Preliminary Project Design Report and Drawings

24-1719 REST, POND 5 REACH ACTIVE CHANNEL PLANTING

Tom Elliott, Yakama Nation, 6-23,2024

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1. Background and Site Conditions

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 most significant change at the site since pre-development times has been the strong regulation of river flow by upstream storage dams and diversions. The 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 1 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.

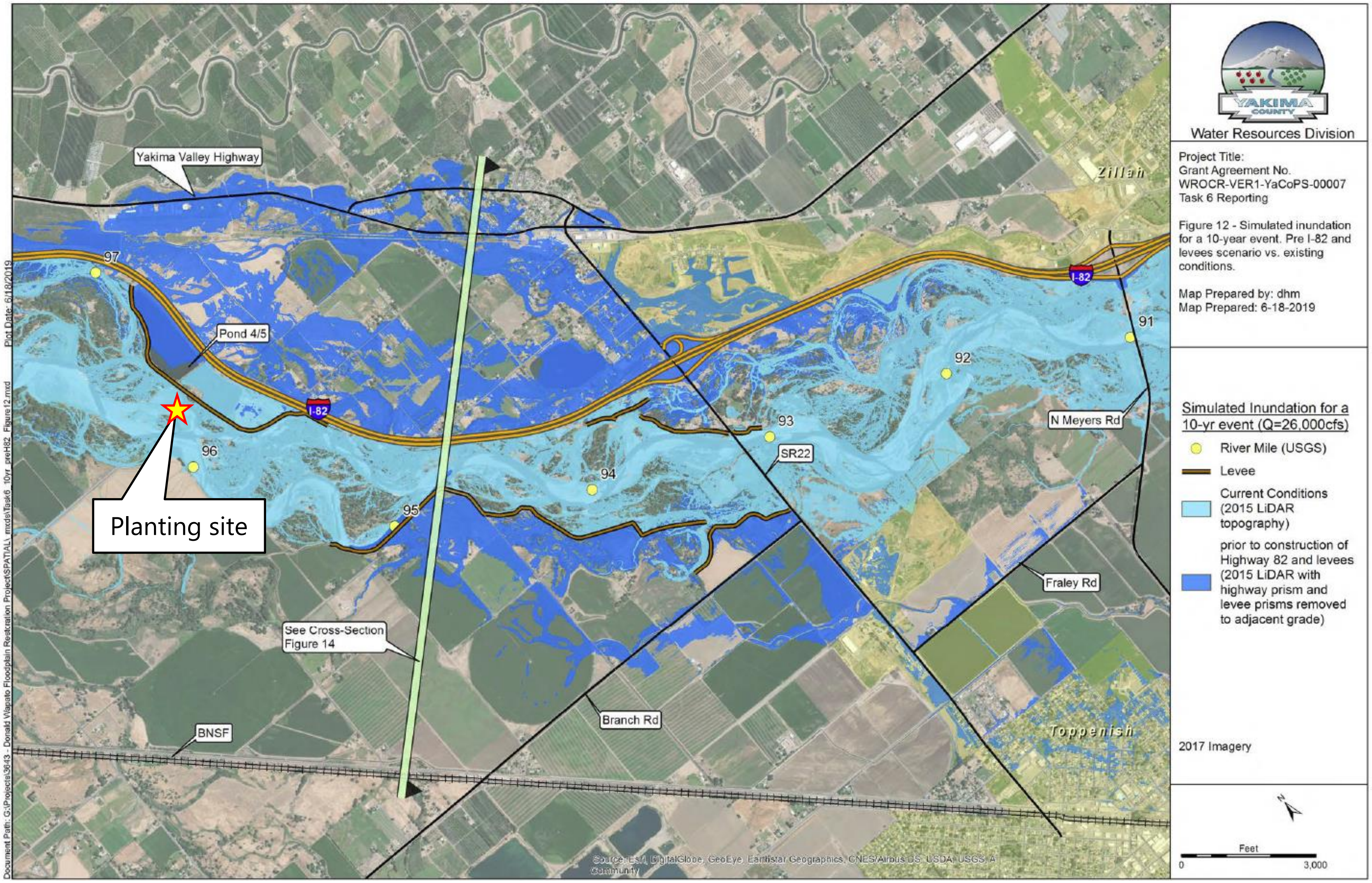


Figure 1. Hydraulic model of the 10 year flood (26,000 cfs) in the project reach. Levees built prior to 1937 and Interstate 82 have severely constrained the floodplain.

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 observation 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.

2. Hydrology

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).

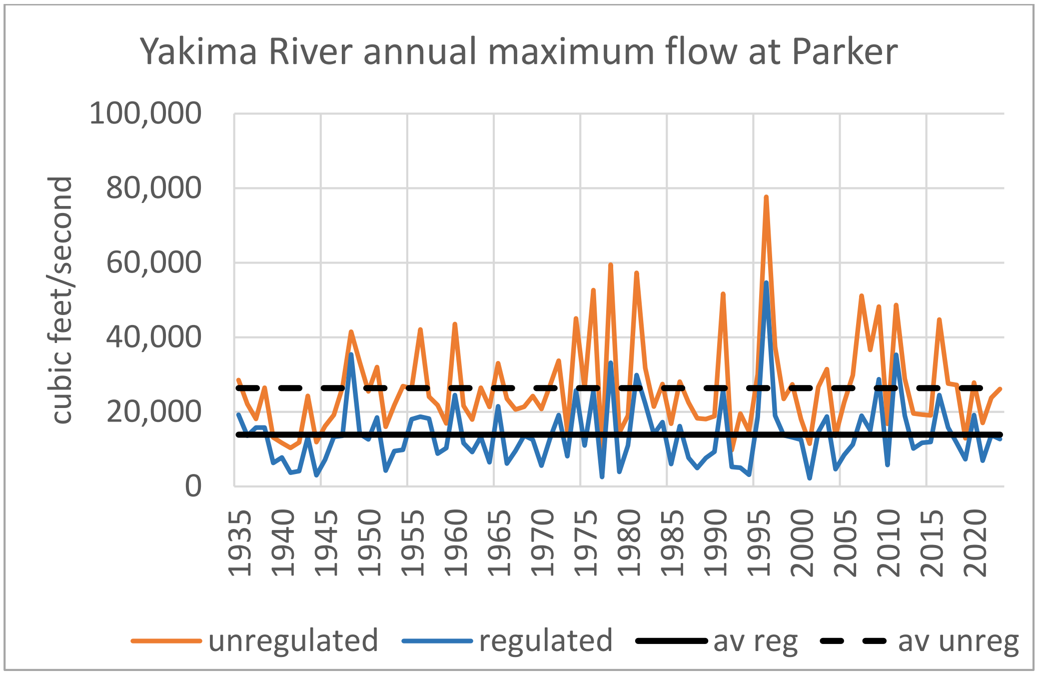


Figure 1. Annual maximum daily flows for the Yakima River at Parker, 1935 to 2023.

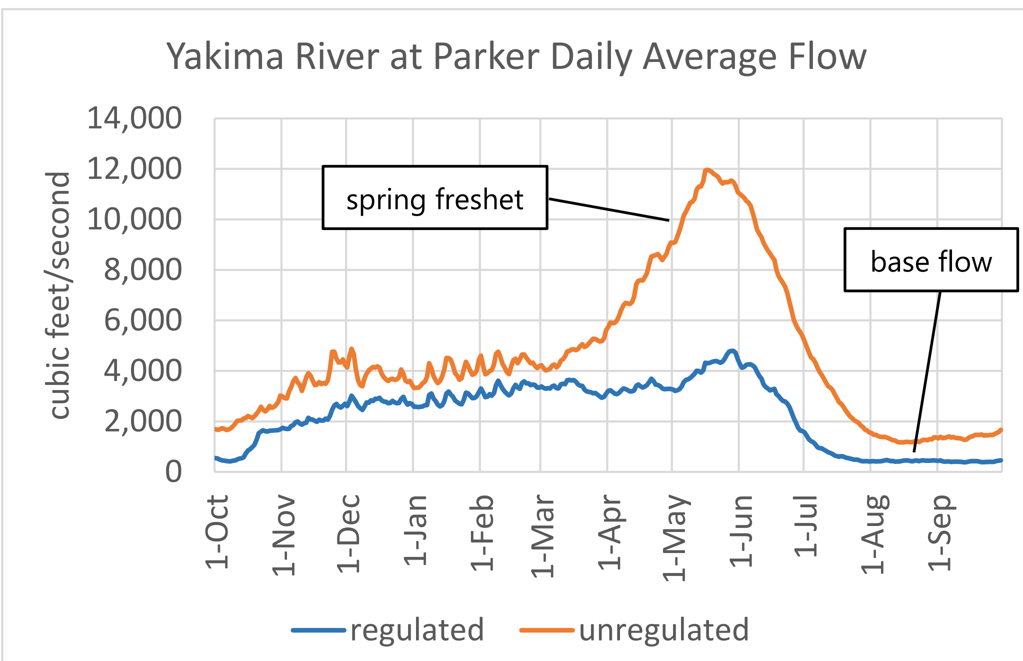


Figure 3. Daily average regulated and unregulated flows for the Yakima River at Parker, 1935 to 2023.

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 3).

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.

Aside from its harmful effect on riparian regeneration, the current flow regime will have direct impacts on the success of the plantings. The artificially low summer base flow pulls down the summer water table and is reason to install plantings at as low an elevation as possible on the bar: however, they need to be located high enough to avoid constant winter inundation, and to reduce the risk of scour or sediment deposition by winter high flows. In addition, plant protections structures need to be placed and built to protect plants from frequent high flows. The criterion we have chosen based on feasibility and cost of the protection structures is for structures to protect against the 5 year flood. See flood table below for flow values.

Recurrence Interval (years)	Discharge (cfs)
2	11,440
10	27,450
25	35,367
50	43,463
100	50,359

3. 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. 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.

4. Installation of protection structures for plantings

The purpose of the protection structures will be to create slow-water zones downstream of themselves during high water to reduce the risk of scour to new plantings. Protection structures and additional vertical posts will also catch large wood carried on the current that otherwise might crush or scour the plantings.

Protection structures are designed to be simple and low-tech so that a combination of a medium size excavator and a hand crew of 4 can install 10 to 15 in 1 to 2 weeks. Materials will consist of purchased dougfir logs (rootwads of they fit within the budget) and 400, 8 inch diameter, 10 foot untreated fence posts. Imported dougfir is preferred for its greater density and durability as compared to most naturally occurring wood on the planting site which is black cottonwood. Greater wood density and durability will enable the logs to resist floating and to persist onsite longer than cottonwood logs would. In addition, we believe that it is better to leave naturally occurring wood jams undisturbed so that the site derives the greatest possible benefits of sediment trapping, floodplain building, and potentially protecting naturally regenerating riparian vegetation.

The following steps and design guidelines will be used to install plant protection structures:

1. The project manager and a qualified engineer or geomorphologist will walk the site and flag 10 to 15 locations where protection structures would have the greatest protective effect for downstream plantings. A simple map with locations and size (1 or 2 logs, and number of posts) will be prepared for technician crews and equipment operators.
2. Up to 30 40 foot X 18 to 24 diameter dougfir logs, some with rootwads, would be purchased and delivered to the site. The exact number depends on cost.
3. 300 6 inch diameter X 10 foot untreated fence posts will be delivered to the site.
4. An excavator will offload the logs and move them across the side channel to each flagged structure location. The same excavator will be on site for installing plants.
5. Hand crews will drive 8 to 10 posts per log (every 8 to 10 feet on either side). Posts will be driven in at an angle (see drawing) in order to pin the logs down and prevent them from floating. Posts will be driven 6.5 feet into the ground if possible. Posts may be driven using either hand held pneumatic pounders or mini-excavator mounted drivers.
6. An additional 100 posts will be driven roughly parallel to the main channel positioned at gaps between the built protection structures. Posts will be approximately 10 feet apart.
7. During and after construction of each structure the project manager and geomorphologist or engineer will inspect the structures, direct necessary changes, and give final approval.

5. Project Drawings and Examples Photos

Planting summary (see Riparian Enhancement Plan for details)

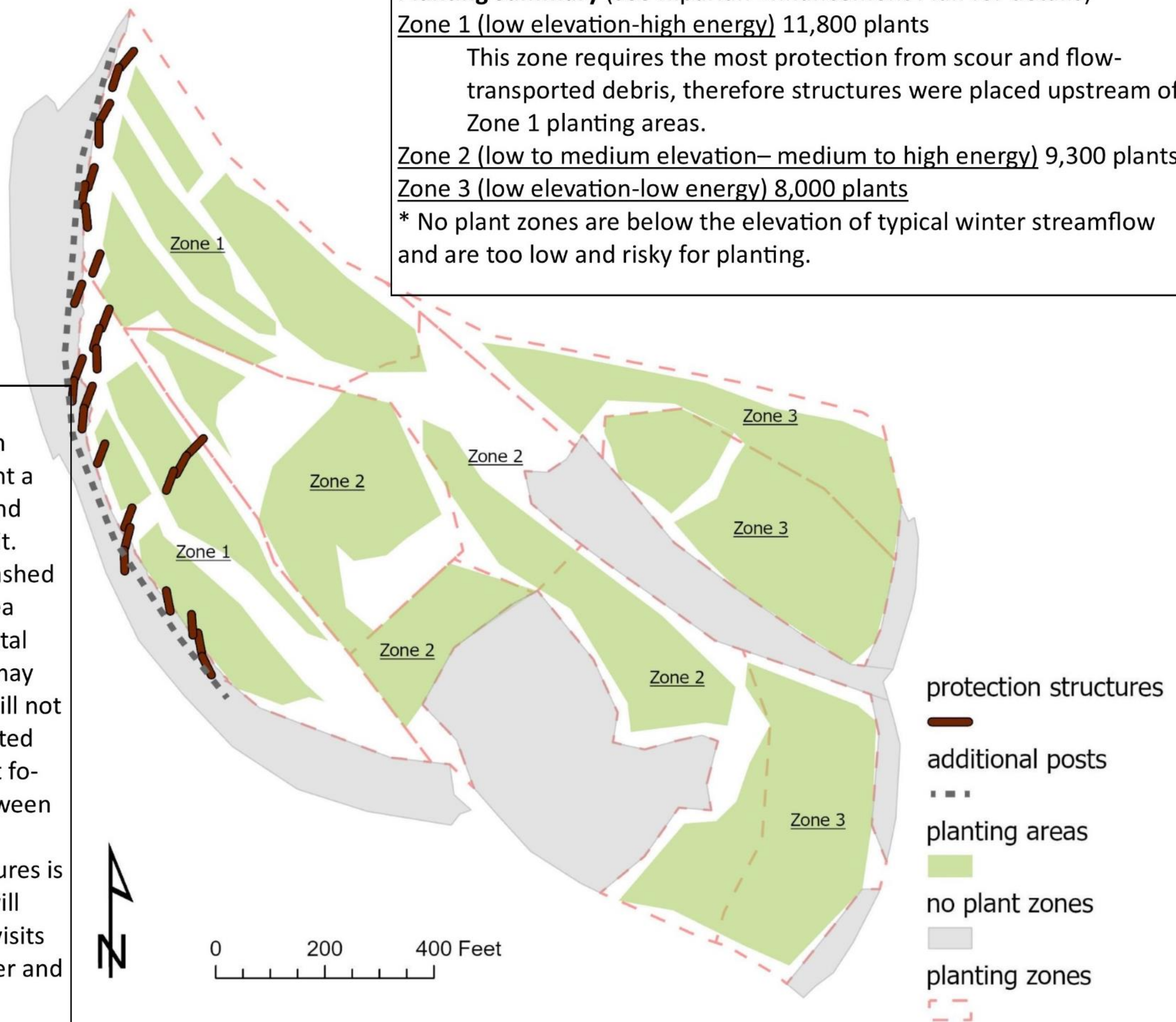
Zone 1 (low elevation-high energy) 11,800 plants

This zone requires the most protection from scour and flow-transported debris, therefore structures were placed upstream of Zone 1 planting areas.

Zone 2 (low to medium elevation– medium to high energy) 9,300 plants

Zone 3 (low elevation-low energy) 8,000 plants

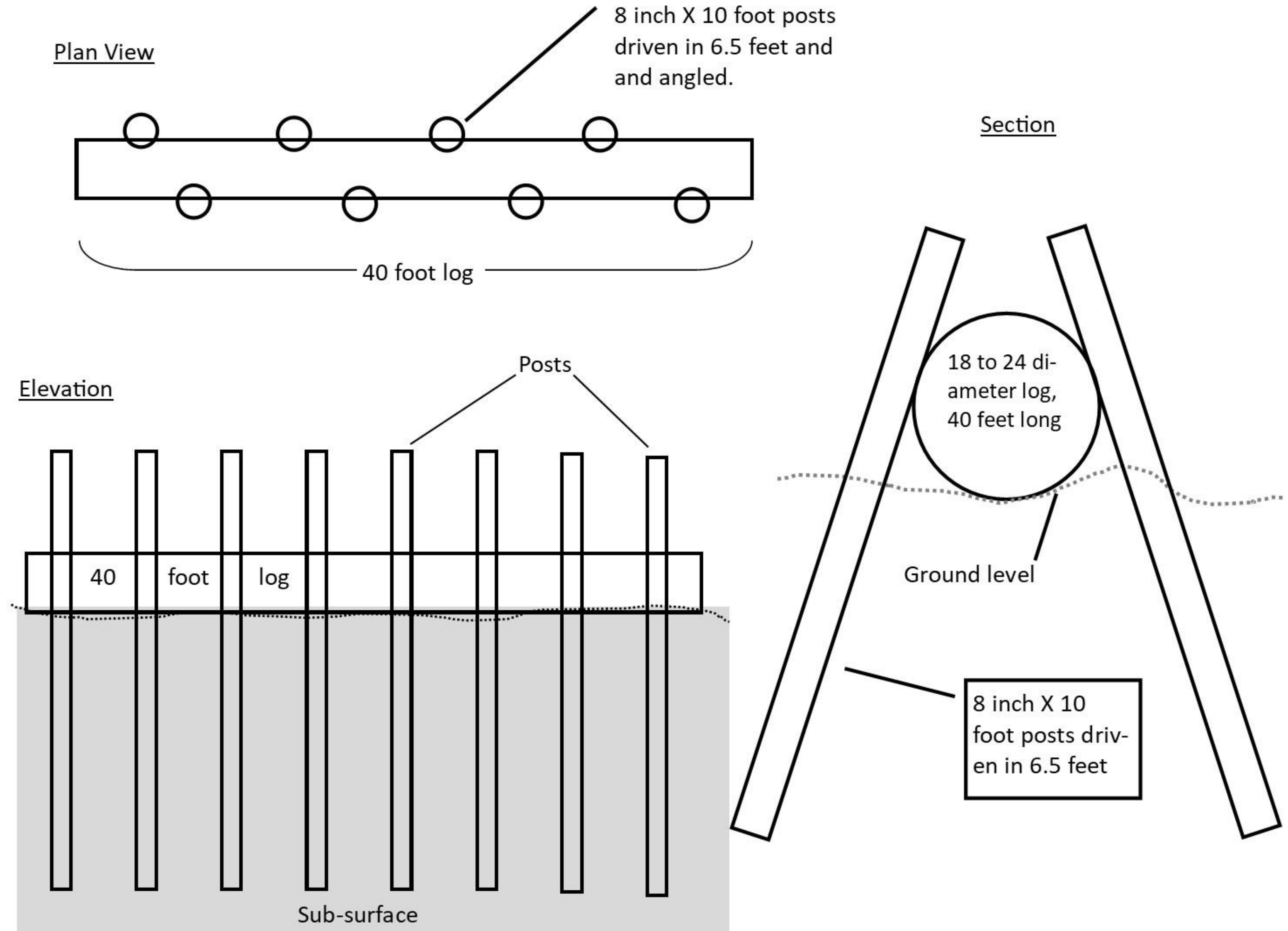
* No plant zones are below the elevation of typical winter streamflow and are too low and risky for planting.



Structure Notes

- Dark lines for each structure represent a 40 foot long log and posts used to pin it.
- Additional post dashed line shows the area where supplemental protection posts may be placed. They will not be evenly distributed along the line, but focused in gaps between structures.
- Location of structures is preliminary and will change after site visits by project manager and engineer.

Typical Protection Structure Detail



Drawings not to scale

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.

Figure 7. Driven post protection structure 15 miles downstream of the Pond 5 project site on the Yakima River. These structures used onsite woody debris rather than imported logs. Posts are sharpened Per WDFW requirement to deter perching by predatory birds.

8. References

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