Addressing Instream Flow in the Shasta River Temperature TMDL

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North Coast RWQCB

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Item 18
Summary

- Temperature objective not achieved without increasing dedicated cold water instream flow

- 45 cfs goal based on sensitivity analysis (Staff Report Sections 6.2.4 and 6.4.1)

- Shasta River watershed characterized by constant source of cold water
Summary

- 60-year average August unimpaired flow at mouth = 353 cfs (CDWR 1994)

- 60-year average August impaired flow at mouth = 39 cfs (USGS)

- Spring flows contribute > 130 cfs near-constant flow

- 45 cfs goal can be achieved by available and existing management strategies and does not alter or reallocate water rights.
Water Quality Objective for Temperature

“The natural receiving water temperature of intrastate waters shall not be altered unless it can be demonstrated to the satisfaction of the Regional Water Board that such alteration in temperature does not adversely affect beneficial uses.”
Water Quality Objective for Temperature

No alteration of natural temperature

Or

Protect beneficial uses
Water Quality Compliance Scenario

- Increased riparian shade
- Reduced irrigation tailwater return flow temperatures
- Reduced tributary inflow temperatures
- Increased dedicated cold water instream flow
Maximum Temperature

Klamath River

Dwinnell Dam

Flow Direction

Salmonid juvenile growth and rearing threshold

Temperature (degree C)

Temperature (degree F)

River mile

Baseline

Master 1 Scenario

Water Quality Compliance Scenario
Master 1 Scenario:

1) Site potential shade

2) Irrigation tailwater return flow – zero net increase in temperature
Water Quality Compliance Scenario:

1) Site potential shade

2) Irrigation tailwater return flow – zero net increase in temperature

3) 45 cfs increase of dedicated cold water instream flow
Water Quality Compliance scenario:

1) Does not adversely affect BU’s, and
2) Results in attainment of temperature objective.

Temperature compliance points
Compliance with Temperature
Objective

<table>
<thead>
<tr>
<th>Factors</th>
<th>Natural Temperature</th>
<th>Altered Natural Temperature – Protect BU’s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shade</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Irrigation tailwater return flows</td>
<td></td>
<td></td>
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<tr>
<td>Flow</td>
<td></td>
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Compliance with Temperature Objective

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<tr>
<td>Shade</td>
<td>Full site potential shade</td>
<td></td>
</tr>
<tr>
<td>Irrigation tailwater return flows</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Flow</td>
<td>Full natural flow</td>
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</tr>
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</table>
## Compliance with Temperature

### Objective

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<th>Altered Natural Temperature – Protect BU’s</th>
</tr>
</thead>
<tbody>
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<td><strong>Shade</strong></td>
<td>Full site potential shade</td>
<td>Full site potential shade</td>
</tr>
<tr>
<td><strong>Irrigation tailwater return flows</strong></td>
<td>None</td>
<td>No net temperature increase</td>
</tr>
<tr>
<td><strong>Flow</strong></td>
<td>Full natural flow</td>
<td>+ 45 cfs of dedicated cold instream flow</td>
</tr>
</tbody>
</table>
TMDLs must result in attainment of water quality standards throughout the year, including under critical conditions.
Temperature TMDL Allocations

Assigns temperature reductions to source categories:

- Riparian shade
- Irrigation tailwater return flows
- Flow
Reductions in maximum daily temperatures at temperature compliance locations

- 2.1°C
- 1.2°C
- 1.5°C
## Average August Flow (cfs)
### Shasta River Near Mouth

<table>
<thead>
<tr>
<th>Unimpaired Flow$^1$</th>
<th>Existing Baseline</th>
<th>WQ Compliance Scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>353</td>
<td>22</td>
<td>67</td>
</tr>
</tbody>
</table>

1. CDWR (1994) Preliminary Unimpaired Flow Study
Average Monthly Flows - Shasta River Mouth

- **Unimpaired flow estimate (CDWR 1994)**
- **Average TMDL flow**
- **Measured flow (USGS)**
- **Existing baseline**
- **WQ Compliance Scenario**

Cubic Feet / Second

May | June | July | August | September | October
Attributes of Shasta River

- Mt. Shasta, Eddy Mountains, Cascade Range
  - Provide constant source of cold spring and snow melt stream flows
  - Water temperatures at the source of springs remain fairly constant year-round from about 11-13 degrees Celsius
- Largely volcanic soils
  - Naturally high nutrient concentrations
- Agricultural economy
  - Irrigated pasture & alfalfa, hay, cow-calf
- Low rainfall, high desert environment
  - Irrigation; mostly flood irrigation at present
What is the basis for 45 cfs goal?
Purpose:

To evaluate the effect of dedicated cold water flow increase on Shasta River temperature.

- Increased baseline flows by 50% at six select locations – one location for each simulation
- Baseline temperature maintained
- Flow maintained to the mouth
Flow analysis – maximum temperature results

50% flow increase downstream of Big Springs Creek has largest affect on Shasta River temperatures; = 45 cfs increase
Action Plan

- Water diverters should employ water management practices and activities that result in increased dedicated cold water instream flow in the Shasta River and its tributaries.

- **Goal**: Increase the dedicated cold water instream flow in the Shasta River by 45 cfs or alternative flow regime that achieves the same temperature reductions.
Shasta River Watershed
Property Ownership Distribution

- Federal Lands  
  ~ 208 sq mi
- State Lands  
  ~ 9 sq mi
- City Boundary  
  ~ 17 sq mi
- Private - Timber  
  ~ 81 sq mi
- Private - Other  
  ~ 474 sq mi
- Reservoirs / Lakes
- Major streams
Big Springs Lake, Big Springs Creek

Lake Shastina

Shasta River

Parks Creek

Little Shasta River

Hole in the Ground Creek

Montague Irrigation District Diversion

Explanation

Diversion (CFS)

- 10 to 50
- >5 <10
- 5 or less
- Unknown

Ditch

Main River or Stream

Montague Irrigation District

Montague Irrigation District deeded land

Shasta Water Association

Big Springs Irrigation District

Grenada Irrigation District

Huesman Irrigated Areas

Lake Shastina

Shasta River Subbasin
Management Strategies

- Water Use Efficiency
- System Reoperation
- Agricultural Lands Stewardship
- Groundwater Storage/ Conjunctive Management
- Municipal Water Reuse
- Ecosystem Restoration
- Economic Incentives
- Water Transfers/Water Trust

-CAL Dept Water Resources, Water Plan Update 2005
Water Use Efficiency

- Ag production per unit of applied water for 32 important CA crops increased 38% from 1980 to 2000.

- Hardware and infrastructure upgrades
  - Data acquisition and control systems
  - Changes in irrigation method
  - Lining of ditches and canals
  - Tailwater recovery

- Water Management
  - Integrated monitoring and management
  - Water to meet crop requirements
System Reoperation

- Change time or volume of reservoir releases
- Temperature control devices
- Groundwater banking
- Coordinate and interconnect storage, conveyance, and delivery systems
- Risk management
- Change points of diversion
- Pulse flows
- Off-stream storage
Agricultural Lands Stewardship

- Irrigation tailwater recycle/reuse
- Crop shifting
- Crop idling
Economic Incentives

- Low-cost loans
- Grants, e.g., CA proposition programs
- Subsidies
- Water audits, rebates
- Water pricing, rate structures
- Water purchase
Water Transfers/Water Trust

- Change in point of diversion, place of use, purpose of use
- Temporary or long-term
- Water is made available through means such as water use efficiency, crop idling, crop shifting, return flow reductions, conveyance loss reductions, groundwater conjunctive use
- In 2001, 1,250,000 ac-ft, 20% long-term.
- Environmental programs: 200,000 ac-ft/yr 1995-2001
- Scott Valley exploring water trust idea
Are these just big ideas or are they real?

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Scott</th>
<th>Shasta</th>
<th>California</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water use efficiency</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Economic incentives</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>System reoperation</td>
<td>Possible</td>
<td>Possible</td>
<td>Yes</td>
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<tr>
<td>Ag. land stewardship</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Water transfers</td>
<td>Proposed</td>
<td>Possible</td>
<td>Yes</td>
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<tr>
<td>GW/SW conjunctive</td>
<td>Yes</td>
<td>Possible?</td>
<td>Yes</td>
</tr>
<tr>
<td>Municipal water reuse</td>
<td>Possible?</td>
<td>Montague</td>
<td>Yes</td>
</tr>
<tr>
<td>Ecosystem restoration</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
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</table>
Win-Win

- Plenty of tools in the tool box
- Solutions do not require reopening adjudications
- All irrigators have the potential to contribute