

Interpreting Temperature Standards in the North Coast Region

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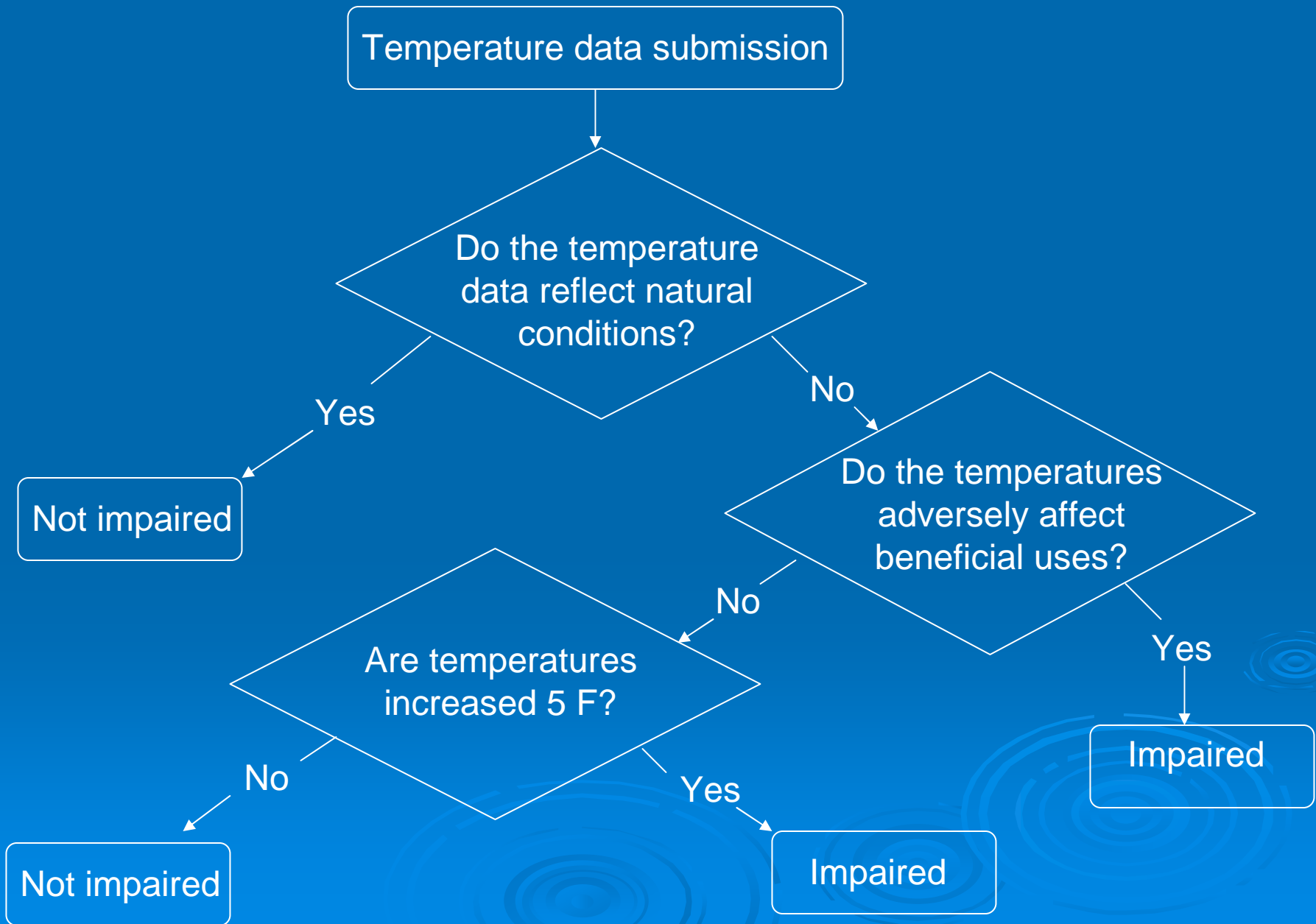
Outline

- Interpreting the intrastate water quality objective for Temperature
 - How do staff evaluate whether the objective is met?
 - natural conditions
 - adverse effects to beneficial uses
 - 5 °F limit
 - Temperature data & metrics
 - How much data is needed?
- 

Basin Plan Intrastate 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.
- At no time or place shall the temperature of any COLD water be increased by more than 5°F above natural receiving water temperature.
- At no time or place shall the temperature of WARM intrastate waters be increased more than 5°F above natural receiving water temperature.”

Interpreting the Temperature Objective in Relation to Impairment



Temperature data submission

Do the temperature data reflect natural conditions?

Yes

Not impaired

No

Do the temperatures adversely affect beneficial uses?

Yes

Impaired

No

Are temperatures increased 5 F?

Yes

Impaired

No

Not impaired

What are natural temperatures?

“The water temperatures that result when the environmental factors that influence stream temperature have not been altered by human activities.”


Scott River TMDL Staff Report, pg. G-4.



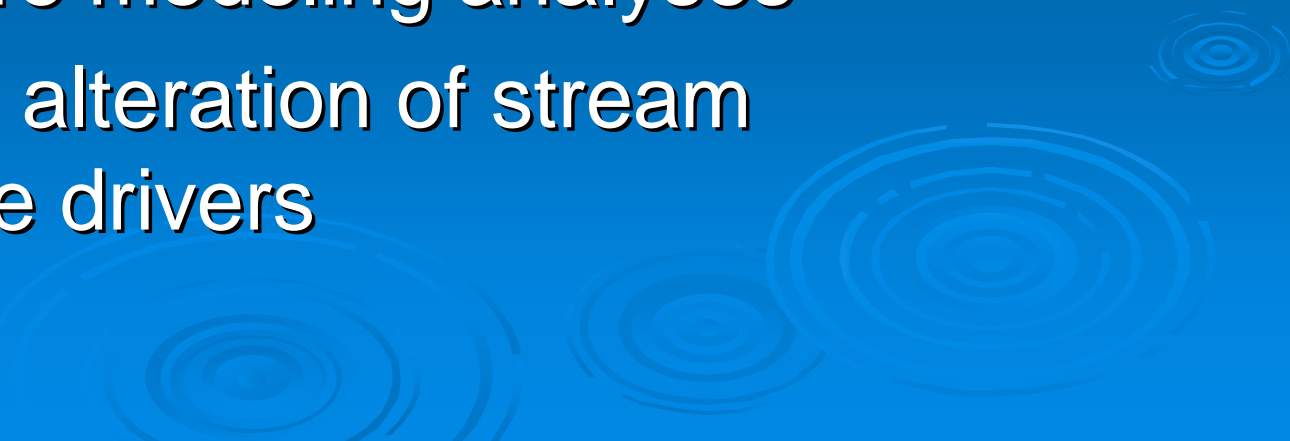
Factors that Influence Stream Temperatures

- Incoming solar radiation
 - shade from vegetation
 - shade from topography
 - cloud cover
- Convection
 - air temperature
 - wind speed
- Conduction
 - channel substrate
 - channel geometry
- Evaporation
 - relative humidity
 - air temperature
 - wind speed
- Advection
 - stream flow
 - tributaries
 - springs
 - groundwater accretion

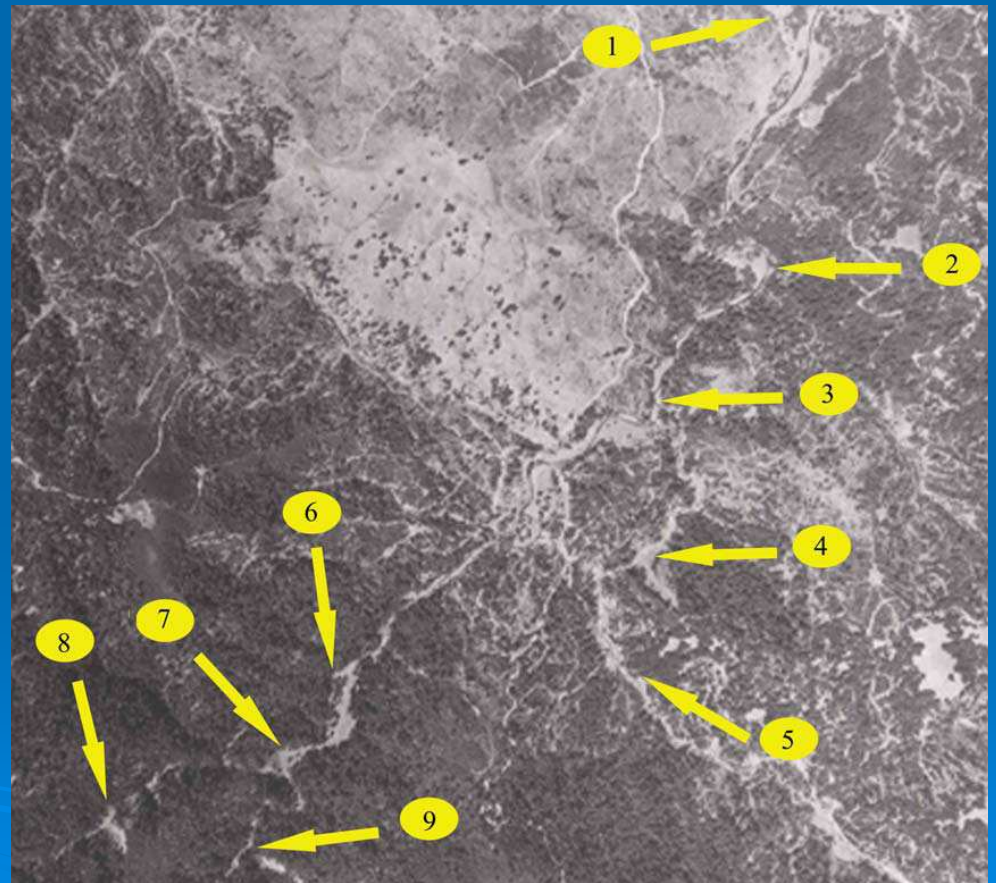
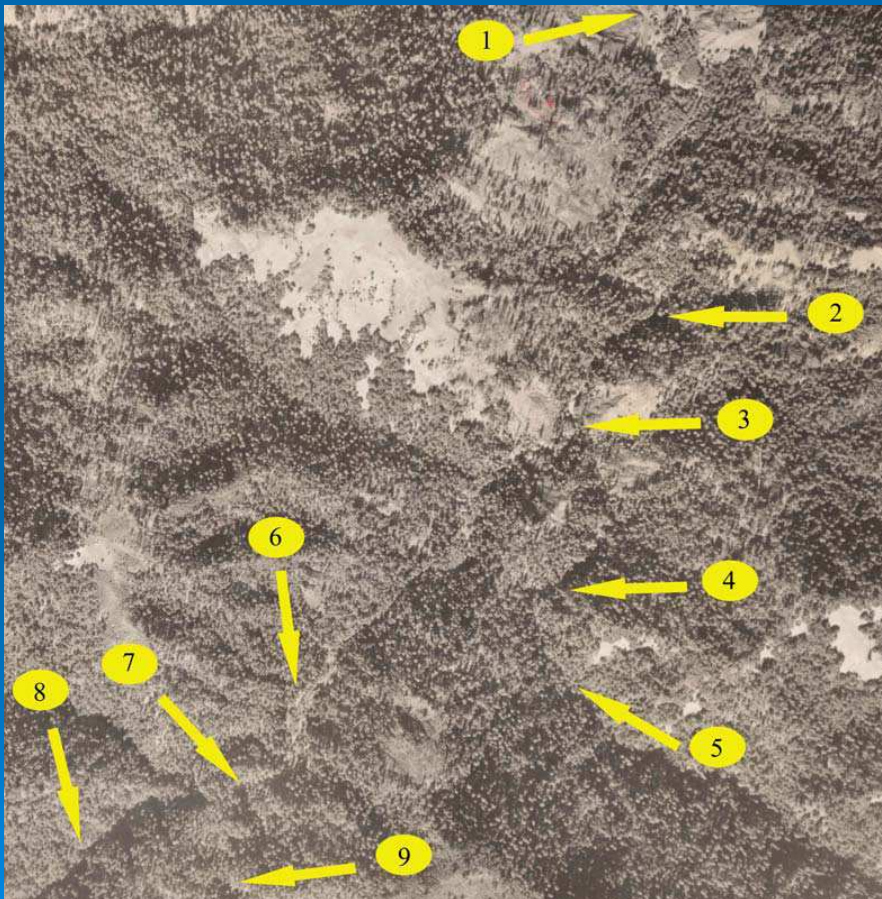
Causes of Temperature Alteration

- Increase in solar radiation reaching water surface
 - Reduction of streamflow
 - Increased width, decreased depth
 - Discharge of warm water (or other material)
 - Impounded water
 - Increase in air temperature, relative humidity
- 

Evidence of temperature alteration

- Comparison of current and historical temperature data
 - Comparison of current temperatures to historical distribution of cold water species
 - Comparison to a nearby reference stream
 - Temperature modeling analyses
 - Substantial alteration of stream temperature drivers
- 

Evidence of human-caused temperature alteration



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What resources are likely to be “adversely affected” by increased temperatures?

- Fish (e.g. salmonids, dace, minnows)
 - Amphibians (e.g. southern torrent salamander)
 - Insects (?)
- 
- The background of the slide features a blue gradient with several faint, concentric white circles representing water ripples, primarily located in the lower right and bottom center areas.

When are beneficial uses “adversely affected”?

Adverse effects can occur at all of
the following life stages:

- Rearing
 - Migration
 - Spawning and incubation
 - Larval development
- 

Salmonid Temperature Criteria

- *EPA Region 10 Guidance for Pacific Northwest State and Tribal Water Quality Standards (2003)*
- *An Analysis of the Effects of Temperature on Salmonids of the Pacific Northwest with Implications for Selecting Temperature Criteria (Sullivan and others, 2000)*
- *Distribution of Juvenile Coho Salmon in Relation to Water Temperatures in Tributaries of the Mattole River, California (Welsh and others, 2001)*
- *Evaluation of Stream Temperature Thresholds Based on Coho Salmon (*Oncorhynchus kisutch*) Presence and Absence in Managed Forest Lands in Coastal Mendocino County, California. (Hines and Ambrose, 1998)*

Temperature Criteria

- Also, see: Carter 2008:

http://www.waterboards.ca.gov/northcoast/water_issues/programs/tmdls/klamath_river/100316/Appendix_4_Water_Quality_Effects_on_Salmonids.pdf

(Appendix 4 of Klamath TMDL staff report, posted on R1 webpage.)

Data Management and Reduction

- Sub-daily values: hourly for 3 months =>2000 data points to handle. Can reduce data quantity by looking at:
 - daily average
 - daily maximum
 - 7-day moving average of daily average
 - 7-day moving average of daily maximums
 - cumulative frequency plots of any of the above

Temperature Metrics

- Various metrics have been used to reduce a season's data to a single value:
 - Instantaneous maximum: highest individual value in a season
 - Maximum Weekly Average Temperature (MWAT): maximum value in a season of 7-day moving average of daily average
 - Maximum Weekly Maximum Temperature (MWMAT): maximum value in a season of 7-day moving average of daily maximums

Relationships Among Metrics

- The instantaneous maximum, MWAT and MWMT metrics are highly correlated with one another
- Use of one metric will represent information associated with the others
- Use the metrics reported in the literature for a given species

Salmonid Temperature Thresholds

Chronic Effect Temperature Thresholds for Salmonids (USEPA 2003)	
Life Stage	MWMT (°C)
Adult Migration	20
Adult Migration plus Non-Core Juvenile Rearing ¹	18
Core Juvenile Rearing ²	16
Spawning, Egg Incubation, and Fry Emergence	13

Source: *EPA Region 10 Guidance for Pacific Northwest State and Tribal Water Quality Standards* (2003)

¹ The Adult Migration plus Non-Core Juvenile Rearing designation is recommended by USEPA (2003) for the “protection of migrating adult and juvenile salmonids and moderate to low density salmon and trout juvenile rearing during the period of summer maximum temperatures,” usually occurring in the mid to lower part of the basin.

² The Core Juvenile Rearing designation is recommended by USEPA (2003) for the “protection of moderate to high density summertime salmon and trout juvenile rearing” locations, usually occurring in the mid to upper reaches of the basin.

Question: How much data is enough?

Answer: It depends...

- What metric are you using?
 - A single value in excess of a lethal temperature threshold may tell you a lot.
 - If you're using a weekly metric, you can't use less than 7 days of data.
- What life stage are you evaluating?
 - King salmon spawning season only lasts ~ 10 weeks.
 - Summer rearing temperatures peak in late July – early August.

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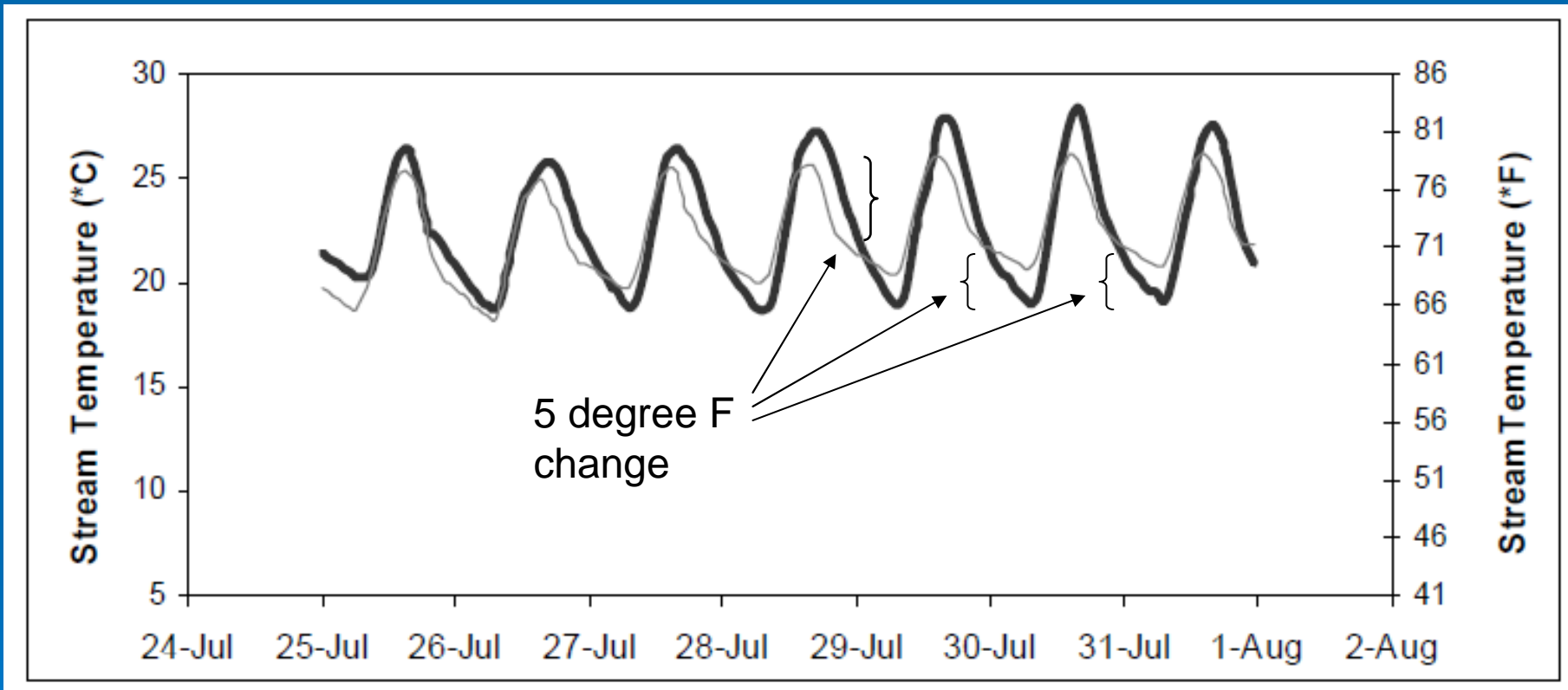
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Evaluation of 5 °F


“...At no time or place...” could be:

- A seasonal change: the timing of seasonal temperature patterns
- Daily: an increase in the daily average
- Instantaneous: point-to-point comparison

Evaluation of 5 °F



Evidence of 5 °F temperature alteration

- Comparison of current and historical temperature data
 - Comparison of current temperatures to historical distribution of cold water species
 - Comparison to a nearby reference stream
 - Temperature modeling analyses
- 

Summary:

Evaluating stream temperatures against the temperature objective involves:

- Understanding a site's history
- Recognizing the sensitive beneficial uses
- Comparing temperature conditions against needs of the beneficial use
- Estimating the magnitude of temperature changes at a site

Finished



State Thermal Plan Interstate Objective

The COLD Interstate Temperature Objective is as follows:

“Elevated temperature waste discharges into cold interstate waters are prohibited.”

“Elevated Temperature Waste” is defined as:

“Liquid, solid, or gaseous material including thermal waste discharged at a temperature higher than the natural temperature of receiving water. Irrigation return water is not considered elevated temperature waste for the purpose of this plan.”

The interstate temperature objective augments, but does not supersede, the intrastate temperature objective.