

Willamette Water Supply
Our Reliable Water

March 30, 2026

Oregon Department of Environmental Quality
700 NE Multnomah Street, Suite 600
Portland, OR 97232

Attention: Brian Creutzburg

Subject: Willamette Water Supply System Commission Annual Report

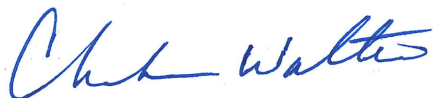
Dear Mr. Creutzburg,

The Willamette Water Supply System (WWSS) Commission is providing the attached annual report, consistent with the requirements of Oregon Administrative Rule 340-039-0017(3). The intent of this report is to document activities conducted in 2025 and to date in 2026 towards obtaining the credits required to offset the thermal impact of the WWSS withdrawal, as documented in the WWSS Thermal Trading Plan, which was approved by the Oregon Department of Environmental Quality in 2020. This annual report documents activities including maintenance of existing plantings, and monitoring.

We are also including a memorandum documenting an independent technical review of the credit calculations documented in the 2025 annual report. The WWSS is working on scheduling a site visit with an independent reviewer to Molalla River state park to demonstrate that this site has been implemented consistent with the standards included in the Thermal Trading Plan.

The WWSS will continue to provide updates on its trading program in annual reports.

Sincerely,



Christina Walter, Permitting and Outreach Manager, WWSP

Enclosed:

Geosyntec Consultants, Inc. 2026. Thermal Trading Annual Report for 2026.

Stantec, 2026. Verification of 2025 Thermal Trading Credit Calculation.

Memorandum

Date: March 30, 2026
To: Christina Walter and Jill Chomycia, Willamette Water Supply Program
From: Jacob Krall, Geosyntec Consultants, Inc.
Subject: Thermal Trading Annual Report for 2026

INTRODUCTION

The Willamette Water Supply System Commission (WWSS Commission) is an Oregon intergovernmental entity formed by Tualatin Valley Water District (TVWD), the City of Hillsboro, and the City of Beaverton. The WWSS Commission was formed to build the Willamette Water Supply System (WWSS) in response to planned growth in their service areas. The WWSS will provide an additional resilient water supply for Washington County. When complete, the WWSS will be one of Oregon's most seismically-resilient water systems—built to better withstand natural disasters, protect public health, and speed regional economic recovery through restoring critical services more quickly.

The Willamette River, one of Oregon's largest rivers, is the WWSS's new supply source. The raw water intake is located at the Willamette River Water Treatment Plant in Wilsonville. From there, raw water will be pumped to the WWSS Water Treatment Plant, a new state-of-the-art water filtration plant where multiple treatment processes will produce high quality drinking water. Drinking water will be pumped to reservoir facilities on Cooper Mountain, then will be gravity-fed to additional storage and customers in the TVWD, Hillsboro, and Beaverton service areas. The new system will be completed in 2026.

On October 23, 2020, the Oregon Department of Environmental Quality (DEQ) approved a Thermal Trading Plan (TTP) to fulfill the temperature offset requirement of the Clean Water Act (CWA), Section 401 Water Quality Certification (WQC) as it pertains to the WWSS. The approved TTP modeled the required thermal offset required at the full withdrawal capacity to be 30.2 million kilocalories per day (MMKcal/day). The maximum withdrawal will be reported in each annual report and compared to the credits achieved.

This annual report describes trading activities conducted since the last annual report, submitted in March 2025.

SUMMARY OF ACTIVITIES SINCE MARCH 2025

The following sections describe work performed in 2025 by Ash Creek Forest Management (Ash Creek) at Molalla River State Park.

Maintenance

Ash Creek Forest Management (Ash Creek) conducted the following maintenance activities in 2025: Additional detail can be found in the Ash Creek annual report (Ash Creek, 2026, reproduced as Appendix A).

- **January 2025:** Cutting invasives
- **February 2025:** Cutting invasives
- **June 2025:** Spraying invasives
- **August 2025:** Spraying invasives
- **October 2025:** Cutting invasives
- **November 2025:** Cutting and spraying invasives
- **December 2025:** Cutting and spraying invasives

Additionally, Ash Creek installed markers at the boundaries of the planting areas to prevent accidental mowing events such as the events which were described in the 2025 annual report (Geosyntec, 2025). Figure 1 shows an example of the markers, which are spaced 15-20 meters apart along the boundary of the planting zones.



Figure 1, Boundary marker showing edge of planting area to prevent accidental mowing. Provided by Ash Creek.

Planting

Ash Creek conducted the following plantings in 2025: Detailed quantities can be found in Appendix A. The zones are shown in Figure 2, reproduced from Ash Creek (2026). Bare-root plantings, cuttings, and Black Cottonwood Poles in the floodplain portion of Phase II Zone A, 5,450 total plants.

- Bare-root plantings and Black Cottonwood Poles in the upland portion of Phase II Zone A, 3,100 total plants.
- Bare-root plantings and Black Cottonwood Poles in Phase II Zone B, 3,000 total plants.
- Bare-root plantings, cuttings, and Black Cottonwood Poles in Phase II Zone C, 5,450 total plants.

Molalla 2025

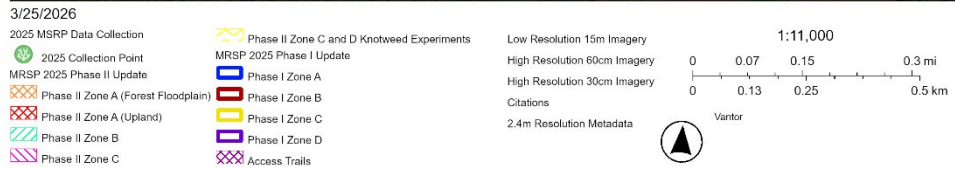
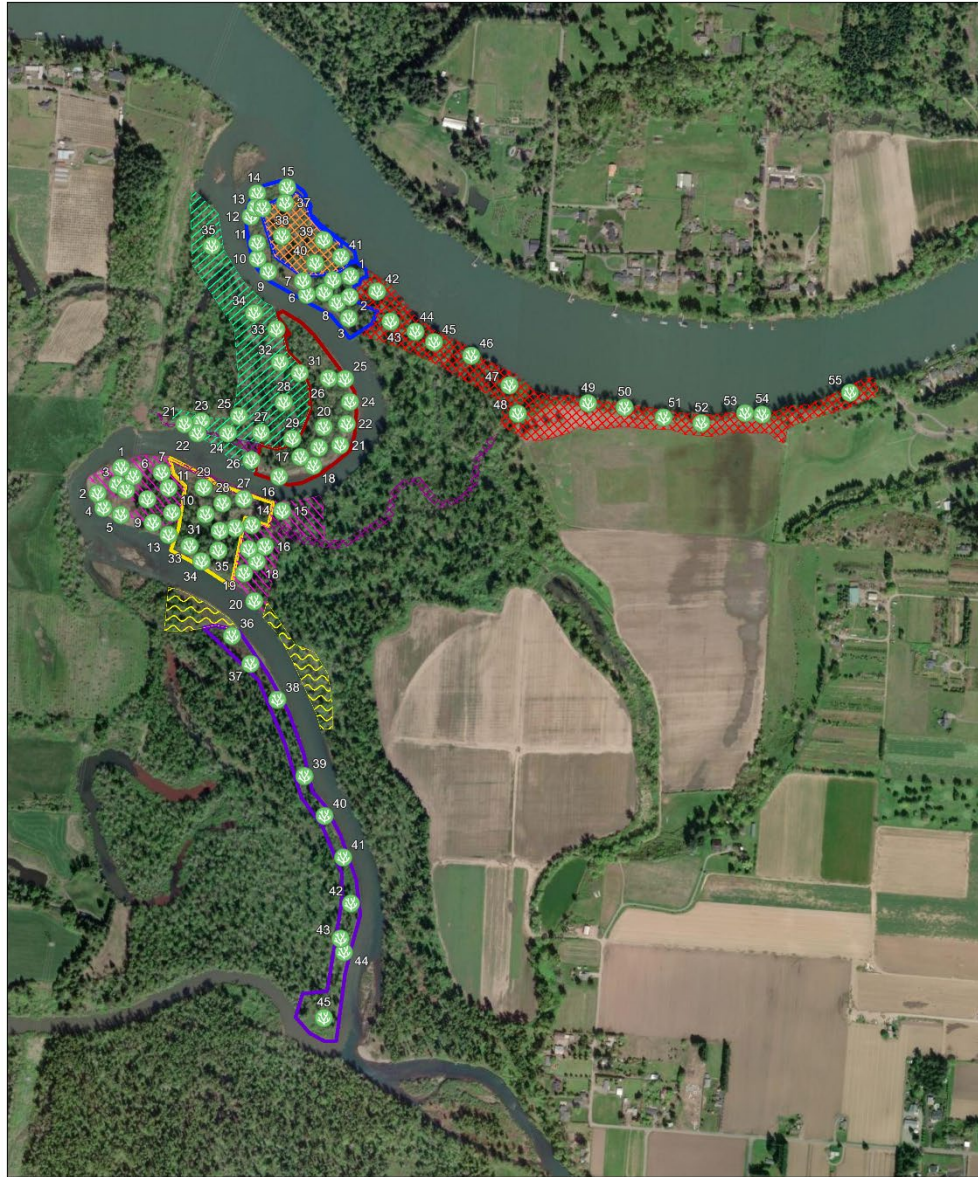


Figure 2. Planting and maintenance zones. Reproduced from Ash Creek (2026).

Monitoring

In 2025, Ash Creek conducted quantitative monitoring of site performance the areas indicated in Figure 3.

Ash Creek monitored a total of 100 locations, 45 in Phase 1 and 55 in Phase 2, and found the following primary takeaways:

- 81% survival of woody stem plantings (up from 75.6% in 2024; and meeting the monitoring goal of 70% survival)
- 59% average canopy cover (up from 55% in 2024) in Phase 1, and 61% canopy coverage in Phase 2 (up from 59%).
- 14% bare substrate in Phase 1 (down from 20% in 2024) and 24% bare substrate in Phase 2 (slightly up from 21% in 2024, but down from prior years).

The Ash Creek (2026) monitoring report also notes improved species richness in both Phase 1 and Phase 2 in 2025 relative to 2024.

Molalla 2025

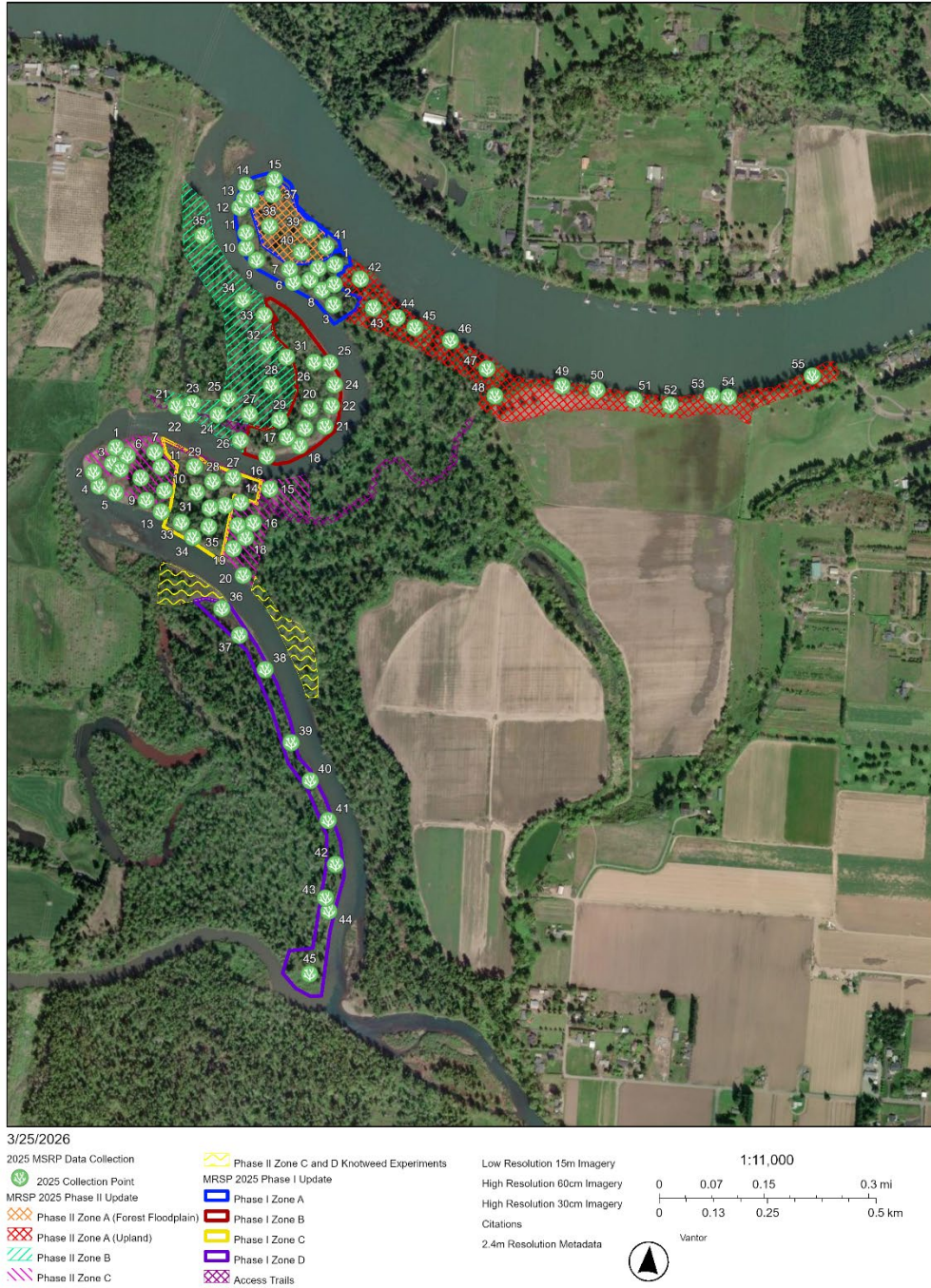


Figure 3. Monitoring locations evaluated by Ash Creek in 2025. Figure reproduced from Ash Creek (2026).

FUTURE WORK AT MOLALLA RIVER STATE PARK

Additional planting and maintenance activities will occur during 2026 at the Molalla River State Park site, including ongoing treatment to prevent regrowth of invasive Himalayan blackberry and knotweed. Specifically, the following planting activities are scheduled for early 2026: Detailed tables are provided in Appendix A.

- 950 plants in Phase 2, Zone A, upland area
- 1,900 plants in Phase 2, Zone A, floodplain area.
- 2,150 plants in Phase 2, Zone C

Activities during the remainder of 2026 and beginning of 2027 will be documented in the next annual report.

UPDATE ON SHADE CREDIT GENERATION

No additional areas were included in the Molalla Confluence Project in 2025. As noted in Ash Creek (2026), new experimental knotweed treatment is being conducted in limited areas in Zone C and D. However, because planting has not occurred in these new areas, an updated shade calculation is not provided in this annual report, and these areas are not included in thermal accounting currently.

Therefore, the total amount of shading credits generated in the Phase 1 and Phase 2 areas is unchanged from the 2025 annual report and is summarized in the table below.

Table 1. Summary of credits expected to be achieved based on plantings at Molalla River State Park.

Project/Phase	Thermal Credits Achieved (MMKcal/day)	Percentage of Credits Required at Full Capacity
Molalla Confluence Project, Molalla River area	12.20	40.4%
Molalla Confluence Project, Willamette River area, Projected	7.65	25.3%
Total	19.85	65.7%

REFERENCES

Ash Creek Forest Management LLC (Ash Creek), 2026. Molalla River State Park- Phase I/II Monitoring Report 2025.

Geosyntec Consultants, Inc. 2025. Thermal Trading Annual Report for 2025. March.

Willamette Water Supply System, 2020. Thermal Trading Plan. October 23.

Appendix A:

Ash Creek Forest Management (2026).

Molalla River State Park- Phase I/II Monitoring Report 2025.



Molalla River State Park - Phase I/II

Monitoring Report 2025

Introduction

The purpose of this report is to summarize restoration goals, actions, and progress on 46 acres of floodplain forest in Molalla River State Park. The goal of restoration is two-fold: removal and control of monoculture-forming, invasive knotweed, and reestablishment of reproductive, native tree and shrub canopy that will provide stream shading among other ecological benefits.

Background

Molalla River State Park is a 567-acre natural area located at the Pudding River and Molalla River confluence, stretching north to the Molalla River and Willamette River confluence. The site is a floodplain cottonwood forest that supports one of the largest Great Blue Heron rookeries in the Willamette Valley. The forest understory and canopy layer in the park were suppressed by a monoculture of Japanese knotweed (*Polygonum cuspidatum*) and Bohemian knotweed (*Polygonum × bohemicum*). To achieve restoration targets, Ash Creek has used a combination of yearly mash and spray treatments (from 2019-2025) to remove the highest density knotweed monocultures.

In 2022, treatments in Phase I Zone D were paused due to successful plant establishment, a reduction in invasive species cover, and limited site access caused by high water and dangerous currents for much of the year. As of August 2025, invasive species treatments in Phase I Zone D have been reinstated due to a significant increase in invasive cover.

Zone A has also been expanded in Phase II to include additional knotweed discovered in 2020. These newly identified acres were treated following discovery but were not included in the initial 2022 planting.

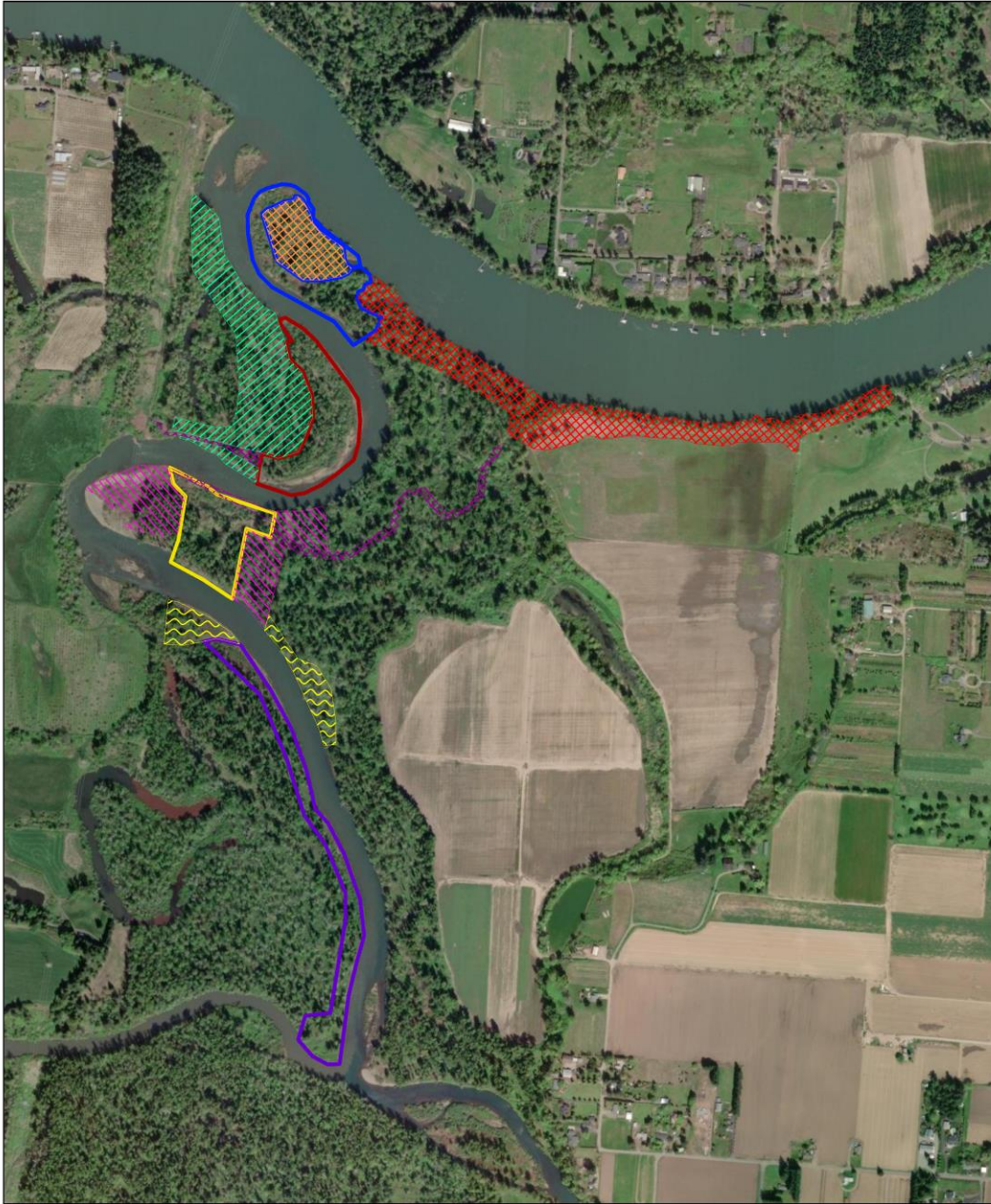
Additionally, two new areas have been incorporated into Phase II within Zones C and D, where Ash Creek is conducting research to compare knotweed treatment methods.

From the winter of 2021-22 to present day, Ash Creek has installed 95,800 bareroots, willow stakes, and cottonwood poles across the 3 zones. Site preparation throughout Phase II began in summer of 2023 including extensive cutting of Himalayan blackberry (*Rubus armeniacus*) and spraying regrowth.

Project Maps

Figure 1: Molalla Phases I and II Map

Molalla 2025



3/25/2026

MRSP 2025 Phase II Update

Phase II Zone A (Forest Floodplain)

Phase II Zone A (Upland)

Phase II Zone B

Phase II Zone C

Phase II Zone C and D Knotweed Experiments

MRSP 2025 Phase I Update

Phase I Zone A

Phase I Zone B

Phase I Zone C

Phase I Zone D

Access Trails

Low Resolution 15m Imagery

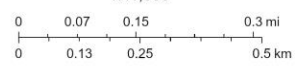
High Resolution 60cm Imagery

High Resolution 30cm Imagery

Citations

2.4m Resolution Metadata

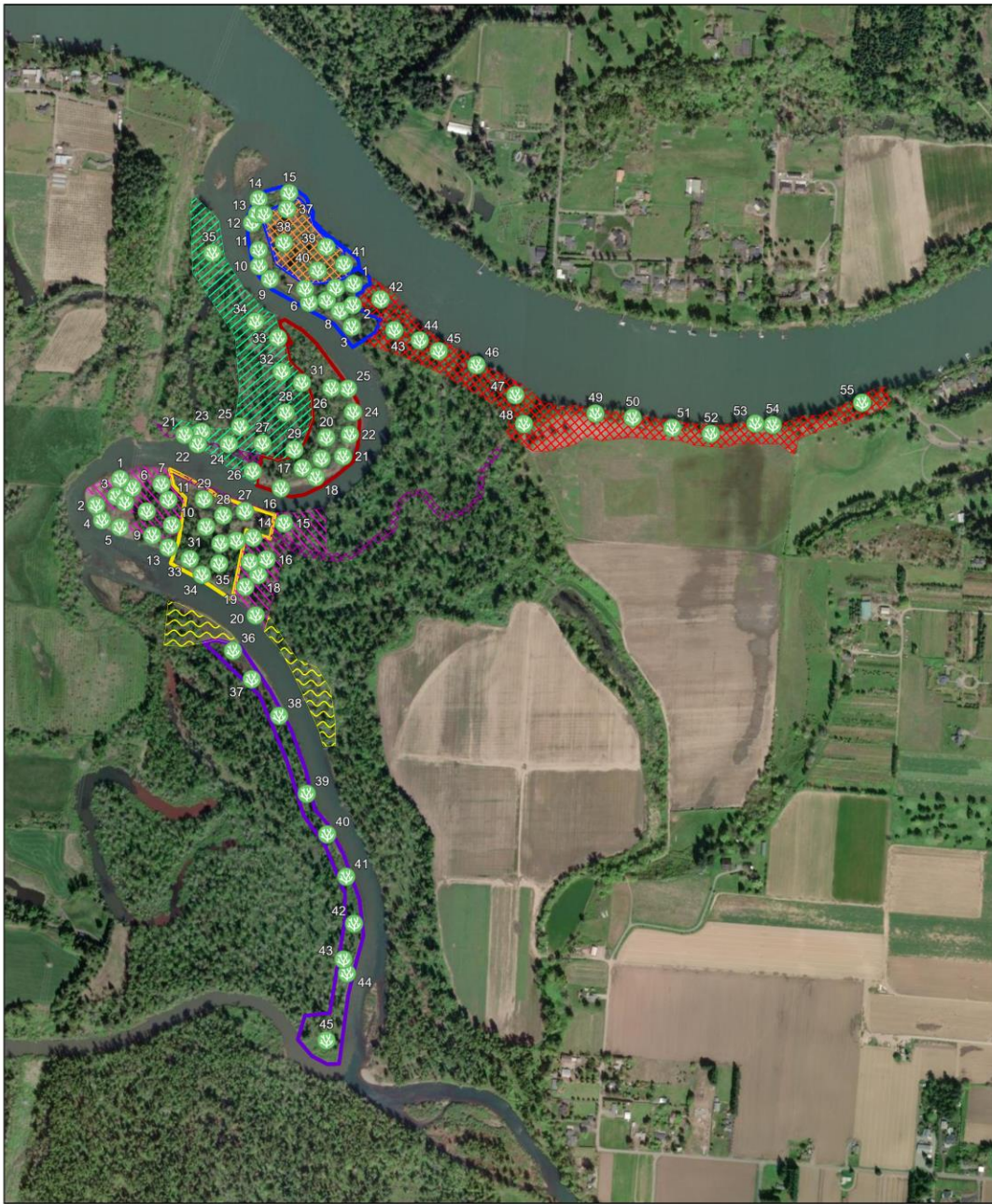
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Vantor

Figure 2: Monitoring Plots Map

Molalla 2025



3/25/2026

- 2025 MSRP Data Collection
- 2025 Collection Point
- MRSP 2025 Phase II Update
- Phase II Zone A (Forest Floodplain)
- Phase II Zone A (Upland)
- Phase II Zone B
- Phase II Zone C

- Phase II Zone C and D Knotweed Experiments
- MRSP 2025 Phase I Update
- Phase I Zone A
- Phase I Zone B
- Phase I Zone C
- Phase I Zone D
- Access Trails

- Low Resolution 15m Imagery
- High Resolution 60cm Imagery
- High Resolution 30cm Imagery
- Citations
- 2.4m Resolution Metadata

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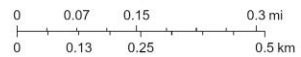


Table 1: 2024-2025 Planting List

Common Name	Scientific Name	Type	Phase II Zone A - Floodplain	Phase II Zone C Floodplain	Phase II Zone A - Upland	Phase II Zone B	Total
Grand Fir	<i>Abies grandis</i>	bare root				250	250
Red Alder	<i>Alnus rubra</i>	bare root	1000	1000	300	500	2800
Incense Cedar	<i>Calocedrus decurrens</i>	bare root			250		250
Pacific dogwood	<i>Cornus nuttallii</i>	bare root	100				100
Red Osier dogwood	<i>Cornus stolonifera</i>	bare root	750	750		250	1750
Oceanspray	<i>Holodiscus discolor</i>	bare root			1000	250	1250
Western Crabapple	<i>Malus fusca</i>	bare root				250	250
Osoberry	<i>Oemleria cerisiformis</i>	bare root			250	250	500
Pacific ninebark	<i>Physocarpus capitatus</i>	bare root	500	500	250	250	1500
Ponderosa Pine	<i>Pinus ponderosa</i>	bare root		250	250		500
Black Cottonwood	<i>Populus trichocarpa</i>	bare root	750	250		250	1250
Black Cottonwood	<i>Populus trichocarpa</i>	Poles	450	450	50		950
Douglas fir	<i>Psuedostuga menziesii</i>	bare root			250		250
Cascara	<i>Rhamnus purshiana</i>	bare root		250		250	500
Piper Willow	<i>Salix piperi</i>	bare root	250	500			750
Piper Willow	<i>Salix piperi</i>	cuttings	400	500			900
Sitka Willow	<i>Salix sitchensis</i>	bare root		250			250
Pacific Willow	<i>Salix lucida</i>	bare root		250			250
Douglas Spirea	<i>Spiraea douglasii</i>	bare root	250	250	250	250	1000
Spiraea or Snowberry		cuttings	500				500
Western Red Cedar	<i>Thuja plicata</i>	bare root	250				250
Viburnum	<i>Viburnum ellipticum</i>	bare root	250	250	250	250	1000
Total:			5450	5450	3100	3000	17000

Table 2: 2026 Planting

Common Name	Scientific Name	Type	Phase II Zone A - Floodplain	Phase II Zone C Floodplain	Phase II Zone A - Upland	Total
Red Osier Dogwood	<i>Cornus stolonifera</i>	bare root	200		50	250
Oceanspray	<i>Holodiscus discolor</i>	bare root			500	500
Black Twinberry	<i>Lonicera involucrata</i>	bare root	600	200	200	1000
Osoberry	<i>Oemlaria cerasiformis</i>	bare root	100	200	200	500
Pacific Willow	<i>Salix lasiandra</i>	bare root	1000			1000
Piper Willow	<i>Salix piperi</i>	bare root		1000		1000
Salmonberry	<i>Rubus spectabilis</i>	bare root		750		750
		Total:	1900	2150	950	5000

Table 3: 2025 Phase I Entries

Date	Services Performed
January 27, 2025	Harvest Poles
January 28, 2025	Harvest Poles
February 14, 2025	Surveying
June 2, 2025	Monitoring
June 3, 2025	Monitoring
June 4, 2025	Monitoring
August 4, 2025	Spray
August 5, 2025	Spray
August 6, 2025	Spray
August 7, 2025	Spray
August 11, 2025	Spray
August 13, 2025	Spray
August 14, 2025	Spray
August 15, 2025	Spray
August 18, 2025	Cutting
August 19, 2025	Cutting
August 20, 2025	Cutting
August 21, 2025	Cutting
August 25, 2025	Planting: Cuttings / Stakes
August 26, 2025	Planting: Cuttings / Stakes
August 27, 2025	Planting: Cuttings / Stakes
August 28, 2025	Planting: Hourly Planting
September 3, 2025	Harvest Cuttings
September 4, 2025	Harvest Cuttings
September 5, 2025	Mash & Spray
September 8, 2025	Spray
September 9, 2025	Cutting
September 10, 2025	Cutting
October 1, 2025	Monitoring
October 2, 2025	Monitoring
October 23, 2025	Plant Hauling / Delivery

Table 4: 2025 Phase II Entries

Date	Services Performed
January 8, 2025	Project Management
January 13, 2025	Harvest Cuttings
January 16, 2025	Project Management
January 22, 2025	Project Management
January 23, 2025	Project Management
January 24, 2025	Project Management
January 27, 2025	Harvest Poles
January 28, 2025	Harvest Cuttings
January 29, 2025	Planting: Cuttings / Stakes; Planting: Poles
January 30, 2025	Planting: Cuttings / Stakes; Planting: Poles
January 31, 2025	Cutting
February 6, 2025	Plant Hauling / Delivery
February 10, 2025	Cutting
February 12, 2025	Planting: Bare-root Planting
February 14, 2025	Project Management
February 17, 2025	Plant Hauling / Delivery
February 20, 2025	Cutting
February 21, 2025	Cutting
February 22, 2025	Cutting
March 3, 2025	Plant Hauling / Delivery
March 4, 2025	Planting: Bare-root Planting
March 5, 2025	Planting: Bare-root Planting
May 5, 2025	Project Management
June 2, 2025	Surveying
June 5, 2025	Spray; Planting: Seed Application
June 6, 2025	Spray
August 1, 2025	Project Management
August 4, 2025	Surveying; Monitoring
August 5, 2025	Surveying; Monitoring
August 6, 2025	Surveying
August 7, 2025	Surveying
August 8, 2025	Surveying; Monitoring

August 12, 2025	Monitoring
August 14, 2025	Surveying; Project Management
August 15, 2025	Labor
August 18, 2025	Surveying
August 20, 2025	Monitoring
August 21, 2025	Monitoring; Surveying
August 25, 2025	Spray; Labor
August 26, 2025	Spray
August 27, 2025	Spray; Labor
August 28, 2025	Spray
August 31, 2025	Spray; Labor
September 3, 2025	Harvest Cuttings; Plant Hauling / Delivery
September 4, 2025	Harvest Cuttings
September 8, 2025	Harvest Cuttings
September 10, 2025	Project Management
September 11, 2025	Project Management
September 12, 2025	Project Management
October 1, 2025	Cutting
October 2, 2025	Cutting
October 6, 2025	Project Management
November 5, 2025	Cutting
November 6, 2025	Cutting
November 7, 2025	Spray
November 19, 2025	Harvest Cuttings
November 20, 2025	Harvest Cuttings
November 21, 2025	Harvest Cuttings
November 25, 2025	Harvest Cuttings
November 26, 2025	Planting: Cuttings / Stakes
December 1, 2025	Spray
December 2, 2025	Spray
December 3, 2025	Spray
December 5, 2025	Cutting

Monitoring Methods

Monitoring is conducted in the summer of every year during peak growth. A total of 1% of the total project area is surveyed in accordance with Bureau of Land Management (BLM) monitoring guides. Parameters surveyed include plant survival, invasive species cover, and canopy cover. In the summer of 2023, surveyors established randomly placed monitoring plots throughout project areas, 35 in Phase I and 55 in Phase II, each 20' x 20' (see Map 2). For continuity across years of data collection and to be able to track change, we use the same established monitoring plots. Note, some stakes denoting plots are lost, particularly in open floodplain areas, and these plots were reestablished using ArcGIS and prior plot photos. During 2025's monitoring season, surveyors added an additional 10 plots to Phase I to cover the addition of Zone D. With this being the baseline data collection for Zone D and the first year of treatment since 2022, monitoring analysis for Zone D will be treated as separate from the rest of the park treatment areas.

Surveyors take photos of each plot facing the river and of the canopy from the center of the survey point. Shrubs and trees are documented by living stem counts. Functional groups including native and non-native trees/shrubs, forbs, and graminoids are documented by percentage cover. Additionally, we quantified percent cover of invasive species of concern including knotweed, reed canary grass, and Himalayan blackberry. Canopy photos are used to quantify percent canopy cover through digital analysis.

Monitoring Goals and Parameters

1. 70% native planting survival
 - 95,800 bareroots, cuttings, and poles have been installed across 77 acres
 - Expected stem count across planting acres is compared to monitoring stem count across monitoring plot acreage
 - Some natural recruitment will occur and count toward restoration success.
2. Less than 20% cover of invasive species
 - Measured by average percent cover across monitoring plots

Monitoring Results

Planting survival rate: 81%

Expected: 9,5800 installed plants over 77 acres: 1244 stems/acre

Monitored: 927 observed plants over 0.918 acres: 1010 stems/acre

Figure 3: Phase I Percent Cover by Functional Group

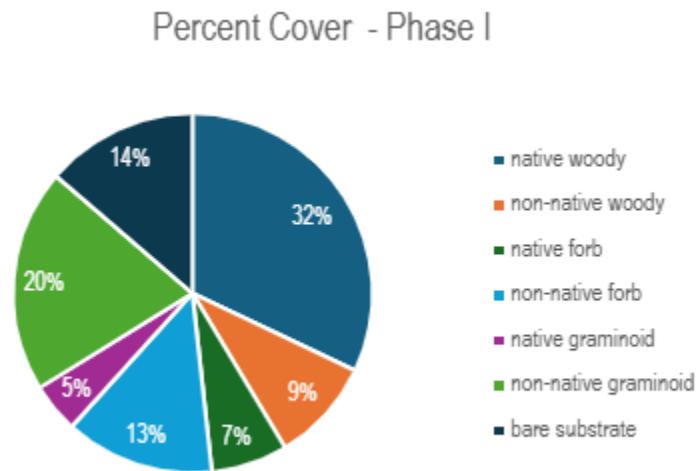
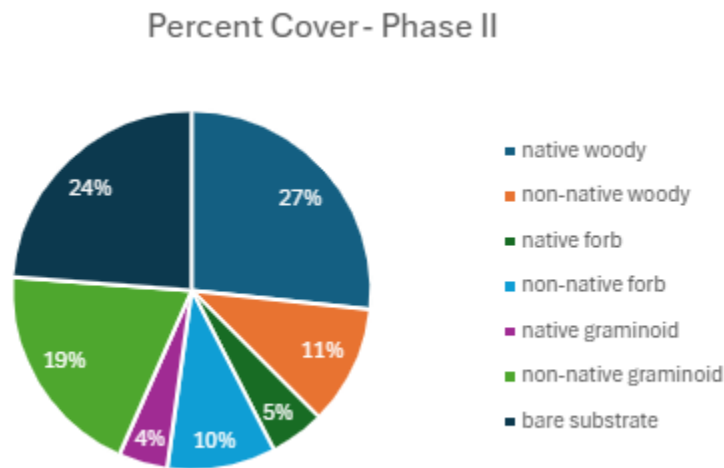
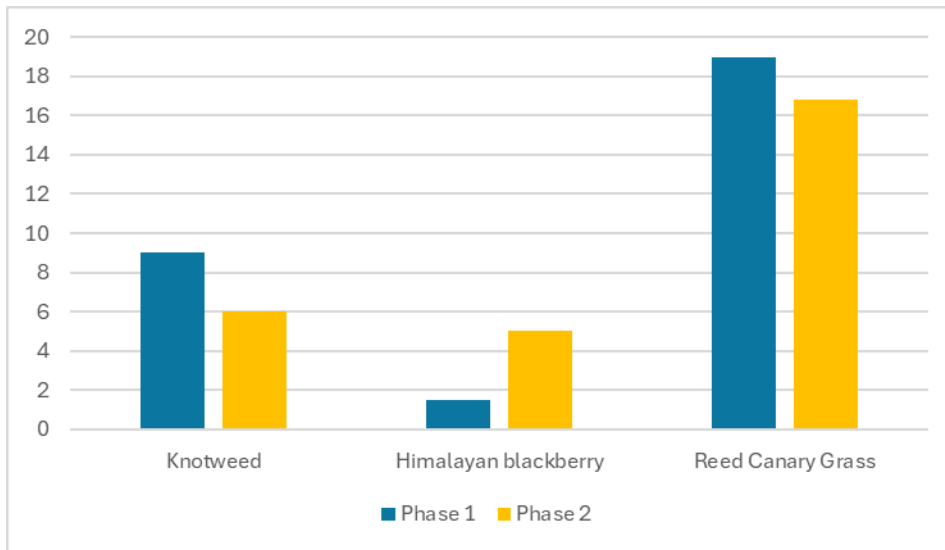


Figure 4: Phase II Percent Cover by Functional Group



Trees and shrubs continue to be the best represented functional group by native species. Non-native graminoids display the most dominant functional group for non-native species. This is largely attributed to scattered but dense areas of reed canary grass. Bare substrate represents 14 and 24 percent cover of phase 1 and phase 2, respectively, both due to removal of Himalayan blackberry monocultures over the past 3 years of treatment and dense thickets of willows and other native shrubs shading out herbaceous cover.

Figure 5: Percent Cover Invasives of Concern Phase I & II



Himalayan blackberry (*Rubus armeniacus*) has shown a dramatic reduction in percent cover from its dense monocultures present prior to treatment began. Knotweed remains a sporadic but persistent presence across both phases. Of the Class B noxious weeds present in the park, reed canary grass (*Phalaris arundinacea*) has the highest percent cover.

Table 2: Percent Canopy Cover Averages by Year

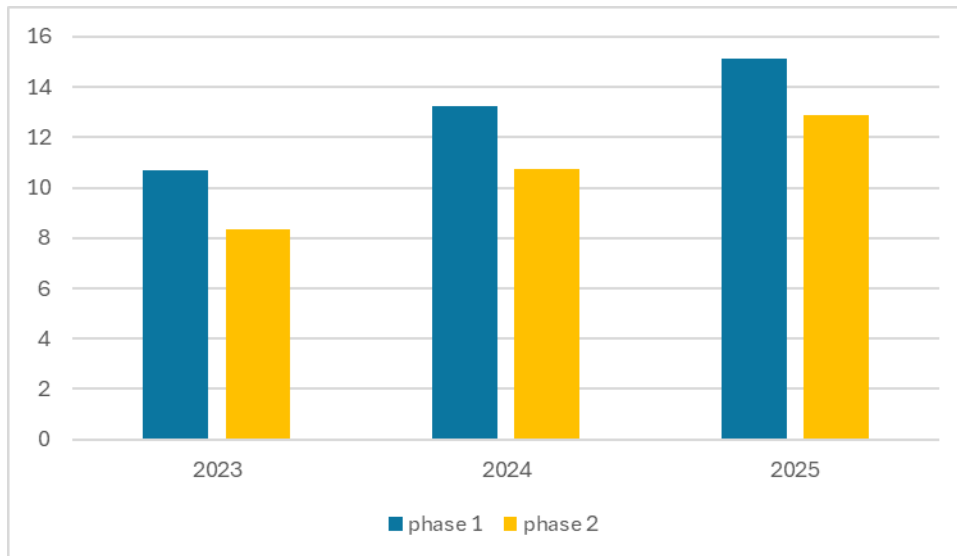
	2023	2024	2025
Phase 1	48%	55%	59%
Phase 2	47%	59%	61%

Canopy cover has shown a slow but consistent increase in percent cover throughout treatment time. While much of the park retains cottonwood and willow canopy, natural recruitment has been thwarted by invasive monocultures for many years. As a result, there is a missing generation in the age of canopy trees. Short lived cottonwoods dying off will produce canopy gaps that planting trees of varying life histories will aim to replace.

Table 3: Average Percent Cover by Functional Group per Year

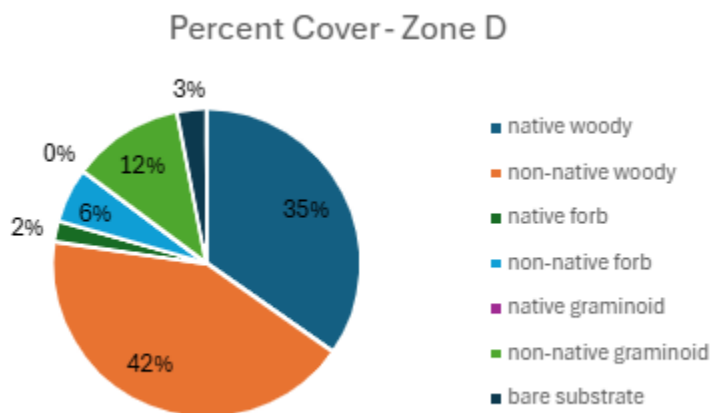
Functional Group	2023	2024	2025
native woody	15	23	29
non-native woody	9	14	10
native herbaceous	7	9	10
non-native herbaceous	48	32	31
bare substrate	21	21	20

Figure 6: Average Species Richness by Phase and Year



Species alpha-diversity across both phases of treatment has seen a steady increase through all years of treatment. This can be attributed to both planting efforts as well as natural recruitment from a seed bank that has been suppressed by invasive monocultures for many years but is now free to grow.

Figure 7: Percent Cover by Functional Group in Zone D



Himalayan blackberry and knotweed dominate Zone D, representing close to half of the percent cover at 23% and 20% respectively. Note that monitoring found 0% cover of native graminoids. Zone D also has the lowest percent canopy cover of any area at 38%. While zone D is almost entirely following the riparian edge and will naturally have fewer trees, this can also be

attributed to the dense monocultures of noxious weeds inhibiting natural canopy recruitment. Lastly, zone D has the lowest species richness of all areas with an average count of 7, another reflection of the necessity for management of Himalayan blackberry, knotweed, and reed canary grass present.

Conclusions

Relative to 2023 baseline monitoring and 2024 data collection, project metrics demonstrate measurable improvement across both phases in habitat diversity and ecological function. Functional group cover trends over three consecutive years indicate a consistent increase in native species alongside a corresponding decrease in non-native cover. While non-native graminoids remain the most abundant invasive functional group, reed canary grass continues to be the primary driver of non-native dominance. Despite this, overall species diversity across both phases has increased by 47 percent since baseline monitoring, reflecting positive responses to sustained invasive species management and restoration efforts.

Conditions in Phase I Zone D remain substantially degraded relative to other treatment areas due to the absence of invasive species management for many years prior to this project. Zone D currently supports approximately three times the percent cover of knotweed and five times the percent cover of Himalayan blackberry compared to other surveyed zones. Canopy cover in Zone D is also notably lower, averaging 38 percent, compared to 59 percent in Phase I and 61 percent in Phase II overall. Reduced canopy cover likely contributes to the persistence and competitiveness of reed canary grass and other invasive species by maintaining high light availability across the floodplain.

Active treatment in Phase I Zone D began in August 2025 and included mechanical and chemical invasive species management, as well as the installation of live stakes to accelerate canopy development. While these initial actions represent an important first step toward recovery, the scale of infestation, combined with persistent seed banks and vegetative reproduction, indicates that continued, multi-year management will be required to achieve restoration targets. Ongoing invasive species control, coupled with follow-up planting, native seeding, and strategic underplanting to increase canopy cover, will be critical to suppress invasive regrowth, promote native recruitment, and improve long-term habitat resilience.

Collectively, monitoring results demonstrate that sustained, targeted management can measurably improve habitat condition over time, while also highlighting the importance of early intervention and long-term commitment in heavily degraded areas such as Zone D. Continued investment in adaptive management will be necessary to build on current gains and ensure durable restoration outcomes across Molalla River State Park.

Future Recommendations

Despite documented reductions from mechanical and chemical control efforts, invasive monocultures at the scale present in Molalla River State Park will require multiple years of repeated treatment to achieve sustained native habitat recovery. Continued intervention is necessary to overcome persistent seed banks, extensive vegetative reproduction, and competitive exclusion of native species.

Himalayan Blackberry (*Rubus armeniacus*)

Himalayan blackberry maintains a substantial and long-lived seed bank and can rapidly reestablish following disturbance if not actively managed. Without continued treatment, blackberry would significantly impede native recruitment. The most effective treatment approach is winter cutting followed by herbicide application in the spring as new growth emerges. Targeting low-growing resprouts reduces overall herbicide use, limits applications during peak flowering periods when pollinators are most active, and improves visibility for identifying and avoiding nesting birds.

Knotweed (*Reynoutria* subspecies)

Knotweed's extensive rhizomatous growth enables rapid spread and recovery following disturbance, presenting a major barrier to native plant establishment. Its growth cycle is well suited to annual mow and spray treatments, which can effectively suppress biomass and deplete rhizome reserves over time. This approach reduces the likelihood of spreading knotweed by fragments created during traditional cutting treatments. Continued annual treatment will be required to prevent reinvasion and allow native vegetation to establish. Ultimately, removing knotweed upstream of Molalla River State Park will be necessary to fully prevent reinvasion of this incredibly virulent species.

Reed Canary Grass (*Phalaris arundinacea*)

Although classified as a lower-concern species by the Oregon Department of Agriculture, reed canary grass is highly competitive and capable of excluding native herbaceous vegetation, as well as inhibiting the establishment of planted and volunteer shrubs and trees. In Zone D, many live stakes are currently growing through and above the reed canary grass; however, continued management will be necessary to establish a diverse graminoid and forb layer and to meet project targets of less than 20 percent invasive species cover. Reed canary grass typically requires one to two treatments in the spring and an additional treatment in the fall. While increasing canopy cover across the floodplain is expected to reduce reed canary grass density over time, active management will be required until planted vegetation is fully established.

Timing, Wildlife Considerations, and Adaptive Management

To minimize impacts to nesting birds, cutting activities should be prioritized during

winter and shoulder seasons. Reed canary grass and Himalayan blackberry exhibit near year-round growth and can recover quickly from prior treatments; if treated only once annually, both species may exceed manageable thresholds.

Follow-Up Planting and Canopy Resilience

Invasive species removal should be continue to be followed by supplemental planting and native seeding to occupy available growing space and reduce the likelihood of reinvasion. In anticipation of Emerald Ash Borer impacts, we recommend underplanting with a diversity of native canopy species as soon as possible in areas where Oregon ash (*Fraxinus latifolia*) currently dominates, to support long-term canopy resilience.

Monitoring Plot Photos



Phase I Plot 30 (2023 left, 2025 right): reduction of reed canary grass, healthy elderberry midstory canopy



Phase II Plot 6 (2023 left, 2025 right): reduction of the size of zone C's knotweed monoculture



Phase II Plot 39 (2023 left, 2024 right, 2025 below): treatment of Himalayan blackberry brambles with regrowth in 2024 and herbaceous growth in 2025



Phase 2 plot 25: one of the largest persisting patches of reed canary grass



Phase 2 plot 6 (2023 left, 2025 right): reduction of Himalayan blackberry and Japanese knotweed on the river edge



Phase 1 plot 42: Large brambles of Himalayan blackberry in Zone D

Supplemental Figures

Supplemental Table 1: 2025 Botanical Monitoring Raw Data

Point	knotweed	HBB	RCG	native woody	non-native woody	native forb	non-native forb	native graminoid	non-native graminoid	bare substrate	species count	canopy
1_1	5	0	9	60	5	5	15	1.5	8.5	5	16	88
1_2	7.5	2	1.5	46	9	5	15	0	24.5	0.5	12	67
1_3	1	1.1	7.7	37.8	2.4	11.9	12.6	4	20.9	10.7	20	66
1_4	1	2	3	36	2.5	2	5	0	4	50	16	85
1_5	0	2	0	47.5	2	3	7.5	0	2.5	35	14	89
1_6	2	2	14.5	1.5	4.5	3	31	0	35	25	21	66
1_7	80	0	0	1.5	80	0.5	5	0	3	10	13	86
1_8	0	4.5	50	10	5	2	7	1	55	20	25	82
1_9	1	1	1	10	2.5	27.5	25.5	0	18.5	16	16	29
1_10	0	0	5	78	0	1.5	6.5	0	10	4	16	23
1_11	20	20	1	30	37.5	2	19	0	4	7.5	18	93
1_12	5.3	0	15	48	5.5	1.6	22.4	0	20.3	2.6	10	69
1_13	88.3	0	2.3	7.3	88.3	0	4.7	0	2.3	0	6	98
1_14	0	0	0	59	0	14	18.3	0	6	2	11	62
1_15	0	0	1	95.7	0	1	2.7	0.7	1.3	0	8	35
1_16	0	0	0	57.5	0	4	1	15	0	22.5	13	0
1_17	4.5	4	35	15.5	7.5	14	6	0	57.5	1	21	70
1_18	0	0	0	0	0	2	11	5	12.5	70.5	15	0
1_19	2.5	1.5	51	20	4	5	15	0	50	8	19	70
1_20	1	0	50	22.5	1	8	14.5	2	50	4	13	76
1_21	0	0	5	10	0	2	3	2	3	82.5	19	0
1_22	2	0	15	13.4	0	16.8	38.4	12.1	14.4	4.8	9	1
1_23	15	5	40	10	0	19.5	25	5	40	0.5	14-	
1_24	4	0	32.5	31	1.5	0	20	12.5	35	0	8	14
1_25	3	0	10	30	0	7.5	42.5	5	15	0	14	15
1_26	6.5	0	32.5	24	0	10	10	5	32.5	17.5	13	76
1_27	5.7	0	91.7	40	5.7	1.3	6	0	50	0	15	92
1_28	8.7	0	91.3	7	5	0	3	85	0	0	8	16
1_29	3	1	2	85	5	2	3	1	2	4	16	90
1_30	1	0	4.3	86.9	1	1.3	2.2	1	4.8	2.8	18	85
1_31	15	3.5	76	16.5	16.5	0	1	0	67.5	0	8	66
1_32	2.5	0	7	47.5	2.5	3	25	0	12.5	9.5	16	94

1_33	6	0.5	3	4.5	6.5	9	27.5	0	35	17.5	31	75
1_34	9.5	2.5	1.5	0	12.5	56	9.5	0	3.5	18.5	24	28
1_35	15	1	4	37.5	16	0	13	0	4	30.5	13	96
1_36	82.5	0	0	17.5	82.5	0	0	0	0	0	5	0
1_37	46	4	37.5	15	45	0	5	0	35	0	8	0
1_38	60	40	0	0	100	0	0	0	0	0	2	31
1_39	0	50	0	25	50	0	19	0	6	0	6	0
1_40	4.5	0	7.5	63.6	4.5	21	4	0	6.8	0	10.9	0
1_41	9	0	45	43.5	9	0	0	0	45	0	7	73
1_42	0	75	1	20	75	2	2	0	1	0	6	65
1_43	0	0	9	87	0	0	0	0	9	3.5	5	50
1_44	0	0	7.5	72	0	1	19	0	8	0	10	94
1_45	0	85	14.5	0	85	0	1	0	14	0	3	10
2_1	4.5	1	1.5	0	5.5	35	4	0	10	45.5	17	0
2_2	0	0	0	0	0	4	0	0	1	95	5	0
2_3	9	0	0	3.5	9	5	25	2.5	4	51	8	2
2_4	0	0	0	0	0	1	4	0	2	93	9	0
2_5	0	0	0	0	5	7.5	2.5	0	45	40	14	0
2_6	1.5	0	1	0	1.5	5.5	8	0	35	50	23	0
2_7	94	1	0	3.5	95	0	1.5	0	0	0	6	0
2_8	2.5	0	0	5	2.5	0	2	0.5	0.5	89.5	8	90
2_9	72.5	2.5	0	5	75	0	1	0	1	18	13	82
2_10	5	1	4.5	15	5.5	1	23.5	10	4.5	40.5	15	68
2_11	12.5	0	9	17	12.5	1	34.5	0	10	25	24	84
2_12	5	0	0	0	5	1	22	2	0	70	11	0
2_13	28.5	31	40	20	31.5	3	7	0	35	3.5	22	80
2_14	3.3	1	8.7	72	4.5	2.5	7.3	0	9.3	4.4	14	76
2_15	0	30	0	5	28.3	19.3	12.7	0	0	36.7	12	86
2_16	7	2.3	2.3	2	8	7.5	22	0	2.2	58	11	59
2_17	2.5	1.5	5	45.5	5.5	5.5	13.5	0	6.5	25	22	83
2_18	2	1	1	41	4	2	19	3	1	30	7	95
2_19	3	1	2	27.5	4	8	20	0	15.5	25	16	88
2_20	4.5	4	0	35.5	8.5	4	1	0	0	51	11	79
2_21	0	0	37.5	42.5	0	4	5	0	42.5	6	22	72
2_22	0	0	60	45	0	0	0	0	55	0	6	65
2_23	0	0	82.5	2.5	0	2.5	3.5	0	84	7.5	18	52
2_24	0	1.5	75	14.5	1.5	4	5	0	75	2.5	17	62

2_25	0	0	96	4	0	0	0	0	96	0	2	58
2_26	11	3	7	20	14	5.5	9.5	41	9	0	13	24
2_27	0	3	2	60	4	5	5.5	8.5	2	15	12	74
2_28	35	40	12.5	4.5	70	1	6.5	2	15	1	18	66
2_29	0	7.5	1	3.25	7.5	3.25	17.25	60.5	0	8.25	16	77
2_30	0	0	16.8	11	0	0	42.5	26	16.8	3.1	10-	
2_31	1	11.5	78	4.5	12.5	1.5	2.5	0	78	1	10	64
2_32	0	15	77.5	6	15	0	1.5	0	77.5	0	8	23
2_33	0	0	65	30	0	0	4	0	65	1	6	65
2_34	0	0	85	10.5	0	2	0	0	85	2.5	6	49
2_35	0	1	0	49.5	1	3	0	30.5	0	16	10	78
2_36	2	3.3	6.7	78	5.6	2.8	6.8	0	6.8	0	17	67
2_37	8	6	48.3	30.6	12.3	2	9.7	0	43.5	2	16	32
2_38	1	4	0	11.5	4	1.5	1	1.5	0.5	80	13	75
2_39	0	3	1	27.5	5	12.5	5	10	20	20	19	86
2_40	8	3	57.5	22.5	11	3	5	0	57.5	1	19	26
2_41	0	0	25	10	0	4	53.5	0	25	7.5	6	73
2_42	5	82.5	4	5	79.5	0	1	10	4.5	0	5	15
2_43	1.6	1	10	7.7	2.7	2.7	70.3	1	11.3	6.3	17	88
2_44	0	0	0	38.5	0.5	1	0	0	0	60	10	94
2_45	0	1	0	59	1	7.5	0	7.5	0	25	10	87
2_46	0	0	1	66	0	4	2	9.5	1	22.5	7	91
2_47	0	0	0	50	0	0	0	0	0	50	3	93
2_48	0	0	0	50	0	5	0	10	0	35	10	92
2_49	0	1	0	90	1	4.5	1	2	0	1.5	18	63
2_50	0	3	0	60.5	3	23.3	12	1	0	3	16	79
2_51	0	2.5	1	30	10	10	12.5	5	10	20	23	59
2_52	0	0	0	70	0	5.5	5.5	0	5	14	10	89
2_53	0	2.3	0	73	2.3	20	0.3	0	1.3	3.1	12	92
2_54	0	3	0	54	4.1	6.7	10.9	0	8.3	16	20	92
2_55	0	0	0	33.3	15	13.3	8.3	0	0	31.7	15	81

To: Christina Walter, WWSP Permitting & Outreach
Manager

Date: 13 March 2026

Project: Willamette Water Supply Program

REFERENCE: VERIFICATION OF 2025 THERMAL TRADING CREDIT CALCULATION

INTRODUCTION

The purpose of this memorandum is to independently verify the shade modeling outputs and associated thermal trading credit calculations reported in the 2025 Willamette Water Supply System Thermal Trading Annual Report. Stantec confirms that the reported total credit of 19.85 MMkcal/day is technically accurate and reproducible using DEQ-approved tools.

Geosyntec conducted the original model execution and credit calculations on behalf of the Willamette Water Supply Program and documented the results in the 2025 Willamette Water Supply System Thermal Trading Annual Report. Stantec then performed a third-party verification of Geosyntec's work on shade-modeling along the Willamette and Molalla rivers. Geosyntec provided data from the outputs of tools they used for modeling, as well as an overview of the model workflow. There are two primary tools used in the model which are created, maintained, and provided by Oregon Department of Environmental Quality (DEQ): The "TTools" and "Heat Source" models. See the *Tools and Software Used* section for specific software version information. Geosyntec also provided credit-calculation spreadsheets that include conversion and comparisons of model outputs (e.g. baseline vs future solar shading) for shading along both the Molalla and Willamette rivers.

Using the same DEQ software, Stantec was able to successfully replicate and verify the model outputs provided by Geosyntec and replicate the conversion from model outputs to shade credit calculation.

TOOLS AND SOFTWARE USED

Software used to perform the shade modeling and review included OR-DEQ's TTools and Heat Source; Esri's ArcGIS software (ArcMap and ArcPro); Microsoft Excel; and custom python scripts.

TTools Version: *tmdlTToolsV91.zip* (C:\Users\keggering\Downloads\tmdlTToolsV91.zip)

Heat Source Version: *9.0.0b14 (heatsource9-9.0.0b14.win32-py2.7.exe)*

ArcMap relies on Python 2.7, reflecting its legacy design, while ArcGIS Pro uses Python 3.x, which is standard for modern GIS workflows and supports the latest scripting capabilities.

For more information see the following links:

<https://www.oregon.gov/deq/wq/tmdls/Pages/TMDLs-Tools.aspx>

<https://github.com/OR-Dept-Environmental-Quality/TTools>

VERIFIERS

The individuals providing independent verification and authoring this memorandum include:

- **Kenneth Eggering, GISP:** Kenneth conducted the replication and verification of the modeling process. He is qualified to independently review the Shade-a-lator modeling because he has practical experience with Python programming, GIS data processing, and spatial modeling workflows. His work routinely involves building and reviewing automated data pipelines, and validating geospatial model inputs for environmental and infrastructure projects. This background provides the necessary technical competence to determine whether the model inputs, processing steps, and assumptions were applied correctly.
- **Jill Chomycia, PH:** Jill reviewed the shade credit calculation. She is qualified to do so based on her formal training in geology, hydrology, and soil sciences and her professional experience supporting large water-resource and environmental programs. Her work frequently requires evaluating technical assumptions related to environmental conditions, regulatory requirements, and analytical methods.

Reference: Verification of 2025 Thermal Trading Credit Calculation

This experience enables her to assess whether the shade credit calculations are technically accurate, appropriately applied, and consistent with relevant scientific and regulatory expectations.

REPLICATION AND VERIFICATION PROCESS

Stantec reviewed and successfully replicated the modeling originally conducted by Geosyntec. Replication refers to independently running the same models using the same inputs and software versions and calculating credit generation using the output, and verification refers to confirming that the model outputs and calculations match those reported by Geosyntec.

HEAT SOURCE MODELING

The first step in Geosyntec's model process involved running TTools, which is:

“a collection of python scripts used to assemble stream channel and land cover geospatial data for input into the Heat Source model... The most recent versions of the tools are written in Python and require some basic knowledge of the python computer language to use. Oregon DEQ does not provide support for use of these scripts. Appropriate use and application are the sole responsibility of the user.”

Stantec successfully ran the same TTools python scripts using ArcGIS Pro's Python 3.x environment and produced an output Geodatabase that matched the one provided by Geosyntec.

The next step in Geosyntec's model process involved running the Heat Source software. Geosyntec used, and provided, an older version of the Heat Source tool, which was built in Python 2. Stantec installed and executed the same version of Heat Source in ArcMap's Python 2.7 environment.

Heat Source outputs data in CSV format. The CSV files created by Stantec were identical to those provided by Geosyntec. This was verified with a Python script authored by Stantec.

SHADE CREDIT CALCULATION

Stantec independently reviewed the calculation of shade credits using the Heat Source outputs. Geosyntec provided credit-calculation spreadsheets that include conversion and comparisons of model outputs (e.g. baseline vs future solar shading) for shading along both the Molalla and Willamette rivers. Both spreadsheets followed the same calculation steps, as summarized below.

The solar power (in watts (W)) incident on the river under baseline and future conditions is converted from the solar flux (in watts per square meter (W/m^2)) by multiplying solar flux by the width of the wetted channel (in meters (m)) (both outputs from Heat Source). This calculation is performed for each river step, in 5-m steps. The equation is shown below:

$$\text{Solar Power (W)} = \text{Daily Solar Flux} \left(\frac{W}{m^2} \right) * \text{length (m)} * \text{width (m)}$$

The difference in solar power (future condition minus the baseline condition) is calculated for each river step. Stantec converted the difference to solar load (kcal/day) and divided by 2 to reflect the 2:1 trading ratio defined in the TTP.

CONCLUSION

Stantec was able to replicate the modeling results and subsequent calculations produced by Geosyntec and reported in the 2025 Annual Report, specifically, 12.20 MMkcal/day in the Molalla River area and 7.65 MMkcal/day in the Willamette River area (for a total of 19.85 MMkcal/day). This memorandum serves as independent technical verification of the credit calculation reported in the Willamette Water Supply System Thermal Trading Annual Report for 2025 (Geosyntec).