Riparian Restoration Planting Plan for the Hat Creek Wild Trout Area

Design and Build: Hat Creek Riparian Restoration, Cultural Protection, and Recreation Improvement Project

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Prepared for:

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Lomakatsi Restoration Project
Restoring Ecosystems, Sustaining Communities

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Executive Summary

This riparian restoration planting plan describes the planting strategy and methods to achieve multiple restoration goals along the 6.3 acre riparian corridor in the upper Wild Trout Area of Lower Hat Creek. The Wild Trout Area (WTA) is located approximately 8 miles NE of Burney, California in Shasta County. The purpose of the project is to restore the ecological function of the WTA riparian corridor, improve conditions for wild trout populations, and protect the unique cultural and recreational attributes that define Hat Creek as one of California's most important cold-water spring-fed natural resources.

The property is currently owned by the Pacific Gas and Electric Company, and is the ancestral lands of the Ilmawi Band who have lived in the Hat Creek area for time Immemorial. The current restoration effort is managed by a diverse group of stakeholders including California Trout (CalTrout), the Pit River Tribe, and the Hat Resource Advisory Committee (HatRAC).

Dominant vegetation in the restoration reach includes ponderosa pine forest, Oregon white oak and California black oak woodland and savanna, open grassland, and riparian vegetation. Grasslands are largely dominated by invasive plants, while the riparian corridor supports a mix of native and invasive vegetation. Riparian restoration planting is planned to mitigate past land use disturbances that have contributed to the degradation of the riparian corridor, unstable stream banks and the absence of habitat diversity, shelter/cover for fish, and large woody debris.

Lomakatsi has developed a riparian planting plan informed by field assessments and a conceptual model of plant succession for the hydrologic regime and biophysical setting. Planting strategies include a variable density -planting guild approach, utilizing 4,681 plants designed to ameliorate stream bank retreat through the planting of a diversity of emergent vegetation, shrubs, and tree species native to the reach. Proposed planting density and spacing were designed to achieve several objectives, including development of dense stream bank root networks and diverse riparian habitat. Planting strategies work to address the reestablishment of culturally significant plants utilized for subsistence purposes by Ilmawi Band members. Plantings will increase native plant diversity, protect fragile low terrace soils, restore eco-cultural plant communities, improve the aesthetic qualities of the riparian zone, and continue to provide for angler access to the stream channel.

I. Introduction

In February, 2013, Lomakatsi Restoration Project entered into a Memorandum of Understanding (MOU) with the Pit River Tribe, establishing a formal partnership to further develop natural resources and ecosystem restoration training and employment programs for tribal members. The objective of the MOU was to initiate natural resource projects that work to restore both terrestrial and aquatic habitats on public, private and tribally owned lands.

In August 2013, Lomakatsi entered into a contract with CalTrout for the implementation of the Hat Creek Riparian Restoration, Cultural Protection, and Recreation Improvement Project. As part of this overall project, Lomakatsi was commissioned by California Trout to develop a riparian planting plan that would provide guidance for the revegetation and restoration of over six acres of the Hat Creek Wild Trout Area, located within a culturally significant aboriginal area of the Ilmawi Band.

In addition to consultation of literature and past watershed and restoration assessments, Lomakatsi conducted field assessments, interviews with Ilmawi and Atsuge Band Elders, community members, consultation with local natural resource management specialists and local fishermen to complete this riparian planting plan.

This document describes the riparian restoration planting plan portion of a collaborative restoration effort between CalTrout, the Pit River Tribe, Waterways/ River Run Consulting (Matt Kiesse) and Lomakatsi Restoration Project. As part of a broader cooperative relationship, the riparian planting plan was developed to meet multiple restoration objectives. This plan outlines project implementation and provides a timeline for project milestones. This document is also intended to serve as a resource for an anticipated Pit River Tribal workforce training and education program during riparian restoration implementation.

The riparian planting plan addresses these restoration objectives:

- stabilize stream bank retreat with native vegetation
- restore native and cultural plant communities
- improve riparian habitat complexity
- improve streamside fish habitat
- provide a visually appealing riparian corridor

The planting plan includes the following elements:

- description of species, planting location and methodology
- noxious weed management strategy
- cultural plant restoration and maintenance approaches
- irrigation, maintenance and monitoring plan

- upland legacy pine -oak management
- site plan and map with layout of project components
- muskrat mitigation strategy

II. Site Description

A. Project Location

Riparian restoration is planned for the 1.5 mile reach of the Wild Trout Area (WTA), located between the Hat 2 Powerhouse and Hwy 299, approximately 8 miles NE of Burney, California in Shasta County. Riparian planting described in this document is planned for the six acre stream bank corridor immediately adjacent to the water channel. The project reach occurs in the lowest portion of the Hat Creek watershed, 1.8 miles above its confluence with the Pit River.

B. Recent History

The annual flow regime to the WTA section of Hat Creek is generally stable at 400 - 650 cubic feet per second; flooding is rare and of relatively small magnitude (Kondolf, 1994). However, a large flood occurred on lower Hat Creek in May, 1915 following an eruption of Mt Lassen, which displaced ranchers and settlers, killed trees and moved large rocks (Vestra, 2010).

The trout fishery in Hat Creek declined in the late 1920's and early 1930's following many years of thriving trout populations. Declines in trout may have been caused by dam construction at Lake Britton and associated increases in warm water fishes in Hat Creek (Deinstadt and Berry, 1999). Decades of active restoration efforts began with the construction of a fish barrier in 1968 followed by chemical treatment and re-stocking (Deinstadt and Berry, 1999). Following the treatment and restocking, the fishery improved throughout the 1970's, but declined again in the late 1980's, ostensibly due to a large body of sediment that moved through the WTA over a 20 year period. This sediment likely killed much of the aquatic vegetation and caused decreases in insect and fish productivity (HatRAC, 2013).

C. Present Conditions

Lower Hat Creek in the WTA flows out of the forested Powerhouse Riffle into a wide, slow meander through a mix of open grassy hills, oak woodlands, and pine forest (Figure 1). Riparian vegetation is highly variable along the stream margin ranging from open, grassy shoreline to patches of emergent aquatic vegetation, to areas dominated by native riparian tree and shrub species. Prominent invasive plants in the riparian zone include reed canary grass (*Phalaris arundinacea*), teasel spp (*Dipsacus sp.*), poison helmlock (*Conium maculatum*) and small occurrences of curly dock (*Rumex crispus*). Upland grassy areas are dominated by yellow star thistle (*Centauria solstitialis*) and non-native annual grasses. Patches of white oak woodland with native bunchgrass understory occur in the lower portion of the restoration reach, and a native ponderosa pine forest community occurs on the opposite bank across the oak woodland in the lower portion of the project area. Riparian vegetation is locally sparse and banks are actively eroding due to decades of heavy grazing, burrowing by introduced muskrats, and foot traffic.

Figure 1. Photograph of Hat Creek in the project reach showing a low terrace formation in photo center, with grasslands and ponderosa pine woodland in the background.

D. Purpose and Need for Restoration

Late 19th and 20th century disturbances related to Euro-American settlement and land use, including heavy streamside cattle grazing, likely simplified and reduced the density of the riparian plant community. The introduction of muskrats in the 1930's appears to have greatly impacted stream bank stability through muskrat bank burrowing and tunneling. Active restoration in the upper Wild Trout section of Hat Creek is needed to protect eroding stream banks and restore native riparian vegetation degraded from past land use (HatRAC 2013). Methods for the use of native plants to aid in stabilization of stream banks and improve the diversity and health of the riparian plant community are described in this plan. In addition to providing bank stabilization, riparian plantings are designed to form dense root networks in the stream margin to discourage muskrat bank tunneling, trap sediment, and provide cover for fish and wildlife.

III. Riparian Planting Plan Development Tools

The planting plan was guided by a conceptual model of succession that was developed through: field assessments, interviews with Ilmawi and Atsuge Elders and Cultural Monitors, consultations with resource specialists, field interviews with local fishermen, and a literature review. Field reconnaissance included detailed mapping of the project reach and visual assessments of reference communities above and below the project area on Hat Creek.

A. Conceptual Model of Succession

Formation of the peaty, low terrace landform found throughout the project area is consistent with the effects of periodic flood disturbance caused by volcanic eruptions in the region (Vestra, 2010). Inundated, low lying floodplains then undergo plant succession from aquatic emergent to herbaceous to woody vegetation. Under this inferred disturbance regime, natural succession in absence of heavy grazing results in slow increases in woody plant density over time. This natural succession follows a soil moisture gradient from emergent to xeric vegetation with distance from the water's edge.

Past assessments suggest that the present lack of dense riparian vegetation is largely an artifact of heavy 20th century grazing, and this assumption is supported by the observation of natural revegetation following removal of cows in 2001 (HatRAC, 2013). Revegetation of the streamside corridor is expected to help mitigate the effects of past cattle grazing by increasing plant diversity and density along disturbed banks. Revegetation may also serve to increase seed availability and accelerate the natural succession of native species, thus increasing riparian community resilience to future disturbance events.

IV. Restoration Planting Strategy

A. Overview

The initial planting of 4,681 native plants in the project area is scheduled for the late fall/ late winter planting season of 2014 -2015. Recommended plant guilds include a mix of emergent, hydrophytic, mesic, and xeric plant assemblages. We recommend the use of emergent and hydrophytic species including cattails, rushes, sedges, willows and alders as the dominant plants installed to increase the root network and bank strength (Micheli and Kirchner, 2003). An Eco-cultural restoration strategy will be incorporated into the riparian planting design in an effort to address the loss of culturally significant plant resources along the project area reach, which are valuable to the Ilmawi Band and the Pit River Tribe. Cultural plant restoration will be complimentary to the overall riparian planting objectives contributing to an increase in plant and wildlife habitat diversity. Numerous additional mesic shrub species including chokecherry, Klamath plum, red osier dogwood, California rose, and others will be included in planted guilds throughout the project reach.

B. Invasive Species Management

<u>i. Invasive Plants</u>

In the project area of the WTA, several invasive species are present and could pose a threat to the long term health of native plant communities. In the riparian planting zones, the dominant invasive weeds are reed canary grass (*Phalaris arundinacea*), teasel (*Dipascus sp.*), and poison hemlock (*Conium maculatum*). In the adjacent upland transition zone, yellow star thistle (*Centaurea solstitialis)* and several non-native grasses including quackgrass (*Elymus repens*) and

cheatgrass (*Bromus tectorum*) occur. Weed mitigation strategies are addressed in this planting plan for the following riparian species: teasel, reed canary grass (RCG), poison hemlock. Weed treatment mitigation strategies for yellow star thistle and invasive grasses are suggested in the Future Restoration Recommendations section (page 29) at the end of this document.

Planting recommendations in areas with heavy RCG infestations:
1- Mow prior to seed set in spring/ early summer and again prior to fall planting
2- Plant a high density of willow cuttings to eventually shade out RCG
3- Remove competing vegetation from a 5' by 3' area, plant densely with shrubs, and cover with landscape fabric
4- Interplant heavily with sedges and rushes in conjunction with the use of landscape fabric

Invasive Plants and Adaptive Management
The combination of invasive weed eradication and experimentation with native plantings should be monitored sufficiently to allow revision or repetition of methods based on success or failure. Restoration goals will be achieved through multiple entries, treatments and plantings over an extended time period.

Invasive Plant Spread Mitigation
During implementation of planned restoration work, care must be taken to avoid the introduction and spread of invasive weeds on site. We recommend washing tools prior to moving from areas infested with weeds to areas not visibly infested, even within the same planting zone. Water jugs or buckets could be transported with other planting gear to facilitate tool cleaning. Excess mud should be washed off boots and tools on the soil, not in the stream channel, to prevent stream transport of seeds or root fragments.

ii. Muskrat Mitigation

The Pit River Tribe Natural Resources Department is currently developing a muskrat mitigation strategy based on a trapping regime. In combination with trapping and reduced population density, eventual dense root mats of planted woody species are expected to discourage muskrat bank burrowing. We recommend that care is taken to avoid harm to beaver and/ or wetland raptors, such as the northern harrier hawk, during muskrat control activities. Beaver (*Castor canadensis*) are important ecosystem engineers who ultimately benefit trout and the health of the riparian ecosystem (Wright et al., 2002).

C. Stream Bank Soils

Stream bank soils in the WTA are composed of a combination of well drained, upper terrace Britton silty clay loams, and lower terrace, permanently wet, peat-like soils. The alluvial Britton soils ranging in slope from 5 to 30 percent are derived from diatomaceous earth parent material (USDA, NRCS Soil Survey, 2013). The peat-like, low terrace stream margin soils are comprised of a dense matrix of organic matter interspersed with fine-grained inorganic materials (Kiesse,

2013). This low terrace, peaty soil provides an optimum environment for hydrophytic and mesic plantings with a high water table year-round. A transition from peat to the alluvial, silty clay loams corresponds with an increase in depth to ground water. The general planting strategy described below suggests the use of guilds of plants that span this soil moisture gradient.

Figure 2. Photograph of a narrow soil transition area from peat to upland alluvial soils in the project area. Reed canary grass forms a near monoculture in the narrow strip of wet soil at the water's edge.

D. Species List

Proposed species for plantings were selected to meet the riparian restoration objectives in this plan and share the following characteristics:

- native species found in the lower Hat Creek Riparian zone;
- suited to their target planting zone soil and water depths;
- commonly used riparian restoration species (Hoag et al., 2008);
- available for purchase and/or propagation to meet the 2014-2015 planting timeline.

Selected species are listed by common and scientific name, along with their soil moisture tolerance and the justification for species selection, in Table 1.

Table 1. Native species recommended for planting and propagation in the project area. Included with the species names are: the water affinity of each species listed as plant "type"; the justification for species selection listed as the plant "purpose"; the relative percentage of each species in the planting plan ("composition"), and the total number recommended for the initial planting effort described by this plan.

Common Name	Scientific Name	Type	Purpose	Composition	Total Number
Pacific willow	*Salix lasiandra*	hydrophytic	1	52.3%	2352
Cattail	*Typha latifolia*	emergent	1	8.4%	380
Tule	*Schoenoplectus acutus occidentalis*	emergent	1	8.4%	380
Spreading rush	*Juncus patens*	hydrophytic	1	8.2%	368
"White Root" sedge	*Carex barbarae*	hydrophytic	1	7.7%	348
White alder	*Alnus rhombifolia*	hydrophytic	1	4.0%	179
Sierra gooseberry	*Ribes roezlii*	mesic	1, 2	2.6%	115
Douglas spirea	*Spiraea douglasii*	hydrophytic	1, 2	2.6%	115
Oregon ash	*Fraxinus latifolia*	hydrophytic	1, 2	1.3%	60
Black hawthorn	*Crataegus douglasii*	mesic	1, 2	1.2%	56
Klamath plum	*Prunus subcordata*	mesic	1, 2	1.2%	56
Red osier dogwood	*Cornus sericea*	mesic	1, 2	1.2%	55
Ponderosa pine	*Pinus ponderosa*	mesic/ xeric	1, 3	1.0%	44
Skunkbush	*Rhus trilobata*	mesic/ xeric	1, 2	1.0%	44
California rose	*Rosa californica*	mesic	1, 2	0.8%	37
Common chokecherry	*Prunus virginiana*	mesic/ xeric	1, 2	0.8%	37
Blue elderberry	*Sambucus mexicana*	mesic/ xeric	1, 2	0.8%	36
Incense cedar	*Calocedrus decurrens*	mesic/ xeric	1, 3	0.4%	17
	Totals:			100%	4681

Purpose codes:
1 = stabilize banks with dense root network
2 = increase native plant diversity
3 = provide for future in-stream large wood recruitment

E. Planting Design

i. Planting Zones

Planting zones were delineated to include previously mapped stream bank erosion areas (HatRAC, 2013). Mapped planting zones were numbered throughout the project reach sequentially from north to south (Figure 3) (Note: Hat Creek flows from south to north). Within each zone, proposed plantings were clustered in large and small plant assemblages at varying densities to achieve bank stabilization and revegetation goals.

ii. Variable Density Guilds

Suggested planting guilds contain 39 plants per guild and are recommended for planting at three different spacing regimes: low, moderate and high density. High density plantings are characterized by willow cuttings or rooted stock planted at 6 inch spacing, while moderate density patches are planted at 1 foot spacing and low density patches are planted at 2 foot spacing. Additional species are planted at regular spacing intervals increasing with distance from

the water edge (see Table 2 for a guild spacing description). Continuous plantings that would obstruct access to the stream channel are not prescribed by this plan. Variable distances between plantings occur in each zone (Table 3). Plantings and protective fences are intentionally clustered, both to create dense root networks, and to allow for angler and tribal subsistence access between trails and the stream channel. Special attention to adequate spacing at the Carbon Bridge site (Zone 6) and the Powerhouse 2 Riffle area (Zones 9 and 10) is recommended based on the maps in Appendix II of high fishing use areas, provided by the State of California Department of Fish and Game. Recommended spacing between clusters in these high use areas ranges from 20 to 60 feet. During planting implementation, attached Fish and Game maps may be referenced to further cluster plantings and increase spacing, particularly in the central portion of the Carbon Bridge reach.

Table 2. Variable density plant guild composition and spacing chart.

		Low Terrace Plant Guild			
Common Name	Scientific name	Low Density Spacing (feet)	Moderate Density Spacing (feet)	High Density Spacing (feet)	Total Number Plants per Guild
Pacific willow	*Salix lasiandra*	2	1	0.5	16
White root sedge	*Carex barbarae*	4	2	1	4
Spreading rush	*Juncus patens*	4	2	1	4
Cattail	Typha spp.	4	2	1	4
Tule	Scirpus spp.	4	2	1	4
White alder	*Alnus rhombifolia*	8	4	2	1.5
Oregon ash	*Fraxinus latifolia*	8	4	2	0.5
Sierra gooseberry	*Ribes roezlii*	8	4	2	1
Douglas spirea	*Spiraea douglasii*	8	4	2	1
Black hawthorn	*Crataegus douglasii*	16	8	4	0.33
California rose	*Rosa californica*	16	8	4	0.33
Red osier dogwood	*Cornus sericea*	16	8	4	0.33
Common chokecherry	*Prunus virginiana*	16	8	4	0.33
Klamath plum	*Prunus subcordata*	16	8	4	0.33
Blue elderberry	*Sambucus mexicana*	16	8	4	0.33
Skunkbush	*Rhus trilobata*	32	16	8	0.4
Ponderosa pine	*Pinus ponderosa*	32	16	8	0.4
Incense cedar	*Calocedrus decurrens*	32	16	8	0.2
	Total:				39

Figure 3. Proposed planting zones within the Wild Trout Restoration Area reach on Lower Hat Creek.

Table 3. Planting type and mean spacing per zone.

	Low Terrace Guilds per Zone				Small Plant Assemblages per Zone						
Zone	Low Density	Moderate Density	High Density	total	Willow/ Alder	Mesic Shrub	Xeric Transition	Tule/ Rush	total	Shoreline length (feet)	Mean Distance between Plantings (feet)
1	0	0	0	0	4	1	0	0	5	639	150
2	0	12	0	12	7	6	4	0	17	1462	38
3	0	0	3	3	0	0	0	0	0	145	40
3a	0	0	0	0	14	3	0	3	20	400	10
4	1	10	4	15	0	0	0	0	0	1118	66
5	0	6	0	6	0	0	0	0	0	777	114
6	0	4	3	7	11	11	8	3	33	1166	18
7	5	0	0	5	0	0	0	0	0	407	49
8	0	7	8	15	4	0	0	5	9	1447	48
9	0	8	2	10	7	7	0	0	14	1386	46
10	3	6	6	15	0	0	0	0	0	1002	55
Totals:	9	53	26	88	47	28	12	11	98	9949	58

iii. Small Plant Assemblages

In addition to the large plant guilds, smaller plant clusters or assemblages were designed for placement in the narrow transition zones between peat and upland soils, and also to fill in gaps between larger guilds where additional plant density is desired. Small plant assemblages were delineated according to plant-water affinity and subsequent suitability for low terrace or transition habitats. The four assemblage types include:

- Willow/ Alder assemblage
- Tule/ Rush assemblage
- Mesic shrub assemblage
- Xeric transition assemblage

Small plant assemblage composition and spacing are defined in Table 4 below. Small plant clusters may be planted in a linear configuration, or in a circular/clustered configuration, depending on the width of the low terrace zone and distribution of surrounding established native plants.

Table 4. Small plant assemblage composition and spacing chart. Species assemblages are delineated by the dashed, horizontal lines in the table.

		Small Plant Assemblage Spacing (feet)				
Common Name	Scientific name	Willow/ Alder[1] (10 plants)	Mesic Shrub (5 plants)	Xeric Transition[2] (3 plants)	Tule/ Rush[3] (8 plants)	Plant Ratio per Assemblage
Pacific willow	*Salix lasiandra*	1				8
White alder	*Alnus rhombifolia*	3				1
Oregon ash	*Fraxinus latifolia*	3				0.5
Spreading rush	*Juncus patens*				2	2.67
Cattail	Typha spp.				2	2.67
Tule	Scirpus spp.				2	2.67
Sierra gooseberry	*Ribes roezlii*		2			1
Douglas spirea	*Spiraea douglasii*		2			1
Red osier dogwood	*Cornus sericea*		2			1
Klamath plum	*Prunus subcordata*		2			1
Black hawthorn	*Crataegus douglasii*		2			1
Blue elderberry	*Sambucus mexicana*			3		0.6
Common chokecherry	*Prunus virginiana*			3		0.6
California rose	*Rosa californica*			3		0.6
Skunkbush	*Rhus trilobata*			3		0.6
Ponderosa pine	*Pinus ponderosa*			3		0.6

[1] Willow/ Alder assemblage: 10 total plants includes 8 to 9 willow, one alder, and the equivalent of one ash in every other planting

[2] Xeric Transition Assemblage: 3 total plants are selected from the xeric transition species group

[3] Tule/ Rush Assemblage: 8 total plants are selected from the emergent vegetation group

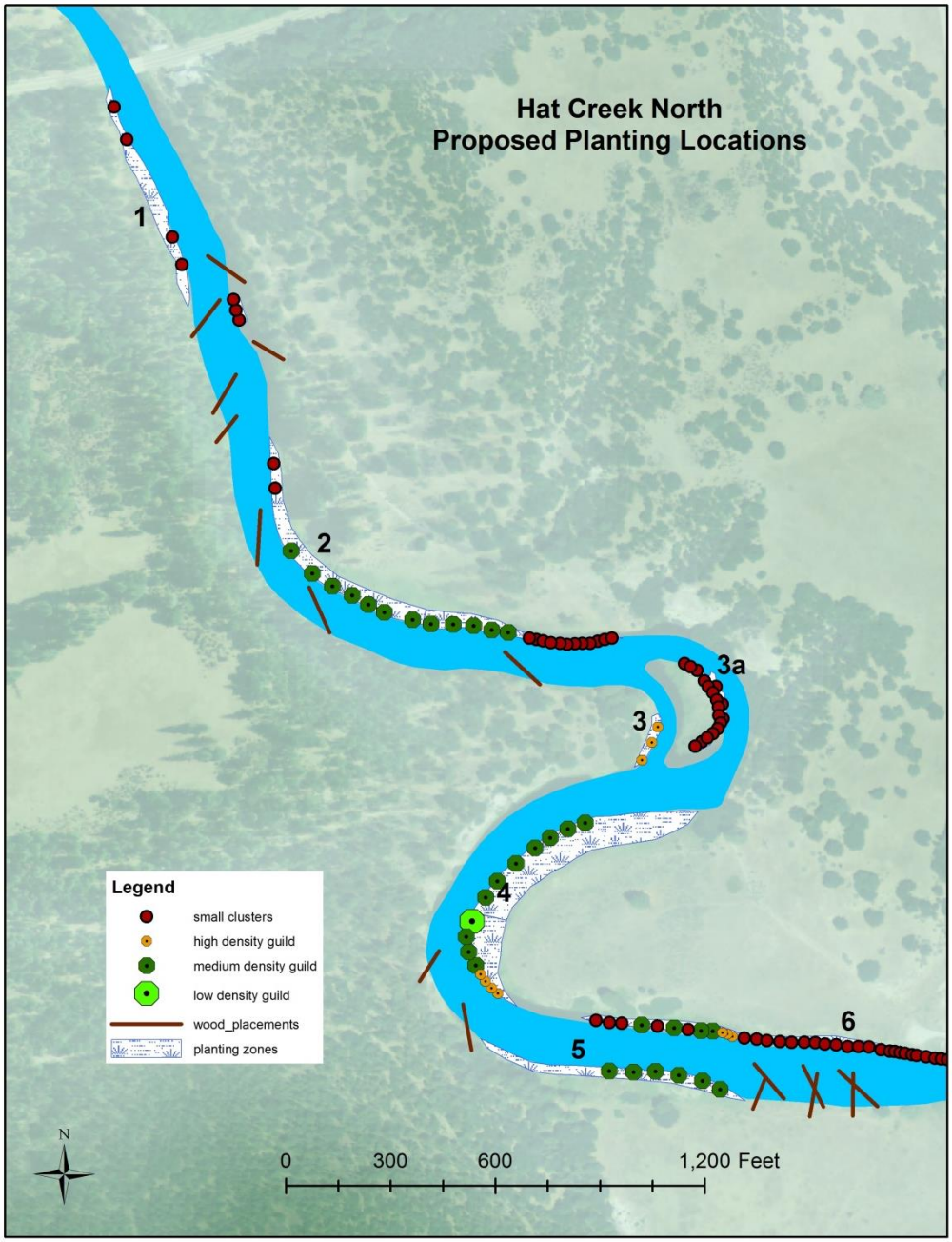

Figure 4. Proposed planting locations for the northern half of the lower Hat Creek Wild Trout Area restoration reach. In this and all subsequent planting location maps, proposed wood placement locations are shown for reference. More information on proposed wood placement can be found in the Hat Creek Geomorphic Assessment (Kiesse, 2013).

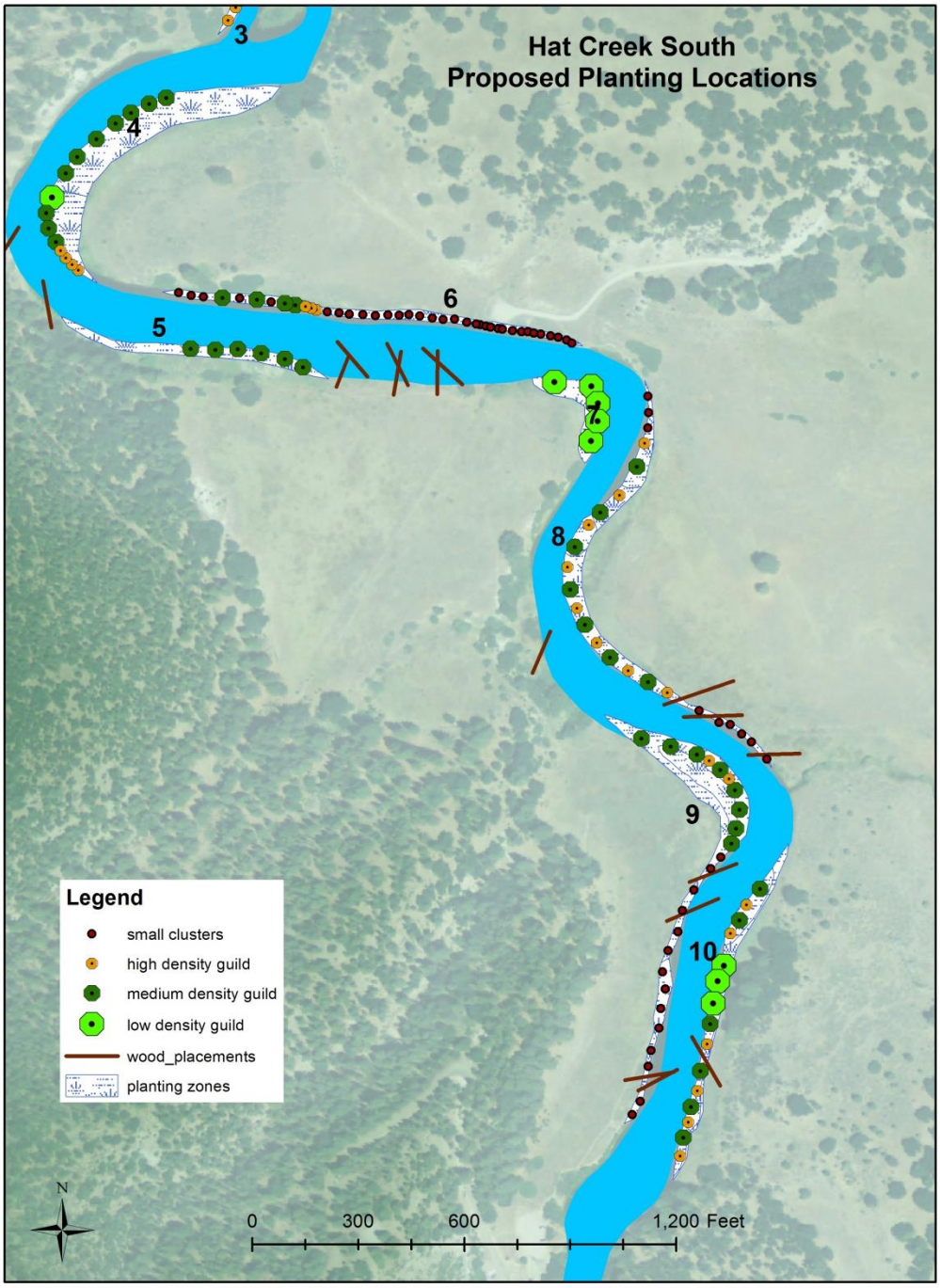

Figure 5. Proposed planting locations for the southern half of the lower Hat Creek Wild Trout Area restoration reach. Note: Wood placement locations may be changed and are shown for reference only. See the Hat Creek Geomorphic Assessment (Kiesse, 2013) for more information on large wood placement.

Table 5. Total number of plants per zone by species.

		Number of Plants per Zone										
Common Name	Scientific name	1	2	3	3a	4	5	6	7	8	9	10
Pacific willow	*Salix lasiandra*	52	305	104	128	297	153	257	137	329	273	297
White root sedge	*Carex barbarae*	0	48	12	0	60	24	28	20	73	40	60
Spreading rush	*Juncus patens*	0	48	12	0	60	24	36	20	73	40	60
Cattail	*Typha latifolia*	0	48	12	12	60	24	36	20	73	40	60
Tule	*Schoenoplectus acutus*	0	48	12	12	60	24	36	20	60	40	60
White alder	*Alnus rhombifolia*	4	25	5	14	23	9	19	8	27	22	23
Oregon ash	*Fraxinus latifolia*	2	10	2	0	8	3	8	3	10	9	8
Sierra gooseberry	*Ribes roezlii*	1	18	3	3	15	6	18	5	15	17	15
Black hawthorn	*Crataegus douglasii*	1	10	1	3	5	2	13	2	5	10	5
Douglas spirea	*Spiraea douglasii*	1	18	3	3	15	6	18	5	15	17	15
California rose	*Rosa californica*	0	6	1	0	5	2	7	2	5	3	5
Red osier dogwood	*Cornus sericea*	1	10	1	3	5	2	13	2	5	10	5
Common chokecherry	*Prunus virginiana*	0	6	1	0	5	2	7	2	5	3	5
Klamath plum	*Prunus subcordata*	1	10	1	3	5	2	13	2	5	10	5
Blue elderberry	*Sambucus mexicana*	0	6	1	0	5	2	7	2	5	3	5
Skunkbush	*Rhus trilobata*	0	7	1	0	6	2	8	2	6	4	6
Ponderosa pine	*Pinus ponderosa*	0	7	1	0	6	2	8	2	6	4	6
Incense cedar	*Calocedrus decurrens*	0	2	1	0	3	1	1	1	3	2	3
	Totals:	63	632	174	181	643	290	533	255	720	547	643

V. Zone Specific Descriptions

Zone 1 - West side of creek, just above the Hwy 299 Bridge

This area, just above the Hwy 299 Bridge at Hat Creek State Park, has high native plant diversity and low to no invasive plant occurrence. Bank erosion is high. Mapped planting areas are low terrace habitat. Willow/ alder plant assemblages are recommended for this zone.

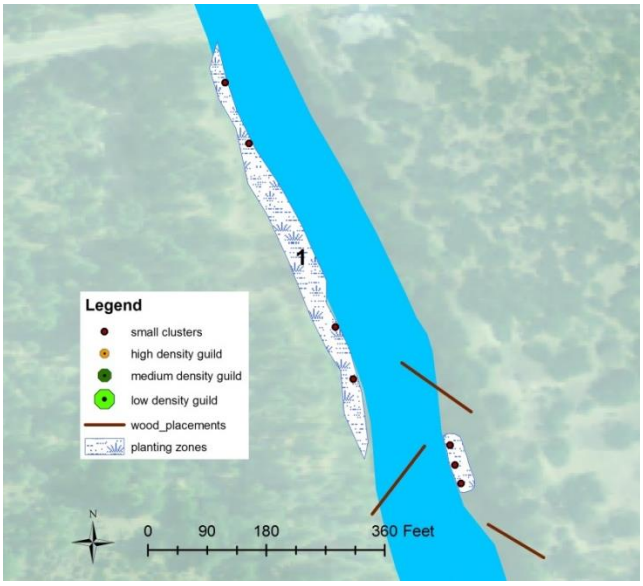

Figure 6. Zone 1 planting area showing small plant assemblage locations and large wood placements.

Zone 2 - East side of creek, below Wood Duck Island

This area includes a large expanse of low terrace habitat that extends up to 100 feet up-land from the water's edge. The bank edge is highly eroded but is dominated by native sedges, forbs and a few shrubs. A large teasel patch occurs in the transition area between the wet lower terrace and drier upper terrace zone. A diversity of moderate density guilds and small plant assemblages are recommended for this location.

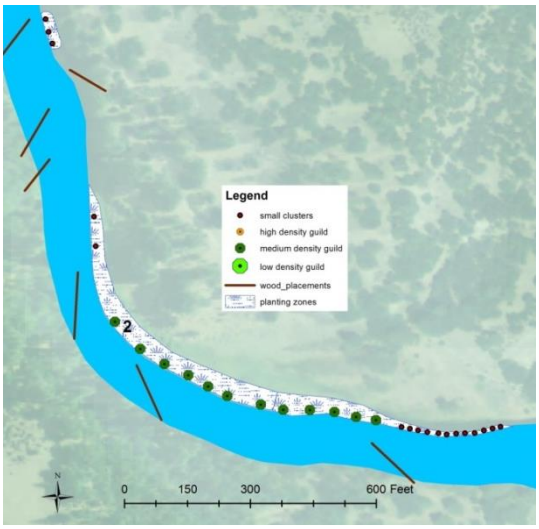

Figure 7. Zone 2 planting distribution of guilds and small plant assemblages.

Zone 3 -- Wood Duck Island, west side of creek

Across from Wood Duck Island, on the west side of the creek, a few high density guilds are recommended for planting along the narrow wet zone to promote bank stability and compete with invasive teasel. Downstream around the same bend, native alder, dogwood, sedges, cattails, rose, spirea, willow and ribes represent nearly a "reference" community of native plants growing in the low terrace and transition zones.

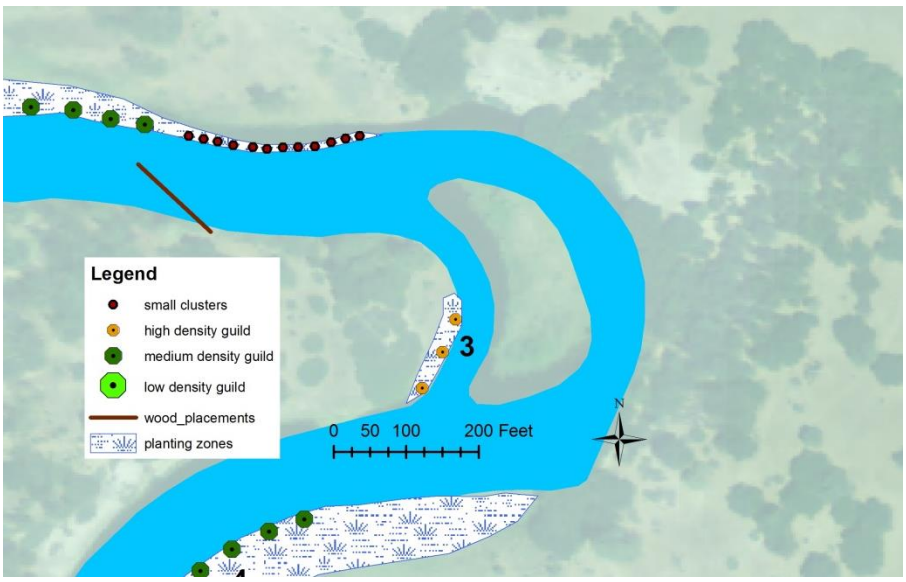

Figure 8. Zone 3 showing high density guild planting locations.

Zone 3a - Wood Duck Island

Wood Duck Island affords a unique opportunity to develop overhanging canopy on both sides of the stream channel. These plantings are intended to improve shade and nutrient inputs to the creek in this reach. Recommended planting composition is primarily willow, with some alder, native shrubs, and a small number of tule or cattail transplants. Due to significant bank erosion on the eastern edge of the island, plantings will generally begin approximately 10 feet in from the water's edge.

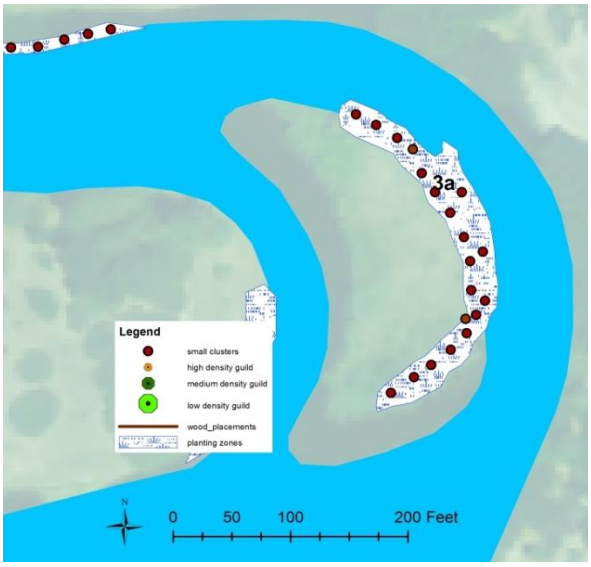

Figure 9. Zone 3a covers the east side of Wood Duck Island. Map shows small cluster planting locations.

Zone 4 - Central Bend above Wood Duck Island

In this Central Bend area, the stream margin has significant bank retreat throughout the majority of the zone, while a smaller section has a healthy rush and cattail community. Varying density guilds are recommended for the stream edges, but planting along the shoreline should be skipped where the edge is dense with rushes and cattails.

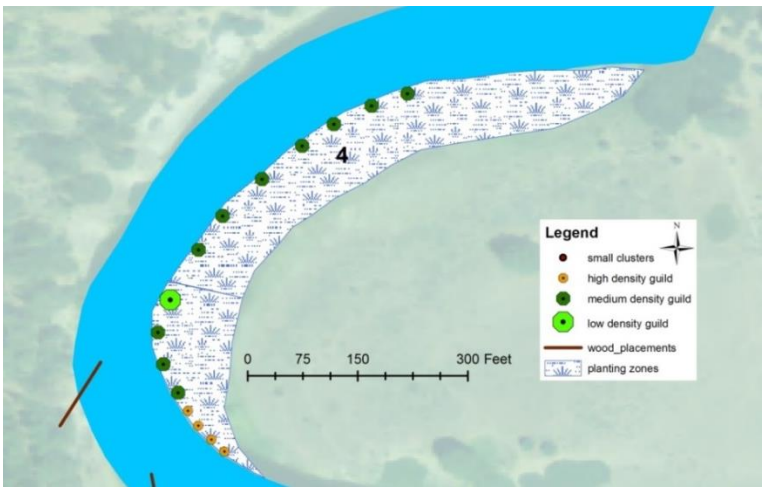

Figure 10. Zone 4 guild and small cluster planting locations.

Zone 5 - South bank, opposite Carbon Bridge

Zone 5 has high native riparian shrub diversity in the western portion of the zone but also has a heavy reed canary grass (RCG) infestation in the area opposite and downstream from the Carbon Bridge structure. Heavy planting to compete with RCG is recommended for the central portion of this zone. Following large wood placement to the east of zone 5, we recommend inter-planting the log structures with Tule and cattail clusters to promote soil retention and wildlife habitat (see Figure 12, south side of creek to the east of Zone 5).

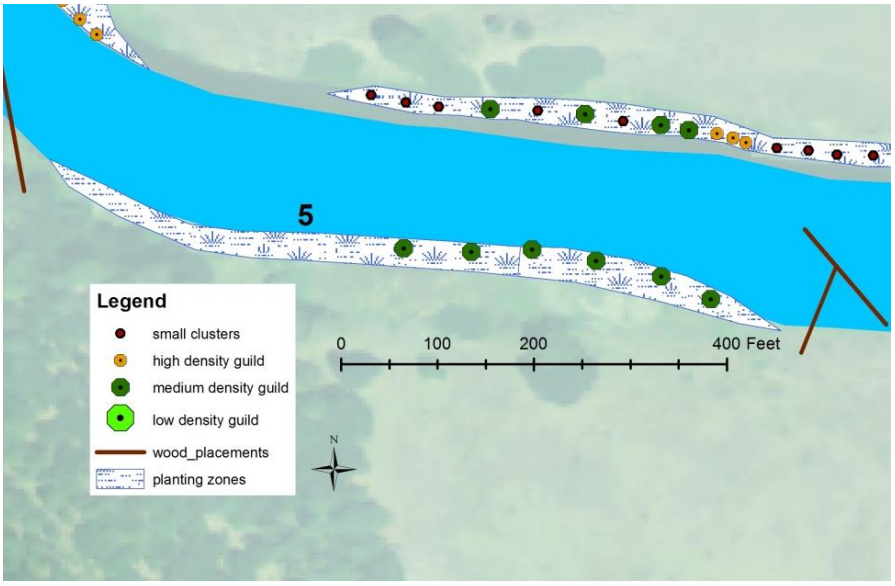

Figure 11. Zone 5 medium density guild locations.

Zone 6 - Carbon Bridge

The Carbon Bridge planting zone (Figure 12) has 3 distinct areas to plant. In the central portion of the zone, heavy planting along the armored bank structure is recommended to improve habitat diversity and structure. There is a narrow strip of deep soil that was filled behind the wooden structure that should provide a good substrate for a variety of container grown trees and shrubs. Because this area is highly disturbed and subject to heavy recreational use by anglers, larger tree stock could be used in this zone to accelerate the development of riparian habitat. Recommended planting composition for this zone is evenly distributed between taller trees and shorter shrubs (Table 3). Installation of a mix of shorter shrubs should help ensure openings and areas of low growing vegetation that would not inhibit anglers from casting on or near shore.

On the west end of the zone, standard low terrace planting guidelines can be applied. Particular attention should be paid to planting at the end of the Carbon Bridge wooden structure where heavy erosion of the low terrace zone has occurred.

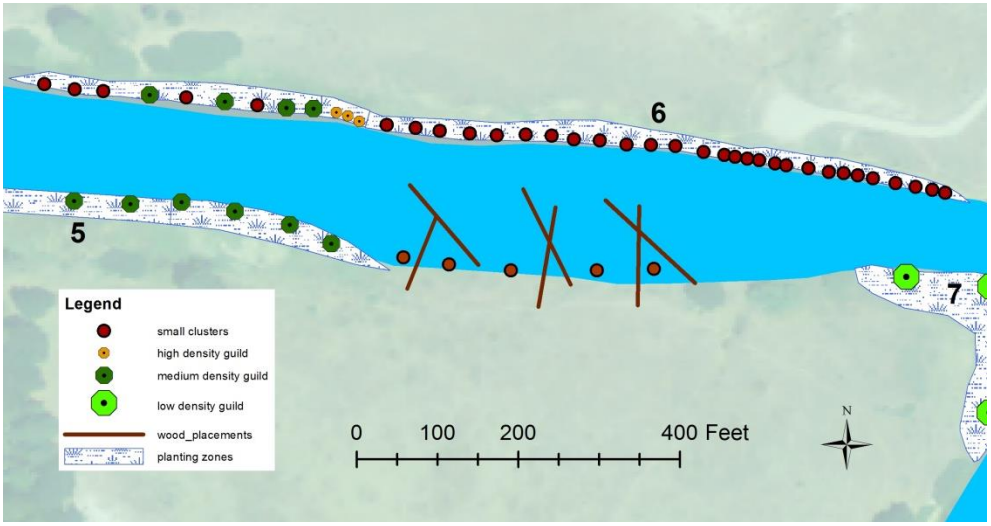

Figure 12. Zone 6: proposed guild and small cluster planting locations shown for the Carbon Bridge site.

Zone 7 - South bank bend, opposite from Carbon Bridge

The level of native plants is high in this location and the density of invasive weeds is very low, however, bank damage is also high. Several low density guilds planted here would be expected to increase bank strength and plant species diversity.

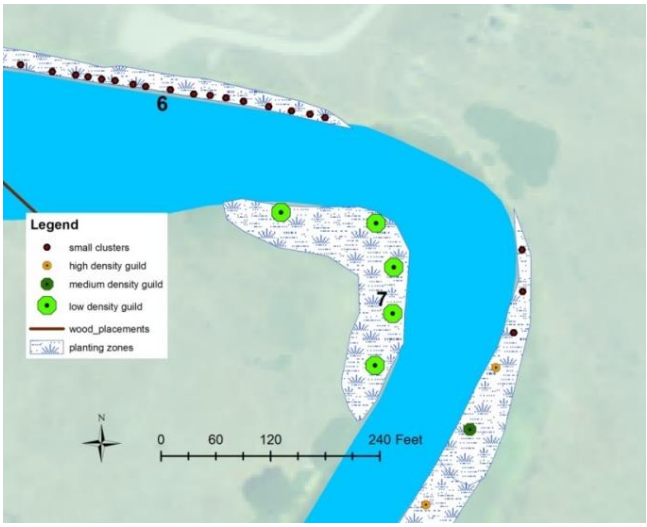

Figure 13. Zone 7 showing low density guild placement.

Zone 8 - East side of bank, south of Carbon Bridge

Zone 8 should be heavily planted on the upstream portion of the curve due to the heavy RCG infestation and high level of bank degradation. Where the native sedge and forb community is healthy lower in the zone, plantings should be less dense. Planting prescription: distribute medium and high density guilds evenly throughout zone. Use landscape fabric in canary grass areas and no fabric in predominantly native plant areas.

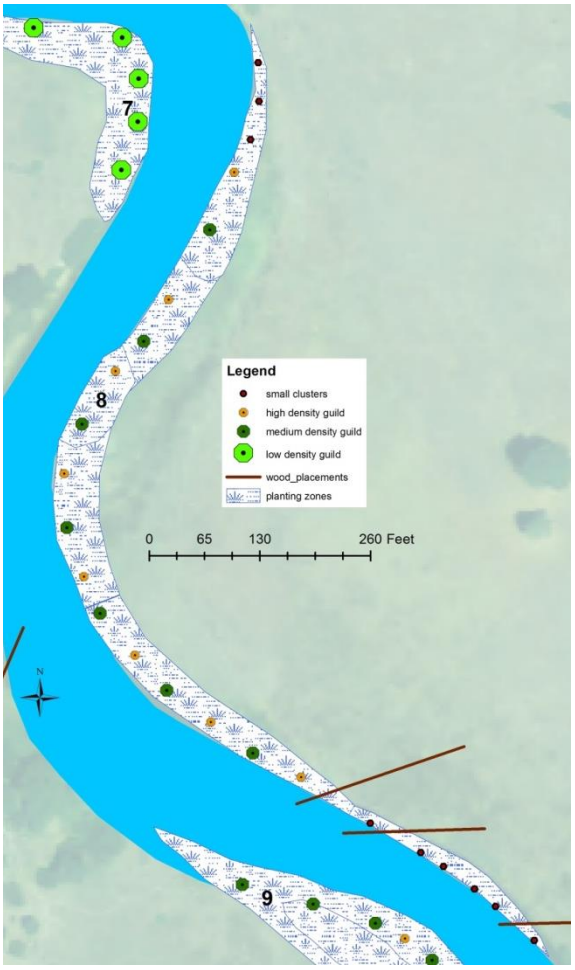

Figure 14. Zone 8 guild and small assemblage distribution.

Zone 9 - West bank downstream from the Hat 2 Powerhouse

The upper portion of zone 9 is slated for large wood placement, and inter-planting of willow/ alder clusters along the narrow wet margin is recommended to compete with RCG and add vegetative complexity between the wood placements. Guild density and placement should vary with invasive weed density and bank degradation along the lower section of the zone. Alternating willow/ alder and shrub clusters are recommended here. Landscape fabric should be used in RCG locations.

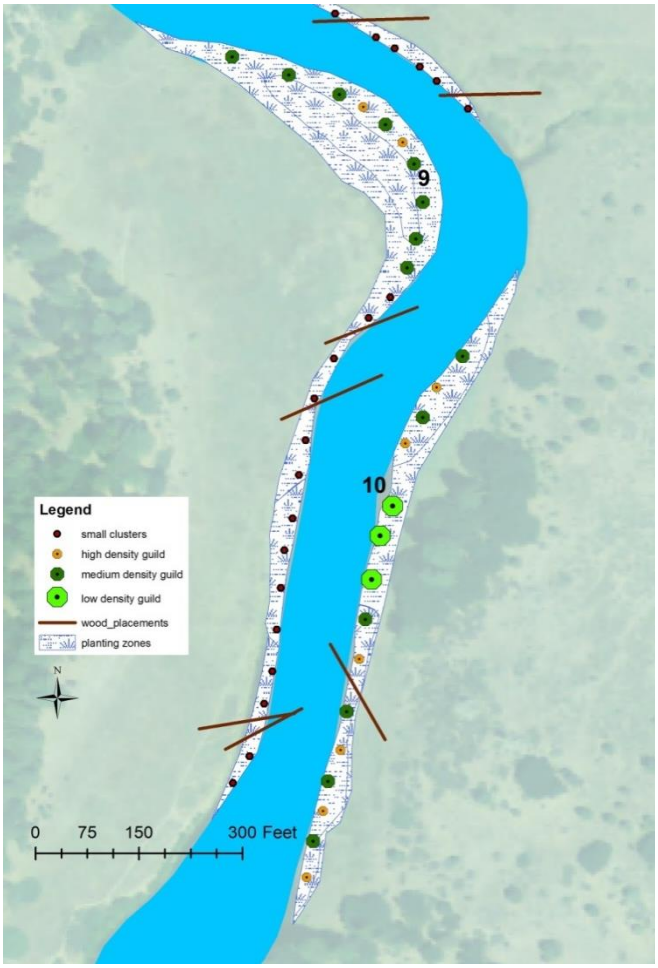

Figure 15. Zones 9 and 10 showing proposed guild and small plant assemblage placements.

Zone 10 - East bank, downstream from Hat 2 Powerhouse

A diversity of guilds and small plant assemblages should be planted at regular intervals throughout this zone for bank stabilization with gaps to allow access for anglers. Zone 10 could provide excellent monitoring and adaptive management opportunities to examine the influence of varying density guilds on plant survival and competitive interactions with RCG, teasel, and poison hemlock.

VI. Planting Methodology

A. Planting Tools

Plants will be installed with hand tools such as planting shovels, hoe-dads and dibbles. These tools are all specially designed to be utilized for restoration out-plantings. Planting shovels have long skinny planting blades for digging deep holes that are not too wide. Hoe-dads are generally designed for bare roots, but can also be used for plants that need a shallow hole. A dibble is long rod-like tool used for creating deep holes for willow cuttings. A planting auger may be used for

larger container stock in deeper overbank and upland soils. The auger can also be used ahead of the crew to open up planting holes ahead of the planters, especially in difficult areas. Lastly, the McLeod tool has a hoe-like blade on one side (and a rake on the other side) that is useful for removing the sod layer prior to planting.

B. Planting Timing

Planting will occur during the dormant season, starting as early as November 15, 2014 and extending no later than March 1, 2015. A seasonal window of time is proposed because weather conditions will have a direct influence on the exact month, week and day(s) that the planting will be implemented. The duration between late fall (mid-November) and late winter (early March) is acceptable for restoration out-plantings, as long as the ground is not frozen or covered in excessive amounts of snow. Dormant rather than actively growing plants can handle the highest amount of disturbance from nursery to staging area to out-planting. Once the plants start to come out of dormancy, the new root and vegetative growth should be in the field and not in the container. Late fall is ideal because the plants get a chance to acclimate during dormancy. Late winter is also acceptable, especially if the fall was dry and unseasonably cold.

The plant order will be delivered to an auxiliary location in Burney in November. The staging site is to be confirmed, but it will be an area where the plants can be safely monitored and cared for until the actual planting date(s). An ideal location will be the (future) site of the Pit River Tribe native plant shade house nursery. Once the order has been acquired from Floral Native Nursery in Chico, California, weather will be monitored to determine planting timing. The planting site must receive fall rains prior to planting. If fall rains have been inadequate and the window is pushed into early 2015, plantings should coincide with spring rain forecasts.

C. Planting Layout

Layout of plants will follow the planting design described in this plan. It is recommended that this is performed by a team of restoration professionals. Plants must be handled carefully at all times. Planting zones will be accessed by an ATV and on foot. Upon completion of each zone delivery, the team of planting technicians will set out the plants in the field prior to planting as the design specifies. Adjustments for layout can be made +/- 20% based on field observations. Spreadsheets will be made available to the layout crew to assist in sub-dividing and tracking the prescribed plant inventory into species amount per zone, guild and assemblages.

D. Planting Installation

Once plants have been properly laid out in a zone, a crew can begin site preparation, planting, mulching and caging with the oversight of a technical team. Planting technicians will work in conjunction with the crew to ensure that plants are properly installed while the next zone layout

is being finalized. Layout and installation should be coordinated in an organized sequence to create an orderly flow and ensure proper oversight and review at all stages of the operation.

E. Site Preparation

Where invasive species occur, variable sized sod layers will be cut back to bare mineral soil with a McLeod or hazel hoe hand tools. This will remove competition from the non-native vegetation to increase survival of out-plantings. The size of the sod layers removed will vary from 12" to 24" based on plant size and surrounding vegetation. At site locations where native vegetation is intact, sod removal is not recommended. On bank edges with high retreat, willow cuttings will be planted (holes will not be excavated) in an effort to reduce soil disturbance and prevent further erosion.

Additional site preparation and planting recommendations in areas with heavy reed canary grass, teasel, and poison hemlock infestations:

1- Mow prior to seed set in early summer to limit seed production
2- Hand pull or mechanically remove competing vegetation and plant densely with willows, shrubs and rushes
3- Thoroughly cover planting area with mulch/ landscape fabric.

F. Hole Depth

Planting holes should be dug 1.5 times wider than the container size of the plant. The hole should be dug as deep as the root system to ensure the root collar is level with the ground and not covered by soil. It is appropriate to flatten the bottom of the hole and tamp it to firm the soil so that the plant doesn't settle in deeper later. When digging the planting hole, the native soil should be kept in an easily reached pile. When ready to backfill the hole, it is good to mix topsoil and subsoil together. As the hole is being dug, the size of the hole should be compared to the container size of the plant. Simply putting the container in or next to the hole is a good measure. It is important to finish digging the hole before removing the container. It is ideal that the disturbance to the root mass is minimal when the root mass is pulled from the container, unless it is root bound. If root bound, the root mass needs to be purposely broken up and any long roots completely encircling the root ball should be cut free. Planting technicians and oversight from a skilled tree planting project manager in the field are necessary to convey planting methodology in detail to the planting crew to increase plant survival.

G. Plant Installation

Plants that have been transported to the restoration site should be well-watered and cared for prior to the installation. Carefully extracting the plant from the container is the first step of successful plant installation. Plants treated with care have increased rates of survival. The importance of proper planting depth cannot be overstressed. If planted too high, the exposed root collar will dry out the specimen; if too low, the vegetative structure of the specimen will be

compromised. Either scenario will increase the chance of mortality. Carefully pack the soil firmly around and on top of the root mass so root collar is even with the surrounding terrain to avoid air pockets.

All willow cuttings need to be pushed into the soil as deeply as possible. A hammer may be used to pound willow stakes into wet soil. Less top vegetation corresponds with improved survival rates. A final inventory of installed plants will be tallied during each completed zone.

On the planting day, newly planted material must be watered in, regardless of the current weather or forecast. Watering immediately promotes closer contact between roots and soil and provides necessary moisture and decreases the impact of transplantation shock.

H. Mulching

Mulching fabric such as Vispore will be used in areas of heavy invasive weed infestation (e.g., teasel, reed canary grass and poison hemlock). The Vispore will need to be fastened on each corner with landscape pins. Mulching fabric will generally not be used where surrounding plants are native. In drier, upland areas, mulching planted trees and shrubs (such as ponderosa pine or skunkbush) is recommended to suppress competing vegetation (generally annual grasses) and facilitate moisture retention.

I. Caging

Individual plants and plant assemblages will be caged with welded wire fencing and t-posts of a 4 foot minimum height. A combination of individual, group and exclosure fencing will be used adaptively within each planting zone. Ponderosa pine, ash, elderberry and other larger single plants will benefit from having fencing put around each individual. Clumps and clusters of willow, alder, dogwood, and Douglas spirea will be fenced in small groups, but large enough so that maintenance can occur. Exclosure-type fencing will be used for the largest clusters. The maximum size for exclosure fencing will average no more than 6-8 feet in diameter. These will be large enough to allow access for maintenance, but small enough to discourage deer from jumping inside. Cuttings will generally not be fenced, primarily due to the fact that they are on the extreme bank edge where fencing is not practical. Caging will be spaced so that anglers can still access the banks in between the guild spacing. Adaptive management will be utilized in regards to fencing. If post planting monitoring reveals heavy predation by small mammals, additional protective measures (such as retrofitting with small gauge wire) will be used. Replacement plantings will be installed and protected to ensure the target survival rate of 70 to 80% during the first two years following initial planting.

VII. Plant Acquisition

Lomakatsi has planned a purchase order from a supplier who specializes in propagation of native California plants for most of the prescribed plants. Floral Native Nursery from Chico, California is a native plant nursery that has a successful history of supplying restoration planting contracts.

Specimen stock described herein as size (cubic inch of soil) and containerized form (size of pot) have been strategically selected in regards to all aspects of site out-planting methodology. Species in the Hat Creek plant list (Table 1) have different rooting/vegetative growth patterns in and out of the containers in which they are grown. Plant stock size was selected to balance the highest likelihood of plant success for the lowest cost possible. Plant stocks selected for each species are listed in Table 6.

A proportion of the plant list is comprised of species such as Pacific willow, sedges, rushes and Tule. These species can be successfully propagated as cuttings and transplanted directly into the field. In addition to these cuttings, Lomakatsi has incorporated these same species into the planned purchase order of containerized plant stock. The strategy of mixing containerized stock with cuttings will increase overall survival rates by not relying solely on the success of cuttings.

A. Plant Propagation and the Pit River Shade House

Additional native vegetation will be propagated from seed and cuttings in the Pit River Tribe's native plant nursery. Nursery development is ongoing in consultation with Germain Boivin of the Floral Native Nursery in Chico. Plant materials propagated at this nursery will be available for out- planting 2-3 years from propagation initiation and will be inter-planted in the Hat Creek project area to replace anticipated out-planting mortality.

Table 6. Site species listed by plant stock size. Listed codes: DP = Deep pots; TB= Tree band; TP= Tree pot; 1G= 1 Gallon. See text for a full description of each plant stock type.

Common Name	Scientific Name	Total Plants	DP	TB	TP	1G	Cuttings
Pacific willow	*Salix lasiandra*	2354	1290				1064
White alder	*Alnus rhombifolia*	179	107		72		
Oregon ash	*Fraxinus latifolia*	60	30		30		
Ponderosa pine	*Pinus ponderosa*	44			44		
Incense cedar	*Calocedrus decurrens*	17				17	
California rose	*Rosa californica*	37		22		15	
Sierra gooseberry	*Ribes roezlii*	115		74		41	
Black hawthorn	*Crataegus douglasii*	56	28		28		
Red osier dogwood	*Cornus sericea*	55	55				
Common chokecherry	*Prunus virginiana*	37	37				
Klamath plum	*Prunus subcordata*	56		56			
Blue elderberry	*Sambucus mexicana*	36	21		15		
Skunkbush	*Rhus trilobata*	44				44	
Douglas spirea	*Spiraea douglasii*	115		65		50	
Cattail	*Typha latifolia*	380		306			74
Tule	*Schoenoplectus acutus* var. *occidentalis*	380		306			74
"White Root" sedge	*Carex barbarae*	348		300			48
Spreading rush	*Juncus patens*	368		300			68
	Totals:	4681	1568	1429	189	167	1328

B. Plant Stock Size Descriptions

Cuttings

All Pacific willow cuttings will be obtained within a similar elevation band as the planting zone (2500-3000 feet) and in the general geographic location of the Hat Creek WTA. Cuttings will be gathered during the dormant season after all leaves have dropped and prior to the formation of buds or flowers (December-March). Size of cuttings selected can vary between "pencil" and "thumb" sized, but they must be young live lower branches or "sprigs". Lomakatsi has identified numerous "nursery" locations of Pacific willow clumps that could be used as cutting sites in and near project area. Willow cuttings will be cut the day of planting, or may be soaked in buckets of water for less than one week before planting. Sprigs can be planted in small bundles of 3-5 and often just pushed into the wet, mucky bank.

All root cuttings of cattail, Tule, sedge and rush will be obtained on the same day as the dormant season planting. Roots will only be dug in areas where large populations are most intact and furthest away from the bank. Only portions of root clumps are to be divided in whole chunks from the mother plant. The root clump divisions can then be carefully planted and tamped into the soil in appropriate wet locations.

"Deep Pot" (DP)

These long, cylindrical containers have 40 cubic inches of soil and are 2.5 inches in diameter by 10 inches long. They are used for species that require deep rooting strategies and/or tap roots which give them a survival advantage in the field as out-plantings. The roots are able to reach the water table successfully within the first year or two. The narrower and deeper pot designs generate a deeper root system allowing transplants in a montane riparian planting environment to maintain contact with the capillary fringe for a longer period of time than is the case with shallower and wider stock types with the same root volume.

"Tree Band" (TB)

These compact containers have 20 cubic inches of soil and are 2.5 inches square by 5 inches long. This stock is appropriately used for specimens that have a rhizomatous rooting strategy that can spread laterally in the field. They do not require a deep hole and can be planted quickly. The tree bands are also easy to transport in the field.

"Tree Pot" (TP) and ***"1 Gallon" (1G)***

Both these containers have 180 cubic inches of soil. Although more costly, these sizes are recommended for specimens that a) are prescribed in low overall amounts, b) are more prone to mortality if planted in smaller stock, and c) contribute to a diversified strategy of planting bigger stock within the guilds. A "Tree Pot"' is 4 inches squared by 14 inches long and benefits plants that, similar to Deep Pots, have deep rooting structures. "1 Gallon" is 6 inches diameter and 7

inches long and benefits plants that don't do well in containers and/or have a lateral, rhizomatous rooting strategy.

VIII. Monitoring

Lomakatsi has developed a science-based monitoring regime to enable use of adaptive management strategies to improve restoration success. During the time of planting an inventory database of each planting assemblage with a unique identifier and spatial location will be compiled. This database will be updated during bi-annual inventory assessments of plant survival to detect patterns of plant mortality or other damage to plantings. A brief report will summarize the results of each bi-annual inventory assessment to enable adaptive management. Immediate changes to site management (i.e., changes to the watering regime, fencing, signage, replacement planting, etc.) can then be implemented. Monitoring of survival and maintenance of plantings will be conducted throughout the life of the project (through November 2017). A survival target of 70 - 80% will be maintained.

Photo points will also be established in each planting zone. Photo points will be established prior to planting and will be re-sampled following planting and during the final inventory (November 2017). Photo points will be re-sampled as needed to accompany bi-annual inventory assessments. At each photo point we propose the use of a wooden stake hammered in low to the ground in addition to a spatial location description to facilitate accurate point resampling. A standard reference photo board will serve both as a size reference and to identify each point in each photograph. The camera type and settings will be recorded along with the date, height of photo, and photo location. At the close of the project Lomakatsi will provide inventory data and a summary report of native planting survival.

A. Adaptive Management

Adaptive management is a structured process that integrates monitoring and implementation to reduce uncertainty and inform decision making. Information is strategically collected to evaluate management targets to enable improved future management. This process can be used to learn about a system and how it responds to changes, and can improve long-term management outcomes.

An adaptive management strategy is recommended throughout all phases of this restoration project and feedback from all interested parties is crucial to informing future restoration success. Both implementation and effectiveness monitoring will be used within an adaptive management context. Implementation monitoring will occur during plant installation where site conditions may dictate changing strategies. Effectiveness monitoring will be conducted on a bi-annual basis to assess planting survival that will inform ongoing maintenance, future planting design, and propagation approaches.

IX. Maintenance

Routine maintenance of restoration out-plantings is important to improve overall quantity and quality of survival rates. The maintenance strategy may be modified as a result of information obtained from bi-annual plant survival monitoring assessments gathered in the field. Upon analysis of the monitoring data, an adaptive management approach will be utilized to improve planted species survival. The standard protocol for long-term out-planting success is to invest in varying degrees of repeated maintenance during the first two to three years. After a period of two to three years, out-plantings should become established to survive without general maintenance, although attention to repair of fencing may still be required to prevent depredation from animal damage such as deer, beaver or small mammal activity.

A. Watering

Restoration out-plantings will need routine watering, depending on their field specifications (plant type and field placement). The watering regime per plant grouping can also be modified based on observations during the period of active plant monitoring.
From June 15 to September 15, during decreased rain and higher average temperatures in the project area, it is recommended that mesic and xeric restoration out-plantings be consistently hand-watered. This will encourage acclimation for containerized plant stock (and some cuttings) to successfully transition to the long-term field setting. The underlying principle is to encourage plant root establishment and rapid growth patterns into the water table.

In general, it is recommended in the first year that the mesic and xeric plants be periodically hand-watered a minimum of once every 7-10 days between the months of June 15 to September 15. This schedule may be changed following precipitation trends. A rule of thumb is that 1" total local rainfall is sufficient to postpone a 10-day period until the next cycle.

A minimum of one gallon per plant per watering will assist in specimen survival. Due to the planting location in proximity of the water's edge in a guild and cluster assemblage arrangement, a system of hand-watering can be achieved by dipping 5-gallon buckets into Hat Creek and pouring it onto the base of the plants. A small, portable in-stream water pump may also be used to assist this process. A "bucket brigade" can be efficiently facilitated through California Trout's Youth Program, a volunteer-coordinated group, or through the Pit River Tribal workforce. A central person will need to coordinate and document the amount and frequency of watering events to ensure that baseline watering measures are being met. Plants can adapt to routines and have a better chance of survival if practices are established and continued. The frequency of watering can lessen as the plants show signs of establishment over the course of two to three years.

Aquatic specimens properly planted in the hydrophytic zone may not need to be considered for a watering routine, unless monitoring suggests otherwise. Xeric and mesic type plantings will need routine watering where they are not planted in contact with the water table.

Alternative watering methods, other than what is currently proposed in this plan, include irrigation systems that require a large initial investment in infrastructure. Gravity-fed systems require holding tanks placed at strategic locations higher in the elevation profile. Holding tanks need to be leveled on multiple points of the landscape. Timers, irrigation fittings, pipe and water-emitters all need to be laid out from tank to plant. Holding tanks need to be filled by means of a pump system. Overall, the final design of a holding tank system may require a professional irrigation specialist. Once established, this system can efficiently operate at programmed intervals, although it will also need routine maintenance.

Lastly, there are a variety of water pumps on the market that can be manually placed in the creek and watered with a hose attachment per zone. This may be needed to supplement the hand watering effort as planned.

B. Mowing/Weeding

Restoration out-plantings will benefit from periodic reduction and removal of invasive weed competition. Mowing by means of gas-powered weed-eaters is the most effective way to reduce competition. Cutting back the weeds around the fence perimeter will provide the out-plantings with more access to sun, nutrients and water.

Hand-weeding around the base of out-plantings may also be necessary to remove competition. Mulch fabric can become compromised by aggressive invasive plants, wind, animals or other disturbance. In this case, maintenance can be achieved by digging up the roots of invasive plants with planting shovels. A concentrated effort should be made to not further damage the restoration specimen when removing invasive plant competition near the base. After weeding, it is recommended that the mulch fabric be repaired and pinned back in place.

X. Upland Legacy Pine-Oak Management

Oregon white oak (*Quercus garryana*) and ponderosa pine (*Pinus ponderosa*) occur within the riparian area of influence of the project. These trees are presently providing streamside shade and will provide future large wood for the aquatic system.

Young conifer encroachment poses the main threat to these larger trees. Due to lack of recent fire disturbance, many young sapling and pole size, 1-10 inch dbh (diameter at breast height) ponderosa pine have become established in high densities. Encroachment affects individual oaks as well as understory associates. The oaks are showing signs of vigor loss from conifer encroachment including large limb mortality and crown dieback. Many young conifers are already piercing into or are poised to pierce through the woodland canopy within the next two decades. If conifer density is not reduced, these large older legacy trees will decline with time due to increased shade and competition for nutrients, sunlight and water resources.

In an effort to increase the “hang time” of these large trees that are serving an important ecological function for both the aquatic and terrestrial system, Lomakatsi proposes to remove the

small encroaching tree stems from under and around the larger trees. The purpose of this radial thinning is to release and increase the vigor of preferred species, while ensuring favorable fuel conditions that limit possibility for fire-related mortality. This legacy tree release prescription calls for thinning trees less than 10” dbh in a radius of twice the dripline, or 30-50’ from the legacy bole, however, distances for drip line-radial thinning will be site specific. Generated activity fuels will be piled and burned.

Data collection and silvicultural prescription development for the 8.6 acre upland oak treatment zone (Figure 16) are scheduled for winter, 2014 and will be appended to this plan upon completion.

XI. Future Restoration Recommendations

A. Grassland Restoration

Lomakatsi recommends that restoration efforts be extended to the upland areas, which provide a constant input of nutrients, plant seeds, sediment and large wood to the riparian zone. The upland pine /oak woodlands and grasslands surrounding the project reach evolved under a frequent fire regime and are dependent on fire for long term ecosystem health (Agee, 1996; Taylor, 2000). Lomakatsi recommends that long term restoration planning for the Wild Trout Area and surroundings include restoration of native bunchgrasses in the upland, which would be implemented using a combination of prescribed fire, reseeding and hand pulling. Proposed prescribed fire units totaling 37.5 acres encompass upland meadow areas surrounding the WTA (Figure 16). Native bunchgrass seed including but not limited to: California brome (Bromus carinatus), native fescues (Festuca spp.), and squirreltail (Elymus spp.), could be cultivated and/ or purchased to accelerate bunchgrass re-establishment following prescribed fire and star thistle control methods. Fall-season prescribed fire, followed by hand pulling during the consecutive growing season, has been shown to heavily reduce yellow star thistle and non-native annual grasses while simultaneously stimulating native bunchgrass growth (DiTomaso et al., 2006). To successfully mitigate invasive weeds and establish native grasses, at least three burning and reseeding events over a five to ten year period are recommended. Additional treatment options may include use of a range drill to apply native bunchgrass seed with ammonium sulphate (21-0-0) fertilizer to accelerate bunchgrass establishment.

Figure 16. Upper Hat Creek WTA aerial image showing the upland legacy oaks management unit and proposed future prescribed fire units.

XII. References

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Appendix I. Cultural Plants and Traditional Ecological Knowledge

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General Notes on Cultural Plant Restoration and Maintenance

Indians in this region used from 200 to 300 plants in 10 cultural categories, and recognized and named most others. But due to loss of most traditional plant knowledge in modern times, both Indian and non-Indian land managers tend to artificially separate cultural from non-cultural species. It is important to remember, despite this loss of knowledge, that the few cultural species that are still known are an integral part of what we now term as "non-cultural" plant communities and should be treated in the same way. Similarly, wildlife habitat is composed of species that serve both an ecological and cultural function for those who still depend on certain animal species for food and cultural items.

Another way to look at the Hat Creek Riparian Restoration Planting Plan is as the restoration of an historical cultural landscape. Native youth who are beginning to become interested in their traditional culture will be able to walk through a landscape infused with cultural meaning as they recognize that most of the plants they see are part of their tribal heritage—and perhaps more importantly—their identity as a Pit River Indian.

Traditional Ecological Knowledge (TEK): Prescribed Fire a Traditional Plant and Animal Management Tool

Prescribed (Rx) Fire was used by all Indian peoples of the region (and most of the continent) to maintain and rejuvenate most plant communities and wildlife habitat. Survival would have been very difficult without regular burning. Women managed all vegetation fire-management except for the very large encircling fires used to trap deer and elk which were administered by men. Frequent light rotational fires of low intensity created and maintained a patchy fine-grained vegetation mosaic. Fires were often small, this year's burn butting up against last year's burn and serving as a "black line" to prevent fire spread. Fire modified plants for cultural use, (e.g., by inducing epicormic and adventitious sprouting suitable for baskets and cordage). Burns were usually done in the autumn every year or two, (e.g., oak savanna and grasslands), but also less frequently (5-10 years in oak woodland, Douglas-fir or pine forest at all elevations).

Riparian areas and wetlands or swamps were also frequently burned, usually after the close of bird nesting season, e.g., to stimulate Tule (*Scirpus* sp.) root for "black root" used for baskets and Cattail (*Typha* sp.) rhizomes baked for food in the spring.

Rx fire kept fuel loads low so that the kinds of very hot catastrophic fires we now experience were extremely rare if they occurred at all. Trees were widely spaced as single or small groupings, eliminating

ladder fuels that now carry fires into the tree overstory. Nutrients were continually recycled (e.g. increased acorn production) and legacy charcoal that sequestered carbon was a result of frequent light burning.

Indian peoples should be seen as very advanced horticulturists and wildland gardeners. Coppicing, tilling ("Indian potato" beds of geophytic corms like ookow, [*Triteleia* sp.]) to increase size of corms and tracts, transplanting, sowing, and selective harvesting were all important cultural practices, without any need to use all of their energy and time as Old World farmers have done for thousands of years. Had California Indians not been discovered by Europeans, they would have continued with their effective knowledge-rich and low-energy gardening indefinitely, still enjoying generous leisure time while being productive. Instead of being "proto" agriculturists (as anthropologists believe), they were sophisticated gardeners. With their removal from most of their Aboriginal homelands, we now have a place uncared for—a "wilderness".

Traditional Indian land care was (and still is in some places) highly knowledge-intensive, allowing considerable leisure time through much of the year. It was the original affluent society. Traditional knowledge-holders specialized in various aspects of landcare, e.g., burning (which was also accompanied by several days of ceremony and songs led by spiritual leaders), seed sowing and erosion control, plant gathering, fishing, hunting—advising band members when necessary, especially during extreme weather events like droughts and floods. Individuals, families, and clans took responsibility for a particular "turf" which was "owned" in the sense of being responsible for its health and productivity, e.g., oak groves, basket plant patches, berry patches, fishing locations, particular animal species, etc. Numerous hunting and fishing taboos ensured good conservation.

Knowledge of plants and animals was essential to survival. Even young children were knowledgeable. Each person in the band had a prescribed role to play in landcare. The reason that so many ecocultural plants have become scarce or are missing altogether is the lack of knowledgeable caregiving and loss of traditional ecological knowledge (TEK) due to genocide, forced assimilation, and poor government/private management, e.g., over-exploitation of resources exacerbated by fire suppression, removal of Indian stewards, and loss of local knowledge developed over millennia..

It is now time to bring back TEK and plant and animal knowledge, ensuring greater food sovereignty and security in time as knowledge is relearned and increased partnershipping with public lands agencies and private organizations like Cal Trout leads to greater access to lost lands and resources. What follows is a list of some of the more important ecocultural plants in the greater Hat Creek/Pitt River area. **Note:** *The use of the term "ecocultural" indicates that most cultural plants also play an important ecological role*.

Important Hat Creek Ecocultural Plants and Their Traditional Uses

Note: It *is important to recognize that many of these traditional plants are also useful medicine and food today. Native species once constituted 75% of US pharmacopeia.*

- • *Refers to species observed on site*
- + *Refers to species from region that could grow in Hat Creek area*

Riparian and Aquatic Plants

- • **Reed Canary-Grass** (*Phalaris arundinacea*) Native strains of RCG were boiled, dried in the sun, turned white, then soaked, and used by some tribes to superimpose white patterns on the weave of split-root baskets. Not sure of Pit River use. Mixed with non-native strains, it is now an aggressive "super-weed" in need of control.
- • **Red-Osier Dogwood** (*Cornus stolinifera*) Berries, bark for smoking mixture, medicine tea [called "red willow" by plains tribes and used in the Sacred Pipe]
- • **Tule** (*Scirpus* sp.) Called "blackroot" because its roots yielded a dark basket weave, used for thatched houses, reed boats, sleeping mats, cordage, and diapers by various tribes
- • **Cattail** (*Typha latifolia*)Rhizomes dug in spring, and baked for food, "cattail" seed panicle used in flat cakes
- + **Basket Sedge** (*Carex barbarae*) Called "white root" and used for baskets, still widely used by many tribes
- + **Yellow Pond-Lilly** (*Nuphar polysepalem*) Seeds and rhizomes used for food (called "wokus") as well as for TB, colds, contraceptive, blood tonic and all-around medicinal, wokus still eaten by the Klamath, usually mixed with wheat flour for delicious muffins
- + **Water Smartweed** (*Polygonum amphibium*) used for piles and itchy skin diseases
- • **Scouring-Rush** (*Equisetum hyemale*) Used as an abrasive for polishing wooden objects, basketry, treatment for urinary and kidney problems as a delicious tea
- + **Field Horsetail** (*Equisetum arvense*) used as a women's aborticant, as a green and tea
- • **Willow, Pacific** (*Salix lasiandra*)—**Scoulers** (*S. scouleriana*)—**Sitka** (*S. sitchensis*)—**Grey** (*S. exigua*) an important basket plant, and others. Used for making rope, basketry, shredded bark for diapers, weaving clothing, pain relief from leaves and bark (source of aspirin)
- • **Oregon** or **Bigleaf Maple** (*Acer macrophyllum*) Paddles and bows, leaves to cover pit-roast meat or camas corms, internal medicine and sore throats
- • **White Alder** (*Alnus rhombifolia*) Smoking salmon (especially when slightly punky), bowls, TB and other respiratory ailments from bark, red dye from bark, wash for skin infections as an anti-microbial

[“fixes” nitrogen, enriching soil that in turn nourishes a healthy understory of grasses, ferns, and sedges]

- **Oregon Ash** (*Fraxinus latifolia*) Tools, bows, anything needing a very tough, flexible wood
- **Black Hawthorn** (*Crataegus douglasii*) Thorns for many practical needs, including piercing ears, fish hooks, games, etc., hand tools and weapons, fruits eaten by many tribes, bark to treat venereal disease, thin blood, heart (one of the best medicines for heart health)

+ **Pacific Ninebark** (*Physocarpus capitatus*) Poisonous but still used at *proper dose* for internal medicine and laxative, and gonorrhea

+ **Black Twinberry** (*Lonicera involucrata*) and other *Lonicera* sp.. Barks and twigs used in medicinal treatment, ranging from digestive disorders to contraceptives, berries for black pigment

Mesic to Dry Upland Plants

Trees and Shrubs

+ **Sugar Pine** (*Pinus lamberiana*) Pitch used to repair boats, etc., fasten feathers to shafts, resin for chewing gum and medicines, seeds (although very tiny seeds in very large cones), vitamin C in new spring needles (steeped and drank as tea; this Indian knowledge saved Europeans from scurvy and death on many occasions; other pines and conifers were also rich sources of vitamin C). Important for wildlife thermal shelter and food: **Ponderosa Pine** (*Pinus ponderosa*) has similar wildlife benefits. Inner bark of many conifers served as a starvation food, spring needles for vitamin C, **Jeffrey Pine** (*Pinus jeffryi*) Basket made from split roots

- **Grey or Ghost** or **Foothill Pine** [formerly “Digger” Pine but that term is considered derogatory] (*Pinus sabiniana*) Large seeds are rich in nutrients comparable to Pinyon Pine, also parts of cones, bark, and buds. Important deer winter range.
- **Common Juniper** (*Juniperus communis*) Berries for urinary tract issues and many other ailments, used in meat stews. Berries eaten by some mammals and birds.
- **Garry** or **Oregon White Oak** (*Quercus garryana*) The Tree of Life for California Indians with ~50 cultural uses in 10 categories ranging from food to games—and is an extraordinary wildlife tree serving thousands of invertebrates, herps, birds, fungi, and mammals. Same is true for the other deciduous oak on site **Black Oak** (*Quercus kellogii*)
- **Western** or **Common Chokecherry** (*Prunus virginiana* var. *demissa*) Berries are eaten by both humans and wildlife, some species eat the foliage, bark peeled in strips for fastening objects
- **Klamath Plum** (*Prunus subcordata*) Plums eaten by humans and wildlife (some varieties have yellow, sweet fruits; others have red, bitter fruits)

- **Skunkbush** or **Sourbush** (once called “Squawbush” but “squaw is a derogatory term and not recommended) (*Rhus trilobata*) Stems (following burning) are an important basket material, berries for slightly sour but refreshing summer drink
- **Wedgeleaf Ceanothus** or **Buckbrush** (*Ceanothus cuneatus*) Leaves and flowers for medicinal teas and tonics, stems for baskets (following burning). Preferred wildlife browse, especially deer winter browse. Birds and wildlife eat seeds. Also used in *pinole* (mix of parched shrub, forb, and grass seeds)

+ **Deerbrush** (*Ceanothus integerrimus*) Flowers made into soap, seeds for *pinole*, very valuable browse

- **Sierra Gooseberry** (*Ribes roezlii*) Berries
- **Blue Elderberry** (*Sambucus mexicana*) Fruits, including wildlife, made into jellies, pies, wine. Digestive tonic and medicine

+ **Redbud** (*Cercis occidentalis*) Stems for baskets (following burning or pruning)

- **Greenleaf Manzanita** (*Arctostaphylos patula*) Fruit eaten, used to make cider, and as a diuretic. Tea from bark for diarrhea. Important wildlife food for birds and mammals of many species (especially bears, coyotes, and foxes)

+ **Mt**. **Dogwood** (*Cornus* nuttallii) Very tough wood for various cultural items, e.g., harpoons, bows, arrows, and implement handles. Bark for blood purifier and stomach ailments, dark-brown dye

+ **Utah Service-berry** (*Amelanchier utahensis*) and **Saskatoon-berry** or **Western Serviceberry** (*Amelanchier alnifolia*) Delicious berries. Tough wood for implements, arrows, digging sticks, drying racks. Several varieties were developed by Indians through selective harvesting. Important winter browse for deer and elk. Birds eat the berries.

+ **Beaked** or **California Hazelnut** (*Corylus cornuta* var. *californica*) Nuts for humans and wildlife (especially jays and squirrels), stems for baskets and cordage (following burning)

+ **Birchleaf Mountain-Mahogany** (*Cercocarpus betuloides*) or **Curlleaf Mountain-Mahogany** (*Cercocarpus ledifolius*) Very tough stems for arrow shafts, digging tools, spears. Inner bark has medicinal qualities. Very valuable wildlife browse, especially for deer

Herbaceous Plants: Subshrubs, Forbs, Ferns, Sedges, and Grasses

Note: *Due to the late season (late October) few herbaceous forbs were visible, especially in grasslands, and some grasses were not readily identifiable*

+ **Beargrass** (*Xerophylum tenax*) leaves from center of plants for baskets (following burning)

+ **Common Camas** (*Camassia quamash*) Edible corms. Camas is one of the many species of **Indian Potatoes**, referring to geophytic corms, tubers, and bulbs that were tended through cultivation (source of the derogatory epitaph, "Diggers"), burning, selective harvesting; such tending by women increasing the quality and size of the corms as well as the populations and sizes of patches) They were pit-roasted, turning sweet from the cooking and ground into flour; other species included **Ookow** (*Dichelostemma* sp.*), Brodiaea* sp.; **Soap Root** (*Chlorogalem pomeridianum*) used for an odorless soap and shampoo, its outer covering of hairy fibers for whisk brooms (still done), food if baked 36 hours, contains a nerve toxin to kill fish, used for a variety of ailments, including as a diuretic and laxative; **Butterfly or Mariposa Lilly** (*Calochortus* sp.); **Yampahs** (*Perideridia* sp.) [Various leafy species were used to cover corms in the pit filled with hot stones and covered with about an inch of soil. These species include Big Leaf Maple, Bracken and Sword Ferns; **Wild Onions** (*Allium* sp.), and many others. **Note**: *Monitoring should take place from late-spring to mid-summer to identify and flag species for future propagation from seed to be used in seed mixes with perennial bunchgrasses where appropriate for fall sowing; or grown in containers for later transplanting*.

+ "**Indian Greens**" are species like **Miners Lettuce** (*Claytonia* or *Montia perfoliata*), **Monkeyflower** (*Mimulus* sp./*Dipacus aurantiacus*), **Columbine** (*Aquilegia* sp.), **Paintbrush** (*Castilleja* sp.), **California Poppy** (*Eschscholzia californica*)**, Lupine** (*Lupinus* sp.) [*Some Lupine species are poisonous*], **Bracken Fern or Fiddleheads** (*Pteridium aquilinum*), **Clover** (*Trifolium* sp.) Native clovers are nearly extinct. [Indians consumed quantities of clovers, down on their hands and knees eating like livestock after a long fall and winter without many greens. Sometimes they would eat so much they became bloated and took soap root tea as a remedy]; **Curly Dock** (*Rumex crispus*), a European species but widely used for greens and medicine since the early 19th century and not particularly invasive. There are many more greens. Most of the proceeding species were also used for *pinole*, a widespread food consisting of a variety of parched shrub, subshrub, forb, and grass seeds.

+ **Yerba Santa** or **Mt. Balm** (*Eriodictyon californicum*) a very important all-around medicinal plant with diuretic properties, **Red Maids** (*Calandrinia ciliata*), with very popular delicious seeds

+ **Cordage species** include **Indian Hemp** (*Apocynum cannabinum*), **Spreading Dogbane** (*Apocynum androsaemifolius*), **Milkweed** (*Asclepias* sp.), ***Iris*** sp., and others.

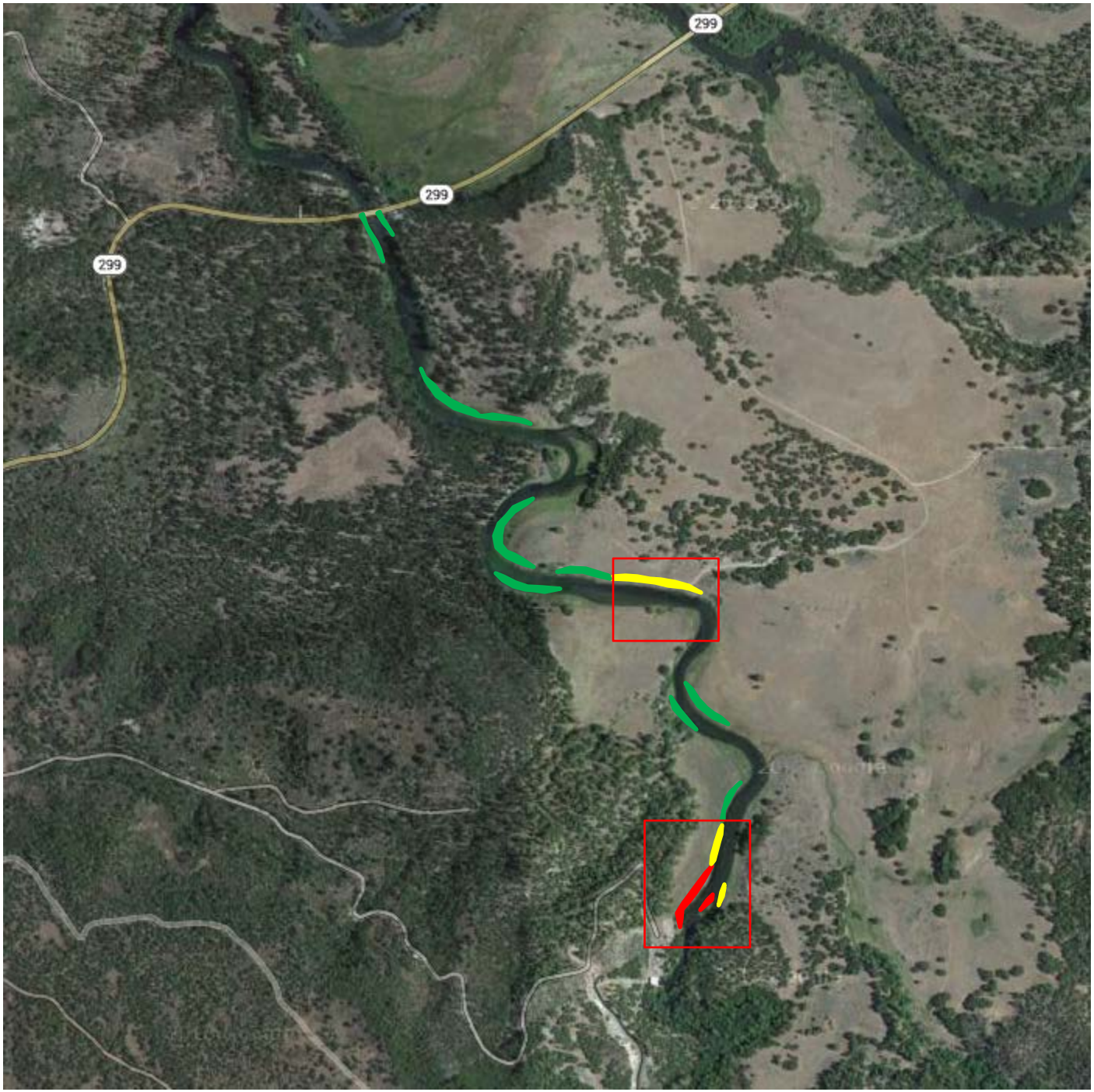
Perennial Bunchgrasses

- **Observed perennial bunchgrasses are Needlegrass** (*Nasella lemmonii*), **Blue Wild Rye** (*Elymus glauca*), **Great Basin Blue Rye** (*Leymus cinereus*), **Idaho Fescue** (*Festuca idahoensis*), **Hard or Sheeps Fescue** (*Festuca ovina var. duriuscula*), and **Squirreltail** (*Sitanion hystrix*).

Additional species that could be found in the Hat Creek area are **Pine Bluegrass** (*Poa scabrella*), **Melic *or Oniongrass*** *(Melica* sp.), **Junegrass** (*Koeleria cristata*), **California Oatgrass** (*Danthonia californica*), **Columbia Brome** (*Bromus vulgaris*), **California Brome** (*B. carianatus*), **Sitka Brome** (*B. sitchensis*), **Bluebunch Wheatgrass** (*Agropyron spicatum*), **Western Needlegrass** (*Nasella occidentalis*), **Green-leaf Fescue** (*Festuca viridula*)**,** and probably others**.**

> **Note:** As mentioned above, most of these native bunchgrass seeds were parched and used in *pinole*, together with native forbs and shrub seeds. Even Indian peoples have forgotten about the importance of grasses in their diets. In some years, grass seeds could be the main vegetative food source when salmon runs or acorn harvests failed. There are numerous grinding holes for grass seeds in some parts of the Sierra Nevada and Southern Cascades.

Hat Creek Fishing Use



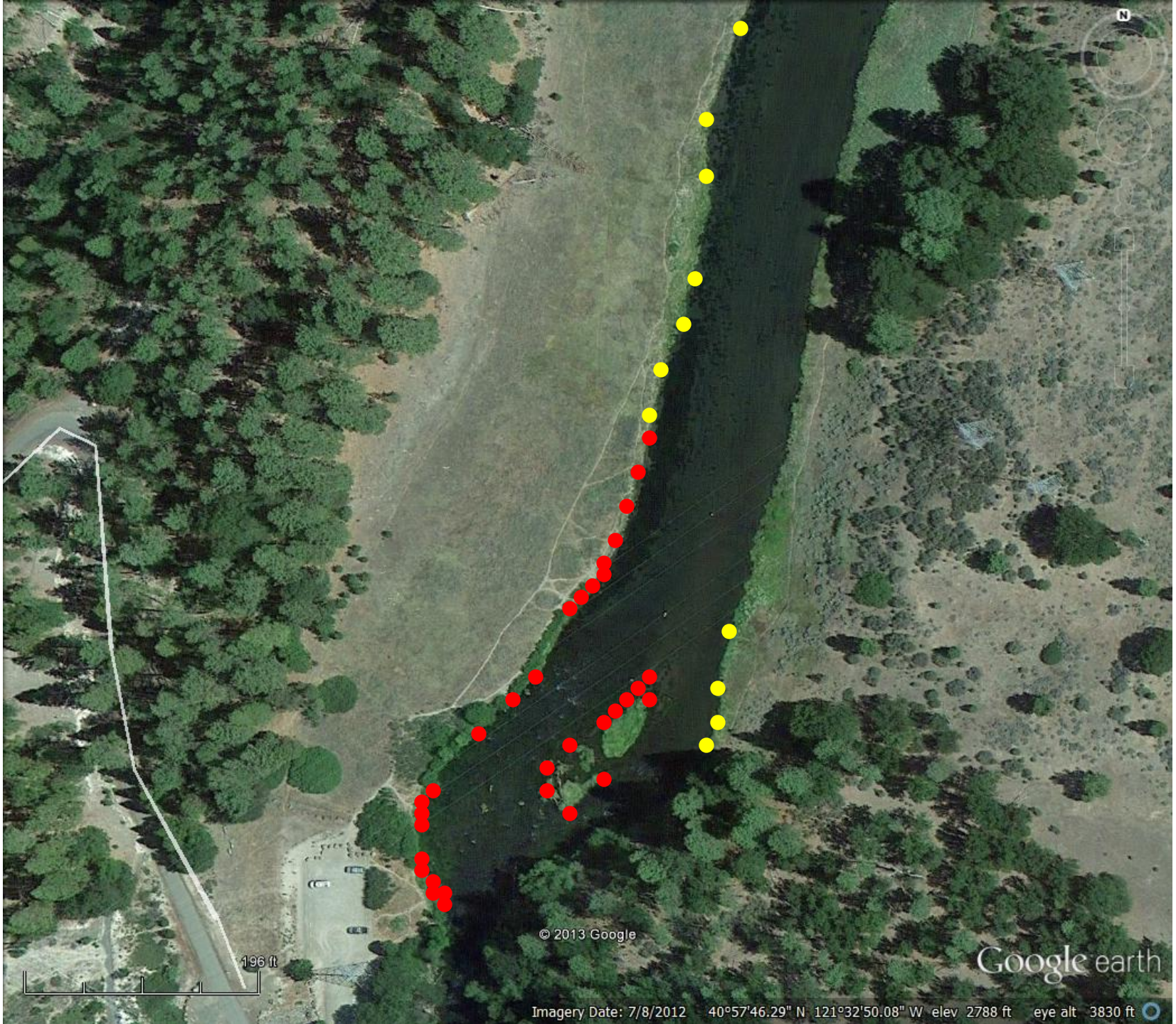
High Fishing Use

Medium Fishing Use

Low Fishing Use

Expanded Area
(med and high use only)

PH2
Riffle
Area



Carbon Area


© 2013 Google
229 ft
Google earth
Imagery Date: 7/8/2012 40°58'06.60" N 121°32'55.82" W elev 2784 ft eye alt 3830 ft