Tribal Cooperation and Design of a Multi-Objective Fish Passage Structure on Kelsey Creek, California

Floodplain Management Association

A Flood of Fishy Issues

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Kelsey Creek

• 3rd largest tributary to Clear Lake
• Watershed upstream of Main St. Bridge is 42.8 square miles
• 1 of 3 remaining Clear Lake tributaries that still support active hitch migration
Watershed Problems

- Channel incision (up to 15 ft)
- Reduced instream flows
- Barriers to hitch migration
- Decreased water quality in Clear Lake
- Increased competition
- Reduction in marshes along Clear Lake
Hitch in Peril

• Hitch population has declined due to:
  – Loss of wetland/marsh habitat
  – Blocked access to spawning locations in tributaries
  – Introduced non-native predators in Clear Lake.
  – Decrease stream flows from irrigation diversion and climate change

• Hitch are culturally significant to Pomo Indians
Hitch Listing

- CDFW listed the Clear Lake hitch as a Fish Species of Special Concern in 1995.
- Added to the California Endangered Species List in 2014.
Clear Lake Hitch

• Endemic to Clear Lake
• In the spring, hitch migrate to tributaries to spawn
• Return to the Clear Lake after spawning
• Millions of spawners reduced to only a few thousand primarily in Abode and Kelsey creeks
• "unimaginably abundant" hitch once clogged tributaries with spectacular spawning runs
Main Street Bridge

- Historical bridge design that is rare in California
- Seismically upgraded
- Existing fish ladder never worked and is currently undermined at downstream extent
- Main Street Bridge grade control structure prevents the use of two miles of habitat
- Hitch blocked from critical pools upstream of the bridge
Tribal Self Governance

• Tribes are sovereign nations
• Tribes have built capacity for watershed restoration, water quality standards, nonpoint source management, and are treated in the same manner as a state by the US EPA
• Tribal watershed management plans were shared between different tribes to facilitate goals of barrier removal
Tribal Cooperation

- Hitch are culturally significant for all tribes surrounding Clear Lake
- Shared watershed based approach to restoration
- Matched funding from one tribe for design of a project in another tribe’s ancestral territory
- Balance goals and objectives between tribes, county, state, and federal governments
Big Valley Rancheria

- Federally recognized Tribe located on shores of Clear Lake, 350 acres in size, 1000+ members. Ancestral boundaries incorporate all of
- Water people, Tribal use of the lake and streams to practice culture and subsistence
- Clear Lake hitch projects: water quality monitoring in streams, collaborative tagging projects, support of barrier removals
Hitching
Elem Tribe

- Elem Indian Colony 50 acres on shores of Clear Lake, approximately 100 members. Adjacent to Sulphur Bank Mercury Mine. Ancestral territory – parts of Cache Creek region, city of Clearlake, town of Clearlake Oaks
- Clear Lake hitch – abundant food source
- Clear Lake hitch projects – design and completion of hitch passageway on a smaller creek - collaborative project with County and State Parks included replacing failing sewer line
Multi-benefit Fish Passage Project

- Engineering and geomorphic analysis to guide design
- Prioritize alternatives to improve fish passage, enhance habitat, & preserve infrastructure
- Long term and sustainable alternative
- Collaborate with stakeholders (tribes, Lake County, landowners)
Design Constraints

• Main Street Bridge
  – Historical bridge design
  – Seismically reinforced
  – Grade control structure

• Flood conveyance
  – Adjacent residential and commercial properties
  – Downtown Kelseyville

• Hitch passage criteria
## Hitch Passage Criteria

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Design Value (units)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slope</td>
<td>&lt;0.03</td>
</tr>
<tr>
<td>Passage flows</td>
<td>15-200 cfs</td>
</tr>
<tr>
<td>Velocity</td>
<td>No Steps!</td>
</tr>
<tr>
<td>Depth</td>
<td>&gt;0.5 ft</td>
</tr>
<tr>
<td>Low flow channel conveyance</td>
<td>15 cfs</td>
</tr>
<tr>
<td>Low flow channel and grade control structure</td>
<td>Width: 8 ft</td>
</tr>
<tr>
<td></td>
<td>Depth: 1 ft</td>
</tr>
</tbody>
</table>
Design Flows

• Hitch passage design flows: 15 to 200 cfs
• 100-year design flow: 11,900 cfs
Design Alternatives
## Prioritization of Alternatives

<table>
<thead>
<tr>
<th>Alternatives</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Larger version of existing passage structure</td>
<td>• Decreased construction costs (shortest length and least amount of fill)</td>
<td>• Passage unlikely for design flow range (velocities likely only suitable at low flow)</td>
</tr>
<tr>
<td></td>
<td>• Limited impact on channel and riparian vegetation</td>
<td>• Existing structure failed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• High maintenance likely (sediment deposition)</td>
</tr>
<tr>
<td>Separate high and low flow channels</td>
<td>• Passage (easier to design for smaller range of flows in the high and low flow channel)</td>
<td>• Attraction flow from high and low flow channel may confuse hitch</td>
</tr>
<tr>
<td>Meandering multi-stage channel</td>
<td>• Natural form (follows the thalweg)</td>
<td>• Sediment deposition in bends</td>
</tr>
<tr>
<td></td>
<td>• Complex channel provides better habitat</td>
<td>• Increased maintenance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Most expensive alternative to construct</td>
</tr>
<tr>
<td>Straight, multi-stage, roughened ramp</td>
<td>• Flushes sediment though the channel</td>
<td>• Excess velocity</td>
</tr>
<tr>
<td></td>
<td>• Lower construction costs than meandering channel and high and low flow channel alternatives</td>
<td>• Limited channel complexity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Low aesthetic value</td>
</tr>
</tbody>
</table>
Preferred Alternative

- A straight, roughened, multi-stage channel with no steps
- Slope not to exceed 3%
- Low flow channel 8 ft wide x 1 ft deep
- Grade control structure retained to prevent undermining of the Main Street Bridge
- Large boulders placed upstream of the low flow channel to provide channel bed stability and prevent debris from clogging the low flow channel
## Roughened Ramp Slope

### Existing and Proposed Conditions for 2%, 3%, & 5% Slope

<table>
<thead>
<tr>
<th>Condition</th>
<th>Graph Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proposed 100 yr WSE 2% slope (n=0.06)</td>
<td>Proposed ground 2% slope</td>
</tr>
<tr>
<td>Proposed 100 yr WSE 3% slope (n=0.06)</td>
<td>Proposed ground 3% slope</td>
</tr>
<tr>
<td>Proposed 100 yr WSE 5% slope (n=0.06)</td>
<td>Proposed ground 5% slope</td>
</tr>
<tr>
<td>Existing 100 yr WSE</td>
<td>Existing ground</td>
</tr>
</tbody>
</table>

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**Flow**

- **Main Street Bridge**
- **Upstream Extent**
- **Downstream Extent**
- **Grade Control Structure**

**Pool**

### Graph Details

- Elevation (ft) vs. Station (ft)
- Various line types for different conditions and slopes.
Hydraulic Modeling Results

Main Street Bridge

Roughened Ramp (3% slope)
Channel Conveyance
# Modeled Roughened Ramp Performance

<table>
<thead>
<tr>
<th>Cross Section Location in Roughened Channel</th>
<th>Discharge (cfs)</th>
<th>Depth (ft)</th>
<th>Velocity (fps)</th>
<th>Channel Width (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upstream</td>
<td>15</td>
<td>0.6</td>
<td>2.8</td>
<td>103</td>
</tr>
<tr>
<td>Upstream</td>
<td>200</td>
<td>2.0</td>
<td>3.1</td>
<td>103</td>
</tr>
<tr>
<td>Downstream</td>
<td>15</td>
<td>0.6</td>
<td>2.8</td>
<td>50</td>
</tr>
<tr>
<td>Downstream</td>
<td>200</td>
<td>2.0</td>
<td>4.2</td>
<td>50</td>
</tr>
</tbody>
</table>
Design Details
Additional Considerations

• Geotechnical investigation
  – Integrity of grade control structure
• Use of local materials
  – Downstream gravel mining operation
• Additional gradient control structures?
• Engineered streambed material
  – Fill void spaces to prevent infiltration to maintain low flow passage
• Letter of Map Revision
  – To be determined after final design
Next Steps

• Identify funding sources
• Complete final design
• Complete CEQA and permitting
• Implement project
Lessons Learned

• Clearly identify and communicate roles and responsibilities for each stakeholder

• Outreach and access takes longer than anticipated
Questions

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