Sound Watershed Consulting

Creating Functional Water Environments

Lower Squaw Creek Restoration Floodplain Technical Workshop Report

for

The Friends of Squaw Creek

Truckee River Watershed Council

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Hydrology
Geomorphology
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Lower Squaw Creek Restoration
Floodplain Technical Workshop Report

The Friends of Squaw Creek convened a small group of stakeholders to discuss approaches regarding specific hydrologic feasibility issues associated with the floodplain functions necessary to restore Lower Squaw Creek summer flow conditions. The group consisted of experts in groundwater hydrology, surface water hydrology, river restoration, water supply and representatives from key landowners and the Squaw Valley Public Services District, and included:

Ed Heneveld	Friends of Squaw Creek
Russell Poulsen	Poulsen Family
Tom Murphy	Ski Corp
John Moberly	Squaw Valley Public Services District
Bob Larsen	Lahontan Regional Water Quality Control Board
Derrik Williams	Hydrometrics
Chris Bowles	cbec
Mike Liquori	Sound Watershed Consulting

The primary objectives of the workshop were to:

- Review feasibility issues associated with the channel restoration alternatives
- Consider water supply factors that may affect instream flows
- Frame our current understanding of the creek and groundwater interactions sufficient to guide feasibility evaluations for the alternative design, and
- Outline opportunities to coordinate with SVPSD science activities.

Much of the information for this discussion was based on existing studies and reports as well as local landowner knowledge and experience. The workshop synthesized the existing information across disciplines to resolve issues and identify new opportunities to address known hydrologic constraints.

The workshop focused on:

a) Water supply factors that may affect instream flows during summer conditions, and

b) Feasibility issues associated with reconnecting the channel and floodplain described in the existing restoration alternatives.

The workshop framed the discussion by outlining key questions that were identified prior to the workshop in an effort to address areas of specific concern that have yet to be resolved. The objective is to satisfy technical issues and concerns sufficiently to demonstrate the feasibility of various restoration alternatives and components. We used the collective knowledge of the group to either resolve each key question, or to identify approaches that could be used to resolve them. The list of key questions and their answers are provided as an appendix to this report.

Sound Watershed Consulting facilitated the workshop, coordinated with each participant prior to the workshop to establish objectives and scope, and is responsible for this report on the results of the workshop. In addition, SWC will spend 1 day onsite at SVPSD offices reviewing existing studies for relevant data and/or information. SWC will also coordinate directly with Derrik Williams to collaboratively identify opportunities to leverage the SVPSD project with this FOSC project.

Additional Resources

Several additional resources were identified that will be reviewed by Sound Watershed Consulting. These include:

- The West Yost reports, including
    - Groundwater Characterization Report (May 2005)
    - Squaw Valley Groundwater Development and Utilization Feasibility Study Update (Aug 2003)
- Chris Hammersmark's dissertation work on Bear Creek in northeast California
- Streamflow data being collected by SVPSD
- Study results and values from recent drawdown tests on existing Resort wells
- Resort at Squaw Creek's recent supplemental draft EIR

Existing Conditions & Issues Background

Among the restoration goals is the desire to increase storage in the floodplain environment to support more perennial flow during summer periods. It's widely believed that increasing summer floodplain storage within the floodplain may help support this goal. However, given that the floodplain is probably saturated during the spring snowmelt runoff

period, its improbable that increasing the frequency of overbank flooding can increase floodplain storage.

Historical conditions provide one reference to help understand how the system functioned before land development practices began in the mid 19th Century. We note that the restoration objectives will not restore historical conditions, but will compensate and mitigate for existing land-use impacts to support important stream functions and processes. Historical (pre-development) conditions probably included a series of smaller stream channels that meandered across a floodplain that included numerous small wetlands and small oxbow ponds. Such conditions can be observed in other alpine meadow systems, on pre-Olympic design drawings, historic photographs and along relict channel segments in the lowest extent of the meadow.

Several significant existing hydrologic alterations limit water delivery to the floodplain during summer months. These include:

- Channel simplification and incision that rapidly drains the meadow soil water storage
- Hillslope development that intercepts and routes water into ditches and other concentrated conveyances so that water is routed within hours as storm runoff instead of infiltrating and routing over months as much slower subsurface runoff
- Interception and diversion of springs along the south slope and within the floodplain surface (e.g. Carl's spring)
- Loss of floodplain infiltration capacity in the parking lots, rooftops and other impervious surfaces within the village along the western end of the valley (approximately 92 acres)
- Possible aquifer influences near the trapezoidal channel (SVPSD is currently studying this effect)
- Possible compaction, subsurface drainage and/or other losses associated with Olympic-era activities upon the floodplain (e.g. parking, trench drains, etc).

These losses represent a sizable volume of water. The lost infiltration from the impervious western surfaces alone could account for about 160 ac-ft of water storage.

The impact of groundwater supply withdrawals is not clear from existing studies. Existing wells are too deep to measure the response of floodplain conditions most important to the creek. Some evidence that

the aquifer intersects the creek bed in the trapezoidal channel will be investigated by a recently funded Squaw Valley Public Services District study.

Perspectives on Feasibility

After some discussion, the group generally agreed on the following factors

- There is insufficient information from which to evaluate the potential storage in the floodplain or its rate of drawdown
- There may be interactions between the channel and the aquifer in the Trapezoidal Channel reach, and this is being evaluated by a recently funded SVPSD study
- The channel incision has probably exacerbated floodplain storage potential, and must be addressed to promote recovery of floodplain storage
- Human development has altered natural hillslope water sources in a manner that cannot be easily restored
- No single source of water would likely replace the various impacts from human development
- There are several opportunities upstream of the Trapezoidal Channel that should receive more focused evaluation

There was general agreement that proposed restoration components could benefit hydrologic conditions, and a list of specific components was identified (see Appendix).

There was broad agreement that the benefits of reconnecting the floodplain will primarily benefit the mid to lower portions of the meadow, and that primary concerns are in the upper meadow. Thus the conversation shifted to sources of storage that could support summer flows in the upper meadow. This lead to a preliminary list of several additional design components described below.

Additional Design Components

One of the conclusions from the workshop is the need to supplement water delivery to the upper meadow with increased summer water storage. Options that simply reconnect the floodplain will not be sufficient to compensate for the loss of hydrologic storage described above. The following sections outline several of these sources, and

describe additional design considerations that should be explored further. Together, these sources could provide as much as 79 ac-ft of storage for summer release, or enough to provide a constant flow of approximately 0.33 cfs through 4 summer months[1].

Site	Length (ft)	Avg Width (ft)	Depth (ft)	Volume (ft3)	Volume (ac-ft)	Avg discharge for 120 days (cfs)
North Bank Wetland (upper)	269	120	1.0	32,280	0.74	0.003
North Bank Wetland (lower)	350	150	1.0	52,500	1.21	0.005
Olympic Channel Wetland	700	100	1.0	70,000	1.61	0.007
Searchlight Pond	158	100		267,458	6.14	0.026
Trapezoidal Channel	2100	60	12	1,512,000	34.71	0.146
Confluence Delta	360	200	10	720,000	16.53	0.069
Combined Lower North Fork	1270	85	7.1	766,445	17.60	0.074
Total				**3,420,683**	**78.53**	**0.330**

WETLAND STORAGE

The conceptual restoration design includes a wetland construction component along the upper reach of the Olympic Channel and Squaw Creek immediately below the Trapezoidal channel. Preliminary estimates for potential water storage range from about 1.5 acre-feet to 3.55 acre-feet, or about enough water to supply 0.015 cfs for 120 days (see Table below). More importantly, this feature will help to sustain high soil moisture content near the creek and could potentially have a positive influence on reducing flood risks and increasing water table elevations.

Design Considerations:

- Infiltration capacity
- Typical range of seasonal water table depths
- Hydraulic modeling for surface elevations
- Wetland configuration and flow routing

SEARCHLIGHT POND

Squaw Valley Ski Corporation has offered access to their Searchlight Pond, which is about 1800 feet west-southwest of the head of the Olympic Channel. This pond can store up to 2 million gallons (approx 6 ac-ft) of water, which is sourced from a small watershed of approximately 44 acres in size. Modifications to the impoundment will

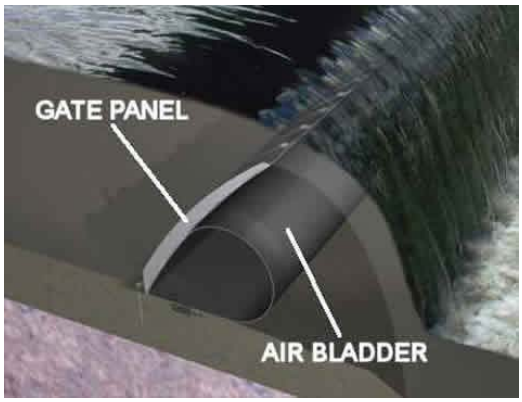
[1] *These values are preliminary, and do not consider losses associated with infiltration, evapotranspiration, flow variation, hydraulic routing, etc.*

be required to provide sufficient controls over flow releases. We understand that existing infrastructure currently is available that can route flows near the head of Olympic Channel, although the capacity of the existing structures to modify flow releases is not clear.

Design Considerations:

- Examine existing impoundment structures
- Review as-built drawings associated with the impoundment's plumbing
- Estimate the timing, volume and routing of un-impounded flows from this feature
- Integrate with the wetland design and Olympic Channel restoration design

TRAPEZOIDAL CHANNEL STORAGE



The concept of using the existing Trapezoidal Channel as a water storage facility was discussed at the workshop. This is a compelling opportunity that could benefit Squaw Creek by a) increasing the water table elevation during the summer, and b) providing surface flows to Squaw Creek. Preliminary estimates suggest that this site could store as much as 35 ac-ft of seasonally-impounded water (see Table). Impoundment may be provided by an inflatable dam structure or a more traditional gate feature. Several considerations will need to be evaluated to verify the feasibility of this concept.

Design Considerations:

- Effects of impoundment on existing riparian vegetation
- Effects of impoundment on existing bank stability and structures

- Conceptual development of impoundment structures
- Review hydrology and streamflow data for the North and South Forks to evaluate flood risks and other factors necessary for design
- Consider impacts to existing storm drainage
- Operational guidelines for storage and release
- Consider risks from unexpected or emergency dam release, and associated design components to reduce this risk

CONFLUENCE DELTA & NORTH FORK STORAGE

There is a approximately 1.6 to 2.4 acres near the confluence with the North Fork and South Fork tributaries that could support a summer water storage facility. This site currently stores sediment that is deposited from the tributaries.

Design Considerations:

- Gradient and hydraulic profiles to establish the upstream backwater extent associated with structures below the Trapezoidal Channel
- Impacts associated with sediment transport
  - Routing and storage of bedload
  - Water quality effects associated with stored suspended load and wash load sediments
- Evaluate flood risks along South Fork
- Consider impacts to existing storm drainage
- Other factors as described for the Trapezoidal Channel Storage

Potential Action Steps

The following actions were identified during the workshop and subsequent review of information. These will be prioritized following the Technical Creek Restoration Workshop, and recommendations for Phase II studies will be developed.

Obtain & Review additional resources – described above (see page 2)

Obtain & Review SVPSD streamflow data – streamflow data was only partially available at the time of the conceptual design report. Review of this data may yield information about floodplain response potential.

Longitudinal profile and channel survey of Lower Squaw Creek, the North Fork and South Fork tributaries upslope of the meadow.

Obtain information from Hydrometrics (Derrik Williams), including:

- volume estimates for water that can be provided by "Carl's Seep" after nearby pumping ceases (data from recent drawdown tests).
- Maps of existing and new well development

Floodplain Water Budget, including existing sources, storage, and water routing. This water budget should include estimates for water inputs (groundwater, creek flows, etc), storage (ponds), and routed return flow

Floodplain Characterization Study – a brief study of floodplain soil conditions to identify hydrologic and hydraulic properties that will describe porosity, conductivity, transmissivity, compaction, depth, stratigraphy and infiltration rates. Depth and types of impermeable lenses that may exist (see well logs from existing wells) may also be valuable information. One or more lateral piezometer transects would be valuable in describing interactions between the floodplain and the channel. Particular attention may be warranted along the drainage ditches established in the Olympic era. These may be evaluated using geotechnical techniques or exploratory soil trenches.

Piezometer Transect – lateral set of shallow piezometers with dataloggers that can record the rise and fall of the floodplain water table would provide data helpful to restoring the floodplain.

Trapezoidal Channel & Water Storage Conceptual Alternatives – conceptual planning study that evaluates goals, opportunities, and constraints for addressing the trapezoidal channel and upper meadow summer water storage alternatives. This study should also consider how the Trapezoidal channel affects the existing meadow conditions, and how it may impact existing conceptual

restoration alternatives. More clear goals for activities upstream of the Trapezoidal channel may need to be developed, as restoration objectives are probably different than for the lower reaches. In addition to the technical conceptual analysis, this study should also identify and evaluated Policy, Legal & Regulatory Issues including:

- FEMA constraints – explore what flood control constraints may limit development of storage alternatives within or near the Trapezoidal channel.

- Water rights/pond hydrology & hillslope storage associated with Resort's sites

- Potential water supply issues associated with the Truckee River Operating Agreement (TROA).

- List of likely permits that will be required to be completed (a preliminary list has already been developed, but may need to be reviewed and amended).