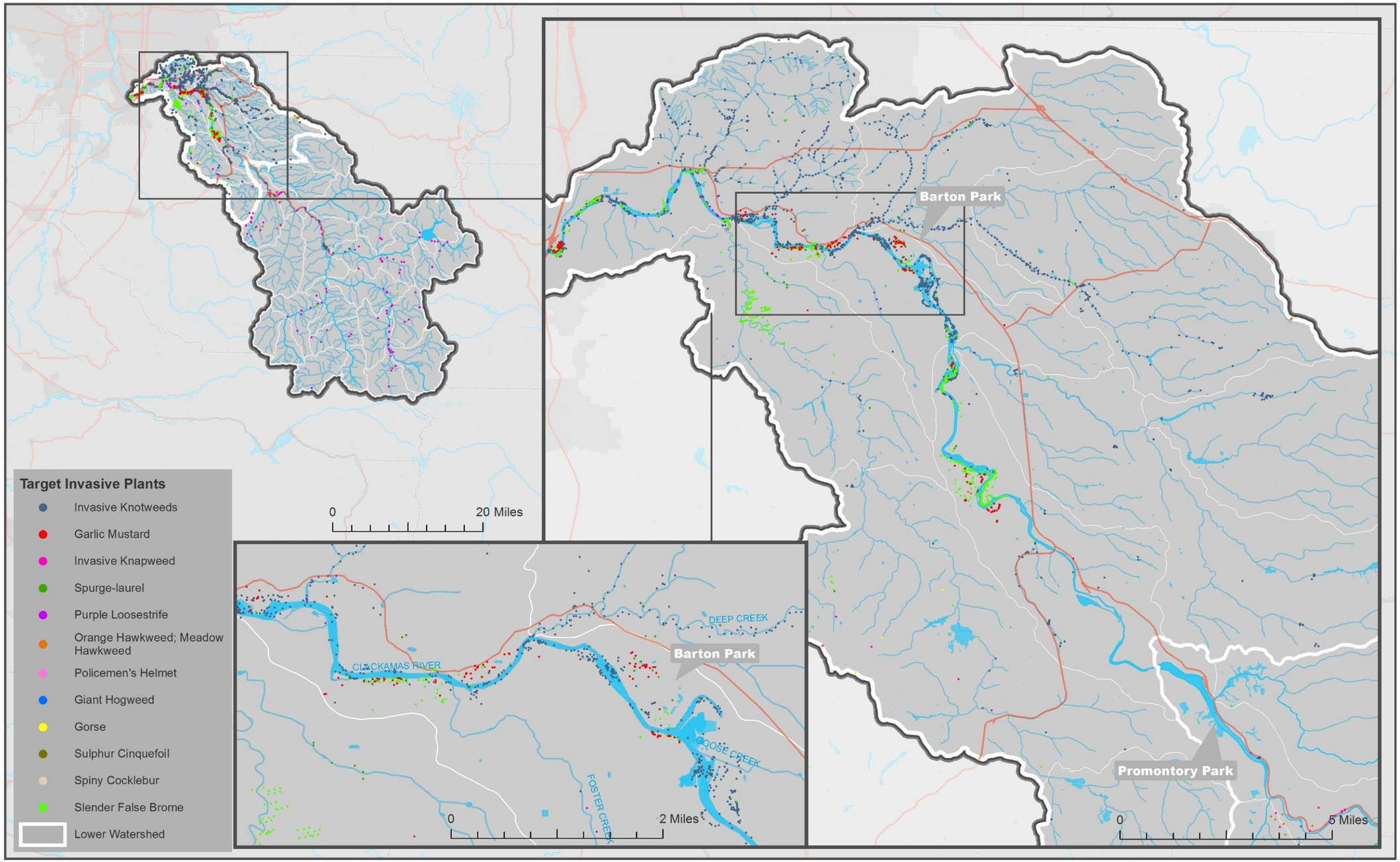


Figure 3.2– Documented Invasive Species Populations *(Map by Jeff Lesh, Clackamas SWCD)*

3.2- A Conceptual Framework for Future Restoration Initiatives

From the survey and follow-up meeting, participants developed a conceptual framework for invasive species control in the basin. The framework includes four primary prescriptions that can be applied across the entire basin to address the threat of invasive species. Application of each specific prescription is based on habitat values, availability of resources, species and site prioritizations, and quality of existing data. Ideally, at least one of the four prescriptions will be applied to every area of the basin allowing for the plan to be implemented basin-wide.

Prescription 1. Prevention

Preventing the spread of invasive species or the introduction of new invasive species is the first and most important line of defense in the basin. This prescription is designed to be implemented basin-wide, but with a particular emphasis on sites with significant habitat value. Prevention actions include public education about invasive weeds, development of informational signage, installation of boot cleaning stations, requiring machinery to be cleaned before mobilization to a site, and after work is completed, use of weed-free straw and gravel, as well as other strategies.

Figure 3.3- Example Boot Brush and Educational Kiosk. (Photo by Jordan Kim, Hood River SWCD)

Prescription 2. Survey and EDRR

The second line of defense against invasive species in the basin is to develop a robust, basin-wide program for surveying and mapping new and priority invasive species. The existing data set of invasive species locations is large, but it is primarily focused on areas where partners are conducting active restoration and land management activities in the basin. There are large portions of the basin that have never had any survey work documented. The focus of this prescription will be to develop a methodology for identifying priority survey areas, integrating presence and absence data for priority invasive species into a shared database, and identifying and eradicating new invaders before they become established.

Prescription 3. Control, Containment, and Exclusion

Once a species has become established in the basin, active control is needed to prevent it from causing additional harm to the local ecology, economy, and human health interests. Many invasive species are already widely established in the basin; others are well established only in portions of the basin. The focus of this prescription is to develop a strategic and calculated approach that allows the partners to prioritize specific species and patches for control based on existing data. Control efforts should focus on identifying vector pathways for spread and preventing further expansion. Existing data about habitat quality, known invasive species patches, species-specific biology, and partner restoration efforts allow infestations to be prioritized to maximize the impact of existing resources within the basin.

Prescription 4. Restoration

Restoration of native plant communities is an important tool for addressing invasive species, but should be considered a tool of last resort. Restoration is an expensive, long-term process that is typically undertaken on a relatively small scale. Restoration must be sited carefully and should only be used when it meets all of the following criteria:

1. The site has been identified as having moderate to high habitat or cultural value;

2. The site is located in an area that will not naturally recover within an acceptable timeframe;

3. There is a reasonable degree of certainty that large-scale disturbances will not occur at the site in the near future;

4. The landowner or managing agency has adequate funding and oversight to ensure successful restoration and long-term maintenance of the site.

Section 4: Invasive Species and Patch Prioritization

One of CRISP's primary goals is to develop a more strategic and cooperative approach to invasive species control across the basin. Because each of the CRISP partners has its own methodology for monitoring, data collection and analysis, a critical first step in developing the plan was to bring all of the data together and to find a single objective methodology for prioritizing invasive species populations for control. Clackamas SWCD reviewed available invasive weed prioritization models and selected the *Weed Heuristics: Invasive Population Prioritization for Eradication Tool* (WHIPPET).

Introduction to WHIPPET

WHIPPET prioritizes weed infestations for eradication based on potential impact, potential spread, and feasibility of control. To score the above criteria this tool utilizes information relating to both population specific details (e.g., distance to other conspecific populations, population size, accessibility of the patch to managers), species-specific details (typical rate of spread, detectability, control effectiveness, control cost, reproductive ability, impact to wildlands) as well as the value of the sites across a region that would be impacted by targeted invasive weed populations. Regional site values were based on the presence of partner projects, the *Regional Conservation Strategy*'s High Value Habitat Model (http://www.regionalconservationstrategy.org), and the presence of documented sensitive, threatened, and endangered species. The impact (including site value), invasiveness, and feasibility scoring factors are detailed in *Figure 4.0* and further in *Appendix 1.2*. Utilizing all of these factors together allows for objective, spatially defined prioritization that can facilitate communication between organizations. This model recognizes that the level of impact, potential for spread, and feasibility of control for each species are not uniform across the landscape. This recognition presents opportunities to identify high-impact populations of lower-priority weeds, low-impact populations of high-priority species, and other useful information.

WHIPPET Results

The CRISP weed dataset contains roughly 3400 observations of 19 target priority species. We used WHIPPET to evaluate twenty target species (see Appendix 1.3 for species scores).

- *Alliaria petiolata*, garlic mustard
- *Brachypodium sylvaticum*, false brome
- *Centaurea diffusa*, diffuse knapweed
- *Centaurea nigrescens*, short fringed knapweed
- *Centaurea stoebe* ssp. *micranthos*, spotted knapweed
- *Centaurea ×moncktonii*, meadow knapweed
- *Daphne laureola*, spurge laurel
- *Fallopia japonica*, Japanese knotweed
- *Fallopia sachalinensis*, giant knotweed
- *Fallopia ×bohemica*, bohemian knotweed
- *Heracleum mantegazzianum*, giant hogweed
- *Hieracium aurantiacum*, orange hawkweed
- *Hieracium caespitosum*, meadow hawkweed
- *Impatiens glandulifera*, policeman's helmet
- *Lythrum salicaria*, purple loosestrife
- *Petasites japonicus*, Japanese butterbur

- *Potentilla recta*, sulfur cinquefoil
- *Ulex europaeus*, gorse
- *Xanthium spinosum*, spiny cocklebur

Species selected for inclusion in this analysis were derived from existing priority species for CRISP partners.

Our results show clear priorities with 7% of the evaluated populations comprising the top 40% of the priority score range (*Figure 4.1*). Target species within this highest priority range included, but were not limited to, the following: *Alliaria petiolata*, *Centaurea diffusa*, *Lythrum salicaria*, *Impatiens glandulifera*, *Ulex europaeus*, *Brachypodium sylvaticum,* and *Fallopia* spp. (*Figure 4.2*). Populations determined to be the highest priority mostly clustered near roads and waterways within partner project areas, particularly along US Forest Service roads and near the Clackamas River from Milo McIver State Park downstream (*Figure 4.3*). The average range of variation of priority scores within a given species encompasses 32% of the range of priority for all of the species showing considerable overlap in priority between species' evaluated. These results suggest that the model effectively prioritized specific invasive species patches rather than specific invasive species. Relative to partner survey results, the WHIPPET results indicate a higher priority at the species level for *Centaurea diffusa*, *Ulex europaeus*, *Lythrum salicaria*, and *Impatiens glandulifera* and a slightly lower priority given to *Fallopia* spp.

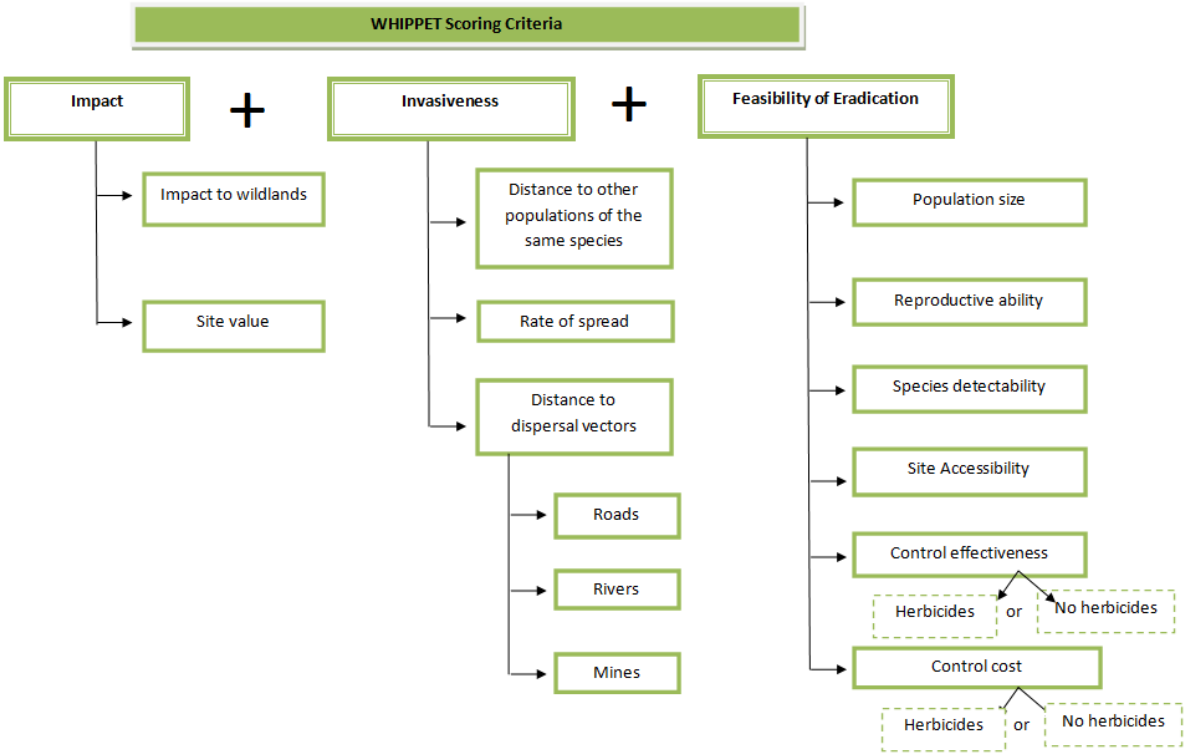


Figure 4.0- Overview of the WHIPPET Scoring Criteria. *(Figure by Gina Darin, © 2015 California Invasive Plant Council)*

Limitations

While the WHIPPET results indicate some clear priorities, factors such as limitations in data quality, incompleteness of some attributes in distributions data, inherent design capacity of the WHIPPET model, and differing partner objectives require consideration when integrating results into partner decision making. Data quality issues included incomplete population size data, differing documentation intensities including gaps in survey efforts and survey targets, and a lack of population accessibility evaluations. Additionally, the WHIPPET model results are designed to be integrated into an organization's operational context, taking into account factors such as financial, jurisdictional and political constraints as well as existing priorities, work areas, and investments.

WHIPPET Summary

Use of this model advances the sophistication of prioritization methodologies in the basin by expanding the number of factors considered by focusing on impact, invasiveness, and feasibility of eradication at the patch and species level. Integrating these factors into organizational prioritization methodologies may help partners focus their limited time and money on the highest impact invasive species populations that also provide the best opportunities for eradication. Model results confirm that evaluating populations individually is useful as evidenced by wide ranges in priority among populations of many species selected by partners. Improvements in data collection methodologies and consistency of documentation targets among partners would make future results even more meaningful.

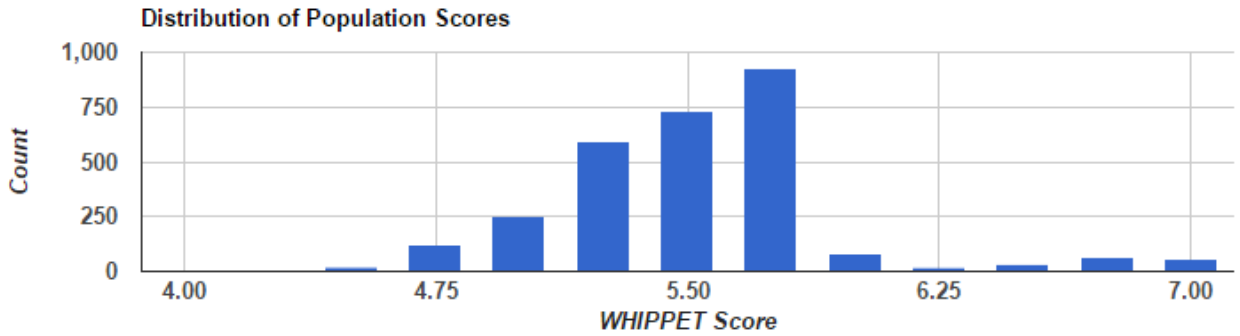


Figure 4.1- Distribution of WHIPPET Population Scores (Figure by Jeff Lesh, Clackamas SWCD)

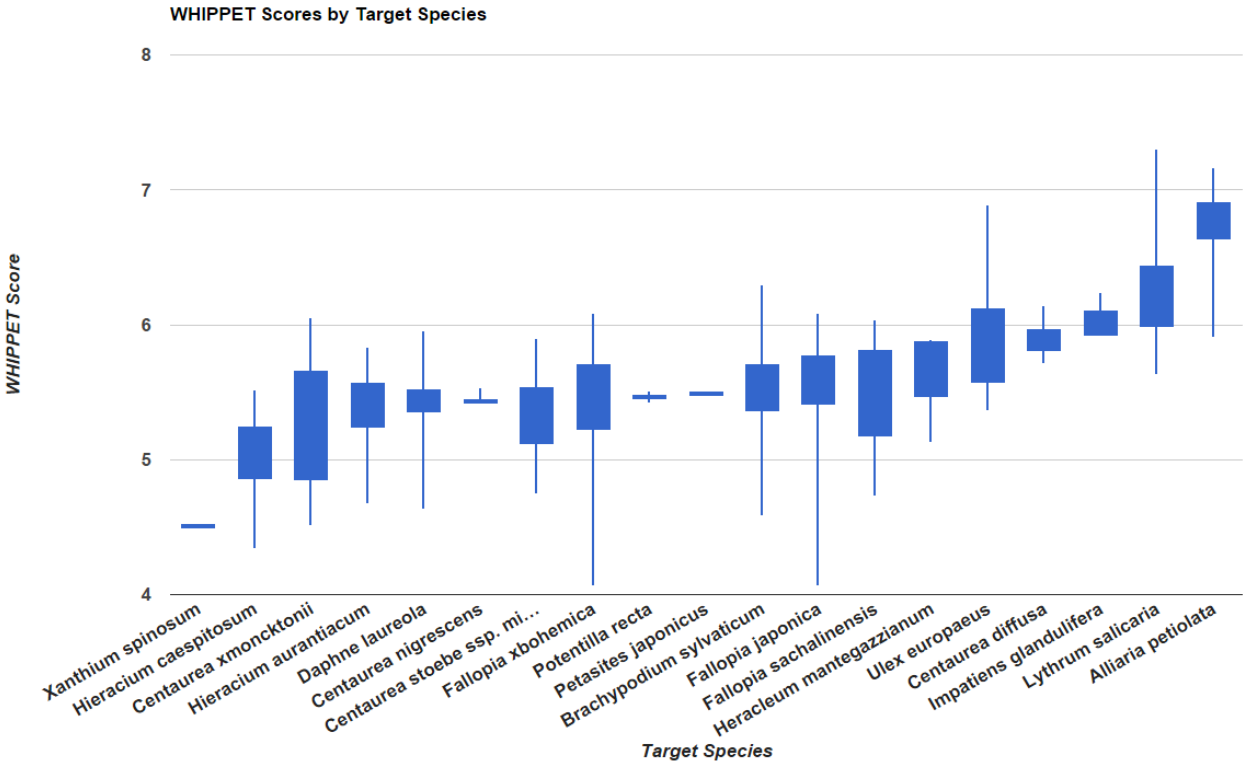


Figure 4.2- WHIPPET Scores by Target Species (Figure by Jeff Lesh, Clackamas SWCD)

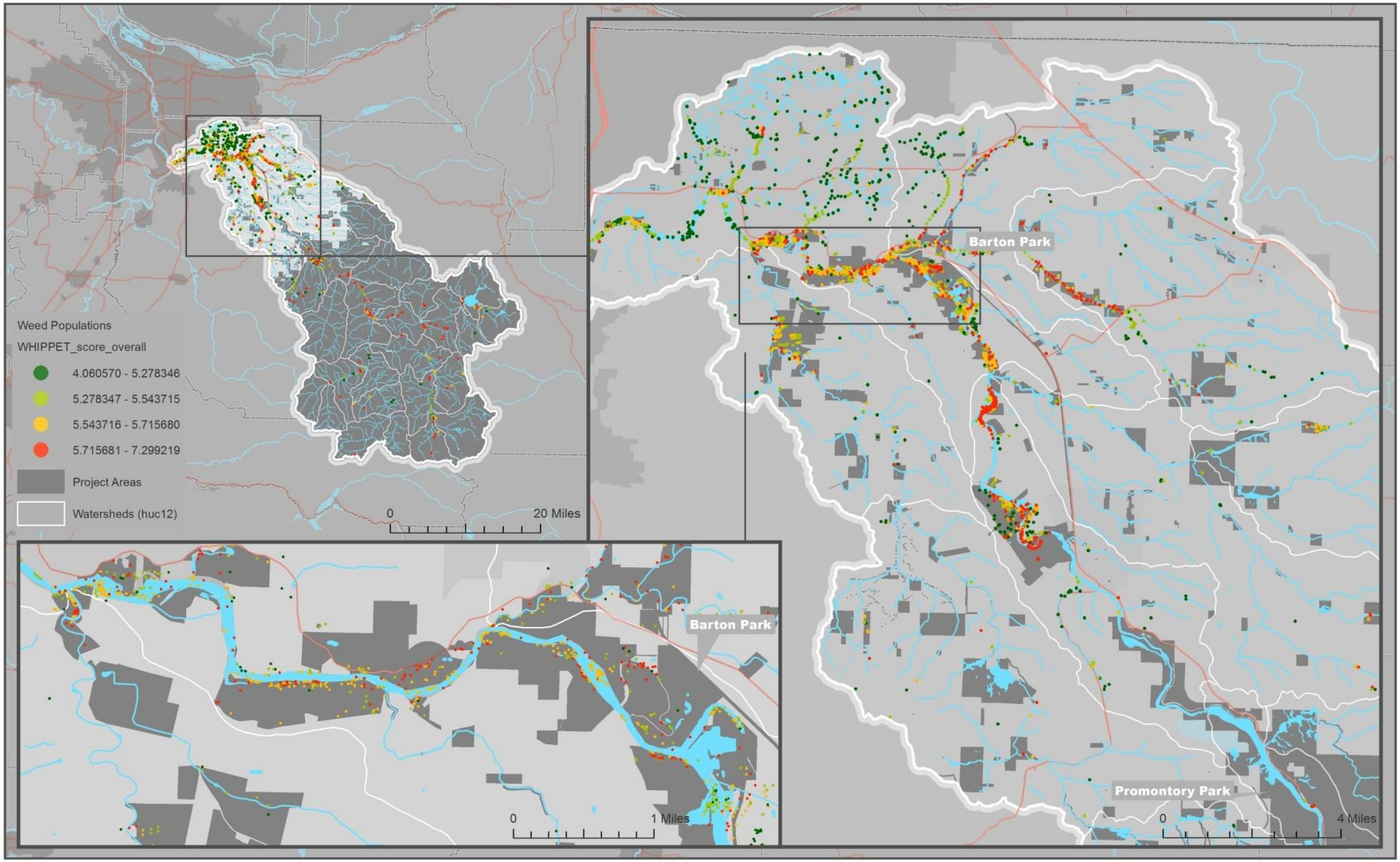


Figure 4.3- WHIPPET Population Prioritization Map *(Map by Jeff Lesh, Clackamas SWCD)*

Section 5: Geographic Prioritization

The Clackamas River Basin is naturally divided into two distinct geographic areas: the upper watershed and the lower watershed. The upper watershed, comprising 444,931 acres or 74% of the entire land area in the basin, is public land managed by the USDA Forest Service and the Bureau of Land Management, lands owned by the Confederated Tribes of the Warm Springs, or private lands owned by PGE, and several large timber companies. The land in the upper watershed, being primarily public, is relatively uninhabited and is generally managed for forestry resources, habitat values, and recreation. The upper watershed's streams and rivers are relatively steep and fast moving with narrow floodplains and few side channels. The forests, streams, and habitats of the upper watershed are relatively intact. Invasive species presence is low relative to the lower watershed.

The lower watershed, comprising 158,394 acres or 26% of the basin's land area is a complex mosaic of natural, agricultural, rural and urban areas. The lower watershed is highly disturbed and has significant populations of invasive species. Ownership within this area is highly fragmented. Public ownership and management in the lower basin is widely dispersed and divided among numerous entities. In the lower watershed the Clackamas River has a lower gradient, is slower moving, and is more sinuous with wider floodplains and numerous large side channels.

Due to the size and complexity of the Clackamas River Basin, as well as resource scarcity relative to management needs the members of CRISP sought to develop a way of prioritizing specific geographic areas for action. This effort began by developing a prioritization model that analyzes data from the *Regional Conservation Strategy*, partner projects identified during the CRISP planning process and rare, threatened or endangered species location data overlaid onto the basin's 35 sub-watersheds. The following formula was developed to rank the sub watersheds as high, medium or low priority:

$$Priority\ score = (S_{Partner} \times 0.36) + (S_{RCS} \times 0.49) + (S_{T\&E} \times 0.15), \text{ where}$$

$$S_{partner} = \left(\frac{partner\ \#}{partner\ \#_{max}} \times 0.67\right) + (partner\ area\ \% \times 0.33)$$

$$S_{RCS} = \left(\frac{average\ RCS}{average\ RCS_{max}} \times 0.73\right) + (\%\ high \times 0.27)$$

$$S_{T\&E} = \left(\frac{T\&E\ \#}{T\&E\ \#_{max}}\right)$$

$$T\&E\ \# = \frac{T\&E\ Stream\ Length\ (ft)}{1320\ (ft)} + Other\ T\&E\ \#$$

Figure 5.0- Formula for Watershed Prioritization

Due to the quality of their habitat and the presence of rare, threatened and endangered species, most of the sub-watersheds in the upper basin ranked as high and medium priorities. Much of the upper watershed is managed primarily by the US Forest Service-Mt. Hood National Forest for multiple uses and

values (e.g., forestry, water quality, fish and wildlife habitat, recreation). As a result, the entire upper watershed was consolidated into a single, high priority unit. The lower watershed was then analyzed separately from the upper watershed to determine the highest priority sub-watersheds in that area. In analyzing the lower watershed on its own, the model determined that the Lower Clackamas/Rock Creek, Lower Eagle Creek, and the North Fork Eagle Creek were high priority watersheds. Dubois Creek/Clackamas River, Upper Clear Creek, and Middle Clear Creek ranked as middle tier priorities, and the Lower Clear Creek and two Deep Creek watersheds ranked as low priorities.

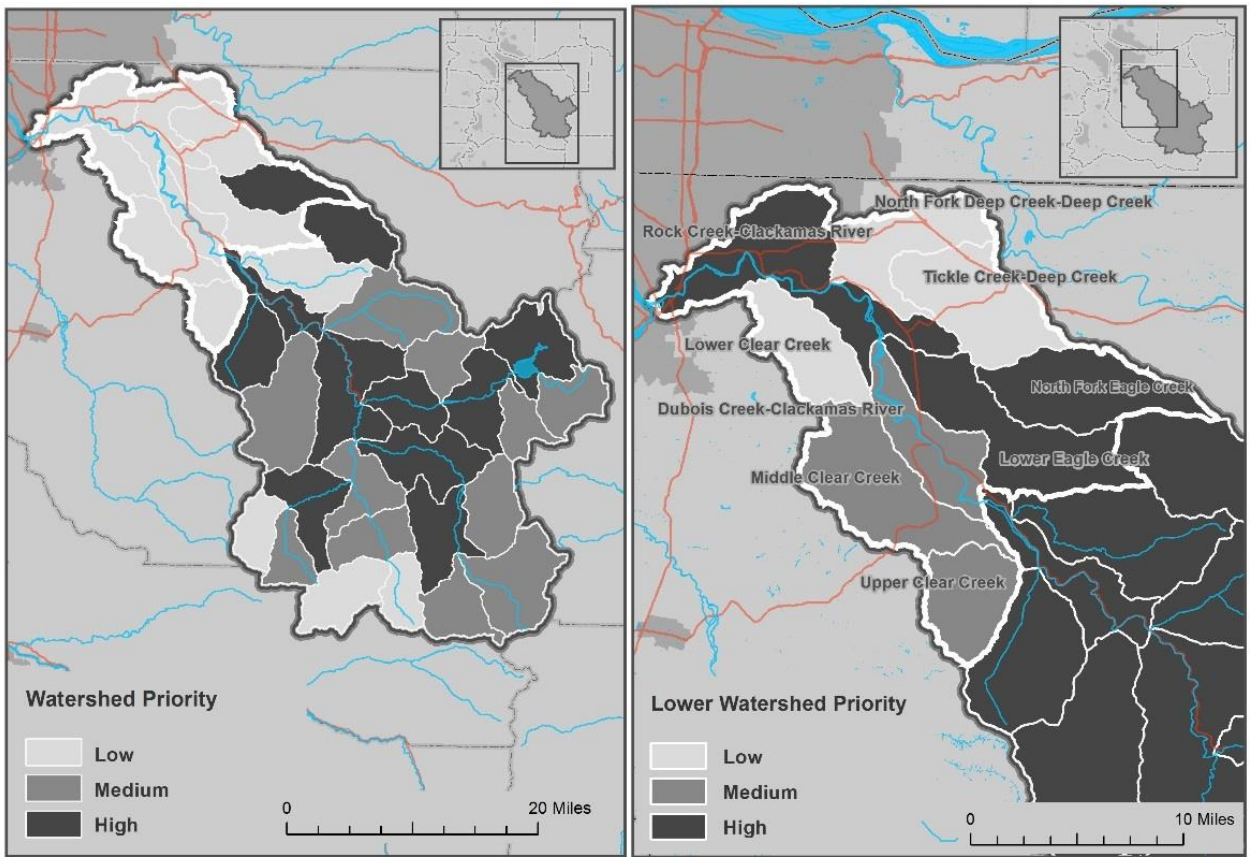


Figure 5.1 – Preliminary Model Outputs for Watershed Prioritization *(Map by Jeff Lesh, Clackamas SWCD)*

The model outputs provided an objective starting point for determining geographic priorities in the basin; however, additional factors not incorporated into the model were also considered. Factors included the relative level of investment being made by partners in on-the-ground restoration, control and survey work, the need for the prioritization process to result in the greatest possible number of partners engaged in priority restoration actions, and the need to expand existing initiatives and investments before creating new ones. These factors, when combined with the model output, resulted in four priority sub-watersheds: the Upper watershed, North Fork Eagle Creek, Dubois Creek/Clackamas River, and Lower Clackamas River/Rock Creek.

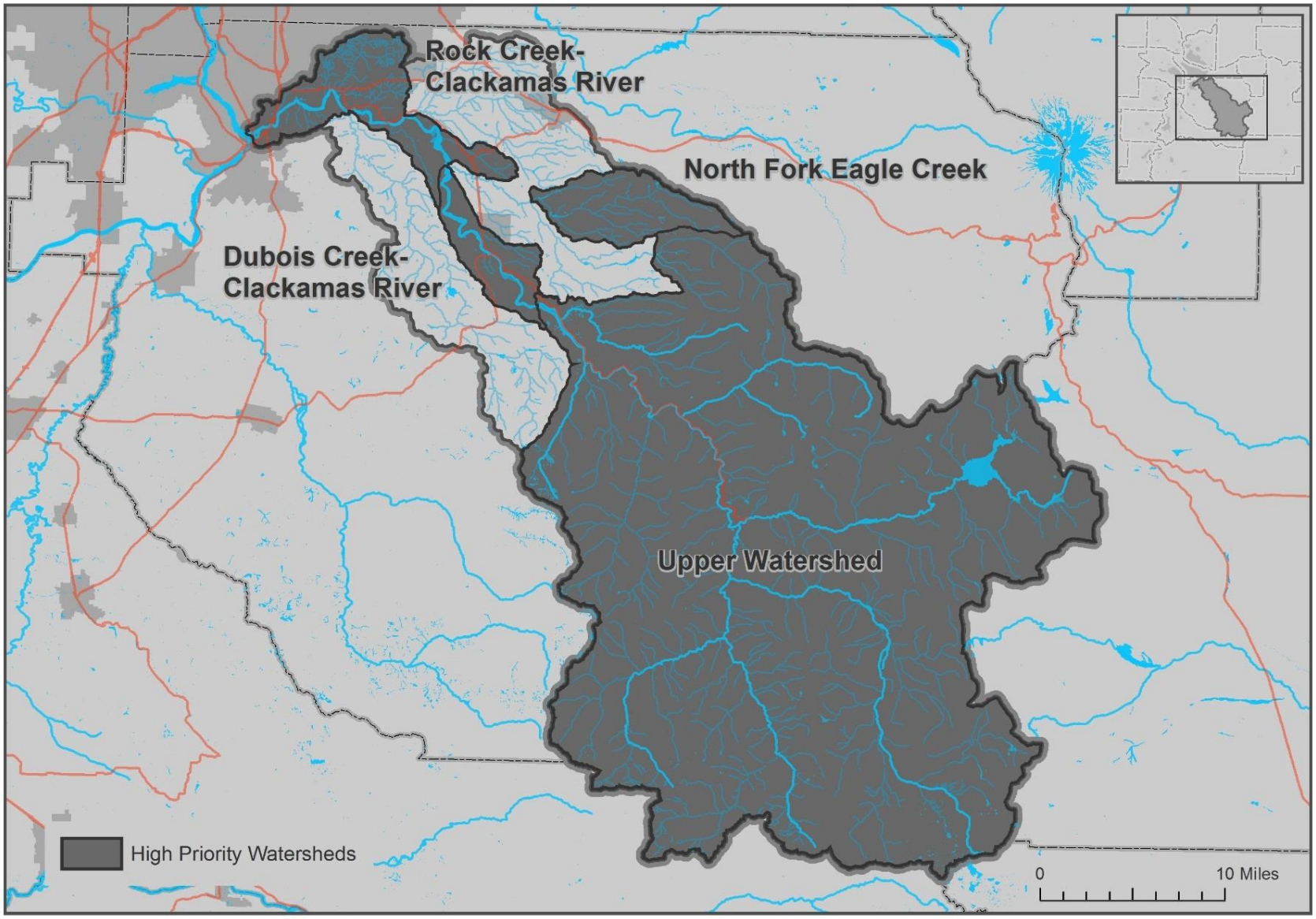


Figure 5.2 – Final Priority Sub-watersheds of the Clackamas Basin (Map by Jeff Lesh, Clackamas SWCD)

Section 6. Priority Sub-Basin Action Plans

6.0 Overview

Each of the four priority sub-basins feature areas of significant habitat value, sensitive species, diverse social and economic interests, and high priority invasive species. All of these factors must be considered when determining an appropriate course of action. For each of the priority sub-basins, we created a series of maps detailing *land cover, prevention, survey and eradication,* and *restoration* opportunities to help visualize the scope and intent of proposed actions.

The land cover maps provide detailed information about dominant land use in the given sub-basin and help show the type and extent of habitats and development.

The prevention maps show areas where partners are actively managing lands, where popular recreation areas exist, and where boat ramps and other likely dispersal vectors for invasive species can be found. These areas should be targeted for activities intended to help prevent the spread of weeds and to educate the public about invasive species issues.

The survey and eradication maps show existing areas where survey and control efforts are ongoing in the sub-basin. The maps also delineate areas where future survey efforts should expand to improve our understanding of invasive plant distributions and were chosen in order to accomplish two goals:

1. Delineate the extent of current infestations.
2. Improve distribution data for invasive species along primary dispersal vectors including roadsides which are underrepresented in our existing data.

To achieve the first goal, known high-priority infestation areas were extended along leading edges to include nearby susceptible, un-surveyed areas. The second goal was accomplished by identifying major roads, major riparian areas, and recreation sites not previously surveyed. Specifically, we are targeting areas not previously surveyed within 50 feet of major roadways, 200 feet from high-priority invasive plant populations, 100 feet from the 1996 flood inundation area along the Clackamas River, public parks, and 100 feet from recreations sites such as camping areas and boat ramps.

The restoration map combines information from the *Regional Conservation Strategy*'s high-quality habitats layer or the Oregon Department of Fish & Wildlife's *Compass Compiled Crucial Habitat* layer as well as the partner project areas layer to visualize potential areas where restoration initiatives could be undertaken. We also map subjectively selected priority restoration areas in order to build upon existing partner efforts. Our goal is to expand these efforts to include additional areas of high-quality habitat, and to elicit public support for invasive species control and restoration initiatives. In selecting these areas we also evaluated the relative engagement of partners within a given geography, and took into account the likelihood that they would be able to expand and maintain these efforts in the long-term. Together, the four maps delineate specific and measurable geographies for prevention, survey, control, and restoration actions in each sub-basin.

6.1 Priority Sub-Basin 1- Upper Watershed

The upper watershed comprises 444,622 acres, most of it public land managed by the US Forest Service. Because there are almost no permanent human settlements in the upper watershed, and because the

area has been managed for forestry, conservation, and recreation, the abundance of weeds is relatively low while the habitat values are high. As a result, active restoration in the upper basin is primarily focused on restoration of forest stand structure through forest thinning activities. Due to the generally low invasive species cover, restoration activities focused on forest community composition would be a low priority in the upper basin. Instead, actions here will be focused on prevention, survey, and targeted weed control efforts.

Prevention

Prevention will be the primary prescription applied in the upper watershed. Much of the upper watershed is designated as a wild and scenic waterway and is a favorite for anglers, boaters, rafters, kayakers, hikers, backpackers, and campers. There are also known locations where these recreation activities are concentrated.

Prevention activities should be focused on increasing awareness of priority weeds, posting and maintaining informational signage, and installing boot brushes to increase awareness in and around popular recreation access points. Such efforts should be focused at recreation sites in close proximity to undisturbed portions of the sub-watershed. If budgets allow, signage and other prevention tools should be specific to these locations and be intended to prevent additional invasive species introductions or continued spread.

Detection of new infestations is also important. Current efforts by the CSWCD and the US Forest Service to train citizen scientists and land managers to identify and report invasive weeds should be continued. Consolidating messaging, promoting information exchange and coordination among CRISP partners will help to develop a greater rapid response capacity.

Additional prevention measures should include education and outreach to support existing messages regarding the use of certified weed-free hay, straw, and gravel; the use of locally sourced firewood, and the cleaning of vehicles, watercraft, and other equipment within the upper watershed.

Land managers working within the upper watershed should focus on the incorporation of clear and concise policies and contract language to prevent the introduction of weeds by staff or contractors when working in the upper watershed. Contract language should focus on the sourcing and importation of materials into the upper watershed, as well as equipment hygiene requirements to ensure that vehicles and heavy equipment are cleaned prior to entry and before leaving sensitive areas in the upper watershed.

Survey

A total of 53 acres have been identified as primary targets for new survey efforts in this area using our standard survey target methodology. Additionally, existing survey efforts in the upper watershed should continue to be focused on timber sales, road building, major roadways, PGE properties and FERC project area, as well as expanded to additional roadways, select riparian corridors, and popular recreation sites, especially trails and ATV roads.

Control

Because invasive species populations in the upper watershed are relatively low, aggressively controlling them before they spread is critical. A total of 142 mapped populations of high and medium priority

weeds exist in this target area. All of these populations should be targeted for control within the next ten years.

Restoration

The Mt. Hood National Forest has a native plant materials program for the propagation of native plants from locally collected seed, cuttings, and divisions that is used to restore disturbed habitats. At this time, no active restoration projects have been identified through the CRISP planning process for the upper watershed. If prevention, surveys, and recommended control actions are implemented effectively, intensive restoration should rarely be needed. The restoration map for this area shows the ODFW crucial habitat areas where potential restoration projects might be considered in the future given a change in sub-basin conditions and need. ODFW crucial habitat areas were used in this area because the upper watershed was not included in the *Regional Conservation Strategy*.

6.2 Priority Sub-Basin 2- North Fork Eagle Creek

The North Fork Eagle Creek sub-basin, comprising 17,840 acres, is owned or managed by numerous private timber companies, BLM, US Forest Service, and rural private landowners. The vast majority of the basin is forested and in relatively good condition. Primary land use within the sub-basin is natural resource related, with scattered residences and farmland. The area has a relatively small number of known invasive species patches, and has very high habitat quality, including the presence of rare, threatened, or endangered species. Minimal restoration is necessary in this basin. Primary actions needed in this area are prevention, survey, and control efforts.

Prevention

The North Fork Eagle Creek sub-watershed has relatively few formal recreation sites. The primary land use activities in the sub basin with a high potential to introduce and spread new invasive species include logging operations, private homeowner activities, and vehicle and equipment entry into the watershed. The primary prevention activities in this basin should include outreach and education to private timber companies, small woodlot owners, and rural homeowners.

Detection of new infestations is also important. Current efforts by CSWCD and the US Forest service to train local landowners and land managers to identify and report invasive weeds should be continued. Consolidating messaging and promoting information exchange are critical to developing a rapid response to new infestations.

Survey

Our standard survey target methodology shows approximately 27 acres of expanded survey area in this watershed. Existing survey efforts in this watershed have focused on areas nearby existing priority infestations and the intersections of roadways and streams with a particular focus on knotweed species. Priority areas for expanded survey efforts should focus on the edge between riparian forests and developed private lands, on new timber harvest sites, and on the sub-basin's primary roadways.

Control

Because invasive species populations in the upper watershed are relatively low, aggressively controlling them before they spread is critical. Control should be the most active prescription utilized in the North Fork Eagle Creek sub-basin. A total of 18 mapped populations of high and medium priority weeds exist in this sub-watershed. All of these populations should be targeted for control within the next ten years.

Restoration

At this time, no active restoration is planned for the North Fork Eagle Creek sub-basin. If habitat conditions were to deteriorate in this sub-basin, the most likely place would be in the downstream portion of the watershed. Logging activity adjacent to and within the sub-basin area, combined with its proximity to numerous private residences may increase the need for more proactive efforts to control invasive species, protect water quality, and increase stream shading. The total size of this area is 2,810 acres, but only a small portion of the area would likely require any active restoration.

6.3 Priority Sub-Basin 3- Dubois Creek/Clackamas River

The Dubois Creek/Clackamas River sub-basin, comprising 12,627 acres, includes lands owned or managed by PGE, US Forest Service, Oregon State Parks, and hundreds of rural private landowners, among others. This sub-basin includes the City of Estacada, the Faraday dam, and Milo McIver State Park. This watershed is highly modified and disturbed by human use. Much of the landscape near the river has been converted to industrial use, rural private development, or agriculture. In-stream conditions are modified by armored banks, dikes, dams, and other structures intended to protect against flooding. This section of the river is extremely popular with recreational users including boaters, disc-golfers, campers, and hikers. There are numerous known invasive species distributed across the sub-basin, and reducing the threat of invasive species in this sub-basin will be much more laborious and expensive, relative to the previously mentioned sub-basins.

Prevention

The Dubois Creek/Clackamas River sub-basin contains several popular recreation sites, the City of Estacada, and the Faraday dam, all of which would make excellent targets for preventive actions. Milo McIver and Bonnie Lure State Parks provide recreational opportunities for thousands of visitors each year. These sites have significant infestations of priority invasive species already identified, but also contain high quality habitats, and are home to rare, threatened, or endangered species. Preventing new introductions of invasive species and curbing the spread of existing populations at these sites is critical to this planning effort. Both of these sites should be targeted for installation of at least one invasive species sign and boot brush station. Priority areas for informational signage and other prevention actions include the disc golf course at Milo McIver State Park, and boat ramps in the sub-basin.

Survey

Within this sub-basin, 3,553 acres have already been surveyed for priority invasive species. Surveys focused primarily on public lands and riparian buffers. These surveys have already identified large numbers of priority invasive species populations. Significant expansion along the edges of the existing survey areas and new surveys along floodplains and major roadways will be prioritized in order to develop a better understanding of the extent of invasive species cover in this sub-basin. A total of 83 acres has been prioritized for additional surveys.

Control

Invasive species populations in this sub-watershed are extensive and widespread. A total of 298 patches of high and medium priority invasive species have already been identified and it is anticipated that many other patches will be discovered with additional surveys. Control actions will need to be focused on the highest priority known patches and on satellite patches discovered during future surveys.

Restoration

The natural area that buffers the river between the upstream end of Milo McIver State Park and the Eagle Creek/Clackamas River confluence has been identified as the initial target for restoration in this sub-basin. This project area includes Oregon State Parks as well as several other sites where partners are actively engaged. These restoration targets total 1,958 acres. Significant opportunities exist within the project area for in-stream restoration actions, as well as riparian forest and upland habitat restoration work. Expanding beyond the existing reach of partner engagement in this target area will require significant private landowner outreach and engagement, large-scale invasive species control, extensive reforestation efforts, and potentially expensive in-stream actions to improve habitat conditions for anadromous fish.

6.4 Priority Sub-Basin 4- Rock Creek/Lower Clackamas River

The Rock Creek/Lower Clackamas River sub-basin, comprising 27,361 acres, includes lands managed by a wide array of public agencies, or lands owned by private individuals and corporations. The land uses include residential, industrial, agricultural, forestry and conservation uses. The majority of public lands in this basin are managed by Clackamas County Parks, Metro, and North Clackamas Parks and Recreation District.

This reach of the river has been the target of significant investments by public agencies on their own lands, as well as by the Clackamas SWCD, the Clackamas River Basin Council, and Water Environment Services on privately owned lands. These efforts have significantly improved in-stream and riparian habitat quality in small portions of the sub-basin. Nevertheless, this sub-basin contains the most extensive and difficult-to-manage invasive species populations identified in the basin. The area is highly urbanized, includes numerous municipalities, and receives intensive and sometimes damaging levels of recreational use. However, because of its proximity to population centers, its highly degraded state, and the high levels of investment by numerous stakeholders, effective action in this sub-basin has the potential to produce significant ecological benefit, and to increase public awareness and support for restoration efforts to a greater extent than in any other portion of the Clackamas Basin.

Prevention

The Rock Creek/Lower Clackamas River sub-basin contains numerous popular recreation sites, the community of Carver, and portions of Damascus, Happy Valley, Gladstone and Oregon City. With invasive species populations at high levels in this sub-basin, prevention efforts will focus on containment to limit the spread of invasive species out of this sub-basin into adjacent areas. Boot brushes, informational signage, and other educational tools should be installed at popular recreation site within the sub-basin.

Survey

A total of 368 acres of riparian and natural area buffers have been identified for future survey efforts. Within the sub-basin, 1,873 acres have already been surveyed for invasive species. Efforts have focused primarily on public lands and riparian buffers. These surveys have identified a large numbers of priority invasive species populations. Expansion of the existing survey areas should include major roadways and riparian reaches adjacent to high-quality habitat areas.

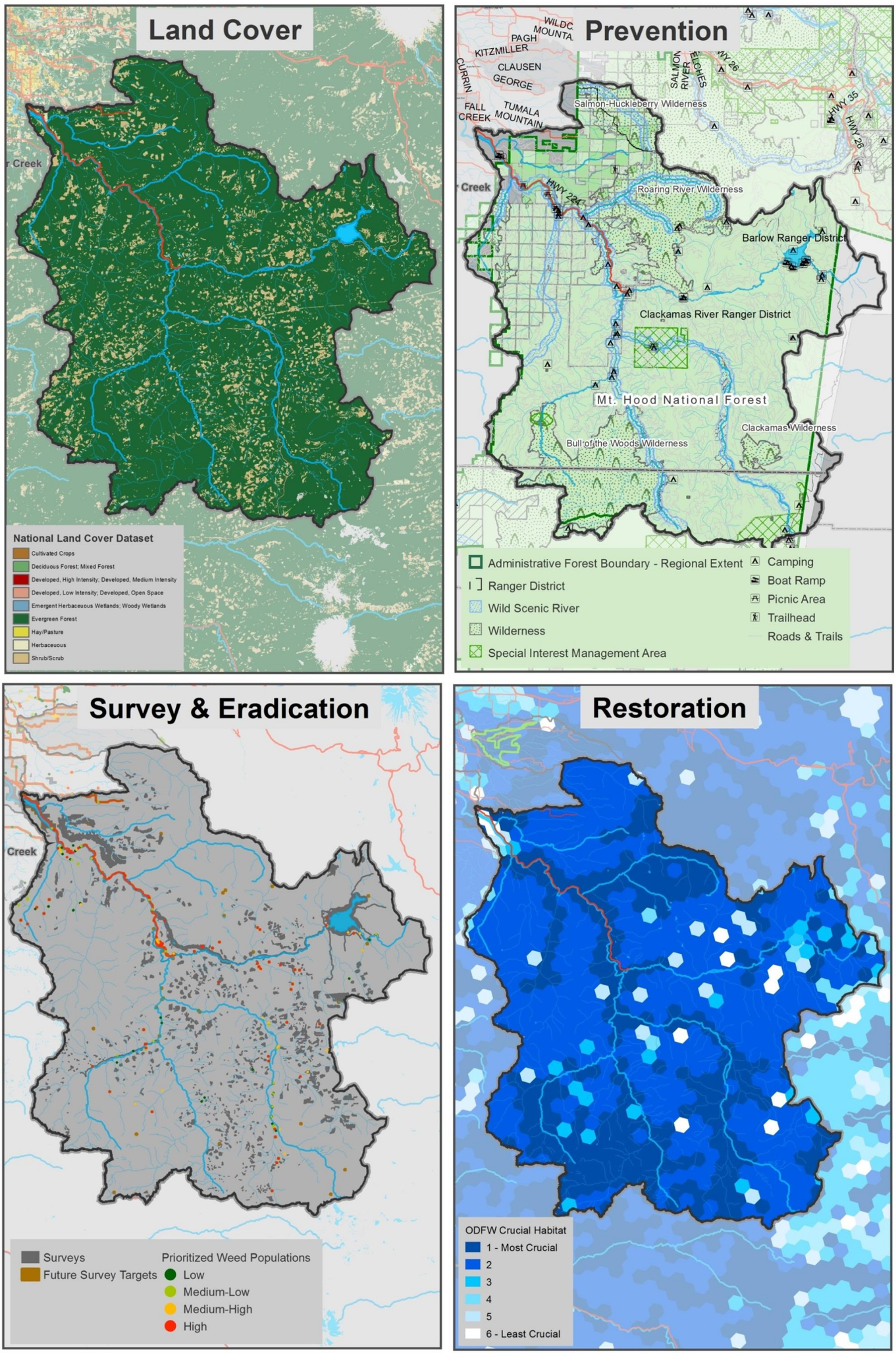
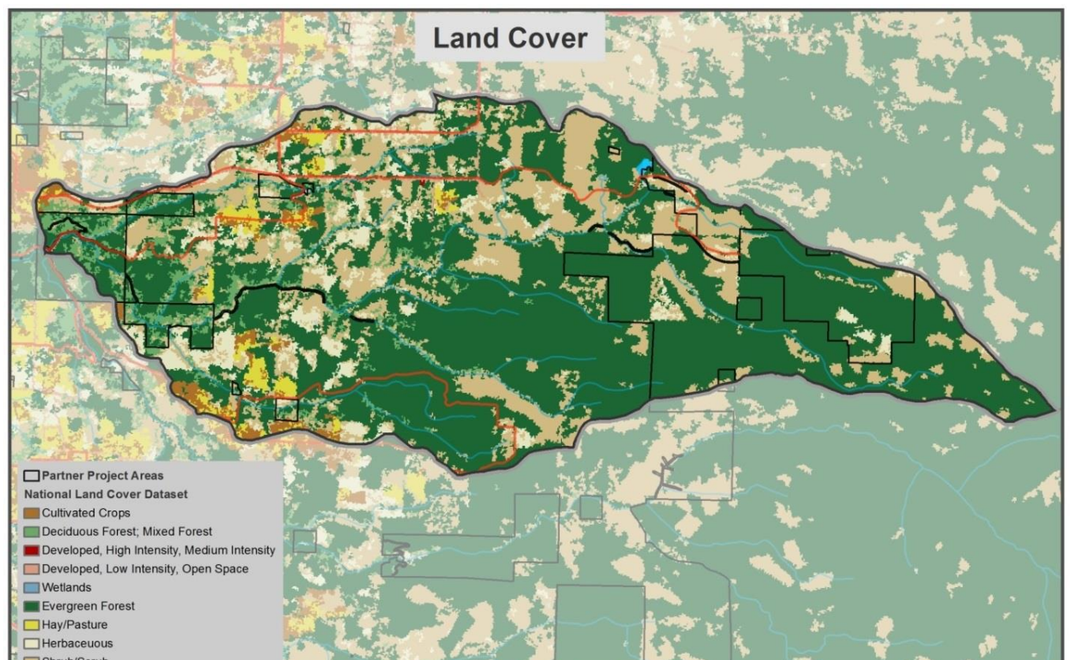
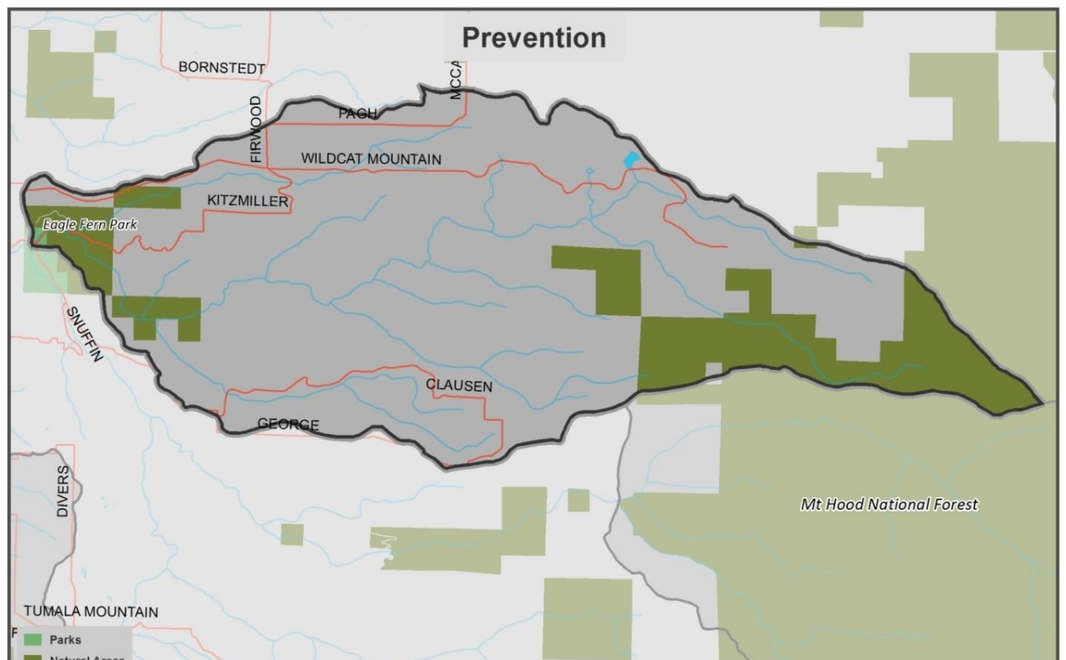
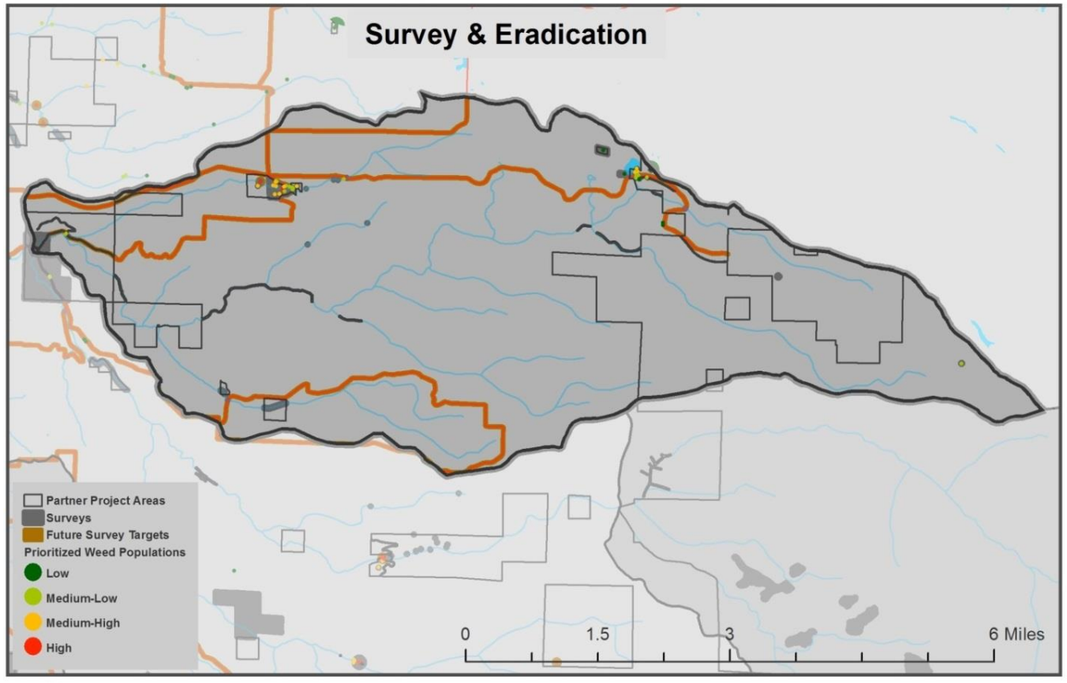


Figure 6.0- Map of Priority Sub-Basin 1: Upper Watershed (*Map by Jeff Lesh, Clackamas SWCD)*







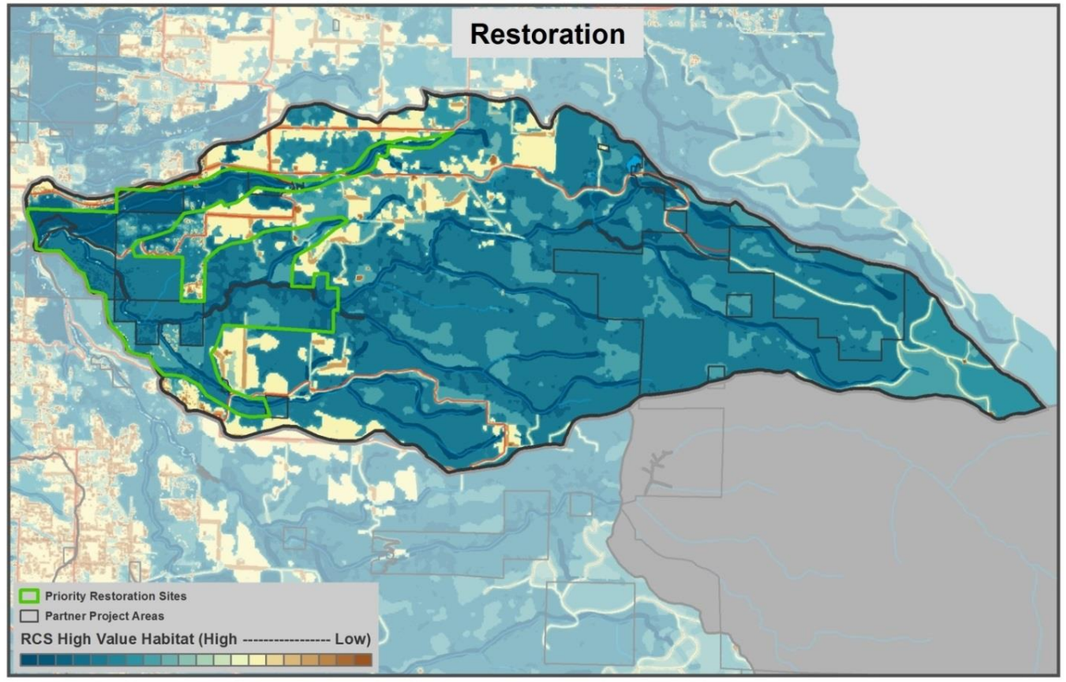


Figure 6.1- Map of Priority Sub-Basin 2: North Fork Eagle Creek *(Map by Jeff Lesh, Clackamas SWCD)*

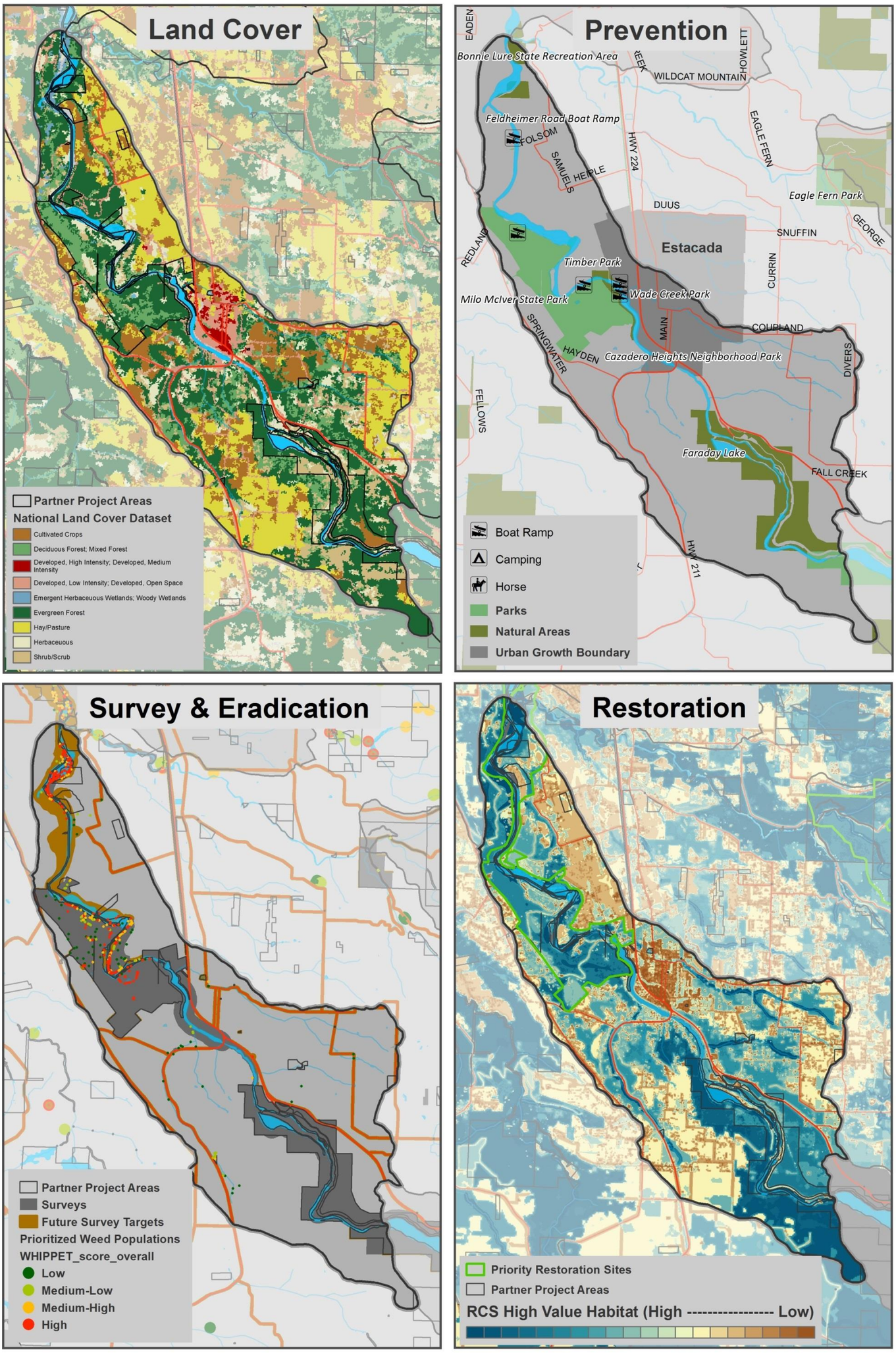
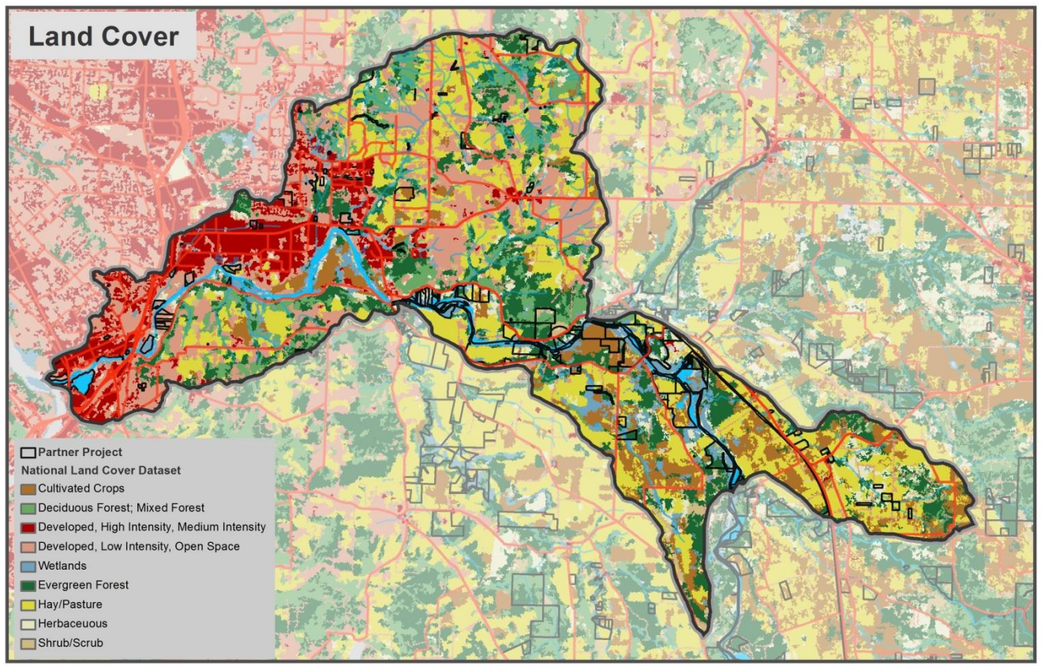
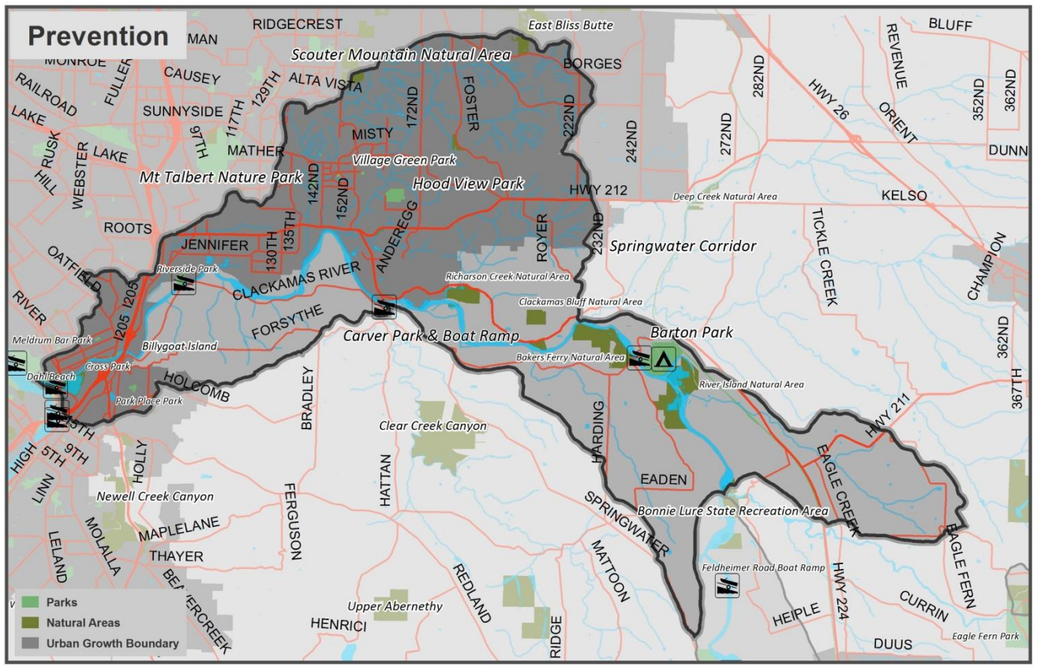
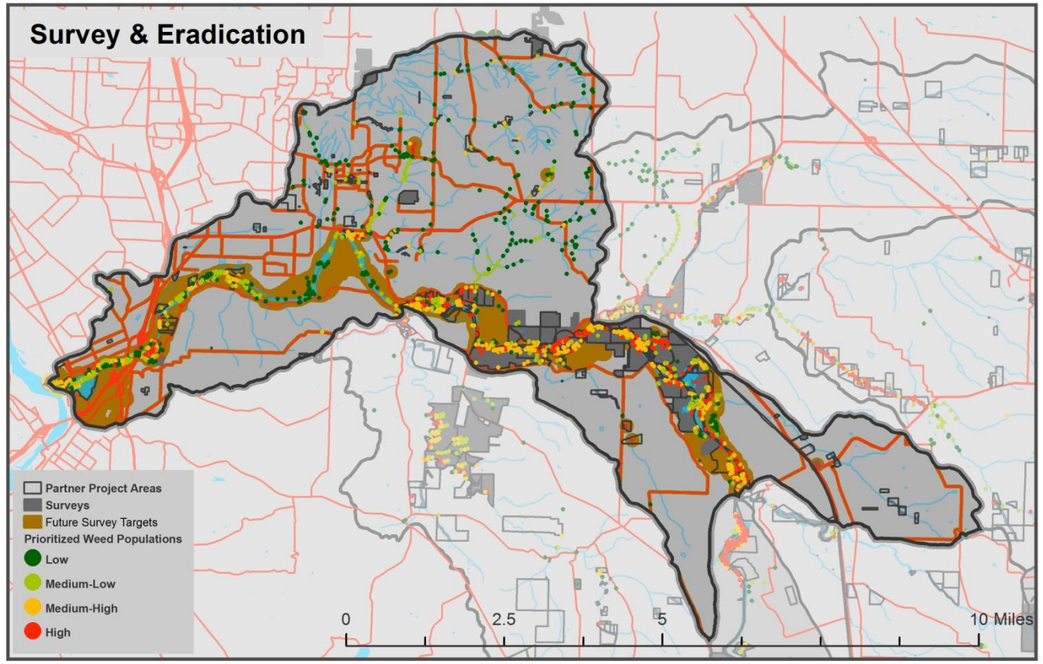


Figure 6.2- Map of Priority Sub-Basin 3: Dubois Creek/Clackamas River (*Map by Jeff Lesh, Clackamas SWCD)*







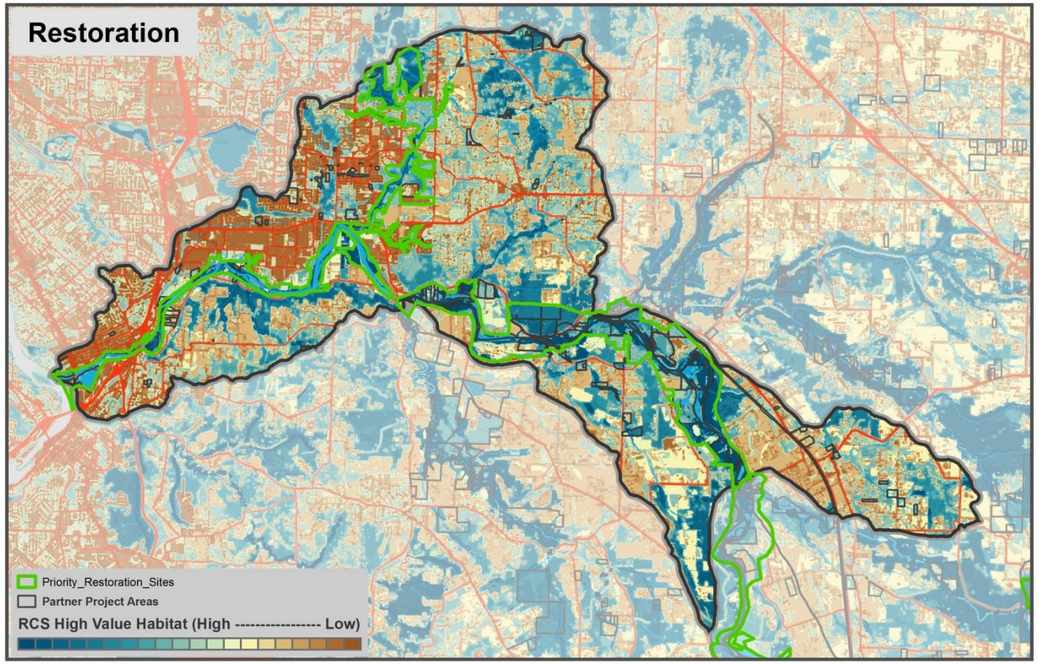


Figure 6.3- Priority Sub-Basin 4: Rock Creek/Lower Clackamas River (Map by Jeff Lesh, Clackamas SWCD)

Control

Invasive species populations in this sub-watershed are extensive and widespread. There are 755 patches of high and medium priority invasive species already identified and it is expected that many other patches will be discovered with additional surveys. Control actions will need to be focused on the highest priority patches that have been identified and on prioritized satellite patches that are discovered during future surveys.

Restoration

Three large natural areas have been identified as potential restoration sites in the Rock Creek/Lower Clackamas River sub-basin. The first site is the riparian buffer that extends from the Clackamas/Willamette River confluence up to Carver Bridge. The second area is made up of the riparian and remaining upland natural areas of Rock Creek Watershed. The last priority restoration area is the forested area buffering the river between Carver Bridge and Eagle Creek. These three restorations targets total 4,016 acres and include some of the most significant riparian and floodplain forest lands in the watershed. These areas are highly modified by development, gravel mining, diking, bank armoring, invasive species, and agriculture. Their restoration will require significant investment by partners. Expanding current restoration initiatives to restore habitat and control invasive species across all priority restoration sites will require additional private landowner outreach and engagement, large scale invasive species control, and reforestation efforts to significantly improve habitat conditions.

Section 7. Ten Year Action Plan

The Clackamas River Invasive Species Management Plan identifies four priority sub-basins that should be the focus of concentrated efforts to address the threat of invasive species in the basin. A working group will be dedicated to each priority sub-basin and include those partners focused to the area. Each working group will refine priorities and identify specific sites and opportunities to collaborate on in that sub-basin. While these four sub-basins will likely receive the greatest resources and attention, the plan is intended to address invasive species watershed-wide. Over the next 10 years, partners will continue to make progress towards watershed-wide control of invasive species and strive to implement the following actions:

1. Develop and maintain a diverse and active partnership that meets at least twice per year, shares information, prioritizes actions, and where possible, allocate resources cooperatively;
2. Develop the structures and tools necessary to effectively communicate data, ideas, and results among the partnership;
3. Allocate the resources necessary to compile, analyze, map, and reprioritize invasive species population location data on a basin-wide scale every two years, and provide it to the partners;
4. Install interpretive signage at identified locations in the watershed, including at least four in the upper watershed, and two in each of the priority main stem Clackamas sub-basins;
5. Conduct presence/absence surveys for priority invasive species in areas identified in the basin specific plans, as well as in priority locations in other areas of the watershed;
6. Control all high and medium priority invasive species in the upper watershed and North Fork Eagle Creek watershed;
7. Control all high priority invasive species populations in the Dubois Creek/Clackamas and Rock Creek/Lower Clackamas basins;
8. Develop, fund, and implement at least three new priority restoration initiatives in the first five years involving at least four different partners and use these as demonstration projects to elicit support and funding for future actions;
9. Develop clear and consistent messaging among partners to communicate current efforts to policy makers, and for outreach to the public.
10. Cultivate public participation in invasive species control efforts, and promote volunteerism among the general public.
11. Draft and distribute a CRISP Annual Report highlighting that year's accomplishments, challenges, and progress toward overall goals.

Section 8. Potential Regulatory Tools

A diverse group of partners has worked to provide input toward the development of this plan. Many of these partners are public agencies who answer to diverse constituencies and work within the confines of their mandates. As a result, the actions prescribed in this plan are limited to voluntary, non-confrontational approaches. While generally effective, these voluntary approaches can be undermined by a few neglectful or uncooperative land owners and practitioners. While rare, such properties can serve as ongoing propagule sources and threaten the viability of invasive species control efforts across otherwise contiguous tracts of actively managed properties. If left unmanaged, they can lead to reinfestation of restored habitats.

8.0 - Zoning and Permitting

One of the most effective ways of reducing the introduction and spread of invasive species is to reduce disturbance. A critical tool for reducing disturbance is to create zoning ordinances on state, county, and local levels that protect riparian habitat buffers, limit the types and densities of development, and require protection of air, habitat, and water quality when disturbances are unavoidable. Many municipalities and counties have imposed mandatory setbacks from creeks, rivers, wetlands, and other important habitats. While these setbacks and other zoning restrictions can reduce the development options available to some private landowners, they can help reduce the likelihood that actions by one landowner will adversely impact others.

8.1 - County Weed Boards

In many predominantly rural areas of the country, County Weed Boards have been established in response to the loss of productivity in the agricultural sector due to invasive species. The role of County Weed Boards has been to require control of invasive species that have a damaging impact on agricultural productivity.

Regulatory in nature, these boards enforce noxious weed control laws by imposing financial penalties on landowners who fail to control priority invasive species on their own lands. Conditions currently exist across the Clackamas watershed where noxious vegetation spreads from one landowner onto neighboring properties. Under such circumstances, the efforts of conscientious landowners are undermined by a lack of regulatory authority at the county level.

In this situation it may be reasonable to make control compulsory. These kinds of enforcement mechanisms currently exist on the state level for specific Class A invasive species that are a threat to public health. Similarly, many municipalities enforce noxious weed laws through their municipal ordinances. Expanding this kind of program to the county may help prevent new outbreaks of invasive species in unincorporated portions of the county.

Clackamas County has a culture of weed enforcement as a result of 40 years of mandatory control of tansy ragwort and other noxious weeds targeted by the county. The Clackamas County formed a Weed Board in 1949, but dissolved the board in 1989, citing budgetary constraints. Since dissolution, the Clackamas SWCD signed an MOU with Clackamas County to act as the Weed Advisory Board for the county. In 2007, Clackamas County residents voted to support the Clackamas SWCD through a permanent tax base, in-part to support invasive plant control efforts.

Marion County currently operates a county Weed Control Board and enforces noxious weed control laws in unincorporated portions of the county. Within Marion County, landowners may be cited for failing to control invasive plants identified by the Marion County Weed board.

8.2 - Taxes and Levies

Given the scope of economic damage wrought by invasive species and the investment being made to control them at the local, regional, and state levels it is to the benefit of landowners, businesses, developers, or other constituencies to contribute towards funding control efforts to support ongoing investments. An economic analysis by the Oregon Department of Agriculture found a $34 return for every dollar of resources invested in prevention and early detection.

The residents of Clackamas have authorized a permanent tax to support the Clackamas Soil and Water Conservation District to support invasive plant control, but the funding available is used primarily for landowner technical assistance, prevention and Early Detection and Rapid response efforts. To effectively control more pervasive weeds, additional revenue is needed.

Formation of a county Weed Control District under ORS 569:420 authorizes counties to levy a tax "*estimated by the county court as being sufficient*" to control invasive plants within the Weed Control District. As such, while a mechanism exists to fund and enforce noxious weed control efforts at the county level, this authority is not currently being exercised by the county.

Section 9. Funding

Results from the CRISP partner survey and initial stakeholder meeting made clear that one of the primary constraints to effectively managing invasive species in the basin is the lack of a plan and the financial resources to implement such a plan. Even with a well-conceived plan, funding remains an ongoing challenge.

9.0 - Existing Funding

The primary sources of existing funding in the basin are the annual operating budgets of public agencies. These budgets fund maintenance of agency owned properties and allow for implementation of priorities exclusive to those agencies. The other major sources of funding in the basin have been grant programs. The Oregon Watershed Enhancement Board, Metro's Nature in Neighborhoods grant program, Clackamas County Water Environment Services, Portland General Electric, National Fish and Wildlife Foundation, Oregon Department of Agriculture, and others provide funding through competitive grant programs to restore habitat, control weeds, and improve the livability of our communities. Each of these programs has or is currently funding work in the basin. However, the projects that have been funded are geographically dispersed and have not been part of a comprehensive basin-wide plan.

9.1 - An Approach to Future Funding Requests

Funding the priority actions described in this plan will only be possible if the partners and stakeholders involved in developing the Clackamas River Invasive Species Management Plan are dedicated to implementing a common vision. Each agency has to provide funding for the management of its own lands before it can prioritize external projects. In many instances, no part of an agency's general budget can be dedicated to non-agency properties. However, where flexibility exists in this regard, some funding should be allocated towards restoration or weed control activities prioritized in the plan, especially when lands are adjacent to existing investment areas. The greatest flexibility of funding will likely come from grants, which can be dedicated to private lands, public lands where the managing agency has insufficient funding to implement the priority actions, and to things like survey, outreach, and education.

Many of the high priority restoration, control, survey, and prevention projects will fall within areas that are already being partially managed by stakeholders. If the existing funding that is going to these areas can be utilized as match, funding requests can be submitted to grant agencies in order to expand the scope and scale of the project to accomplish priority actions set out in the plan.

9.2- Estimated Funding Requirements

Implementing all of the priority actions described in this plan will be an expensive, long-term effort. Estimating the cost of implementing these actions is difficult because conditions on the ground are widely variable, with partners having different requirements for permitting and planning. Restoration, as defined in this context, spans the gamut from release of viable but degraded forest from heavy invasive cover to the reestablishment of native riparian forest over a 5-6 year period. Numbers that can be used to estimate the annual funding needs for implementing on-the-ground actions described in this plan are as follows:

1. Install two prevention kiosks each year at a cost of $1,500 each for a total cost of $3,000 per year.

2. Survey 20 miles of road or streams and 20 acres of high quality habitats in priority sub-basins each year at a cost of $1,000/mile of road or stream at $200/acre for a total cost of $24,000 per year.
3. Control or eradicate 250 patches of high or medium priority weeds at a cost of $200/patch; this equates to $50,000 per year.
4. Restore 100 acres of priority restoration areas at an average cost of $4,000/acre for a total of $400,000 annually.

The estimated annual funding requirement, excluding staff costs, for implementation of all activities outlined in the ten-year plan is $477,000 per year. While this represents a significant investment, much of the need is already expended by CRISP partner organizations. Existing shortfalls are best addressed by leveraging existing resources through grants and additional investment from CRISP partners. The prioritization process undertaken in development of the *Clackamas River Invasive Species Management Plan* helps to make current efforts nimble and resilient to variable and deficient funding levels. Priority activities are scalable, but are also designed for maximum impact given limited resources.

Section 10. Conclusions

For at least 8,000 years, the Clackamas River Basin has been actively managed for a variety of land uses. The Clackamas Basin has provided fish, game, food crops, timber, water, electricity, recreational opportunities, and great beauty to millions of visitors and thousands of residents. Today, more people live, work, and play in the Clackamas Basin than ever before. In order to maintain the basin for generations to come, care needs to be taken to sustainably manage our resources and limit the impacts of development and disturbance.

Invasive species are currently impacting the productivity of our farmlands and forests, degrading our riparian areas, reducing our water quality and affecting the sustainability of our communities. This *Clackamas River Invasive Species Management Plan* should be looked as setting the course for how natural resources managers, private landowners, and community groups in the basin can work together to reduce these impacts into the future.

This plan provides an estimate of how and where the stakeholders can work together most effectively. That said, significant gaps remain in our understanding of invasive species threats to the basin. The WHIPPET model has provided an impartial way to prioritize the seemingly overwhelming distribution of invasive species within the basin. While the model remains untested in the Clackamas Basin, the clarity of approach allows for adaptive management over the long term as priorities and unforeseen threats emerge.

The effort to compile and prioritize information has been made with the goal of catalyzing collective action to reduce the threat of invasive species and improve habitat quality in the basin. By moving forward and implementing the recommendations in this report, CRISP partners will gain valuable new information that will inform and guide each successive effort to plan and prioritize invasive species management in the basin. The planning and prioritizing process must be ongoing and iterative, incorporate changes in on-the-ground conditions as new information becomes available.

This ten-year plan proposes four primary prescriptions to implement across the basin to address invasive species; *prevention, survey, control*, and *restoration*. At the same time, it recognizes that funding is limited and resources must be allocated to the highest priorities in order to ensure meaningful impact.

The *Clackamas River Invasive Species Management Plan* prioritizes all mapped priority weed infestations in the basin in order to identify those populations whose control will produce the greatest benefit. Going one step further, the plan prioritizes four sub-basins that should be the primary targets for future collaborative efforts by stakeholders. Within the four sub-basins, the plan outlines the highest priority locations for prevention, survey, control, and restoration activities. A very rough estimate of the costs associated with implementing these efforts is provided as a starting point for planning efforts. Finally, the plan suggests additional steps beyond the on-the-ground efforts that stakeholders could take in order to more proactively address the ongoing invasion of non-native species.

One of the most valuable outcomes of the planning process may ultimately be the completion of the plan itself. Numerous stakeholders described the lack of a plan as the primary impediment to effective action in the basin. With this detailed plan as a guide, stakeholders can now focus their efforts on the real work of improving conditions on the ground.

Appendices

Appendix 1.0 Sample data sheet

<table>
<tr><td colspan="7">WEED SURVEY SHEET</td></tr>
<tr><td colspan="2">Name:</td><td colspan="2">Date:</td><td colspan="3">Site:</td></tr>
<tr><td>ID</td><td>Species/ Sample</td><td>Estimated Dimensions: length and width or diameter (ft),</td><td>Percent Cover</td><td>Habitat Type/Land Use</td><td>Growth Stage</td><td>Growth Form (circle one)

S=Seedling, V=Vegetative, B=Bolting, F=Flowering, R=Reproducing,</td></tr>
<tr><td colspan="2">GPS coordinates or Waypoint ID

N</td><td colspan="5">Notes (i.e. side of road/stream, substrate, landmarks, control issues, dist from water, revegetation needs, etc.)</td></tr>
<tr><td colspan="2">W

Photo ID</td><td colspan="5">Notes (i.e. side of road/stream, substrate, landmarks, control issues, dist from water, revegetation needs, etc.)</td></tr>
</table>

Appendix 1.1: Clackamas County Weed List

Clackamas County Weed List

Clackamas County SWCD WeedWise Program

Common Name	Scientific Name	ODA Listing	Priority
Velvetleaf	*Abutilon theophrasti*	B	
Biddy-biddy	*Acaena novae-zelandiae*	B	
Russian Knapweed	*Acroptilon repens*	B	yes
Pheasant's eye	*Adonis aestivalis*	B	yes
Jointed goatgrass	*Aegilops cylindrica*	B	yes
Ovate Goatgrass	*Aegilops ovata*	A	yes
Barbed Goatgrass	*Aegilops triuncialis*	A	yes
Tree of Heaven	*Ailanthus altissima*	B	
Camelthorn	*Alhagi pseudalhagi*	A	yes
Garlic mustard	*Alliaria petiolata*	B,T	yes
Yellow tuft	*Alyssum corsicum*	A,T	yes
Yellow tuft	*Alyssum murale*	A,T	yes
Ragweed	*Ambrosia artemisiifolia*	B	yes
Skeletonleaf bursage	*Ambrosia tomentosa*	A	yes
False indigo bush	*Amorpha fruticosa*	B	
Common bugloss	*Anchusa officinalis*	B,T	yes
Italian arum	*Arum italicum*		
Giant reed	*Arundo donax*	B	
Hoary allysum	*Bertoa incana*	A,T	yes
False brome	*Brachypodium sylvaticum*	B	yes
White bryonia	*Bryonia alba*	A	yes
Butterfly bush	*Buddleja davidii (Buddleja varabilis)*	B	
Flowering rush	*Butomus umbellatus*	A,T	yes
Plumeless Thistle	*Carduus acanthoides*	A,T	yes
Musk Thistle	*Carduus nutans*	B	yes
Italian Thistle	*Carduus pycnocephalus*	B	yes
Slender-flowered Thistle	*Carduus tenuiflorus*	B	yes

Drooping Sedge	*Carex pendula*		
Smooth distaff Thistle	*Carthamus baeticus*	A	yes
Woolly distaff Thistle	*Carthamus lanatus*	A	yes
Purple Starthistle	*Centaurea calcitrapa*	A,T	yes
Diffuse Knapweed	*Centaurea diffusa*	B	
Iberian Starthistle	*Centaurea iberica*	A,T	yes
Spotted Knapweed	*Centaurea maculosa (C. stoebe)*	B,T	
Meadow Knapweed	*Centaurea pratensis (C. jacea x nigra)*	B	
Yellow starthistle	*Centaurea solstitialis*	B	yes
Squarrose knapweed	*Centaurea virgata*	A,T	yes
Rush skeletonweed	*Chondrilla juncea*	B	
Canada Thistle	*Cirsium arvense*	B	
Bull Thistle	*Cirsium vulgare*	B	
Old man's beard	*Clematis vitalba*	B	
Poison hemlock	*Conium maculatum*	B	
Field bindweed	*Convolvulus arvensis*	B,T	
Jubata grass	*Cortaderia jubata*	B	yes
Common crupina (bearded creeper)	*Crupina vulgaris*	B	
Japanese dodder	*Cuscuta japonica*	A,T	yes
Dodder	*Cuscuta spp.*	B	
Houndstongue	*Cynoglossum officinale*	B	yes
Yellow nutsedge	*Cyperus esculentus*	B	
Purple nutsedge	*Cyperus rotundus*	A	yes
Scotch Broom	*Cytisus scoparius*	B	
Portuguese Broom	*Cytisus striatus*	B,T	
Spurge laurel	*Daphne laureola*	B	yes
Cape ivy	*Delairea odorata*	A	yes
Cutleaf teasel	*Dipsacus laciniatus*	B	yes
Paterson's curse	*Echium plantagineum*	A,T	yes
South American waterweed	*Egeria densa*	B	
Spanish heath	*Erica lusitanica*	B	
Leafy Spurge	*Euphorbia esula*	B,T	yes
Myrtle Spurge	*Euphorbia myrsinites*	B	
Oblong spurge	*Euphorbia oblongata*	A,T	yes
Japanese Knotweed	*Fallopia japonica*	B	yes

	(Polygonum cuspidatum)		
Giant Knotweed	*Fallopia sachalinensis (Polygonum sachalinensis);*	B	yes
Goatsrue	*Galega officinalis*	A	yes
French Broom	*Genista monspessulana*	B	
Shiny leaf geranium	*Geranium lucidum*	B	
Herb Robert	*Geranium robertianum*	B	
Halogeton	*Halogeton glomeratus*	B	yes
English ivy	*Hedera helix*	B	
Irish ivy	*Hedera hibernica*	B	
Spikeweed	*Hemizonia pungens*	B	yes
Giant hogweed	*Heracleum mantegazzianum*	A	yes
Orange Hawkweed	*Hieracium aurantiacum*	A,T	yes
Meadow Hawkweed	*Hieracium caespitosum*	B,T	yes
Yellow Hawkweed	*Hieracium floribundum*	A,T	yes
Mouse-ear Hawkweed	*Hieracium pilosella*	A,T	yes
King-devil Hawkweed	*Hieracium piloselloides*	A,T	yes
Hydrilla	*Hydrilla verticillata*	A	yes
Common frogbit	*Hydrocharis morsus-ranae*	A	yes
St. Johnswort	*Hypericum perforatum*	B	
Policeman's helmet	*Impatiens glandulifera*	B	yes
Yellow flag iris	*Iris pseudacorus*	B	
Dyers woad	*Isatis tinctoria*	B	
Kochia	*Kochia scoparia*	B	yes
Yellow archangel	*Lamiastrum galeobdolon*	B	
Perennial peavine	*Lathyrus latifolius*	B	
Lens-podded Whitetop	*Lepidium chalepensis*	B	yes
Hoary cress	*Lepidium draba*	B	yes
Perennial pepperweed	*Lepidium latifolium*	B,T	yes
Hairy Whitetop	*Lepidium pubescens*	B	yes
West Indian spongeplant	*Limnobium laevigatum*	A	yes
Dalmatian Toadflax	*Linaria dalmatica*	B,T	
Yellow Toadflax	*Linaria vulgaris*	B	
Water primrose	*Ludwigia grandiflora*	B,T	
Water primrose	*Ludwigia hexapetala*	B,T	
Water primrose	*Ludwigia peploides*	B,T	

Garden yellow loosestrife	*Lysimachia vulgaris*	A	yes
Purple loosestrife	*Lythrum salicaria*	B	yes
Eurasian watermilfoil	*Myriophyllum spicatum*	B	yes
Parrots feather	*Myrophyllum aquaticum*	B	
Matgrass	*Nardus stricta*	A,T	yes
Yellow floating heart	*Nymphoides peltata*	A	yes
Scotch Thistle	*Onopordum acanthium*	B	yes
Taurian Thistle	*Onopordum tauricum*	A,T	yes
Small broomrape	*Orobanche minor*	B	
African rue	*Peganum harmala*	A,T	yes
Japanese Butterbur	*Petasites japonica*		
Ribbongrass	*Phalaris arundinacea* var. *'Picta'*	B,T	
Common reed	*Phragmites australis ssp. australis*	B	yes
American pokeweed	*Phytolacca americana*		
Himalayan Knotweed	*Polygonum polystachyum*	B	yes
Sulfur cinquefoil	*Potentilla recta*	B	yes
Kudzu	*Pueraria lobata*	A,T	yes
Lesser celandine	*Ranunculus ficaria*	B	
Creeping yellow cress	*Rorippa sylvestris*	B	
Armenian (Himalayan) blackberry	*Rubus bifrons (R. armeniacus, R. procerus, R. discolor)*	B	
Ravennagrass	*Saccharum ravennae*	A	yes
Mediterranean sage	*Salvia aethiopis*	B	
Tansy ragwort	*Senecio jacobaea*	B,T	
Blessed Milk Thistle	*Silybum marianum*	B	yes
Silverleaf nightshade	*Solanum elaeagnifolium*	A	yes
Buffalobur	*Solanum rostratum*	B	
Johnsongrass	*Sorghum halepense*	B	yes
Smooth Cordgrass	*Spartina alterniflora*	A, T	yes
Common Cordgrass	*Spartina anglica*	A,T	yes
Dense-flowered Cordgrass	*Spartina densiflora*	A,T	yes
Saltmeadow Cordgrass	*Spartina patens*	A,T	yes
Spanish Broom	*Spartium junceum*	B	yes
Swainsonpea	*Sphaerophysa salsula*	B	

Medusahead rye	*Taeniatherum caput-medusae*	B	yes
Saltcedar	*Tamarix ramosissima*	B,T	
European water chestnut	*Trapa natans*	A	yes
Puncturevine	*Tribulus terrestris*	B	yes
Coltsfoot	*Tussilago farfara*	A	yes
Gorse	*Ulex europaeus*	B,T	yes
Spiny cocklebur	*Xanthium spinosum*	B	yes
Syrian bean-caper	*Zygophyllum fabago*	A	yes

Appendix 1.2 Adapted WHIPPET Scoring Algorithm and Criteria

WHIPPET Scoring Algorithm

$$Overal\ priority\ score\ for\ a\ population = S_{impact}(0.378) + S_{invasvieness}(0.229) + S_{feasibility}(0.393), \text{ where}$$

$$S_{impact} = S_{wildlands}(0.483) + S_{sitevalue}(0.517)$$

$$S_{invasiveness} = S_{conspecifics}(0.378) + S_{spreadrate}(0.393) + (0.22)[S_{roads}(0.333) + S_{rivers}(0.425) + S_{mines}(0.243)]$$

$$S_{feasibility} = S_{popsize}(0.253) + S_{reproduction}(0.177) + S_{detectability}(0.125) + S_{accessibility}(0.150) + S_{controleffectiveness}(0.190) + S_{cost}(0.105)$$

and

$$S_{sitevalue} = S_{partner}(0.36) + S_{rcs}(0.49) + S_{t\&e}(0.15), \text{ where}$$

$$S_{partner} = \left(\frac{partner\ \#}{partner\ \#_{max}} \times 0.67\right) + (partner\ area\ \% \times 0.33)$$

$$S_{rcs} = \left(\frac{average\ RCS}{average\ RCS_{max}} \times 0.73\right) + (\%\ high \times 0.27)$$

$$S_{t\&e} = \left(\frac{T\&E\ \#}{T\&E\ \#_{max}}\right), \text{ where}$$

$$T\&E\ \# = \frac{T\&E\ Stream\ Length\ (ft)}{1320\ (ft)} + T\&E\ observation\ count$$

WHIPPET Scoring Criteria

Criteria	10	6	3	1	0	Weight
Impact						0.378
Impact to Wildlands	A	B	C or U	D		0.483
Site value			see formula			0.517
Invasiveness						0.229
Distance to conspecifics	>12.5 mi	5-12.5 mi	.5-5 mi	0.05-.5 mi	<0.05 mi	0.378
Rate of spread	A	B	C or U	D		0.393
Distance						0.229
to Roads	<0.05 mi	0.05-.5 mi	.5-5 mi	5-12.5 mi	>12.5 mi	0.333
to Rivers	<0.05 mi	0.05-.5 mi	.5-5 mi	5-12.5 mi	>12.5 mi	0.425
to Mines	<0.05 mi	0.05-.5 mi	.5-5 mi	5-12.5 mi	>12.5 mi	0.243
Feasibility of Eradication						0.393
Population size	<0.1 ac	0.1-.5 ac	.5-5 ac	5-50 ac	>50 ac	0.253
Reproductive ability	D	C or U	B	A		0.177
Detectability	Highly Visible	Visible	Moderately Visible	Somewhat Visible	Cryptic	0.125
Accessibility		Lack of Data – All scored Moderate (3)				0.15
Control effectiveness	Very High	High	Moderate	Low	Very Low	0.19
Control cost	Very Low	Low	Moderate	High	Very High	0.105

Appendix 1.3: Species level scoring results

Species	Impact to Wildland	Rate of spread	Reproductive Ability	Detectability	Control Effectiveness	Control Cost	Vector - roads	Vector - rivers	Vector - mines
Alliaria petiolata	10	10	1	3	10	6	yes	yes	yes
Brachypodium sylvaticum	6	10	1	1	6	3	yes	yes	yes
Centaurea diffusa	6	6	3	6	6	3	yes	yes	yes
Centaurea nigrescens	6	6	1	6	6	3	yes	no	yes
Centaurea stoebe ssp. micranthos	6	6	1	6	6	3	yes	no	yes
Centaurea xmoncktonii	6	6	1	6	6	3	yes	no	yes
Daphne laureola	6	6	6	6	6	3	no	no	no
Fallopia japonica	6	6	3	10	3	3	yes	yes	yes
Fallopia sachalinensis	6	6	3	10	3	3	yes	yes	yes
Fallopia xbohemica	6	6	3	10	3	3	yes	yes	yes
Heracleum mantegazzianum	6	10	1	6	6	6	yes	yes	yes
Hieracium aurantiacum	6	10	1	3	6	3	yes	no	yes
Hieracium caespitosum	6	10	1	1	3	1	yes	no	yes
Impatiens glandulifera	6	10	3	6	6	3	yes	yes	no
Lythrum salicaria	10	10	1	10	3	3	yes	no	yes
Petasites japonicus	6	6	3	10	3	3	no	yes	no
Potentilla recta	6	10	1	6	3	3	yes	no	yes
Saponaria officinalis	3	6	1	3	6	6	yes	yes	yes
Ulex europaeus	10	6	1	6	3	3	yes	yes	yes
Xanthium spinosum	3	6	3	6	6	3	yes	no	no

The WHIPPET Species Assessment form was used to create these scores.

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