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# Memorandum

**To:** Bassett Creek Watershed Management Commission
**From:** Barr Engineering Co. (Kallie Doeden, Parker Brown, and Karen Chandler, PE)
**Subject:** Item 5B: Additional Information for Ponderosa Woods Stream Restoration Project Feasibility Study
BCWMC June 15, 2023 Meeting Agenda
**Date:** June 8, 2023

## 1.0 Background

At the May Commission meeting, the Commission Engineer presented the draft feasibility study for the Ponderosa Woods Stream Restoration Project (BCWMC CIP 2024 ML 22). The project would stabilize stream banks to reduce erosion along the existing stream, improve and restore in-stream and riparian habitat, and improve water quality and reduce sediment and phosphorus entering Medicine Lake. Additional stormwater features would also trap sediment from road runoff, decreasing the amount of sediment flowing into the stream reach. Four Alternatives (1, 1.5, 2 and 3) were presented at the meeting. The Commission Engineer and the City of Plymouth recommended Alternative 1.5; Alternative 1 would be the next recommended alternative if the Commission prefers a lower cost alternative or prefers less buckthorn removal.

At the meeting, the commissioners requested the following additional information:

- Comparison of Alternatives 1, 1.5, 2 and 3
- Comparison of proposed project pollutant load reductions to the pollutant load reduction required in the Medicine Lake TMDL
- Supplemental details on buckthorn removal and revegetation water quality benefits
- Further description of existing permanent easements and potential additional easements required

## 2.0 Additional information

The following paragraphs provide responses to the commissioners' request for additional information.

### 2.1 Comparison of Alternatives 1, 1.5, 2 and 3

At their May meeting, the Commission requested the following additional information:

- Drainage and utility easement location
- Location of desktop delineated wetland area within the project extents; this area would be considered part of the stream riparian area
- Comparison of the different project extents for Alternatives 1, 1.5, 2 and 3
- Identification of private versus public land parcels

Figure 1 (attached) shows the additional information.

The table below summarizes the pros and cons for Alternative 1, 1.5, 2 and 3.

### Table 1 - Comparison of Alternatives 1, 1.5, 2 and 3

| Alternative | Project Pros | Project Cons |
|---|---|---|
| **Alternative 1 –**<br>Small Footprint Design | • Lowest overall construction cost<br>• Lowest cost per pound for pollutant removal<br>• Smallest project area (minimal habitat and vegetation disturbance)<br>• Least number of trees removed<br>• Significant bioengineering elements<br>• Least amount of post-construction vegetation management<br>• No additional easements are needed | • Least amount of stream bank pollutant load reductions (quantitative)<br>• Least amount of riparian and floodplain pollutant load reductions (qualitative)<br>• Smallest project area (least amount of improvements to stream channel, floodplain and riparian area)<br>• Least amount of buckthorn removed<br>• Least amount of floodplain access improvements in the upstream stream reach |
| **Alternative 1.5 -**<br>Small Footprint Design<br>(with added buckthorn removal) | • Low project cost<br>• Low cost per pound for pollutant removal<br>• Least number of trees removed<br>• Most amount of buckthorn removed<br>• Most amount of riparian and floodplain pollutant load reductions (qualitative)<br>• Significant bioengineering elements<br>• Lower amount of post-construction vegetation management than Alternative 3<br>• No additional easements are needed | • Higher project costs than Alternative 1<br>• Least amount of stream bank pollutant load reductions (quantitative)<br>• Largest project area (significant habitat and vegetation disturbance)<br>• Least amount of floodplain access improvements in the upstream stream reach<br>• Higher amount of post-construction vegetation management than Alternative 1 |
| **Alternative 2 –**<br>Medium Footprint Design | • Moderate project cost<br>• Moderate number of trees removed<br>• Most amount of buckthorn removed<br>• Most amount of riparian and floodplain pollutant load reductions (qualitative)<br>• Most amount of hard armoring elements to protect stream banks and homes from bank erosion<br>• Most amount of floodplain access improvements in the upstream stream reach (added resiliency)<br>• Lower amount of post-construction vegetation management than Alternative 3<br>• No additional easements are needed | • Higher project costs than Alternative 1 and Alternative 1.5<br>• Highest cost per pound for pollutant removal<br>• Least amount of stream bank pollutant load reductions (quantitative)<br>• Largest project area (significant habitat and vegetation disturbance)<br>• Most amount of hard armoring (minimizes biological, ecological, and hydrological benefits of bioengineering elements)<br>• Higher amount of post-construction vegetation management than Alternative 1 |

| Alternative | Project Pros | Project Cons |
|---|---|---|
| **Alternative 3 –** Large Footprint Design | • Lower cost per pound for pollutant removal than Alternative 2<br>• Most amount of stream bank pollutant load reductions (quantitative)<br>• Most amount of buckthorn removed<br>• Highest riparian and floodplain pollutant load reductions (qualitative)<br>• Most amount of floodplain access improvements in the upstream reach (added resiliency)<br>• Significant bioengineering elements<br>• No additional easements are needed | • Highest project cost<br>• Higher cost per pound for pollutant removal than Alternatives 1 and 1.5<br>• Largest project area (largest habitat and vegetation disturbance)<br>• Most number of trees removed, which leads to additional stabilization measures that need time to establish<br>• Highest amount of post-construction vegetation management<br>• Increased stream length and sinuosity due to stream re-meander (may increase amount of stagnant water leading to poorer water quality habitat)<br>• Highest level of construction impact to nearby homeowners (significant public support will be necessary) |

## 2.2 Comparison of proposed project load reductions compared to the Medicine Lake TMDL

Below are the anticipated pollutant reductions and estimated costs for each of the Alternatives as presented at the May Commission meeting.

### Table 2 - Ponderosa Woods Stream Restoration Project Alternatives Cost Summary

| Alternative | Project Cost Estimate | Annualized Cost | TP Loading | | TSS Loading | |
|---|---|---|---|---|---|---|
| | | | Load Reduction (lb/yr) | Cost/lb/yr Reduced | Load Reduction (lb/yr) | Cost/lb/yr Reduced |
| **Alternative 1 –** Small Footprint Design | $252,000 ($202,000–$328,000) | $17,000 | 7.4 | $2,300 | 14,770 | $1.15 |
| **Alternative 1.5 -** Small Footprint Design (with added buckthorn removal) | $297,000 ($238,000-$387,000) | $20,000 | 7.4 | $2,700 | 14,770 | $1.35 |
| **Alternative 2 –** Medium Footprint Design | $429,000 ($344,000-$558,000) | $27,000 | 7.4 | $3,650 | 14,770 | $1.83 |
| **Alternative 3 –** Large Footprint Design | $506,000 ($405,000–$658,000) | $34,000 | 10.8 | $3,150 | 21,580 | $1.58 |

The Medicine Lake Total Maximum Daily Load (TMDL) Study estimates that a total phosphorus (TP) load reduction of 1,287 lbs/yr will be necessary to meet the TMDL requirements (References 1 and 2). The TMDL assessment represents reductions needed from watershed conditions that existed in 2007. The Ponderosa Woods project anticipates a TP load reduction of 7.4 to 10.8 lbs/yr, which would represent about 0.6 to 0.8% in TP load reductions compared to 2007 levels.

The Ponderosa Woods subwatershed area is not included as a separate watershed within the Medicine Lake TMDL. The Ponderosa Woods stream reach flows into Plymouth Creek, through the Plymouth Creek Water Quality Ponds, and into Medicine Lake. The TMDL estimated that 2,360 lbs/yr of TP annually entered Medicine Lake from the Plymouth Creek subwatershed (References 1 and 2). The total TP load to Medicine Lake in 2007 was 4,770 lbs/yr, so Plymouth Creek contributed approximately 49.5% of the entire TP load entering the lake (References 1 and 2). Many water quality improvement projects have been constructed within the Plymouth Creek subwatershed since 2007 to reduce TP loads. A calculation of current loading to Medicine Lake from the Plymouth Creek subwatershed is not currently available. (However, an estimate of TP loading through the creek will be available next year after analysis of the 2022/2023 Plymouth Creek monitoring effort.)

## 2.3 Supplemental details on buckthorn removal and revegetation benefits

The project area is in a heavily forested area, which is highly degraded and dominated by buckthorn on stream banks and in the riparian area (including the floodplain). Many trees are dead or dying (including green ash trees, which may be affected by Emerald Ash Borer). The buckthorn is extensive and dense, and there was little to no understory vegetation present during the November 2022 field visit. All of the design alternatives include a significant amount of buckthorn removal to help restore this project area – along the stream banks, and in the floodplain and riparian areas.

The riparian area extends from the stream channel to the edge of the floodplain as shown in Figure 2. Riparian areas include vegetation species that are more water-tolerant, whereas upland vegetation tends to prefer less water. In the case of buckthorn, it resides both in riparian and upland areas because it can tolerate both wetter and drier habitats. Because buckthorn grows well in both habitats, it can grow to be pervasive throughout a large area, degrading both riparian and upland areas. For the Ponderosa Woods project area, the riparian area may extend to the limits of the project area or beyond (especially in the downstream reaches with the easier access to the floodplain) as shown on the attached Figure 1; further field investigations would be necessary to determine the exact extents of the riparian area. The floodplain forest wetland area shown in Figure 1 is meant to approximate the riparian and floodplain area since there are no floodplain elevations included in the BCWMC model for this reach. Note, the riparian area may extend outside of the project area shown on the attached Figure 1.

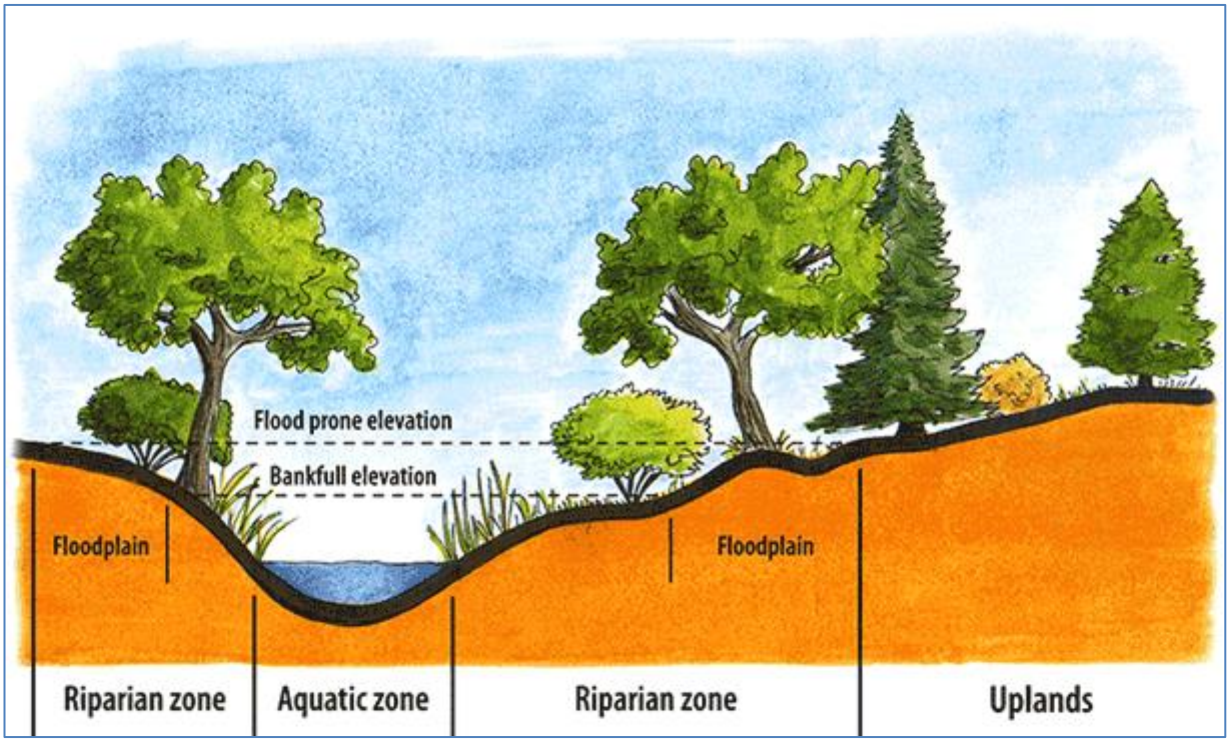



**Figure 2– Riparian Versus Upland Areas (Reference 3)**

The Commission Engineer presented the following qualitative benefits for buckthorn removal and revegetation of the understory vegetation at the May Commission meeting:

- Buckthorn shades out the understory vegetation, which leads to exposed soils and increased erosion potential (more sediment runoff) to the stream and downstream water bodies (including Plymouth Creek, Plymouth Creek Water Quality Ponds, and Medicine Lake).
- Removing buckthorn and other degraded trees opens up the tree canopy and allows sunlight to reach the ground to promote understory vegetation growth (including native plants). This decreases the amount of exposed soil, which can improve water quality by preventing sediment from entering the stream.
- Buckthorn will continue to re-seed the area if not removed.
- The more buckthorn that can be removed leads to more water quality and habitat improvements.

In addition to these benefits, the Commission Engineer sought to find additional quantitative information on the benefits of buckthorn removal and revegetation of the understory vegetation on phosphorus and sediment load reductions to streams and other water bodies. However, there is limited quantitative information available; the following information is a summary of some of the additional information available from a recent literature review.

Preliminary research shows buckthorn's impact on carbon and nitrogen cycles and on increased areas of exposed soils (References 4, 5, and 6). Researchers have found that carbon and nitrogen can accumulate beneath buckthorn at a higher rate and will eventually accumulate within the carbon and nitrogen cycling within the soil. This is potentially due to its higher productivity of leaf litter, which also has been shown to decompose at a faster rate than native plants. The quick decomposition of leaf litter that occurs beneath the buckthorn may also result in higher leaching rate of nitrogen. Though phosphorus was not evaluated in the research, it is possible to infer that there would also be a higher leaching rate of phosphorus. Researchers also found that the increase in carbon and nitrogen levels attract another invasive species, the earthworm, and together they can quickly demolish the leaf litter layer and expose the soil. Once the soil is exposed, it is more prone to erosion and can alter the structure of the forest floor.

As mentioned earlier, buckthorn is prevalent at the Ponderosa Woods site in both riparian and upland areas. Of special concern are exposed soils in the riparian area resulting from increased amounts of buckthorn. Loose soils may be eroded during higher flow events that reach the riparian areas (and therefore the floodplain).

### 2.4 Further description of available and potential easements

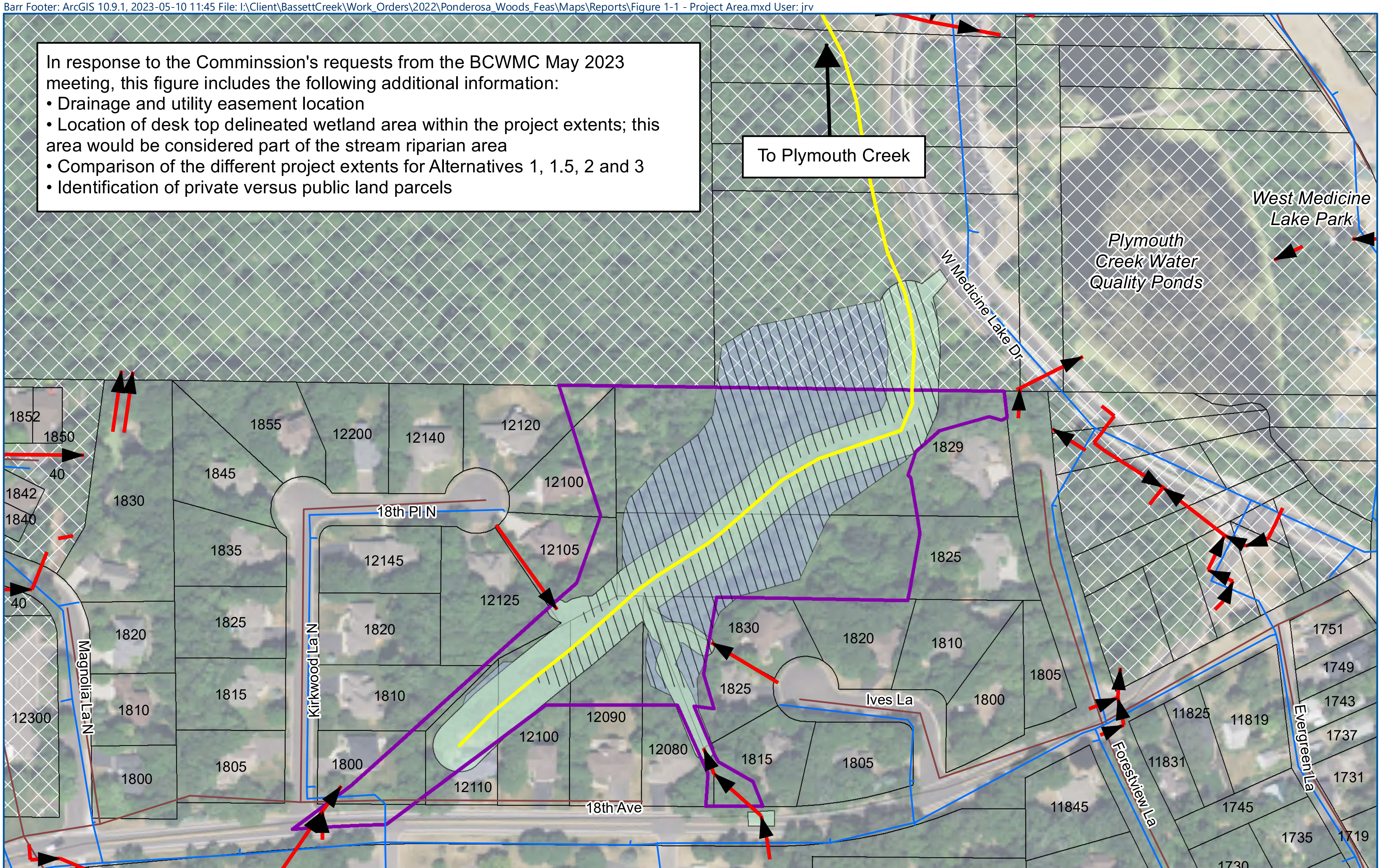
As presented at the May 2023 Commission meeting, the City has a permanent drainage and utility easement encompassing the entire project area as shown on Figure 1. Therefore, no additional point-of-entry agreements, vegetation management easements, or permanent easements are anticipated for any of the alternatives.

## 3.0 References

1. Medicine Lake Excess Nutrients Total Maximum Daily Load Implementation Plan. Prepared for the Minnesota Pollution Control Agency and the Bassett Creek Watershed Management Commission. Sep. 2010. https://www.pca.state.mn.us/sites/default/files/wq-iw8-19c.pdf
2. Medicine Lake Excess Nutrients Total Maximum Daily Load. Prepared for the Minnesota Pollution Control Agency and the Bassett Creek Watershed Management Commission. Nov. 2010. https://www.pca.state.mn.us/sites/default/files/wq-iw8-19e.pdf
3. "The Riparian Zone." Watershed Planning and Restoration: The Riparian Zone, 19 Aug. 2016, slco.org/watershed/streams-101/the-riparian-zone/.
4. Knight, K.S., Kurylo, J.S., Endress, A.G. *et al.* Ecology and ecosystem impacts of common buckthorn (*Rhamnus cathartica*): a review. *Biol Invasions* **9**, 925–937 (2007). https://doi.org/10.1007/s10530-007-9091-3
5. Liam Heneghan, Farrah Fatemi, Lauren Umek, Kevin Grady, Kristen Fagen, Margaret Workman. The invasive shrub European buckthorn (Rhamnus cathartica, L.) alters soil properties in Midwestern U.S. woodlands, *Applied Soil Ecology* **32**, 142-148 (2006). https://doi.org/10.1016/j.apsoil.2005.03.009
6. Goodfellow, John. *Invasive Buckthorn Can Cause Increased Erosion and Nutrient Runoff into Nearby Waters*, 30 Jan. 2019, www.stcroix360.com/2019/01/invasive-buckthorn-can-cause-increased-erosion-and-nutrient-runoff-into-nearby-waters/.

## 4.0 Attachments

- Figure 1 – Additional Project Information




Main Stream Path
Storm Sewer
Watermain
Sanitary Sewer
Floodplain Forest Wetland
Drainage and Utility Easement
Small Project Extents (Alternative 1)
Large Project Extents (Alternatives 1.5, 2, 3)
Private Parcel
Public Parcel

100 0 100
Feet

Note: The Commission Engineer performed a desktop evaluation for where the Floodplain Forest Wetland may exist within the project area. A field wetland delineation will be necessary to determine actual extents.

Imagery: USDA, 2021

Additional Project Information
Ponderosa Woods Stream Restoration Feasability Study
BCWMC

FIGURE 1