Riparian Enhancement Plan

24-1719 Rest, pond 5 reach active channel planting

Tom Elliott, Yakama Nation, 6/23/2024

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1. Existing Conditions Assessment

Overview: This project aims to plant 20 acres of riparian shrubs and trees on a 37 acre depositional bar on Washington Department of Fish and Wildlife and Yakama Nation land. The site is about 4 miles north west of Toppenish Washington, on the Yakima River at river mile 98.5, in the lower Yakima River downstream of Parker Dam. The bar has developed over the last 75 years from regulated river cut and fill processes; 7 to 8 acres currently support naturally generating riparian scrub and woodland primarily of coyote willow (*Salix exigua*) and black cottonwood (*Populus trichocarpa*), with the remainder of the bar surface largely covered with gravel, cobble, and sand. A recent riparian assessment (Yakama Nation 2020) revealed that the riparian forest in the active channel migration zone of the reach containing the site declined by 50%, a rate that projected to the year 2100 would result in near total loss of the forest.

Target species: The species of concern in the mainstem Yakima River within the project reach are all anadromous stocks that migrate up- and downstream. These include ESA listed middle-Columbia steelhead, chinook salmon (spring, summer, and fall runs), Coho salmon, sockeye salmon, and Pacific lamprey.

Environmental Setting: The dominant ecological driver in the lower Yakima is the flow of water downstream. The natural flow regime in the project reach has been highly disrupted by flow regulation for the purpose of irrigated agriculture, accomplished by storage reservoirs in the headwaters and irrigation diversions just upstream of the reach. The most significant ecological effects on riparian vegetation are 3 changes in hydrograph components, or regularly occurring features of the annual pattern of flow, as detailed in a riparian report for the Yakima River from 2007 by a foremost western riparian expert, Stewart Rood (Braatne et al 2007). First, the size of floods has been reduced by about 50% (figure 1).

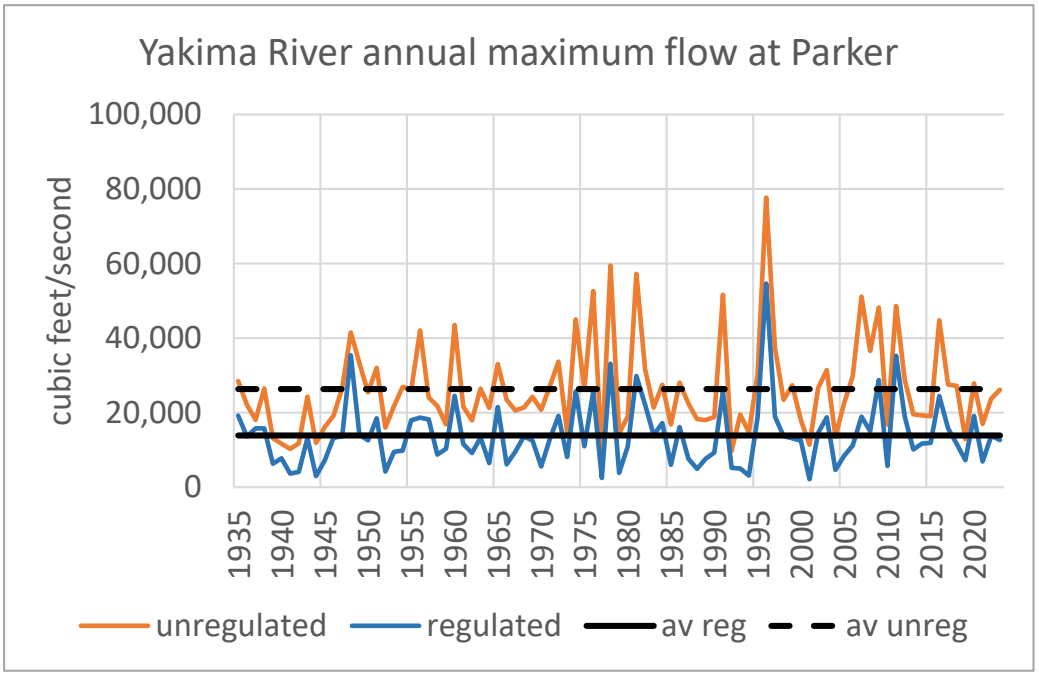

Figure 1. Annual maximum daily flows for the Yakima River at Parker, 1935 to 2023.

The reduction in flood power diminishes the amount of bedload transport and channel migration, and thus the formation of fresh channel deposits of gravel and sand, which are key sites for cottonwood and willow regeneration. Second, the spring freshet, which is the flow pulse resulting from annual snowmelt in the headwaters and occurring April through June, has been dramatically reduced in size and duration (figure 2).

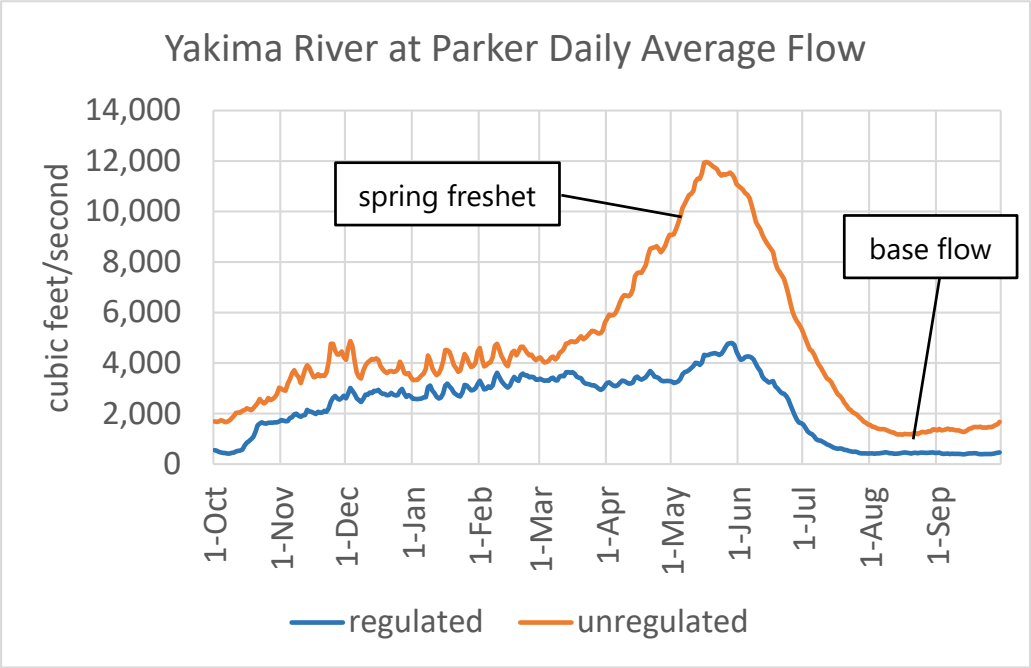

Figure 2. Daily average regulated and unregulated flows for the Yakima River at Parker, 1935 to 2023.

The average size of the of the freshet has been reduced from 12,000 cubic feet per second (cfs) to 4,000 cfs (66%), and the duration has been reduced from 5 to 2 months. The characteristics of the freshet are critical to cottonwood and willow reproduction, as seed reproduction of willows and cottonwoods has evolved in tight coordination with the snowmelt pulse in rivers of the interior western United States (for more details see Braatne et al 2007 and Rood et al 2003). Third, and finally, summer flows in the project reach have been reduced from 1,500 cfs to 500 cfs, or about 2/3. The artificially diminished flows lower alluvial groundwater levels and reduce the water supply for cottonwood and willow seedlings of the year, resulting in increased mortality.

The combined effects of these changes in flow regime has been extremely low regeneration of cottonwoods (and to some extent willows) in the lower Yakima River compared to pre-regulation levels (Rood et al 2007). However, bank erosion, beaver felling, land clearing, and increased riparian fire have destroyed mature riparian forests at an appreciable rate. Since 1949, the rate of forest destruction has been about 2 times that of new forest creation (Yakama Nation 2020). This situation leads to the necessity of riparian planting projects to at least maintain, if not increase, the area of riparian forest in the lower Yakima River floodplain. A more process based solution of implementing a managed flow regime for riparian regeneration is being assessed, but will be difficult given the over-allocation of river flows for irrigated agriculture in the Yakima Basin.

In addition to changes in flow regime, the river and floodplain near the project site have been highly modified and constrained by diking for agricultural development and by the construction if Interstate 82 in the 1980s. Figure 3 on the following page shows the change in inundated width at the 10 year flood, according to hydraulic modelling conducted by the Yakima County Surface Water Program (Yakima County 2019). The model suggests that 10 year floodplain width has been reduced by 50 to 80% in the project reach, with a concomitant reduction in the space available for riparian establishment and growth.

Land use: The restoration site has been part of the active river channel since pre-development times, and today is managed as part of the Washington State Sunnyside Wildlife Area. Across the levee from the site are two ponds, also part of the Sunnyside Wildlife Area, that are managed for recreational fishing. Interstate 82 also runs nearby to the east of the site.

Soils: The US Department of Agriculture Web Soil Map shows that the entire site is covered with Weirman sandy loam, a well drained soil derived from alluvium. Onsite observations indicate that the site surface is covered with recent alluvium (largely since the 1970s) consisting of river cobbles, gravels, and sand, depending on flood energy at particular bar locations.

Hydrology/Water Quality: The lower Yakima River is listed on the Washington State Department of Ecology 303d list (category 5) for pH, DO, and temperature, and has TMDLs for suspended sediment and DDT. In addition, the project reach experiences water temperatures in excess of 22 degrees Celsius, above published tolerances for salmon and steelhead.

Site Constraints: The primary site constraints are access routes for heavy equipment and personnel, and challenges planting in the active channel zone of a large alluvial river. Access to the site is either via a 1 mile route along an irrigation diversion service track and through existing riparian forest, or along 3/4 mile route along a levee that would require the construction of a ramp and side channel crossing. Both are feasible but would require some time to scout, flag, and potentially design and permit a ramp and stream crossing.

Planting in the active channel zone will expose plantings to potentially high energy flows and damage from sediment and large wood moving with the water. In addition, low water tables in the summer and fall could constrain planting locations to areas that are low enough with respect to summer base flow, or require the use of irrigation. Finally, the site shows abundant sign of beavers which could destroy plantings.

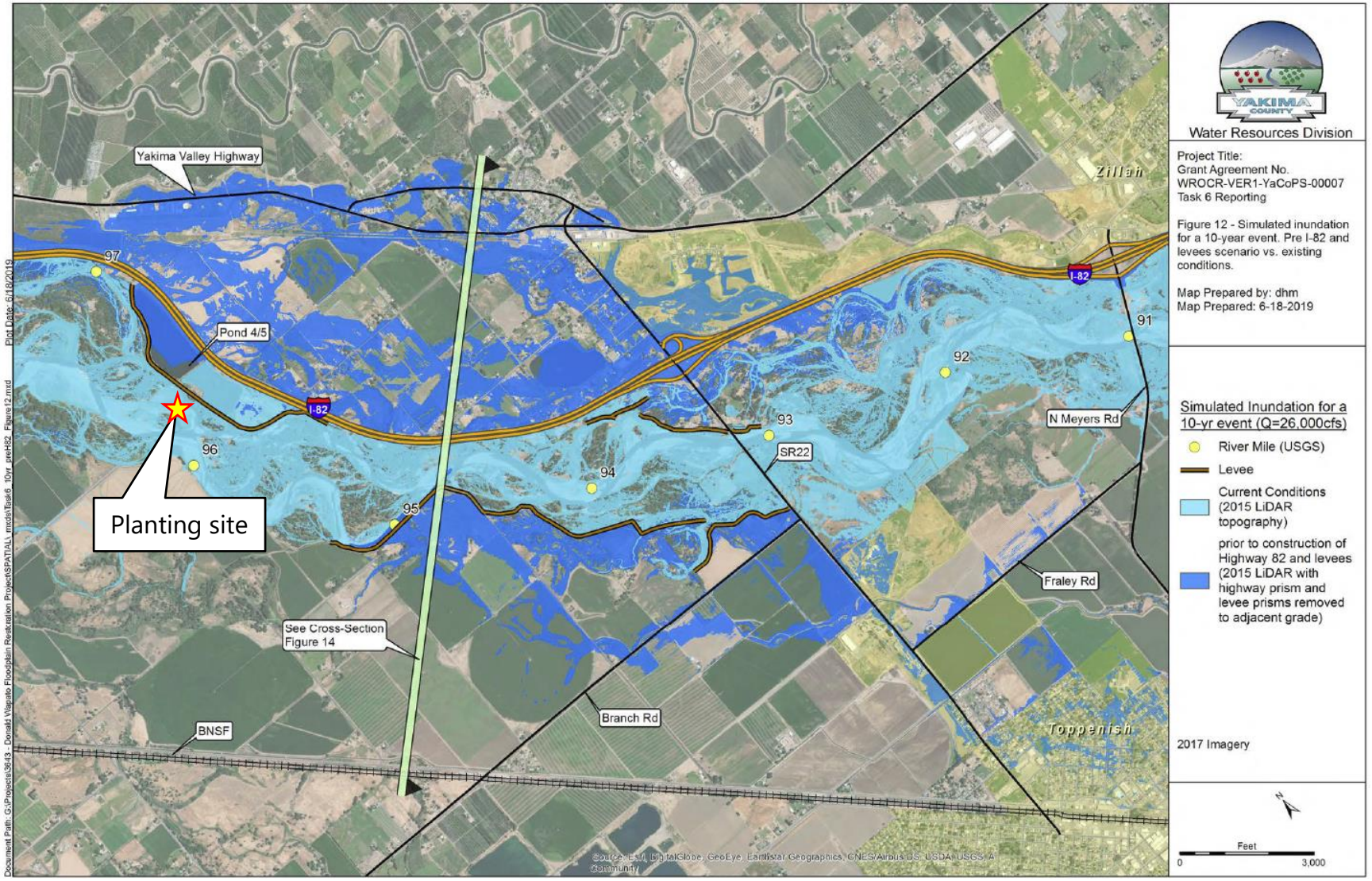

Figure 3. Hydraulic model of the 10 year flood (26,000 cfs) in the project reach. Levees built prior to 1937 and Interstate 82 have severely constrained the floodplain.

2. Restoration Objectives

The goals of this restoration plan are 1) to increase riparian forest area to offset ongoing forest loss, and 2) to enhance channel and floodplain function and processes to support anadromous fish species that use the project reach. The objectives are to increase riparian area and stem density within the active channel zone to promote sediment deposition, channel narrowing and deepening, and eventual recruitment of large wood into the channel.

1. Suppress on-site invasive weeds across the site through mechanical and chemical control.

    a. Before planting native species, treat areas with reed canary grass cover to suppress its growth during and after the planting window. Reed canary grass covers less than 5% of the site so this will not be a major task.

    b. Following initial planting, maintain invasive weed aerial cover of less than 50 percent across the site for the first ten years. The sponsor expects this will allow native species to suppress nonnative cover to less than 30 percent beyond year fifteen. Due to the high energy, low nutrient, and dry conditions on the site surface invasive species control is not expected to be a major component of site maintenance.

2. Establish native riparian plant composition on the site using the following guidelines:

    a. Achieve at least a 100 foot buffer from the average winter flow line (occurs at approximately 4,500 cfs), following Washington Department of Fish and Wildlife recommendations. There is no site potential tree height defined for the planting site.

    b. Plant tree species at 1/2 to 3 meter spacing on center across 15 acres of the site, planted in clusters. Expect 50% survival at year 5. Tree species will be planted using one of two methods, depending on the elevation and flow energy of the planting location. In low elevation, high energy zones, 1 to 2 year old nursery grown cottonwood seedlings will be planted at high densities behind hydraulic protection structures. In higher elevation, lower energy locations nursery grown tall tree pot plants will be deep planted using an excavator or hydraulic ram at 2.5 to 3 meter on center spacing.

    c. Establish native shrub density across 5 acres of the site with 1 to 3 meter spacing on center Maintain 50 percent survival to year five. Shrubs will be planted from nursery grown tall tree pots and live stakes (whips). In lower elevation locations stakes will be hand planted. At higher elevations stakes and tree pots will be deep planted to achieve contact with the water table.

    d. As specified by design plans, install 10 to 15 hydraulic protection structures in the high-energy flow zones of the planting site to protect plantings.

e. Install plastic tubes on nursery grown plants to protect them from beaver depredation. Replace tubes as necessary over 5 years.

3. Track performance of enhancement efforts through monitoring in years one through five as described elsewhere in this document.

3. Plan Maps

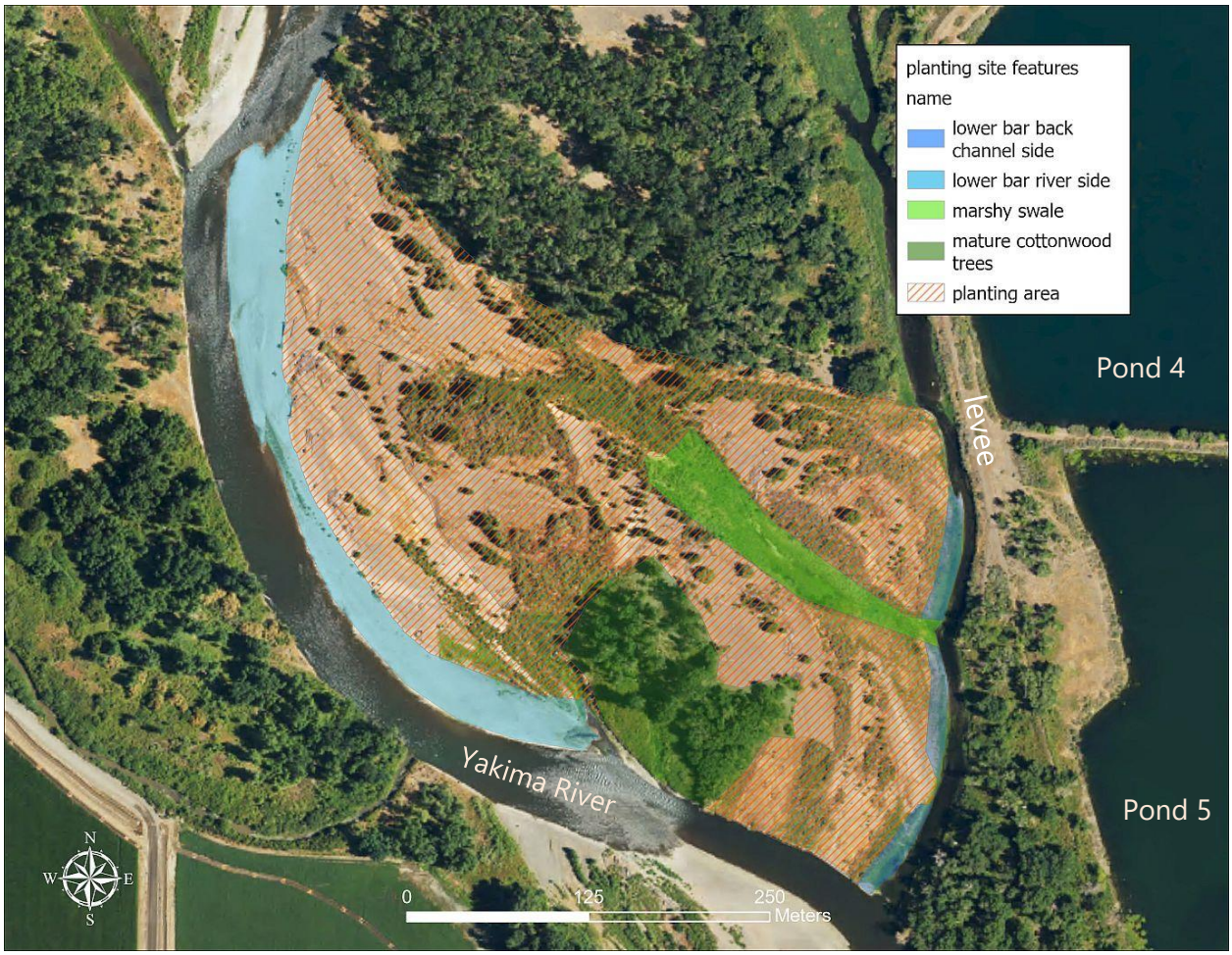

Figure 4. Features of planting site. The lower bar surfaces are inundated by the average winter flow (4,000 cfs) and do not support perennial vegetation. The grove of mature cottonwood trees does not need additional planting, and the marshy swale is too wet for terrestrial plants. The red hashed area is at appropriate elevations and of suitable substrate for riparian plantings. Aerial image is from July 2023.

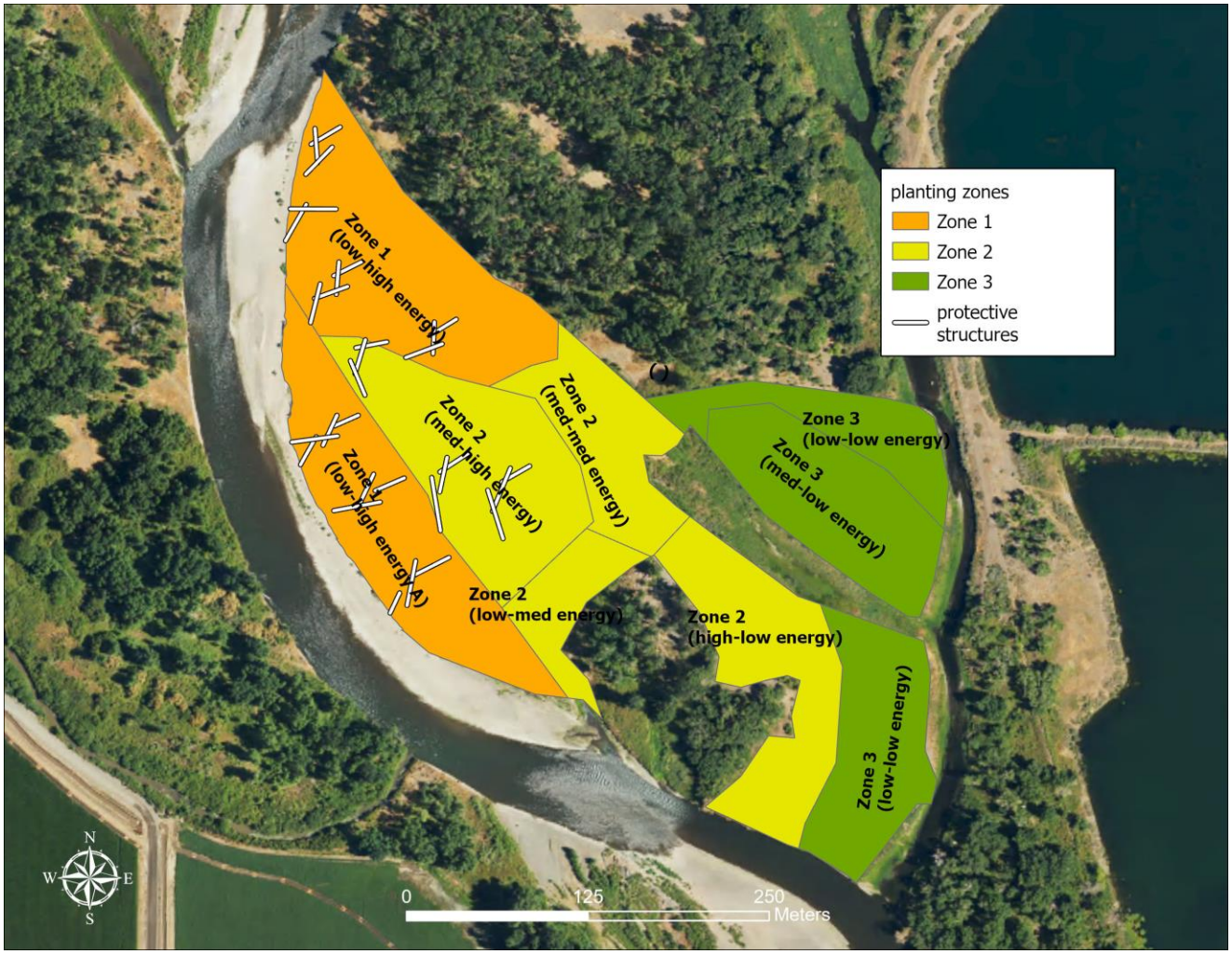

Figure 5. Planting zones, defined relative elevations above baseflow and energy of water flow across the bar. Relative elevations were derived from lidar and range from 1 to 6 feet; energy zones were defined by substrate size and position on the bar. Labels show the elevation followed by the energy zone, e.g. L-H indicates low elevation-high energy. Low elevation-high energy zones are frequently flooded and are covered in cobbles to large gravels. Low elevation-low energy zones are frequently flooded and are covered by small gravels and sand. Medium elevations and energy zones have intermediate characteristics. Protective structures are shown in approximate locations for illustration purposes only; the final placement and design will be determined during the site planning process.

Figure 6. Examples of protective hydraulic structures similar to what is expected at the Pond 5 site. They consist of large logs pinned in place by piles driven in at an angle, to prevent floating. The piles can be driven by hand held pneumatic hammers or by drivers mounted on heavy equipment.

4. Site Preparation Methods

The sponsor will secure funding and a contractor to perform the work. The sponsor will secure any permits and licenses needed to complete work, including aquatic noxious weed control permits or land-use permits, and will ensure that contractor crews possess necessary licenses and qualifications. The sponsor will provide forty- eight-hour notice before accessing the property and a minimum of one week notice before completing any herbicide application.

Reed Canarygrass (*Phalaris arundinacea*): Initial site preparation of reed canarygrass will involve mowing using brushcutters 1 to 2 times in the spring of the planning year, followed by 1 to 2 spot applications of aquatic formula glyphosate in the summer and early fall. Planting of native species will occur during the fall of the same calendar year. Care will be taken to shield native shrubs and forbs on site during initial herbicide treatment.

Further control and treatment of these species will be included in the Post-Implementation Maintenance section 7 below.

Plant protection structures: Log structures to protect plantings from scour and damage from debris moving with the current will be designed in year one of the project, and installed in the summer of year 2, prior to weed control and planting. Structures will be designed to be simple and cost effective, and will consist of large logs pinned in place by piles driven in at angles. The location and placement of structures will be determined using hydraulic models and field evidence to determine high energy flow locations. Planting locations, distributed in clusters, will be determined by hydraulic modelling of the shape and size of the "hydraulic shadow" created by the protection structures.

Piezometer installation: Piezometers will be installed the year before planting to assess summer groundwater levels throughout the site. 3 to 5 piezometers will be installed by hand or small machinery with the assistance of a staff hydrogeologist. They will be instrumented with continuously recording water level recorders and checked twice a month for proper function and vandalism. Piezometers will be monitored for up to one year before planting, depending on the timing of installation.

5. Riparian Planting Methods

Planting will consist of live stakes, bare root, and potted plant stock. Plant stock will be sources as locally as possible, but at the farthest will be from the lower Yakima river basin. Seeds for bare root cottonwood seedlings will be collected in the spring of the planting year and grown out to 20 to 30 centimeter tall bare root seedlings. They will be planted by hand or with machinery depending on substrate characteristics. Live stakes of coyote willows (*Salix exigua*) will be collected in nearby areas that will be scouted the year before planting. They will be collected as late as possible in the planting year to ensure dormancy and planted by hand or machinery, again depending on substrate characteristics. Potted cottonwoods, peach leaf (*Salix amygdaloides*), and Pacific (*Salix lasiandra*) in tall tree pots

(4″ x 12″ or similar size) will be grown from cuttings collected late in the fall before the planting year. They will be planted using hand or machine augers or a hydraulic ram (stinger) mounted on an excavator, depending on substrate size and depth to summer ground water. For example, in sand or small gravels with a high water table, hand augers may suffice, but in cobbles or large gravels with a low water table a machine mounted auger or hydraulic ram will probably be necessary. All planting will be completed by the end of November, assuming flow and weather conditions are favorable. A draft planting plan is included in Table A. It includes a species list for each planting zone. This list is subject to change based on plant availability.

Vinyl tree protectors with stake support will be installed to prevent herbivory and plant damage during maintenance. Vinyl tree protectors will be removed and properly disposed of no later than year five of monitoring. Flagging will be tied onto the stake to assist in location during post-implementation maintenance. Supplemental watering may be necessary during the driest months 2 to 3 years post planting. Watering may be accomplished with a permitted pump and drip system, or alternatively with crews by hand.

Table A: Species List

Zone 1 (low elevation-high energy) Bare root cottonwoods seedlings planted on 1/2 meter centers, Coyote willow live stakes planted on 1 meter centers		
Species	**Count**	**Stock type**
Salix exigua (Coyote willow)	4,000	Live stakes
Populus trichocarpa (Black cottonwood)	3,800	Tall tree pots
Populus trichocarpa (Black cottonwood)	4,000	12"-18″ bare root seedling
Subtotal	**11,800 plants**	
Zone 2 (low to med elevation-med to high energy) Cottonwood tree pots planted on 3 meter centers Coyote willows planted on 2.5 meter centers		
Species	**Count**	**Stock type**
Populus trichocarpa (Black cottonwood)	6,300	Tall tree pots
Salix exigua (Coyote willow)	1,600	Tall tree pots
Salix exigua (Coyote willow)	1,400	Live stakes
Subtotal	**9,300 plants**	
Zone 3 (low to med elevation-low energy) Cottonwood tree pots planted on 3.5 meter centers Willows planted on 2.5 meter centers		
Species	**Count**	**Stock type**
Populus trichocarpa (Black cottonwood)	2,000	Tall tree pots

Salix exigua (Coyote willow)	1,000	Tall tree pots
Salix lasiandra (Pacific willow)	2,500	Tall tree pots
Salix amygdaloides (Peach-leaf willow)	2,500	Tall tree pots
Subtotal	**8,000 plants**	

Total plant count = 28,300

6. Implementation Monitoring

To evaluate if the enhancement activities meet the restoration objectives (section 2), the sponsor will perform implementation monitoring in years two, three, and five. Percent survival of tree stock will be based on quantitative sampling from year one through five. Naturally regenerating species will be included in this count. In addition, high resolution drone imagery of the entire planting site will be flown every year at full leaf-out in years one through five.

- Percent survival of tree and shrub species (quantitative), years one through five
- Vigor and health assessment of species (qualitative)
- Bar evolution through erosion and deposition, qualitative through drone imagery for planform changes and semi-quantitative for sediment deposition through sediment thickness point measurements.
- Ground-based photo points from at least six stations.

Monitoring results will allow sponsor to assess the need for adaptive management of the restoration site. Monitoring likely will occur in July and August, to target growing season and correspond with annual maintenance activities. The sponsor will provide a summary of data to RCO in the final report and as part of future stewardship grant requests.

Out-year monitoring and maintenance (years 5 through 15) will occur depending on future stewardship grant funding from RCO.

7. Post-Implementation Maintenance

Table B: Maintenance Schedule

Work	Timing
Chemical spot treatment of invasive nonnative plants	Years 1-5 in summer and fall
Replant native species to maintain survival/cover objectives	Years 1-5 in fall
Replace herbivory protection	Years 1-5 in early summer
Irrigation	Years 1-3 in summer
Remove herbivory protection	Year 5 in summer

Maintenance will occur until plants reach a stage where natural suppression of invasive species and forest succession appear to be self-sustaining. Control methods of most invasive vegetation will include chemical spot treatment with possible mechanical mowing (hand-held brush cutter) or grubbing as needed. Irrigation will occur via a solar powered electric pump and drip lines, or hand watering as required.

8. Adaptive Management

Beaver, ungulate, losses from flooding and desiccation are expected at this site. Replanting from these impacts will occur to maintain survival and cover performance metrics. Under heavier loss conditions, the following adaptive management will be considered.

Beaver: if beaver activity causes more than 10 percent mortality plantings, chicken wire or other beaver-proof material will be applied to tree bases in a to-be determined area from the shoreline and extend further as needed. In higher areas where frequent flooding is not expected, beaver-proof fencing may be installed as an alternative.

Ungulate: if grazing pressures cause more than 25 percent mortality and/or significant defoliation of plants, a spray deterrent will be considered.

Flooding: if any single flood causes more than 25 percent mortality, additional plantings may be added directly to the upstream side of plants in the impact zone. Further, additional planting protection log structures may be installed.

Irrigation: Irrigation volume will be increased in years 1-4 if more than 15% of plants show signs of dying from desiccation.

9. As-Built Documentations

Update the riparian enhancement plan if implementation resulted in significant changes from what was proposed. Be sure to update design drawings, maps, site preparation, planting method, and monitoring elements of the plan as necessary.

No example provided.

10. Stewardship Activity Report

This is a written report that documents activities implemented as part of the stewardship project. If adaptive management was a significant factor, document the changes implemented on site. Provide implementation monitoring results to show how the site is achieving restoration objectives.

No example provided.

11. References

Braatne, J., Jamieson, R., Gill, K. & Rood, S. Instream Flows and the Decline of Riparian Cottonwoods along the Yakima River, Washington, USA. River Research and Applications - RIVER RES APPL 23, (2007).

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