

Strategy and Guidance for Minimizing Hybridization Risk of Golden Paintbrush With Harsh Paintbrush



Photos by Tom Kaye, IAE

Erin Gray
U.S. Fish and Wildlife Service
Washington Fish and Wildlife Office

Golden paintbrush (*Castilleja levisecta*)

- Endemic to PNW prairies
- Host plant for the Taylor's checkerspot butterfly
- Listed as threatened in 1997
- Proposed for delisting in 2021

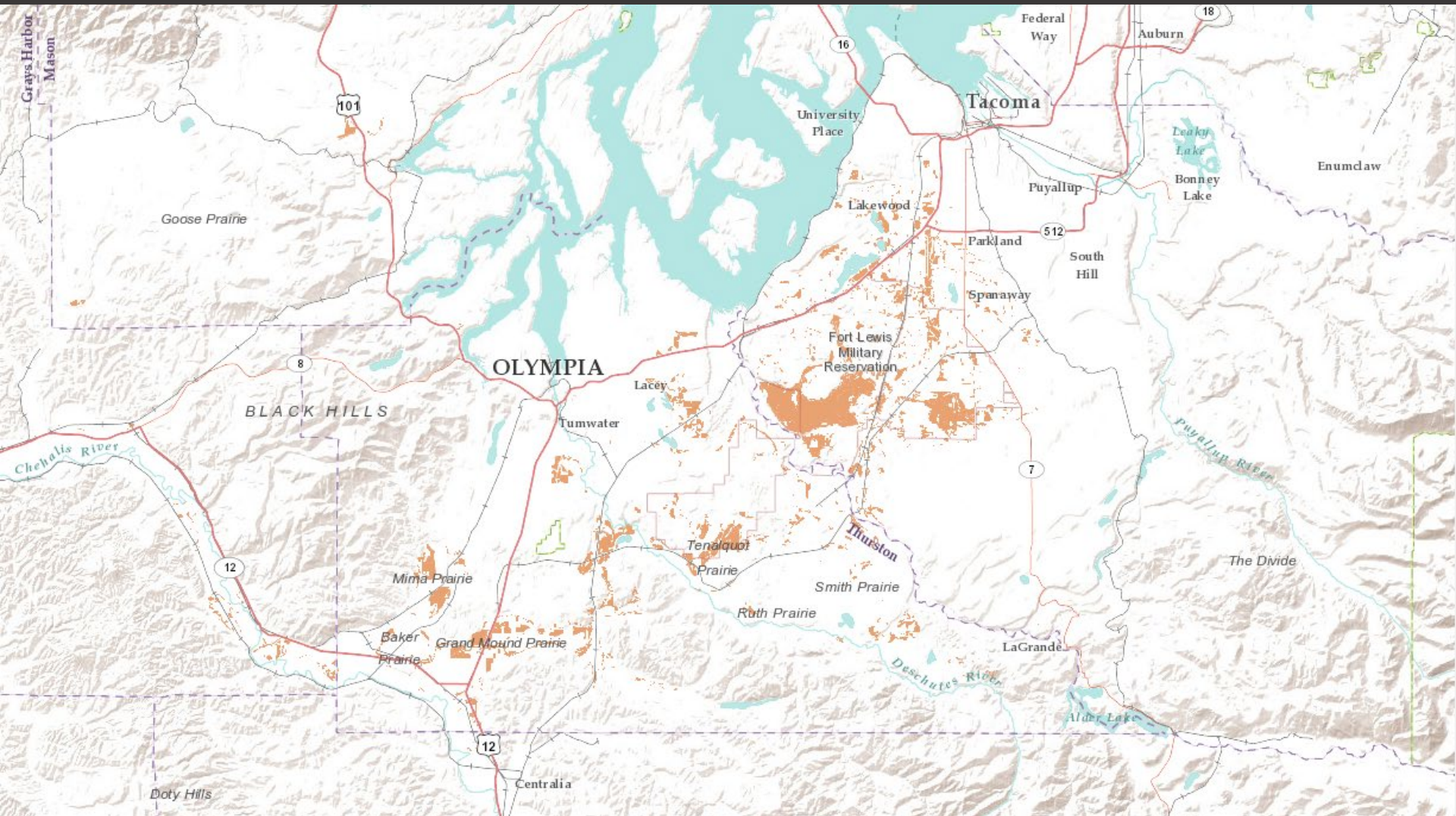


Photo: USFWS

Historical South Puget Sound Prairies



Current South Puget Sound Prairies



Hybridization with harsh paintbrush

- Harsh paintbrush (CAHI)- larval host plant for Taylor's checkerspot butterfly
- Hybridization confined to south Puget Sound prairie region



- 3 sites have been discounted for recovery due to hybridization



MEMORANDUM OF UNDERSTANDING

Strategy for
Securing
Golden
Paintbrush
(*Castilleja
levisecta*)
Populations at
Risk of
Hybridization



- **U.S. Fish and Wildlife Service**

- **Washington Department of Natural Resources**

- **Washington Department of Fish and Wildlife**

- Manage the long-term threat to golden paintbrush from hybridization with harsh paintbrush

- Maintain existing populations of golden paintbrush

Strategy and Guidance for Minimizing Hybridization Risk of Golden Paintbrush with Harsh Paintbrush While Advancing Conservation of Golden Paintbrush and Taylor's Checkerspot Butterfly

Goals:

- 1) Communicate the issue of paintbrush hybridization
- 2) Outline solutions necessary for protection of golden paintbrush and use of harsh paintbrush as a host plant for Taylor's checkerspot butterfly (TCB)
- 3) Provide information on sites, geographic areas, and proximity guidelines to implement solutions



Photo by USFWS

Solutions

Prevent	Prevent hybridization in other geographic areas
Implement	Implement a decision-making framework for new sites
Manage	Actively manage sites with both paintbrush species or those that are hybridized
Map	Map the golden and harsh paintbrush distribution and refine active inventory
Adopt	Adopt seed equipment decontamination procedures
Formalize	Formalize seed production risk management
Disseminate	Disseminate information
Improve	Improve understanding of hybridization risk and its impact to species

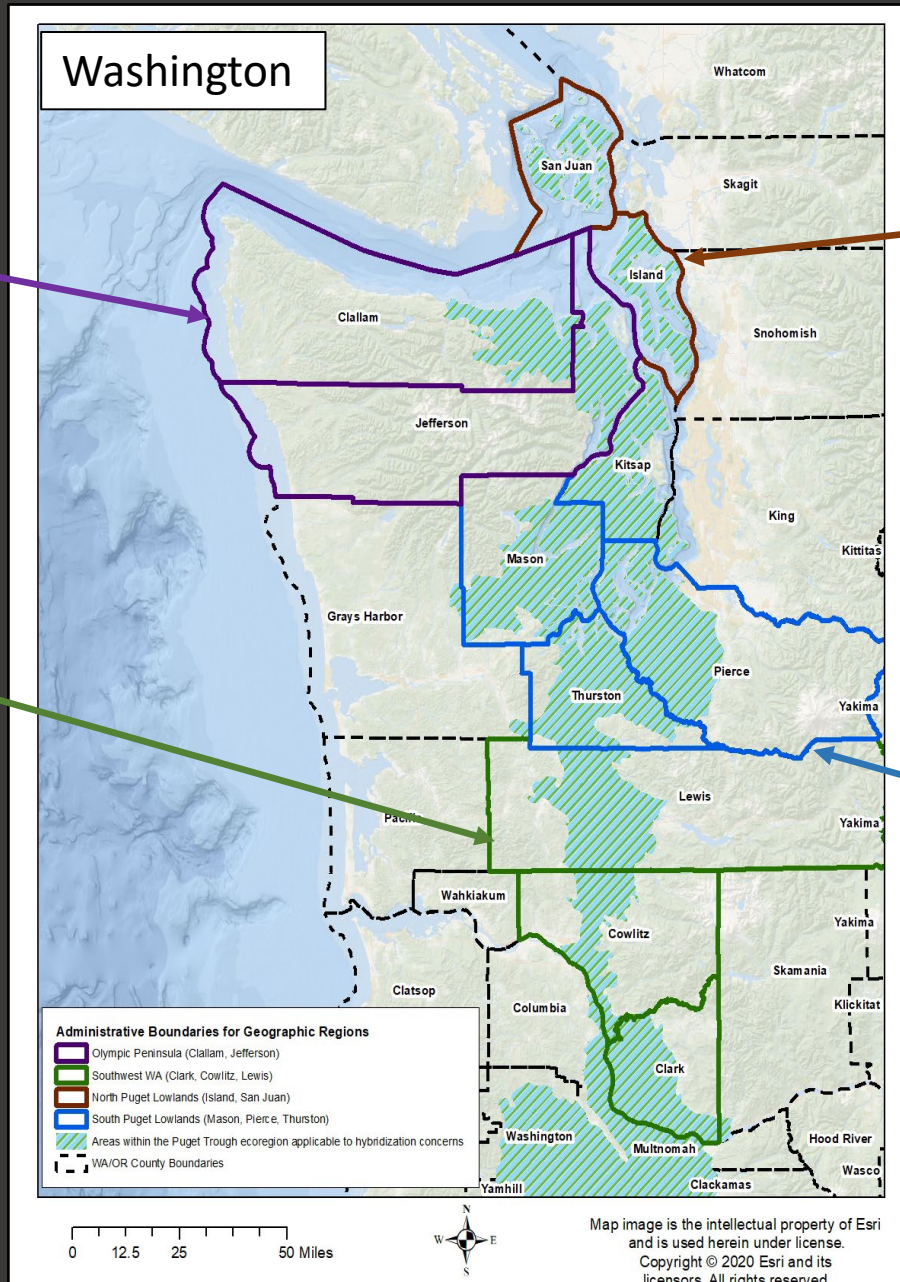
Geographic Regions

North Olympic Peninsula:
TCB priority

Southwest Washington:
No priority assigned

North Puget Lowlands:
CALE priority

South Puget Lowlands: Both
CALE & TCB
priority.
Assigned by site
and site cluster



Geographic Regions: Oregon

**Willamette
Valley Oregon:**
Golden
paintbrush
priority

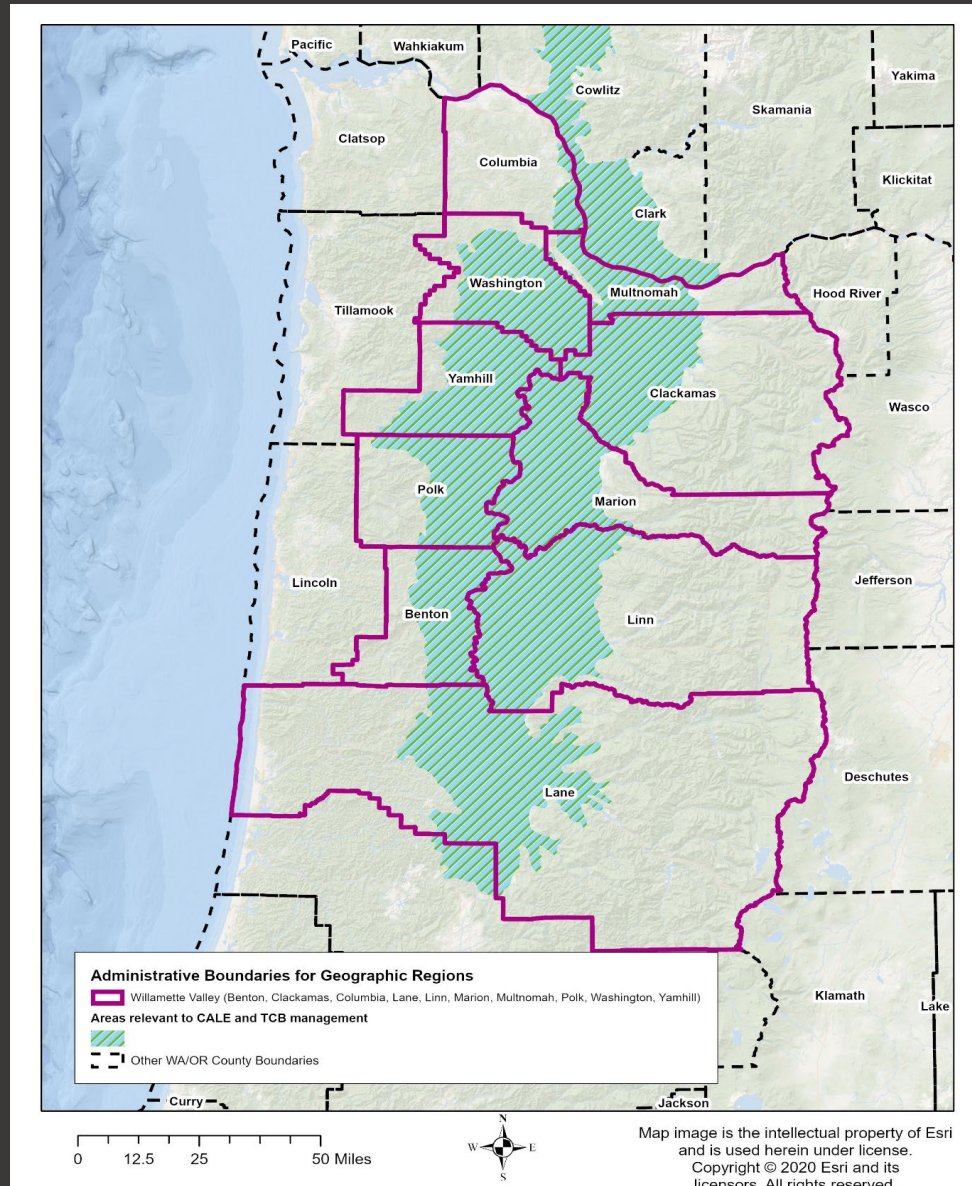
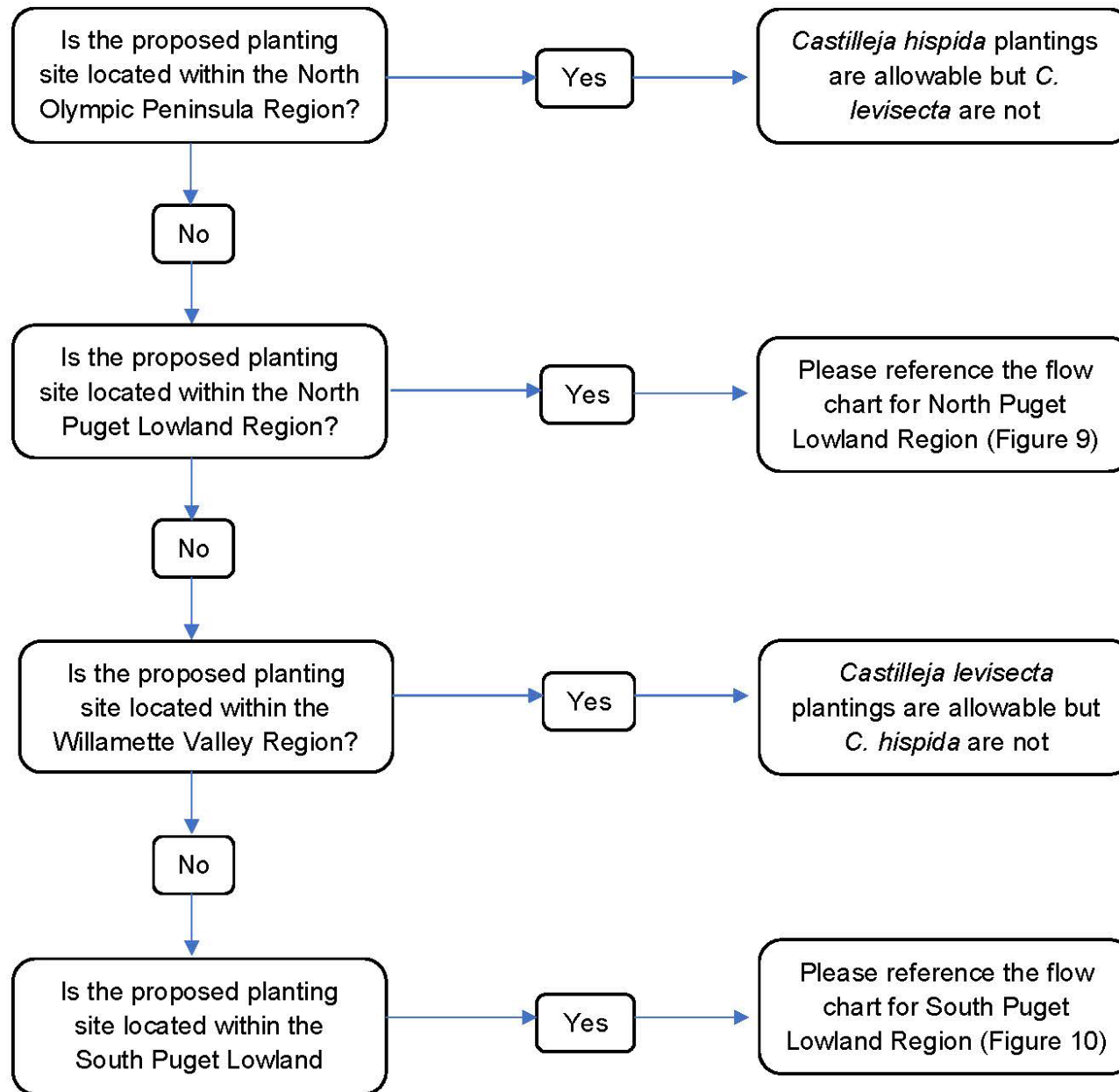


Figure 8. Decision Flow Chart for Planting *Castilleja* Species:

Guide to Regions (please refer to planting priority maps, Figures 1 and 2)



General planting guidelines

Please follow decision making flow charts and regional priority suggestions

If one paintbrush species is present, do not plant the other (harsh or golden paintbrush) within 1 km* of existing sites

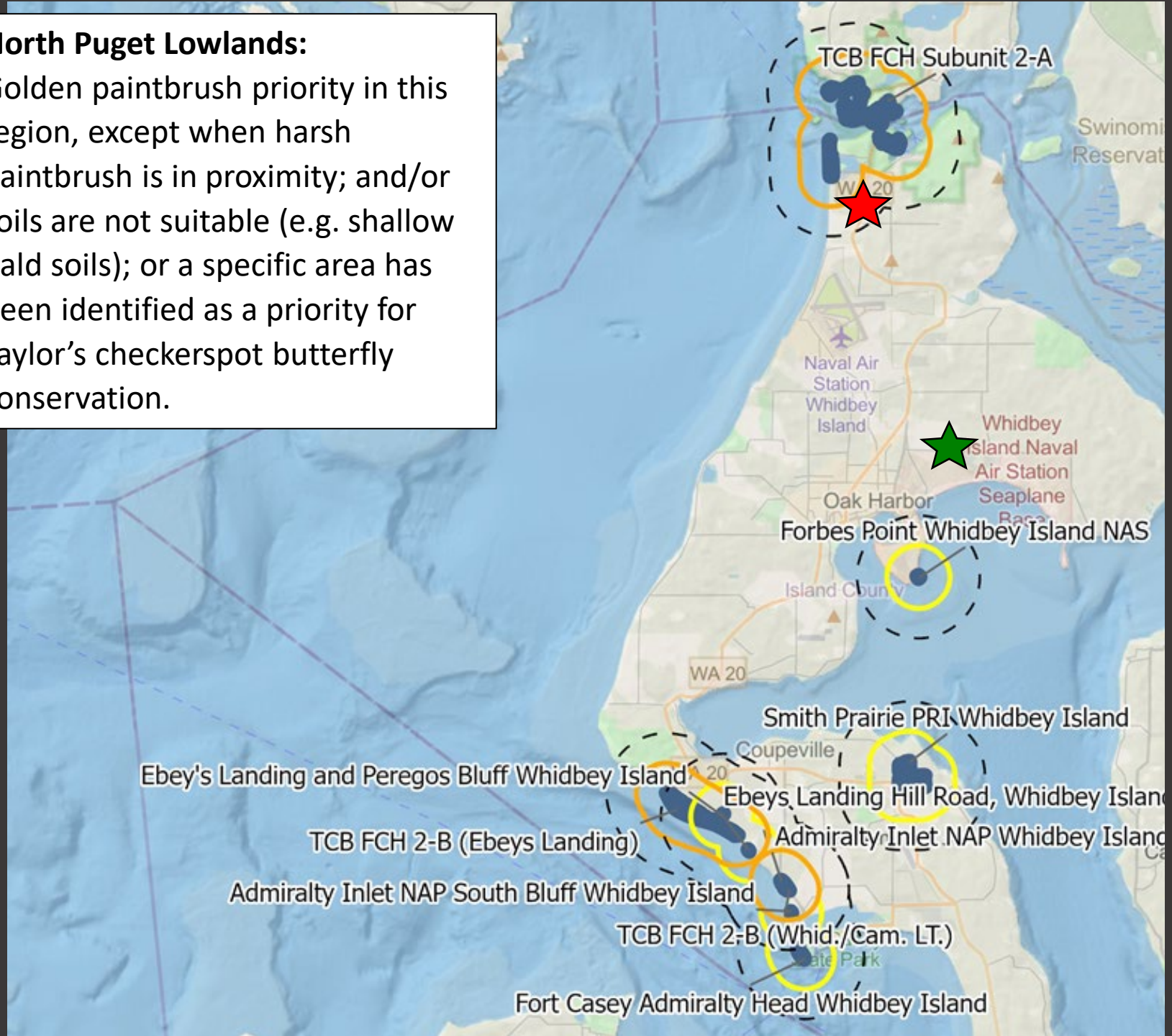
For new plantings situated between 1 km -2 km from existing sites, please submit a proposal for site-based recommendations

Following regional priority suggestions, for new plantings > 2 km from existing sites, please submit planting information for plantings be tracked and to inform future efforts

*1 km distance is based on foraging activity by *Bombus* spp.

North Puget Lowlands:

Golden paintbrush priority in this region, except when harsh paintbrush is in proximity; and/or soils are not suitable (e.g. shallow bald soils); or a specific area has been identified as a priority for Taylor's checkerspot butterfly conservation.



Steps to submitting a proposal for review

- Complete the Outplanting Proposal Form
- Proposals can take **30-90 days to review**
- Submit your completed form and any maps or photos to **FW1_paintbrush_hybridization@fws.gov**



A close-up photograph of a yellow flower, likely a sunflower, showing the bright yellow petals and the green, fuzzy stamens. The image is positioned on the left side of the slide, partially overlapping the dark background.

What happens after review?

- Expected response time is **30-90 days**
- The Agency Review Team will either
 - 1) Endorse implementing the project,
 - 2) Endorse implementing the project, with recommended modifications, or
 - 3) Advise against proceeding due to an elevated risk of hybridization.
- Written explanation of the recommendation will be provided
- Willing to meet to discuss

Where can I access this information?

<https://www.fws.gov/project/hybridization-strategy-and-guidance-golden-paintbrush-and-harsh-paintbrush?id=149489737>

Tip: google “paintbrush hybridization”

This includes:

- Memorandum of Understanding
- Hybridization Strategy and Guidance
 - Outplanting Proposal Form
 - PDF maps
- Contact information

Year in Review

- 3 outplanting proposals for CALE in south Puget Sound
- Technical assistance
- Active management of hybrid sites
 - Funded 3 sites
 - Funded CALE seed production
- Upcoming
 - Map updates
 - Document updates
 - Public outreach/information for growers

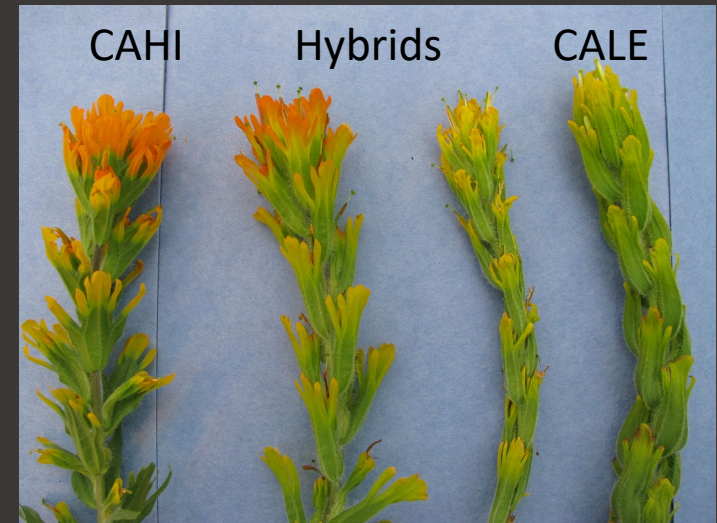


Photo by Tom Kaye, IAE

Questions?

Contact:

- USFWS: Erin Gray
 - erin_gray@fws.gov
- WDFW: Hannah Anderson
 - h.anderson@dfw.wa.gov
- WDNR: Joe Rocchio
 - joe.rocchio@dnr.wa.gov

Photo by Tom Kaye, IAE



Additional slides

North Olympic Peninsula prairie conservation sites and their CALE and TCB priority

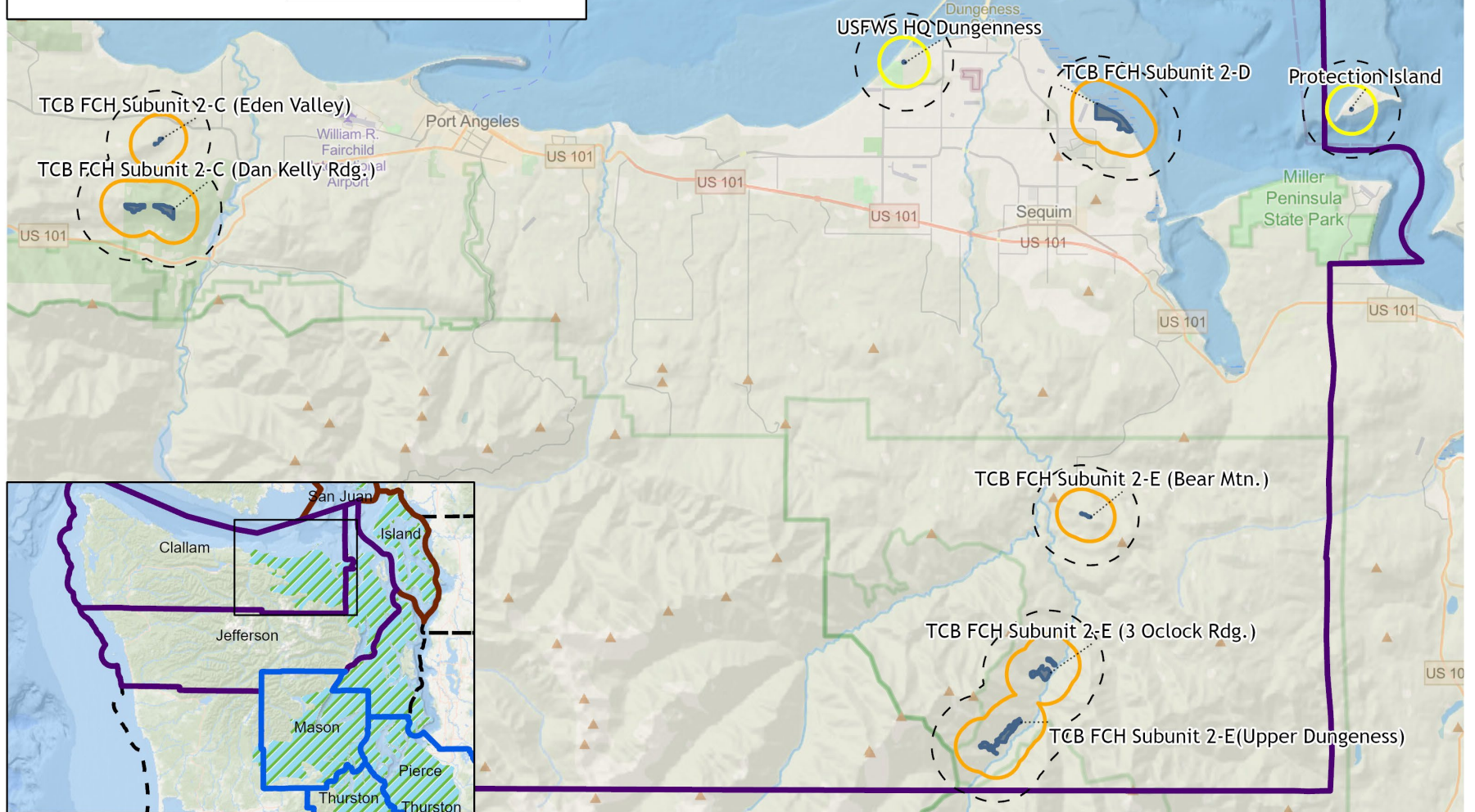
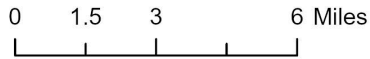
Sites

Recovery Priority - 1 km buffer

CALE



2 km buffer



South Puget Lowlands prairie conservation sites and their CALE and TCB priority

Recovery Priority - 1 km buffer

CALE

Unresolved

TCB

Seed Production Nurseries - 1 km buffer

Seed Production

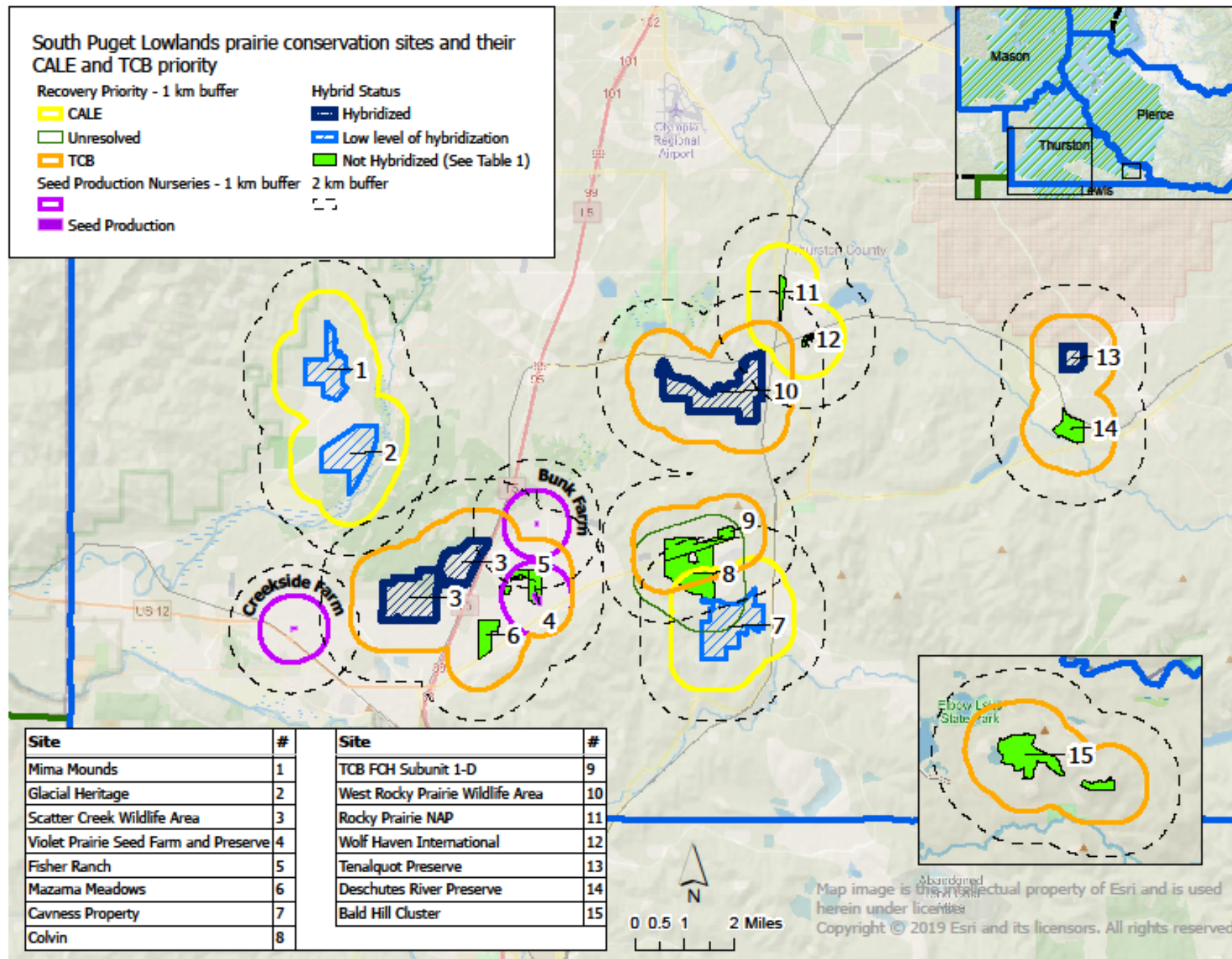
Hybrid Status

Hybridized

Low level of hybridization

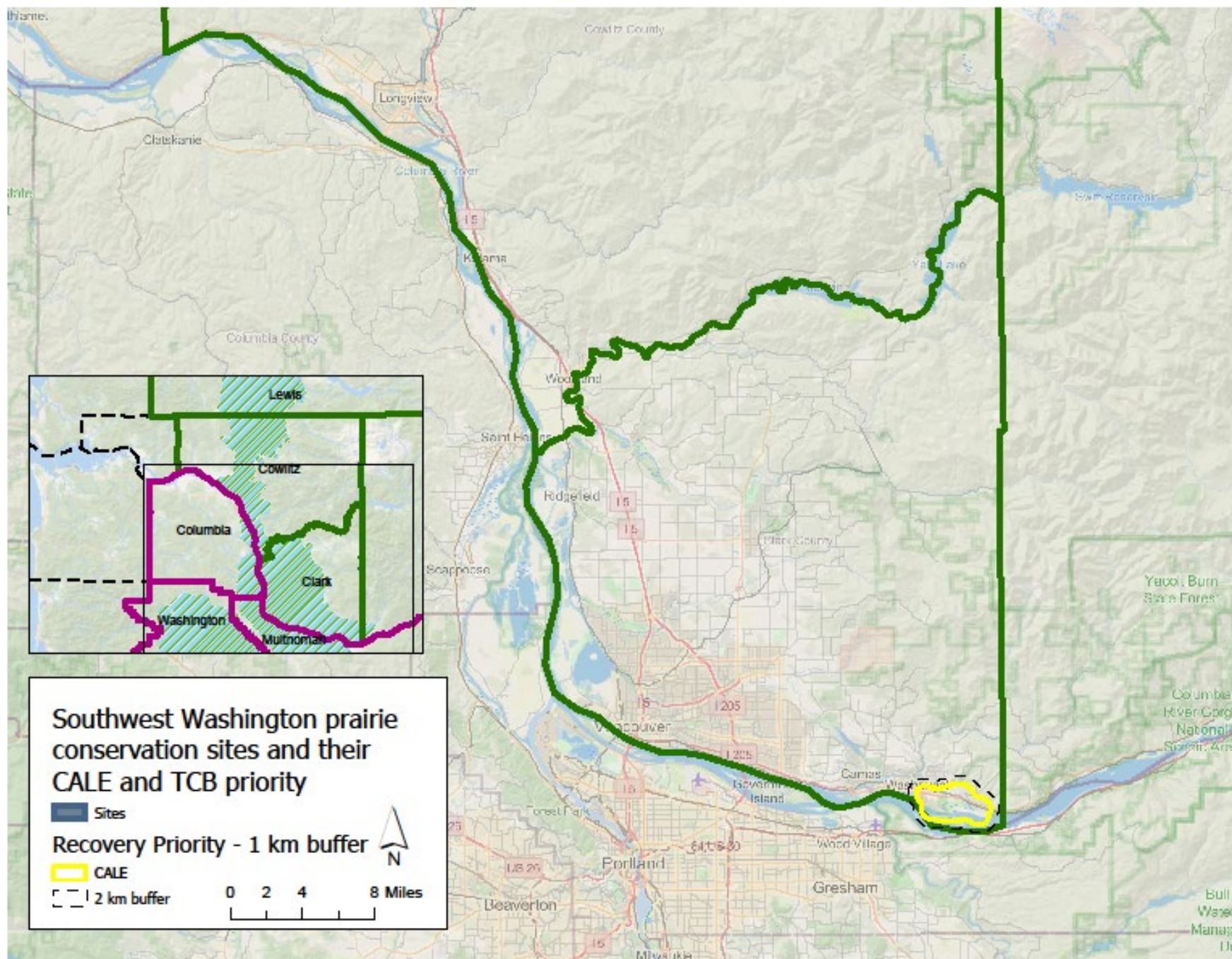
Not Hybridized (See Table 1)

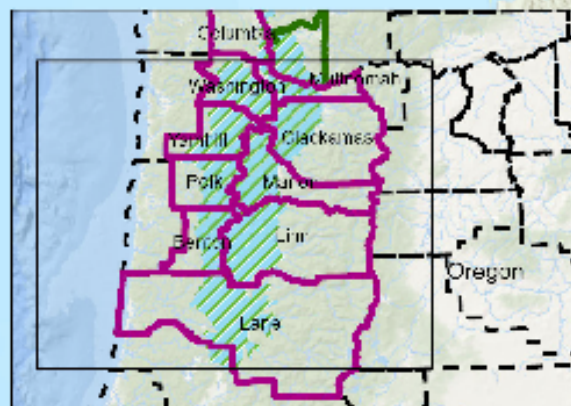
2 km buffer



Site	#	Site	#
Mima Mounds	1	TCB FCH Subunit 1-D	9
Glacial Heritage	2	West Rocky Prairie Wildlife Area	10
Scatter Creek Wildlife Area	3	Rocky Prairie NAP	11
Violet Prairie Seed Farm and Preserve	4	Wolf Haven International	12
Fisher Ranch	5	Tenahquot Preserve	13
Mazama Meadows	6	Deschutes River Preserve	14
Cavness Property	7	Bald Hill Cluster	15
Colvin	8		

Map image is the intellectual property of Esri and is used herein under license. Copyright © 2019 Esri and its licensors. All rights reserved.





0 5 10 20 Miles

Willamette prairie conservation sites and their CALE and TCB priority

 Sites

Recovery Priority - 1 km buffer

 CALE

Seed Production

 Seed Production Nurseries - 1 km buffer

 CALE

 2 km buffer

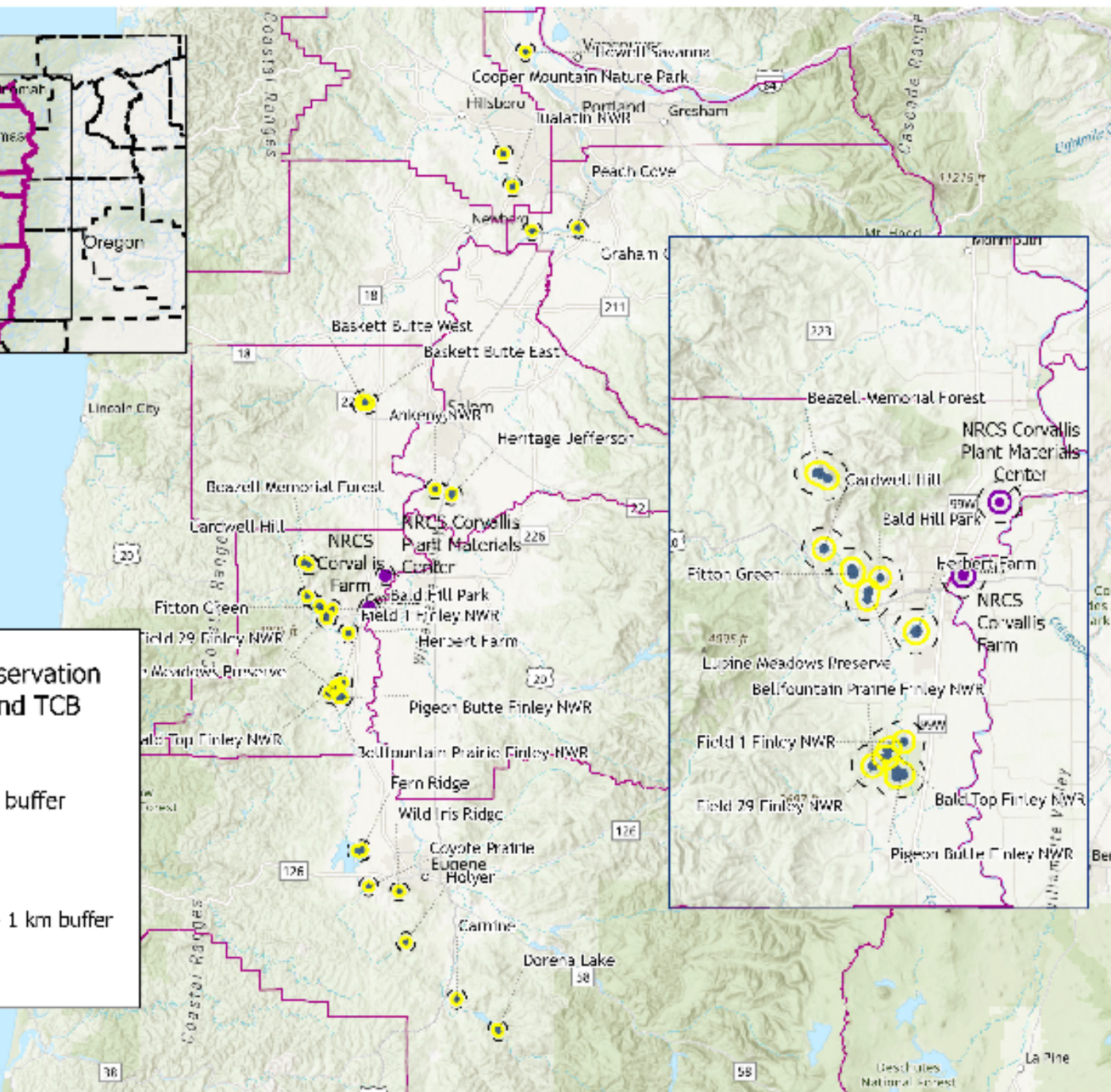


Table 1. South Puget Lowlands prairie conservation sites and their assigned CALE and TCB priority and hybrid status. Alternate shading indicates site clusters, which are sites in close proximity to each other, refer to Figure 5.

Site Name	Ownership	Recovery priority	<i>Castilleja</i> occurrence	Hybrid Status
Mima Mounds Natural Area Preserve	WDNR	CALE	CALE, Hybrids	Low level of hybridization
Glacial Heritage Preserve	Thurston County, WDFW inholding	CALE	CALE, CAHI, Hybrids	Low level of hybridization
Scatter Creek Wildlife Area	WDFW	TCB	CAHI, Hybrids	Hybridized
Violet Prairie Seed Farm and Preserve	CNLM	TCB	CAHI	Not Hybridized
Fisher Ranch	Private, NRCS Easement	TCB	None	Not Hybridized
Mazama Meadows	CNLM	TCB	None	Not Hybridized
Cavness	TNC, CNLM	CALE	CALE, Hybrids	Low level of hybridization
Colvin	Private, NRCS Easement	Unresolved	CALE	Not hybridized
West Rocky Prairie Wildlife Area	WDFW	TCB	CAHI, Hybrids	Hybridized
Rocky Prairie Natural Area Preserve	WDNR	CALE	CALE	Not Hybridized
Wolf Haven International	Private	CALE	CALE, non-spreading tetraploid CAHI	Not Hybridized
Tenalquot Preserve	CNLM, WDFW Easement	TCB	CAHI, Hybrids	Hybridized
Deschutes River Preserve	CNLM	TCB	CALE	Not Hybridized
Bald Hill Cluster	WDNR, Weyerhaeuser	TCB	CAHI	Not Hybridized

**Figure 9. North Puget Lowland
Planting Decision Flow Chart**

Golden paintbrush is the priority in this region and takes precedence, except when harsh paintbrush exists in close proximity; and/or soils are not suitable (e.g. shallow bald soils); or a specific area within the region has been identified as a priority for Taylor’s checkerspot butterfly conservation.

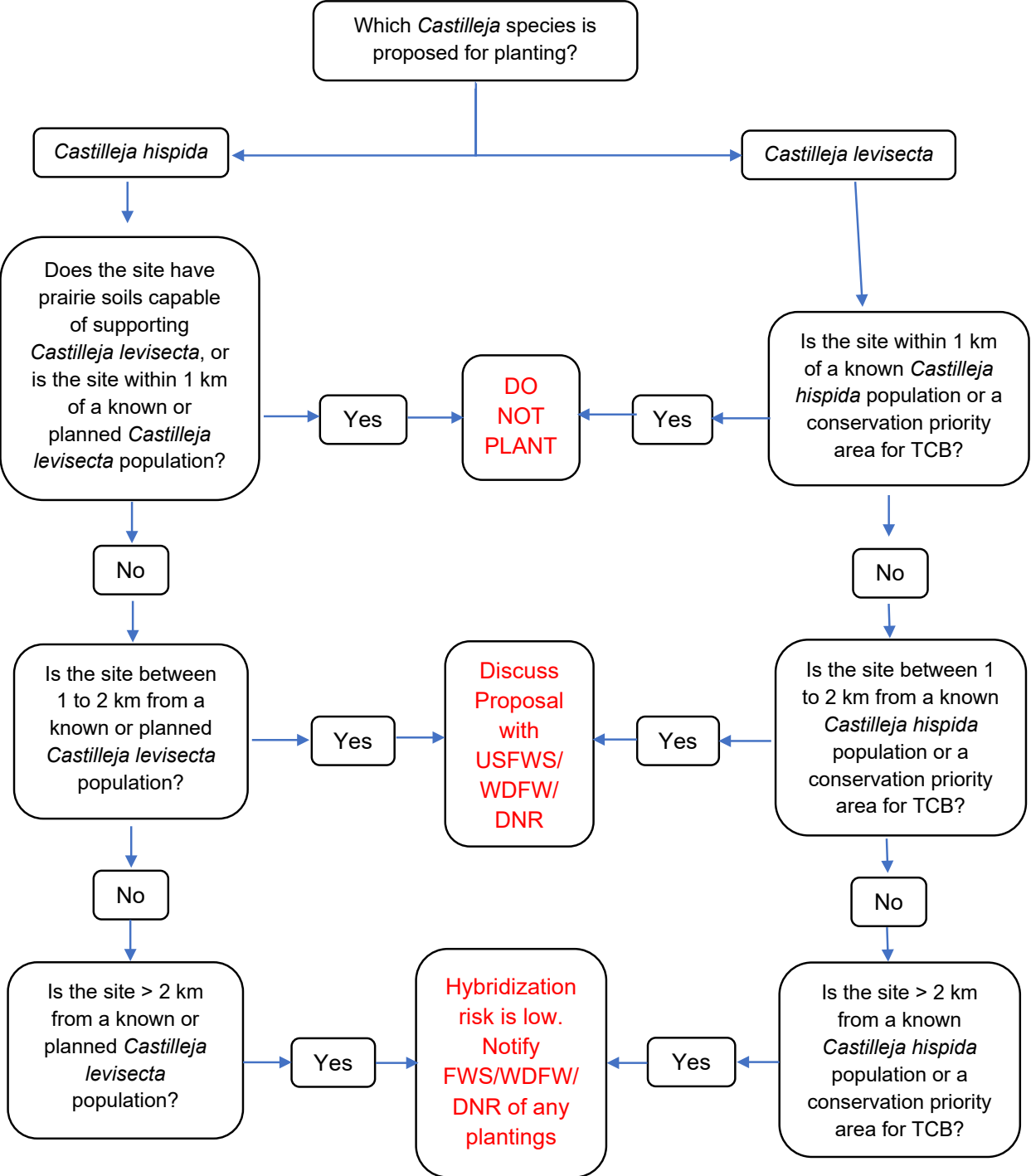
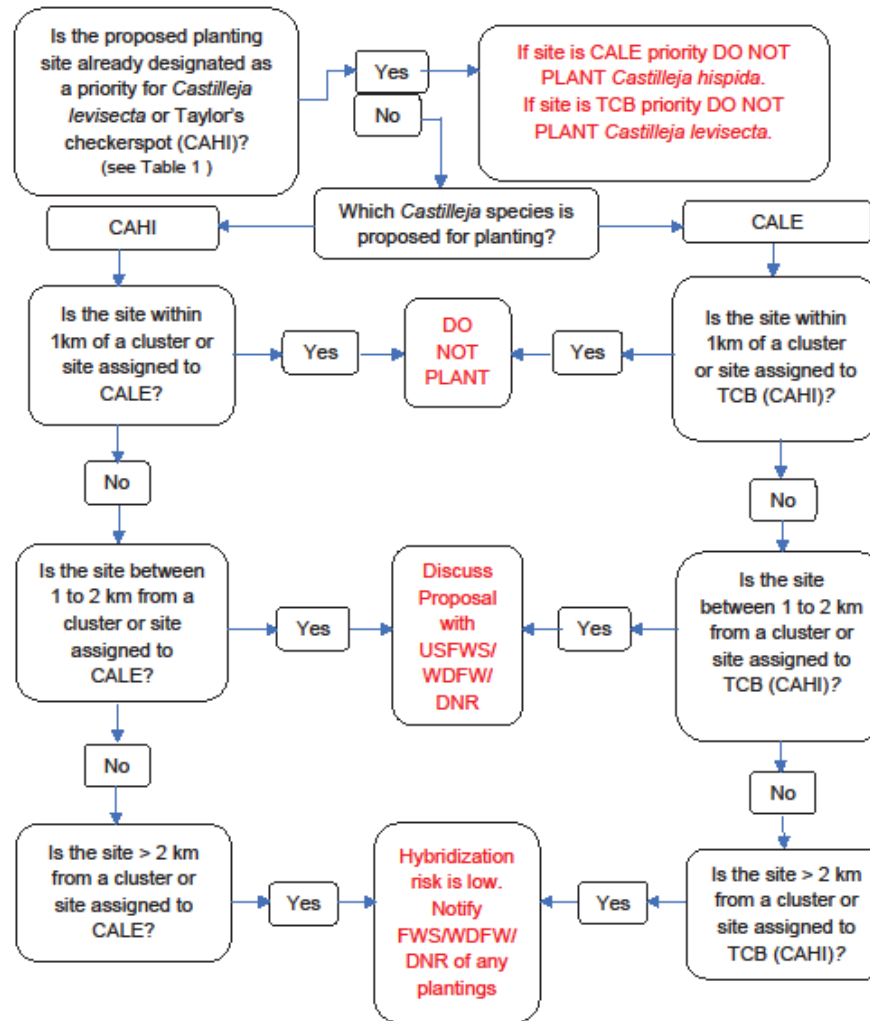


Figure 10. South Puget Lowlands Planting Decision Flow Chart



Hybridization, Ploidy level and gene flow

- **Gene flow** from common species has put rare species at increased risk of extinction by **genetic swamping**, where the local genotypes are replaced by hybrids.
- **Ploidy**
 - CALE = diploid ($2n = 12$)
 - CAHI = diploid ($2n = 12$) or tetraploid ($2n = 24$)
- **Hybridization:** the process of crossbreeding between genetically dissimilar parents to product a hybrid. Frequently results in polyploid offspring
 - Diploid CALE X Diploid CAHI = diploid hybrids that can interbreed
 - Diploid CALE X Polyploid CAHI = triploid hybrids that can't backcross with their parents but can cross with themselves.
 - Differences in ploidy between CALE and CAHI have been shown to greatly reduce gene flow.
 - Reproduction is still possible at very low levels and the impacts across multiple generations are not well understood.

Sites and site clusters

- A site is defined as an open grassland area of single ownership that is or could be occupied by either golden or harsh paintbrush
- A cluster is defined as a group of sites linked by the potential for reproductive exchange