Appendix B-2

Excavation and Vegetation Estimate Methodologies

ESA

OWENS RIVER WATER TRAIL

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Purpose

The purpose of this report is to document the methodologies used by ESA to confirm the excavation volumes contained in the Inyo County Construction Plan dated September 2016 for the implementation of the Owens River Water Trail (ORWT or project). The methodologies are provided for the volume of material to be excavated from the channel and the vegetation to be removed to construct the ORWT, which would create a navigable water trail for small, non-motorized watercraft along the Owens River between a proposed boat launch at Lone Pine Narrow Gauge Road and a proposed boat take-out near Highway 136. The ORWT would create a 15-foot wide navigable water trail. Recreation season flows in the river are typically between 48 and 50 cubic feet per second (cfs); this provides an operating margin greater than the mandated minimum of 40 cfs. For a discussion of project scenarios evaluated please see *Owens River Water Trail – Hydraulic Analysis* (ESA, 2019); the proposed project is Scenario 5. Broadly speaking, the river channel has two constraints to navigability: narrow channel reaches and reaches with occlusions blocking the channel. The following methodologies were used to refine estimates of the in channel excavation volumes and the volume of vegetation to be removed to support the CEQA analysis and inform mitigation measures.

Methodologies

The following describes the methodologies to estimate the materials that would be removed and placed in the spoils areas. There are three (3) types of estimates: occlusion excavation, narrow channel excavation, and above water surface vegetation. More specifically, the occlusion excavation would occur at areas of mapped obstructions (i.e., large woody debris). The narrow channel excavation is the volume of material that would be removed in locations where the channel is less than 15 feet wide. The vegetation removal is the above water surface stalks of the tules and cattails that would be removed. The methodology for each of these is described below.

Occlusion Excavation Quantities

ESA staff calculated excavation volumes at river occlusions based on a combination of field measurements and GIS software analysis. In the field, staff mapped each occlusion by taking a GPS point at the beginning and end of the obstruction. Staff then estimated occlusion lengths in GIS by digitizing a line between the start and end points along the channel. Occlusion excavation

volumes were calculated by multiplying the occlusion length by an average excavation depth of one foot, by the 15-foot channel design width.

Narrow Channel Excavation Quantities

ESA staff used GIS software to perform a combination of manual digitization and image classification in order to estimate excavation volumes for locations where the channel is less than 15 feet wide. Staff first digitized an estimated river centerline based on aerial drone ortho-mosaic imagery captured by Eastern Sierra Aerial Mapping & Photography on May 14, 2018, which was provided to ESA by Inyo County. The Project reach was estimated to have a flow of 40 cfs when imaged, which is reflective of typical flow and anticipated Project conditions. ESA staff generated a 7.5-foot polygon buffer on either side of the centerline to create a 15-foot wide channel that estimates the Project channel area (see **Figure 1**).

Next, staff applied a supervised image classification to the ortho-imagery to create a two-class raster representing water and 'other.' A raster is a way of categorizing spatial information into classes or "bins"; rasters create individual cells with each cell having a value corresponding to the bin classification. The 'other' class represented all cells which were not water and potentially indicate areas of vegetation requiring excavation to create the navigable channel. This raster was converted to a polygon shapefile and then clipped to the centerline buffer. The 'water' class was then deleted, leaving only 'other' inside the buffer (see pink shading in Figure 1). The resulting classification layer was edited to remove all shapes less than 0.2 square feet in area to reduce noise (i.e., small fragments of cells which were not indicative of vegetation). For instance, a tree branch over the water less than 0.2 square feet would have been filtered out. The layer was further edited to remove ESA mapped occlusion areas. Staff then inspected the imagery to manually remove areas determined to be vegetation overhanging the channel but not constricting its width and thus not needing to be excavated (see the overhanging tree limbs in Figure 1 below).

Finally, staff calculated two metrics of the project: work area length and excavation volume. ESA estimated project excavation length in approximately one tenth of a river mile sections based on the classification layer. Excavation length, or distance along the channel, was approximated separately because this metric is anticipated to be used by contractors to have an understanding of total work length. Excavation volume was calculated as the product of area multiplied by an assumed one-foot excavation (i.e., square feet of excavation * one-foot excavation depth= cubic feet of excavation).

Vegetation Quantities

ESA staff calculated the quantity of vegetative material above the water surface elevation in the areas of the occlusions and narrow channel that would be removed based on a combination of field measurements and GIS software analysis, as discussed above, and the following assumptions. The vegetation consists of tules and cattails, which can vary in height and density. ESA staff estimated the length and width of the excavation areas in which vegetation would need to be removed, as described above. ESA applied an average tule and cattail above water height of 5 feet. The maximum vegetation removal volume was then calculated by multiplying the length

times the width times the plant height. The next step was to apply a factor to account for the density or occupied air space of the plant material. Cattails and tules have different densities with about 25% density of stalks and leaves for cattails and 33% density of stalks and leaves for tules. Therefore, ESA assumed a 25% and 33% scenario of occupied area in order to determine a range of vegetation material removed from the riparian habitat.

It should be noted that the use of aerial imagery has its limitations, as it does not differentiate between solid stands of upright tules and masses of stems and leaves that arch over, or lay upon open water; which is a common feature in dense tule stands. As such, the use of aerial imagery would somewhat overestimate volumes. (see **Figure 2**).

Results

Using the methodologies described above, ESA estimated the total volume of material to be excavated and vegetation above the surface to be removed in the areas of the occlusions and narrow channels for the Owens River Water Trail project.

VOLUME OF MATERIAL REMOVED TO CREATE THE CHANNEL

Channel Type	Estimated Excavation Volume (Cubic Yards)
Occlusion	2,900
Narrow Channel	2,300
Total Excavation	**5,200**

VOLUME OF VEGETATION ABOVE WATER SURFACE TO BE REMOVED

	In Channel Area (SF)	Volume (CY)
Occlusions	78,615	
Narrow Channel	60,970	
Total	**139,585**	
25% Occupied Space		6,462
33% Occupied Space		8,530

Note: The estimation of vegetation to be removed is provided as a range assuming the stalks and leaves occupy from 25 to 33% of the geometric area.

Combining the material from the in-channel excavation with the vegetation removal, the project would result in approximately 11,662 to 13,730 cy of wet material.

Note regarding estimated excavation and vegetation volumes: ESA's approach calculates in-situ volumes. Considerable "deflation" of the material will occur. Mechanisms of this deflation include dewatering and compaction of organic materials. Based on results of the Experimental Tule Control Project, which was conducted from 2013 to 2019 and included three seasons of tule removal and six years of monitoring, the County estimates initial deflation to be 40 to 60 percent

for the vegetation, such that dry spoils volume would be 40 to 60 percent less than initial wet volume.

Please refer to detailed maps for the project (provided in Appendix B-3 of the Draft EIR) that show the locations of in-channel work. Total channel length treated in the project area is estimated at approximately 2.6 miles of the 6.3-mile project reach.

Figure 1

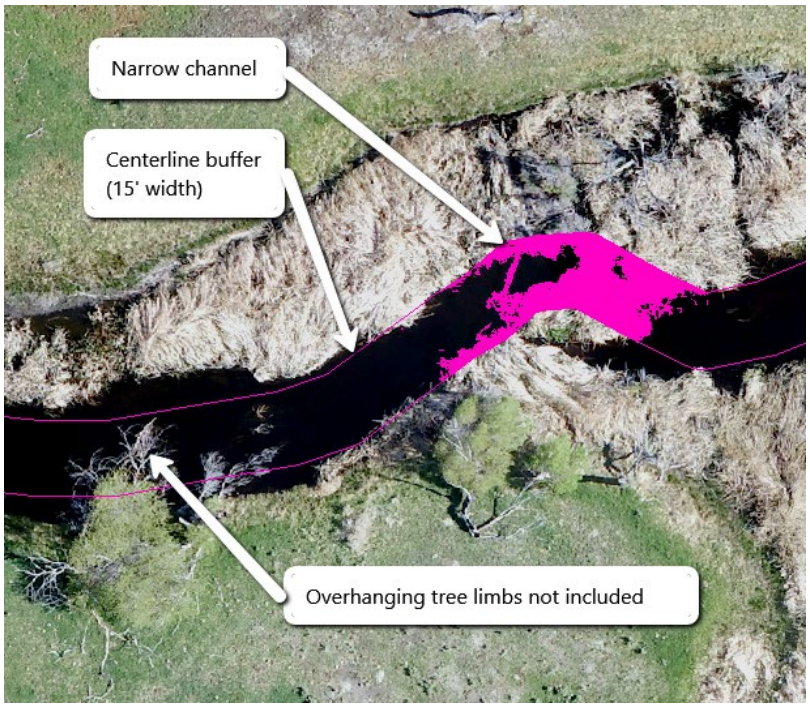

Figure 2