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# Stossel Creek Case Study: Adaptive Restoration in the Puget Sound Lowlands

## Quick Facts

**Location:**
Near Duvall, Washington (King County)

**Property Size:**
154 acres

**Forest Type:**
Early-seral mixed forest

**Soil Type:**
Mosaic of glacial outwash and volcanic soils

**Stand Age:**
Regenerating forest, logged in 2012

## Project Objectives

The long-term goal is to establish a mature, resilient forest that continues to provide critical ecosystem functions (late-successional wildlife habitat, riparian functions, and water cycle regulation) well into the next century.

## Property Background

The Stossel Creek site consists of 154 acres located in the Tolt watershed east of Seattle. Stossel Creek, which runs through the property, provides habitat for steelhead and salmon. The upland areas of the site provide forest and wetland habitat for many wildlife species.

Historically, the site supported mixed conifer-hardwood forest and riparian habitats. The site was logged by a private landowner in 2012, and is now dominated by even-aged, early-seral forest and peppered with invasive species. Restoration efforts began in 2020.

## Project Description

Restoration of the Stossel Creek site is intended to increase its resilience to a changing climate both by increasing species diversity and running a decade-long adaptive planting trial using seedlings sourced from warmer and drier climates. Natural regeneration is happening on all 154 acres, with active restoration on 51 of those acres. Adaptive management planting trials will be used to assess the viability of various species planted across the site. Climate-adapted seedlings sourced from other regions are being interplanted with locally-sourced seedlings and trees that have naturally regenerated on the site.

## Planting Process

The site was divided into 19 units based on geography and vegetation type. A planting plan was drawn up based on soil, topography, and existing species within each unit.

The reforestation plan sought to increase biodiversity and structural diversity by establishing a mix of forest habitats including forests of long-lived conifer species, mixed conifer-deciduous forests, and deciduous forests on different areas of the site.

The location of invasive species were mapped, and before planting began the most aggressive invasives were addressed through manual, mechanical, and chemical removal.

**Example of Planting Trial Layout**

| *Tree Species* | *Species Local/Outside Range (ex. CA Doug-fir, incense cedar)* | *Quantity* | *Size Option/Container* | *Seedling Costs* | *Shipping Costs* |
|---|---|---|---|---|---|
| Douglas Fir | CA seed zone 092 | 750 (800 ordered) | Plug +1 | $800 | $80 |
| Douglas Fir | OR seed zone 051 (Tillamook, OR) | 1000 | Plug +1 | $524 | pick up |
| Western Redcedar | OR seed zone 251 (Willamina, OR) | 960 (1100 ordered) | Plug +1 | $524 | pick up |
| Western White Pine | Whidbey Island Orchard | 3200 | Plug +1 (600) and Styro 8's (2500) | $963 | pick up |
| Garry Oak | Puget Lowlands | 1500 | 18"-36" bareroot | $1,350 | $165 |
| Western Redcedar | WA seed zone 412 | 1125 | 12" plus | $709 | $400 - $500 |
| Douglas Fir | WA seed zone 412 | 825 | 6-12" | $355 | N/A |
| Grand Fir | WA seed zone 221 | 2225 | 12" plus | $824 | N/A |
| Shore Pine | WA seed zone 221 | 1450 | 12" plus | $537 | N/A |
| Incense Cedar | OR seed zone 270 (2000' elevation) | 1100 | 3" band pots w/ 1/4" caliper (9" plus height) | $1,705 | $300 |
| Totals | | 15,060 | | $8,291 | |

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There has been more natural regeneration from hardwood species than native conifers. To increase structural and seral stage complexity, the project retained naturally regenerating deciduous species and planted additional conifer species to establish a mix of conifer and deciduous forest types.

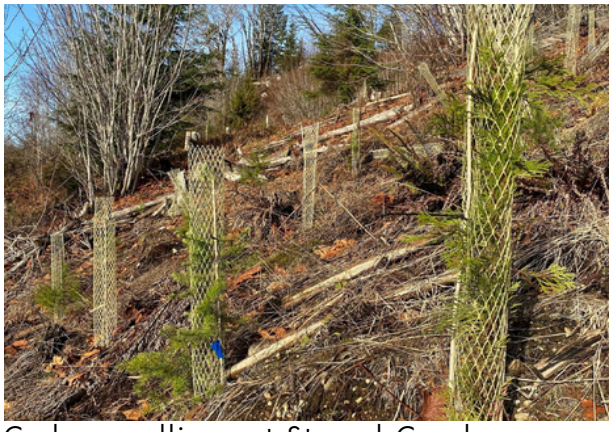
Three native conifer species were planted: Douglas-fir, western redcedar, and western white pine. For Douglas-fir and western redcedar, a combination of seedlings from the local seed zone and 1-2 other seed zones were planted. For the other seed zones, the project used the Seedlot Selection Tool to identify areas with a climate that matches the projected climate for Stossel Creek in the mid to late century. The best climate analogs for the projected future climate of the Stossel Creek area are southern Oregon and the Northern California coast. Seed sources for Douglas-fir and western redcedar were identified in these areas.

The project also aimed to increase tree species diversity: it includes planting trials of coniferous and deciduous species not currently present at the site and sourced from warmer, drier climates. Shore pine, grand fir, incense cedar, and Oregon white oak were interplanted with the local species. The project includes range expansion of one species, incense cedar, which is typically found in the southern Oregon coast range. Some adjustments to the original plan had to be made based on seed stock availability.

## Trees Ordered from Nurseries

Sourcing seedlings was a logistical hurdle, as there was no one-stop-shop for all sources and species. The project worked with five nurseries, which made logistics and timing more complicated, as availability, timing, and size of material on delivery varied by nursery.

Seedlings planted at Stossel Creek



Cedar seedlings at Stossel Creek

## Cost

The costs of the restoration planting were mostly similar to a non-climate adapted planting. The 14,000 tree seedlings were $0.50-$0.75 each, for a total of about $12k including shipping. Labor costs were $30-40k, though there were additional labor costs for invasive species removal in advance of planting.

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## Lessons Learned and Recommendations for Similar Projects

1. Land managers have already adopted practices that amount to climate adaptation, even if they aren't explicitly labeled as such. These strategies include extending watering periods, using more drought tolerant species, expanding seed sources, and reducing tree densities. Recognizing the role of these practices in creating more resilient forests can help focus management and plan a more comprehensive approach

2. Availability of selected species is an issue, and if a particular species needs to be planted, managers may need to have seedlings grown under contract. If there is sufficient lead time, it would be ideal to contract with a single nursery to request specific species and reduce logistical issues.

3. If a planting project is selecting specific species and seed zones from outside its close local region, it may be necessary to order material two to three years in advance.

4. There are questions remaining on how well the new trees will survive cold snaps, as swings in temperature outside their normal range will still occur.

5. Monitoring is an added cost and a long-term commitment; project managers need to think through ways to conduct practical monitoring to understand if planting trees from different seed lots is worth the effort. Examples include flagging differently, photo point records, and GIS mapping of trees from different zones.

6. The Stossel Creek site was fortunate to have limited presence of invasive species; other sites may have notable additional costs related to invasive species removal to improve the survival chances of new tree species.

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