Memo

To: Adrienne Graham

From: David Shaw

Date: September 23, 2014

CC: Chevis Hosea, Squaw Valley Real Estate

Subject: Squaw Creek Restoration Goals, Objectives, and Anticipated Benefits, Squaw Valley Specific Plan, Placer County, California

In July 2014 Balance Hydrologics submitted an Advanced Conceptual Design and Design Basis Report for the Squaw Creek Restoration, part of the Squaw Valley Village Specific Plan in Placer County, California (Shaw and others, 2014). You have asked us to prepare this supplemental summary memo to elucidate restoration objectives and the anticipated benefits of the proposed restoration design[1] on fisheries, riparian, and wetland habitat, sediment retention, and groundwater recharge, particularly with regard to downstream reaches in the Squaw Valley Meadow. This memo outlines the anticipated restoration outcomes, the particular elements and design features that will lead to those outcomes, and analyses or reasoning which leads us to believe that these outcomes can be achieved.

Design Objectives

In addition to improving aesthetics, maintaining regulatory compliance, and creating a recreational and educational resource, the Squaw Creek restoration design focuses on the following primary objectives:

1. Increase the area of and quality of wetland, riparian, and aquatic habitat;
2. Reduce fine sediment transported and deposited in downstream reaches of Squaw Creek;
3. Reduce fine sediment carried in suspension to the Truckee River;
4. Maintain or increase floodplain storage;

Anticipated Benefits

Aquatic habitat

The channel restoration design has been developed to maximize gains in high-quality fish habitat. For the purposes of quantifying these benefits and evaluating their feasibility, we constructed a 2-dimensional hydraulic model and quantified increases in wetted area associated

[1] The channel restoration design has been completed to an advanced conceptual level. Specific project features may be revised during final design development.

with the introduction of a meandering and multi-threaded channel and expanded floodplain areas.

The model allows us to calculate gains in areas of deep and/or slow moving water at low and high flows, and indicates that during the low flow season when rearing occurs and nursery habitat is needed, the wetted area increases by 11,500 square feet (0.25 acres), and 83 percent of that increase will be in the form of deeper pools and higher-quality habitat. During high flow periods, when pockets of slow or deep water are required for fish to hold over in the system, the total wetted area is anticipated to increase by 68 percent, from 141,210 square feet 237,030 square feet (3.2 to 5.4 acres). Most of this increase comes from widespread inundation of a restored floodplain where slower-moving water is able to provide refuge and allow for upstream migration.

The introduction of areas of slow moving water will also allow for aquatic organism passage in areas that are considered to be velocity barriers at high flows.

Wetland, floodplain, and riparian habitat

Detailed planting plans have not yet been included in the advanced conceptual design; however, newly restored and expanded floodplain areas will be planted with a range of riparian species and herbaceous meadow vegetation. With more frequent inundation of existing wetland and meadow areas, a functional lift is expected to occur across approximately 2.2 acres of existing wetlands. Further expansion of riparian, wetland and floodplain areas will result in an additional increase of approximately 3.2 acres of restored wetlands, for a total restored wetland area of approximately 5.4 acres.

Sediment transport reduction

The proposed restoration design is anticipated to reduce fine sediment delivery to Squaw Creek in the Squaw Valley Meadow and the Truckee River, where aquatic habitat is impaired by fine sediment deposition (Curtis, 2006). Under current conditions, nearly the entire reach of Squaw Creek within the Specific Plan Area is dominated by sediment transport, with suspended and bedload sediment readily transported to and impairing downstream areas. The proposed restoration design will result in conversion of these reach from fine sediment transport to fine sediment-deposition.

By increasing channel and floodplain connectivity, overbank flooding will occur in most years during snowmelt runoff, over a more widespread area. The frequency, duration, and sediment transport capacity at these ‘bankfull’ flows are such that the bulk of the annual sediment load tends to be delivered during these times. Hydraulic and sediment transport modeling indicates that flow depths and velocities will not be sufficient to mobilize or maintain mobilization of fine sediment particles (<4mm) in restored/created floodplain areas, so by increasing inundation duration in these areas, floodplain sediment retention will be maximized. Further retention of

fine sediment is anticipated to be achieved through the construction of backwatered areas along the Olympic Channel, which is known to have among the highest rates of suspended sediment transport.

Through these sediment reduction efforts, less sediment is anticipated to be available for deposition and bed filling in downstream areas.

Bedload sediment transport continuity

The current configuration of the trapezoidal channel through the Specific Plan Area in the 1950s does not allow for deposition of bed load sediment at the valley head. As a result, coarse material is now transported and deposited on the meadow, where gravel bar development destabilizes banks and generates fine sediment for delivery to downstream areas. Widening the channel near the confluence of the North and South Forks will allow for coarse sediment deposition upstream of the meadow during very large flow events. As a result, lateral channel bank erosion and sediment generation in the meadow is anticipated to decrease.

Groundwater recharge

Other investigators (Hecht and Jett, 1988; Moran, 2013; Hydrometrics WRI, 2011; 2013a; 2013b) have presented information to suggest that the recharge to Squaw Valley aquifer is dominated by mountain-front processes where coarse material has been deposited at and near the mouths of canyons. Since Squaw Creek is now channelized and portions of the mountain front area have been paved, infiltration and groundwater recharge can be limited during the summer and early fall. These studies have also found that groundwater drains to the deep channelized reach of Squaw Creek during the winter and spring.

The restoration project will decrease the overall gradient of the channelized reach and increase the wetted area by as much as 0.25 acres during low flow period, when the stream has been documented to be losing water to the ground. As a result, losses to the stream and potential groundwater recharge is anticipated to increase through the project areas, thereby increasing groundwater storage and potentially increasing discharge from the aquifer to the creek along the meadow reach.

References:

Curtis, C., 2006, Total Maximum Daily Load for sediment, Squaw Creek, Placer County, California Regional Water Quality Control Board, Lahontan, 2006, Final Staff Report, 8 p. incl. tables.

Hecht, B., and Jett, G. 1988, Sedimentology and recharge of a Sierran glacial-valley aquifer: Squaw Valley, California: Poster session presented at the International Mountain Watershed Symposium, Calneva Lodge, Lake Tahoe, 3 p. + figures.

Hydrometrics WRI, 2011, Squaw Valley Creek / Aquifer Interation Study Final Report: consulting report prepared for Squaw Valley Public Service District, 37 p. + appendices.

Hydrometrics WRI, 2013a, Task 4.1 Technical Memorandum on Seasonal Creek / Aquifer Interactions: consulting report prepared for Squaw Valley Public Service District, 39 p. + appendices.

Hydrometrics WRI, 2013b, Task 4.2 Technical Memorandum on Pumping Impacts on Squaw Creek: consulting report prepared for Squaw Valley Public Service District, 23 p. + appendices.

Moran, J., Examination of Groundwater Inflow to Squaw Creek using Radon and Other Tracers, 25 p.

Shaw, D., Kulchawik, P., and Hastings, B., Design basis report: Squaw Creek Restoration, Squaw Valley Specific Plan, Placer County, California: Balance Hydrologics consulting report prepared for Squaw Valley Ski Holdings, LLC, 34 p. + tables, figures, and appendices.

Shaw, D., and Roberts, B., 2013, Squaw Valley Water Quality Investigation Report, Drainage Area of Squaw Creek at the Confluence of the Main Stem and the Olympic Channel: Balance Hydrologics consulting report prepared for Squaw Valley Ski Holdings, LLC, 19 p. + tables and figures.