California Forestry Association
1215 K Street, Suite 1830
Sacramento, CA 95814
(916) 444-6592 fax (916) 444-0170
www.foresthealth.org cfa@foresthealth.org

137

655

January 31, 2006

RECEIVED
JAN 2006
SWRCB
Executive Ofc.

303 (d) Deadline:
1/31/06

Tam Doduc
Chair
State Water Resources Control Board
Executive Office
1001 I Street, 24th Floor
Sacramento, CA 95814

Re: 2006 Section 303(d) List Amendments

Dear Chair Doduc,

The California Forestry Association ("CFA") is a non-profit trade association whose members include forest landowners, professional resource managers, and producers of wood products and biomass energy throughout the state of California. Collectively, CFA members own approximately 4 million acres in the state of California.

CFA contends that the proposal by the State Water Resources Control Board ("State Board") to add certain waterbodies to the 2006 California section 303(d) list ("2006 List") as impaired for water temperature levels should not be adopted.[1] Moreover, CFA believes that the single temperature standard (14.80 c) used as a threshold throughout the North Coast Region is not scientifically supportable, nor physically achievable, and it should be revised to reflect the geographic, topographic and latitudinal differences for each stream segment . There are many examples where this standard is unachievable, even in a natural setting that has been unaltered by human activity. Unless the standard is revised, CFA members will bear unnecessary costs of compliance and resource management, as well as lost revenue resulting from unnecessary harvest restrictions imposed by the listings. The proposed 2006 List and the requirements that would flow from listing are very important to CFA and its members. CFA requests your careful consideration of these comments.

BACKGROUND

In February 2003, the State Board adopted the 2002 Clean Water Act section 303(d) ("2002 List"). The 2002 List includes a number of North Coast waterbodies or segments listed as water quality limited solely due to elevated temperatures as a basis for its 2006 List proposal, the State Board is relying on the administrative record from the 2002 List.[2] CFA contends that the methodology used

[1] The Albion River, Noyo River, and Pudding Creek are recommended for listing based on the 14.8 degree Celsius standard. The Middle Fork of the Eel River, South Fork of the Eel River, Big River, and Ten Mile River are all recommended denial of delisting based on exceeding the 14.8 degree Celsius standard. The evaluation guideline is Sullivan et al. (2000).

[2] "In developing SWRCB staff recommendations it was assumed that: The 2002 Section 303(d) list (Appendix 1) would for the basis for the 2006 list submittal." *See* Staff Report, Volume 1, p. 3. "A list of data and information in the administrative record used for development of the 2006 section 303(d) list is presented in the Appendix 2. Data and

A more recent study suggests that the high incidence of temperature exceedences in the West is due to criteria being applied in places or at times that temperatures are naturally warmer than the criteria.[4] (Attached). The suggested remedy is state water quality programs that use modeling tools to predict natural patterns of stream temperature to set achievable temperature criteria. The study also reveals that most water quality standards, as in the present case, fail to consider the temporal and spatial variability in water quality that occurs naturally in a watershed. At least part of the problem is that standards are set for what are judged to be optimal or preferred temperatures for cold-water fish without regard for what is possible. Experts in forested watersheds explain naturally warmer stream patterns on elevation, latitude, flow path, natural channel exposure to solar radiation and residence time of water in the channel. The study concludes that these well known patterns can and should be incorporated into regulations.

The numeric standard is seriously flawed because it establishes a "one-size-fits-all" standard for all North Coast Region watercourses, regardless of significant variations in climate, soils, geology, and land uses within the region, and even within individual contiguous ownerships. The use of numeric targets simply cannot be met in all places at all times given the variability in watershed conditions and responses. More specifically, some of the targets may be unattainable, regardless of location and time.

In effect, the State Board's establishment of a surrogate standard (14.8 degrees Celsius) for the narrative standard in the North Coast Basin Plan results in a change to the water quality standard itself without accountability of the public process required for doing so. Any process that replaces or redefines the existing water quality objectives is wholly inconsistent with the 303(d) listing process. The 303(d) process is not for the purpose of changing existing standards or setting new ones. Unless narrative water quality objectives are replaced with numeric standards through the proper process, narrative standards must be implemented on a case-by-case basis (where the translation of the narrative standard into specific regulatory requirements can be examined carefully for its nexus and proportion to the discharge.) The "one-size-fits-all" targets included in the 2002 List and the proposed 2006 List are wholly improper.

II. THE STATE BOARD'S ACTION IS INCONSISTENT WITH STATE LAW AND PROVIDES NO ADEQUATE BASIS UNDER FEDERAL LAW.

CFA believes the State Board is inappropriately adding new streams to the 303(d) list of water bodies as that are temperature impaired in reliance on a numerical temperature standard that was neither currently included in the North Coast Basin Plan nor properly adopted as a new or amended standard or translator methodology according to the process required by law. Because these deficiencies exist, we believe the numeric temperature standard relied upon by the State Board and the resulting 303(d) listings is fatally flawed.

The State Board cannot, consistent with the Porter-Cologne Water Quality Control Act,[5] "interpret" a narrative standard without a valid translator methodology adopted through a public process. Nevertheless, the State Board is proposing to do such by this action. Even if the State Board were justified in adopting a single numeric temperature standard for the entire North Coast region, it

---

[4] Use of Natural Temperature Patterns to Identify Achievable Stream Temperature Criteria for Forest Streams, *Ice et al* (2004)

[5] California Water Code § 13000, *et seq.*

could only do so properly by formal rulemaking to amend the Basin Plan, consistent with the Porter-Cologne Act, the Administrative Procedures Act and the California Environmental Quality Act, not by adopting additions to the 2002 or 2006 California section 303(d) list. Moreover, the State Board failed to provide any basis to support the derivation of such a numeric standard from the Basin Plan's narrative statement, which remains in place today.[6]

In setting a single stream temperature standard for all streams in the North Coast, the State Board is making at least two fundamental errors. First, the State Board is impermissibly misinterpreting or "translating" the first part of the North Coast Basin Plan's narrative temperature standard, which is:

> "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."[7]

Rather than follow proper regulatory process to come up with a numeric standard consistent with the above narrative standard, the State Board arbitrarily utilized the numeric standard of 14.8 degrees Celsius. Second, the State Board is totally ignoring the second half of the North Coast Basin Plan standard, which provides:

> "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."[8]

In concluding that certain waterbodies are temperature impaired, the State Board is ignoring the individual natural temperatures of those receiving waters; despite the fact that the Regional Board previously considered and rejected that approach. The 14.8 degrees Celsius "standard" was neither articulated in the North Coast Basin Plan nor was it approved, to the best of CFA's knowledge, by the North Coast Board for use as a guideline.

The State Board is improperly ignoring evidence that 14.8 degrees Celsius is not an appropriate measure of compliance with the existing standards. Even if more specific standards or numeric translators are necessary and appropriate, they may not be adopted except pursuant to the appropriate regulatory process. Absent an existing, duly adopted numerical standard, the State Board is abusing its discretion when it acts in excess of its authority in using such a standard by effecting a *de facto* amendment of the North Coast Basin Plan to adopt the numeric temperature standard, and the 303(d) listing of waterbodies that do not meet an improperly adopted standard.

The State Board's Action is Inconsistent With State Law.

CFA contends that any standard that does not consider the individual natural background temperatures of the receiving waters for each waterbody is fundamentally flawed and it should not

[6] The North Coast Basin Plan contains a narrative standard for temperature. *See,* section 3-3.00 to 3-4.00.
[7] North Coast Basin Plan at 3-3.00 to 3-4.00.
[8] *Id.*

be adopted. In any case, if a "translator" is used to bridge the gap between a narrative standard and a numeric standard, the translator must be adopted through the appropriate public process. Further, because the purpose of the 303(d) listing process is to determine when and under what circumstances waterbodies do not meet current water quality standards, any action taken to define the standard itself can not be taken as part of the 303(d) listing process.
CFA objects to the State Board's continued effort to "interpret" narrative water quality objectives through numeric surrogates without first going through the Basin Plan amendment process, and at least one court has agreed that such an approach is unlawful.[9]

In CFA's view, the only situation where it is appropriate to develop a numeric surrogate for a narrative standard is on a site-specific basis. It is improper to adopt a "one-size-fits-all" numeric surrogate, because such an approach does not provide a sufficient bridge between the narrative requirement duly-adopted and included in the Basin Plan and the numeric limit, which must take account of site-specific conditions.

In other words, neither the Regional Board nor the State Board can rely on an arbitrary interpretation of the narrative standard for the entire Region. The Regional Board must explain, in a way that can be examined for nexus and proportion to actual discharges, how specific numeric limitations are derived for specific listed waters based upon their unique conditions. Therefore, the State Board continues to act arbitrary, and if it adopts the proposed listing of additional temperature impaired streams in the North Coast Region relying on a "one-size-fits-all" standard and ignores individual North Coast waterbodies.

Finally, the State Board is proposing to list streams for elevated temperatures even though they are only impaired by nonpoint sources of pollution. The Clean Water Act only allows listing of waters that are impaired, at least in part, by point sources of pollution. Therefore, the adoption of this "one-size-fits-all" approach is an abuse of discretion violating the federal Administrative Procedures Act and federal Clean Water Act section 303(d) listing criteria.[10]

III. RECOMMENDATION

Setting and achievement of water quality goals for individual waterbodies should consider the unique set of physical and environmental characteristics that determine water temperatures for individual stream segments within a watershed. The water quality goals should recognize that the physical and environmental characteristics of the watershed could severely limit the effectiveness of any proposed mitigation to improve water quality. Effective mitigation to improve water quality should focus on sub-watersheds that currently have water temperatures outside the natural range of variability found within that specific watershed.

CFA recommends that the State Board carefully review the scientific research contained in the record. We believe there is clear, compelling and substantial scientific evidence that the continued listing of and proposal to list additional forest streams of Northern California as temperature-impaired is unwarranted.

---

[9] *See,* City of Los Angeles/City of Burbank v. State Water Resources Control Board, Los Angeles Superior Court Nos. BS 060 957, BS 060 960 (April 4, 2001).
[10] *See* 5 U.S.C. § 500 *et seq.*; 33 U.S.C. § 303(d); 40 C.F.R. § 130.7.

Included in the record for your consideration are the following documents:

- T.E. Lewis, D.W. Lamphear, D.R. McCanne, A.S. Webb, J.P. Kreiter, W.D. Conroy. *Regional Assessment of Stream Temperatures Across Northern California & Their Relationship to Various Landscape-Level and Site-Specific Attributes*. Humboldt State University Foundation: Forest Science Project, 2000.
- Andrea E. Tuttle, Mary D. Nichols, Gray Davis. *Hillslope Monitoring Program . . . Monitoring Results from 1996 through 2001*. Board of Forestry and Fire Protection, December 2002.

The initial document sited above, *Regional Assessment of Stream Temperatures Across Northern California and their Relationship to Various Landscape-Level and Site-Specific Attributes* (Lewis et al 2000) represents the state-of-the-art knowledge of forested stream temperatures of Northern California. The study represents continuously recorded stream and air temperature data from 1,090 individual sites with stream temperature records spanning nine years from 1990 to 1998. Significant conclusions of the study were:

(1) Local ambient air temperatures greatly influence stream water temperatures by increasing (interior watersheds) or decreasing (coastal fog watersheds) water temperatures.
(2) Stream water temperatures increase with increasing distance from watershed divide, increase as watershed drainage area increases and increase as stream gradient decreases.
(3) Historical stream temperature data collected between 1950 and 1969 by the U.S. Geological Survey gauging stations found an observed decrease in recent stream temperatures from levels seen in the 1950's and 1960's.
(4) Historical stream temperatures throughout Northern California regularly exceeded 20° C in the 1950's and 1960's.
(5) Empirical modeling to predict stream water temperatures found that regional air temperature, watershed size, distance to watershed divide were essential data along with solar radiation exposure (canopy closure) to predict stream water temperatures.

In summary, the study found that a single stream temperature standard is difficult and inappropriate to apply across a broad region such as Northern California. Each stream differs markedly in size, watershed area, distance from watershed divide, elevation, climatic conditions and aspect. These physical factors directly or indirectly influence water temperatures regardless of any forest management that occurs adjacent to stream protection zones. The adoption of a single stream temperature standard for all streams within Northern California is contrary to the results of this study and our current knowledge of Northern California ecosystems. Moreover, historical temperature data indicate that the proposed standard for impairment would be unachievable in nearly every stream across the entire range of analysis, regardless of the natural quality of riparian conditions related to stream temperature.

The *Hillslope Monitoring Program Results from 1996-2001* report summarizes the results of six years of implementation and effectiveness monitoring of California's forest practices. This report is based upon a statistically valid stratified random sample of 300 timber harvest plans and non-industrial timber management plans. The study states "[r]esults to date show that implementation rates of the Forest Practice Rules related to water quality are high . . . Overall implementation ratings were greater than 90 percent for landings and for road, skid trail, and watercourse protection zone transects."

Actual field data reveal that post operational canopy closure for Class I (fish bearing) and Class II (non-fish bearing) streams in the Coast Region were 82.8 percent and 79.9 percent, respectively.

These canopy levels provide, in effect, full and complete shade cover for North Coast forest streams. Furthermore, such canopy closure levels virtually eliminate any potential impacts from management activities on stream temperature. It also demonstrates an important aspect of the forest practice protection measures; that being site-specific mitigations. While minimum vertical canopy closure requirements are 50 percent, the average canopy closure across the entire Coast District exceeded 80 percent over a six–year period.
Clearly, from these site-specific studies, the direct natural relationship between ambient temperature and stream temperature cannot be overstated. Also, the natural gradient of increasing temperature from headwaters to lower reaches is confirmed. This consideration is important because these discrete zones with different temperature regimes further negate the concept of applying a single temperature standard to all conditions and stream segments associated with an individual waterbody. Likewise, the quality of stream protection zones and the overwhelmingly dense shade canopy they provide is indisputable, all but eliminating any direct causal relationship between streamside vegetation management and water temperature. The scientific conclusion is that natural riparian and climatic conditions have the only significant direct causal relationship to stream temperatures, not human impacts. Furthermore, the proposed threshold temperature is unachievable as a "not to exceed" standard, and inappropriate for use in this region.

Meeting general statewide criteria will result in prohibitively expensive controls that provide little or no improvement in terms of beneficial use. Before deciding to list a particular waterbody, analysis should focus on demonstrating that naturally occurring pollution, physical and hydrologic conditions, irreversible modifications, and widespread economic or social impacts prevent attainment of the designated use.

There is a need to refine standards. The lack of progress in refining standards is likely the result of a combination of factors: a focus on technology-based rather than water quality-based requirements; lack of resources at the regulatory agencies; unbalanced public participation; and the mistaken perception that any revision will result in diminished water quality.

CFA recommends that the State Board consider an approach for adopting temperature standards that is similar to those recently adopted for Oregon and approved by U.S. EPA. (Attached). The new standards are the result of extensive public review and consultation with the U.S. Fish and Wildlife Service, National Marine Fisheries Service, Pacific Northwest tribal governments and the Oregon Department of Fish and Wildlife. The standards provide a state of the art tool for local communities and watersheds. They are firmly ground in sound science, easy to understand, and continue the protection and recovery of the state's endangered salmon and trout species. A significant feature of the new water quality temperature standards is the ability to work with comprehensive watershed maps that identify individual temperature requirements for each waterbody in the state. Factors for consideration in setting individual temperature standards include spawning use, habitat use, rearing and migration use, migration corridors, natural seasonal thermal patterns, downstream waterbody temperatures, seasons and air temperatures.

IV. CLOSING

CFA requests that the waterbodies being proposed for listing as temperature impaired in the North Coast Region based on the 14.8 degree Celsius "standard" be removed from consideration.

If the State Board lists these streams, CFA and its members will suffer increased regulatory burden, amplification of water board involvement and oversight of CFA members' activities with no demonstrable possibility for improvement, or need for improvement, in water quality conditions. CFA anticipates increased expenses relating to additional conditions that could be imposed to Timber Harvesting Plans and waste discharge permits without demonstration of the possibility for water quality improvement or the need for such improvement.

Through cooperative efforts, CFA and its members seek to ensure that existing watershed protection is adequate to achieve habitat conditions that can sustain healthy populations of salmonid species, and protect the aquatic and riparian resources throughout California.

We look forward to developing water quality objectives on an individual watershed basis that are scientifically sound, protective of appropriate uses and realistic in terms of attainment. With these important objectives in place, real, sustainable progress can be expected in developing and implementing protection and restoration plans to meet those goals.

Sincerely,

Michele Dias

Michele Dias
Vice President, Legal and Environmental Affairs

Electronic Attachments:
Use of Natural Temperature Patterns to Identify Achievable Stream Temperature Criteria for Forest Streams, *Ice et al.* (2004)
EPA Approves Oregon Water Quality Standards, *State of Oregon Department of Environmental Quality*, (2004)

WESTERN

JOURNAL OF APPLIED FORESTRY

Volume 19 Number 4 **October 2004**

SOCIETY OF AMERICAN FORESTERS
www.safnet.org

PRESIDENT **John H. Beuter**
VICE-PRESIDENT **John A. Helms**
EXECUTIVE VICE-PRESIDENT AND CEO
Michael T. Goergen, Jr.
ADVERTISING SALES **William V. Brumby**

WESTERN JOURNAL OF APPLIED FORESTRY
EDITOR **Tim O'Keefe**
NRM Department
Cal Poly
San Luis Obispo, CA 93407
tokeefe@calpoly.edu
JOURNAL PRODUCTION MANAGER **Matthew Walls**
Cadmus Professional Communications
940 Elkridge Landing Road
Linthicum, MD 21090
wallsm@cadmus.com

ASSOCIATE EDITORS
Silviculture
Robert Deal
Ole Helgerson
Regeneration and Site Preparation
Robin Rose
Tree Improvement and Genetics
Brad St. Clair
Soils and Hydrology
Walter F. Megahan
Social Sciences
James D. Absher
Engineering and Harvesting
Loren Kellogg
Forest Fire
Robert Zybech
Forest Measurements
Susan Hummel
Wildlife and Fisheries
Thomas J. DeLiberto
Pest Management
Paul Hennon
Forest Products Utilization
Susan A. Willits
Management and Economics
Hayley Hesseln

Send address changes to Address Change Department, Society of American Foresters, 5400 Grosvenor Lane, Bethesda, MD 20814-2198.
Send manuscripts (4 copies) and related correspondence to Tim O'Keefe (see address above).
Send other inquiries to *WJAF*, Society of American Foresters, 5400 Grosvenor Lane, Bethesda, MD 20814-2198.

Permission to Reprint.—Individuals, and nonprofit libraries acting for them, may make fair use of the material in this journal, for example, copying an article or portion of an article for use in teaching or research. Individuals may also quote from the publication if the customary acknowledgement of the source accompanies the quotation. To request permission to make multiple or systematic reproductions or republish material (including figures and article excerpts) contact the Copyright Clearance Center, Customer Service Department, 222 Rosewood Dr., Danvers, MA 01923 (978) 750-8400. Fax: (978) 750-4470; www.copyright.com. A fee for commercial use will be determined depending on use.

A Publication of the Society of American Foresters

The *Western Journal of Applied Forestry* is published quarterly—January, April, July, October—by the Society of American Foresters, 5400 Grosvenor Lane, Bethesda, MD 20814. Copyright © 2004 by the Society of American Foresters. ISSN 0885-6095. Subscription rates are $52 for individual SAF members, in the U.S. and Canada ($72 in foreign countries), $26 for student SAF members in the U.S. and Canada, $75 for individual non-SAF members ($95 in foreign countries), and $170 for institutions ($190 for foreign institutions). All subscriptions are considered to start with the first issue of the calendar year. Missing issues will be replaced free if the claim is made within 2 months from U.S. or Canadian addresses or 6 months from other addresses. Single issues are $20 for individuals and $48 for institutions.

WJAF is online at www.safnet.org/periodicals/regionaljournals.cfm

Use of Natural Temperature Patterns to Identify Achievable Stream Temperature Criteria for Forest Streams

George G. Ice, *National Council for Air and Stream Improvement, Inc., P.O. Box 458, Corvallis, OR 97339-0458;* **Jeff Light,** *Plum Creek Timber Company, PO Box 216, Toledo, OR 97391; and* **Maryanne Reiter,** *Weyerhaeuser Company, 785 N 42nd Street, Springfield, OR 97478.*

ABSTRACT: *Almost 90% of the streams listed on the EPA's nationwide database as water-quality impaired for temperature are in the Northwest. Historic records, monitoring of streams in federal wilderness areas in Oregon, and available data for least-impaired streams in Oregon, Washington, and Idaho show that many of these streams cannot achieve state temperature criteria. Forest management often is cited as a cause for increased stream temperature above state standards. The expectation that all forested streams should be below state targets has led to unnecessary listing of streams as impaired, wasting limited watershed protection resources. State water-quality programs should base water temperature criteria on natural patterns of stream temperature and on factors that have biological relevance to beneficial uses. West. J. Appl. For. 19(4):252–259.*

Key Words: Fish habitat, forest practices, least-impaired streams, temperature, water quality.

Water temperature is one of the most important factors affecting habitat quality for fish and is an important benchmark used to assess the effectiveness of forest practice rules. Water temperature influences fish in three important ways: by directly controlling physiological rates; by affecting interspecies competition and fish pathogens; and by determining biochemical rates and gas solubilities in the water environment (Lantz 1971). Like many environmental parameters, stream temperatures vary in time and space, which complicates development and use of numeric criteria in water-quality standards. Historic records in the Pacific Northwest, monitoring of streams in federal wilderness areas in Oregon, and available data for least-impaired streams in Oregon, Washington, and Idaho indicate that many of these streams cannot achieve state temperature criteria.

State water-quality standards, including those for temperature, are designed to restore or protect water quality and fish habitat. Under §303 of the federal Clean Water Act (CWA), states are required to establish and periodically review water-quality standards. The US Environmental Protection Agency (EPA) has oversight and must approve these standards. Water-quality standards include designated beneficial uses of the water, numeric or narrative water-quality criteria, and anti-degradation provisions to avoid lowering water quality. The criteria for water temperature have become especially important in recent years with listings of numerous runs of cold-water-loving salmon and trout as threatened and endangered and with increased use of Total Maximum Daily Load (TMDL) assessments under §319 of the CWA. Waters not achieving water-quality criteria often are presumed to be impaired and not protecting beneficial uses. A survey of the EPA's database for waterbodies listed as water-quality limited (updated in 2002) found that 86% of the listings nationwide for temperature occur in the northwestern states of Oregon (48%), Washington (23%), and Idaho (14%). The importance of stream-temperature criteria in this region is highlighted by EPA Region X attempts to draft guidance for states and tribes on approaches to setting temperature criteria (US EPA, www.epa.gov/r10earth/water.htm, Nov. 28, 2001). Water-quality criteria become benchmarks to assess the condition of streams and the performance of water-quality protection programs, including the Forest Practices Acts of this region. In this article, we suggest that the high incidence of temperature exceedences in the Northwest is due to criteria being applied in places or at times that temperatures are naturally warmer than the criteria. To remedy this, we believe that state water-quality programs should use modeling tools to predict natural patterns of stream temperature to set achievable temperature criteria (see discussion on identifying natural stream patterns).

NOTE: George Ice can be reached at (541) 752-8801; Fax: (541) 752-8806; GIce@wcrc-ncasi.org. Copyright © 2004 by the Society of American Foresters.

State Water-Quality Criteria for Temperature

Under the CWA, states are required to develop water-quality standards to protect beneficial uses, with the EPA providing oversight to these standards. Yet, even decades ago, some warned that water-quality standards were difficult to apply to nonpoint sources. Harper (1987) observed that "standards were developed primarily to address point source types of pollutants and... existing standards in most States do not adequately reflect natural background conditions, nor do they address natural variability." Most water-quality standards fail to consider the temporal and spatial variability in water quality that occurs naturally in a watershed.

Water temperature probably seems one of the easiest parameters for which to develop an appropriate water-quality standard. Low-cost temperature-recording devices allow widespread deployment of monitoring instruments. Heat-load models are available to predict stream temperatures at the reach and watershed scales, as well as their response to management (Brown 1969, Theurer et al. 1984, Beschta and Weatherred 1984, Boyd 1996, HDR Engineering 2002). Research on the temperature requirements of many fish species is available (Brett 1952, Bjornn and Reiser 1991, Selong et al. 2001). Best management practices (BMP) such as the use of streamside management zones to maintain shade are available (Ice et al. 1994); yet, we find the Pacific Northwest embroiled in a debate about appropriate standards, and many of the streams in the region listed as impaired due to excess temperature. At least part of the problem is that standards were set for what were judged to be optimal or preferred temperatures for cold-water fish, including trout and salmon, without regard for what is possible.

Each of the three northwest states described here has similar but unique water-quality standards.

Oregon

In Oregon, three criteria are especially important for forest managers and landowners. There is a general 64° F criterion for basins where salmonid rearing is a designated beneficial use. There is a 55° F criterion "... in waters and periods of the year determined by the Department to support native salmon spawning, egg incubation, and fry emergence from the egg and from the gravels in a basin..."; the Oregon Department of Environmental Quality relies on the Oregon Department of Fish and Wildlife to identify reaches and times of salmon spawning, egg incubation, and emergence. Finally, there is a 50° F criterion for waters with native Oregon bull trout. Each of these criteria is based on the annual maximum of the 7-day moving mean of the daily maximum stream temperatures (hereafter 7-day maximum). No measurable increase in surface water temperature is allowed if these criteria are being exceeded. Also, no measurable increase is allowed where the Oregon Department of Environmental Quality has determined there to be ecologically significant cold-water refugia or the presence of federally listed threatened and endangered species (if increases in water temperature would impair "the biological integrity" of the threatened and endangered population).

Oregon water-quality regulations recognize that exceedances of these three criteria (64, 55, and 50° F) are not automatically water-quality standards violations. When natural conditions cause the water temperatures to exceed the numeric criteria, the natural temperature becomes the numeric standard. In addition, the criteria can be exceeded under extreme climatic conditions. These are defined as 7Q10 low flow (lowest 7-day consecutive average flows with a 10-year recurrence interval) or 7-day average maximum air temperatures above the 90th percentile.

Idaho

In Idaho, most forest streams fall under a cold-water aquatic life (CWAL) category. The water temperature criteria for these streams is 71.6° F for an instantaneous maximum and 66.2° F for a maximum daily average. A subset of these cold-water streams (mostly larger streams) also are protected for salmonid spawning. The criteria for these streams is 55.4° F instantaneous maximum or a maximum average for the day of 48.2° F, when and where spawning occurs. There are additional criteria for seasonal cold- and warm-water fisheries, but only a few streams are classified as such. Natural background conditions are addressed under provisions that waters are not to vary from the criteria due to human activities. All the criteria are relaxed during exceptionally hot weather conditions, when the air temperature exceeds the 90th percentile for the maximum weekly average air temperature. When natural background conditions exceed temperature criteria, a 0.5° F increase due to human activity is allowed.

Washington

The surface water-quality standards in Washington recently have been revised significantly. The older standards (used for the 2002 §303D list) were structured around five classes of water (AA, A, B, C, and Lake), with designated uses assigned to each. Class AA (extraordinary) waters were regarded as of the highest quality and were assigned a 1-day maximum temperature criterion of 60.8° F. The criteria for Class A (excellent), B (good), and C (fair) waters were 64.4, 69.8, and 71.6° F, respectively. The water-quality standard for lakes was no measurable change from background. Class AA and A waters represented the majority of forested streams in the state, and salmonid fishes were the chief beneficial use. Class B and C waters usually included larger mainstems. Where temperatures from least-disturbed drainages exceeded the numeric criteria, these "natural" temperatures prevailed as the local standard. An incremental increase of 0.5° F was allowed for human warming of these naturally warm waters. Where streams were colder than the criteria, an incremental increase of up to 5.0° F was allowed, provided the thresholds were not exceeded. There was no provision for unusually warm climatic conditions.

Washington's new standards are structured to better recognize natural patterns of stream temperatures. The class-based system is now a use-based system, organized by the temperature requirements of different species and life stages of salmonid fishes. The new criteria are based on the 7-day maxium. The coldest criterion, 53.6° F, was designed to protect spawning and juvenile rearing of native char (*Salvelinus* spp.). Pacific salmon and trout (*Oncorhynchus* spp.) are assigned a 60.8° F criterion for the spawning and rearing life stages in core areas. A 63.5° F criterion is used for noncore rearing and migration. Separate criteria for the spawning life stages of salmon, trout, and char are assigned when the rearing criteria are not fully protective. Nonanadromous interior redband trout are protected with an 64.4° F criterion. Warm water species are protected with a 68° F criterion (typically not streams in forested basins). Because different fish species and life stages are adapted to natural thermal regimes, application of these temperature criteria to times and locations where these beneficial uses occur has the inherent benefit of fitting criteria to where they are more likely to be attainable.

Washington's new standards incorporate other features to address natural variability of temperatures in forested streams. The criteria were set at the upper end of the range of temperatures thought to represent full protection, and they are expected to be met only 9 out of every 10 years on average. Provisions for temperatures that naturally exceed the numeric criteria and for incremental warming from human disturbances are the same as in the older standards.

Despite allowances for warm weather and other natural conditions in the water-quality standards described, the number of waterbodies listed in Oregon, Idaho, and Washington as water quality limited due to temperature (unless the source of runoff is clearly from a reference watershed without any management impacts) implies that human activities are contributing widely to temperature problems (Park and Boyd 1998, Whiley and Cleland 2003; see also USDA and US Department of the Interior Bureau of Land Management, www.icbemp.gov, Aug. 4, 2003). To determine if this accurately portrays human influences on thermal regimes of surface waters, particularly in forested environments, it is important to understand just what types of patterns in stream temperatures we can expect.

Temperature Patterns in Unmanaged and Least-Impaired Forested Streams

There is historical evidence that some northwest streams experienced periodic high temperatures even before extensive development of the region. Spangrude (2003), in an article published in the Columbia Bulletin, summarized the findings of some key surveys of stream temperatures prior to 1900, including monitoring by Gilbert and Evermann (1895) and Stone (1878). Spangrude states that the Gilbert and Evermann report includes single-value water temperatures measured at discrete locations along various rivers and waterbodies (Table 1).

Measurements by Gilbert and Evermann (1895) for the Clearwater River in Lewiston, ID, are particularly interesting. Temperature measurements in the morning (10:00 am) were 63.5° F, while by 4:00 pm the temperature was 83.5° F, a remarkable 20° F increase in just 6 h. If these data are valid, they could only occur with very low flows and exposed stream reaches, conditions that could have preceded construction of Dworshak Dam.

Spangrude reported that Stone (1878) found that water temperatures for the Columbia River at Clifton, OR, exceeded 68° F from Jul. 17, 1875 to the middle of Aug. of that year. While these data are scattered and some only represent data for a single day, they indicate that stream temperatures were probably at or above the water-quality standards currently set for the northwestern states.

Reference or least-impaired watersheds have long been used to identify expected watershed conditions and water quality (Dissmeyer 1994). Data from monitoring and research efforts using control and reference forest watersheds are presented below. In addition, during the summer of 2001 we deployed VEMCO 8-bit temperature probe/data loggers in a number of streams within or immediately downstream from federal wilderness areas. The 2001 water year represented a period of very low flows. Duncan (2002) reported that summer as the second worst drought on record in Oregon. Based on a review of gaging station records for Oregon, some streams approached the 7Q10 low flow in 2001, although the lowest flows appear to have occurred in early autumn after peak stream temperature days. Data were collected at 10-minute intervals and probe performance was verified prior to deployment using protocol prescribed by the Oregon Salmon Plan (www.oregon-plan.org/cdrom/monguide2001.pdf, Oct. 6, 2003). The following is a summary of site conditions and results from this monitoring and other relevant data.

Table 1. Single value temperatures reported by Gilbert and Evermann (1895) for 1891 from Spangrude (2003).

Location	Date	Temperature (°F)
Yakima River at North Yakima, WA	Aug. 23	64
Yakima River near Prosser, WA	Aug. 24	70
Walla Walla River near Wallula, WA	Aug. 23	70
Palouse River near Colfax, WA	Aug. 17	74
Pataha River (Creek) near Starbuck, WA	Aug. 14	68
Ross Fork of the Snake River, near Pocatello, ID	Aug. 4	72.5
Portneuf River near Pocatello, ID	Aug. 2	76
Boise River near Caldwell, ID	Aug. 8	66
Clearwater River near Lewiston, ID	Aug. 15	83.5
Columbia River near Kettle Falls, ID	Aug. 16	62
Coeur d'Alene Lake, ID, near the outlet	Aug. 21	75
Umatilla River near Pendleton, OR	Aug. 12	70

Boulder Creek, OR

In the summer of 2001, a set of three recording temperature probes were placed in Boulder Creek in the Oregon Cascades east of Roseburg. The monitoring sites were all within the Boulder Creek Wilderness Area, and flow in Boulder Creek above the monitoring sites is entirely within the Wilderness Area. Boulder Creek drains 31 mi^2. Based on only 3 years of continuous discharge monitoring and some spot discharge measurements, the average annual flow for Boulder Creek is just over 70 cfs with a minimum flow measured of 3.0 cfs (Holaday 1992). Less than 5% of the watershed has been harvested, with most of the harvest in the headwaters (Holaday 1992). Holaday reported that the watershed is in the western hemlock zone. The uppermost site experienced a maximum temperature of just under 70° F and a 7-day maximum of 69.3° F. The maximum 7-day moving mean of the MINIMUM daily water temperatures was 65° F. The lower sites had slightly higher temperatures (maximum of 71° F, 7-day maximum of 70.6° F). This is warmer than reported by Holaday for 1992, but may reflect the unusually low flow year of 2001. All these sites would fail Oregon's temperature criteria.

City Creek, OR

Holaday (1992) looked at the level of forest management in tributaries to Steamboat Creek, a tributary of the Umpqua River, OR. City Creek, which is located in the upper reaches of the Steamboat Creek Basin, had only 6.7% of the watershed harvested between 1955 and 1990. None of the harvest was adjacent to streams. City Creek is a small stream draining a basin of 160 ac with an average discharge in July and Aug. (1969–1990) of 2.5 cfs. Still, maximum temperatures July 27, 1969 and 1990, were 67 and 64° F, respectively (1-day monitoring results rather than 7-day maximum). These temperatures, if experienced for 7 consecutive days, would exceed the criterion for Oregon (64° F).

Drift Creek, OR

Drift Creek flows though the Drift Creek Wilderness area near Tidewater in coastal Oregon. The Drift Creek Wilderness contains one of the largest stands of old-growth forest in the Coast Range, providing a lush forest environment. Drift Creek drains both managed and unmanaged forest land. By the time Drift Creek enters the 5,800-ac Wilderness, it is already draining several square miles of watershed. During the summer, the 20-ft wide creek is wadeable. In the summer of 2001, two probes were deployed at the southwest (downstream) corner of the Wilderness. Both monitoring sites were located within the Wilderness several miles below where Drift Creek enters it. The lowest site had a maximum temperature of 70° F and a 7-day maximum of 66.7° F. The second site, located upstream, experienced a maximum of 67° F and a 7-day maximum of 65.5° F. These temperatures exceed the criteria for Oregon.

Mule Creek, OR

Mule Creek, a tributary to the Rogue River, flows through Forest Service and Bureau of Land Management-managed forest land and wilderness. Three probes were deployed above Tucker Flat Campground within the Wild Rogue Wilderness. Flow at this site has either originated within or been flowing through the Wilderness for several miles. The watershed draining to this location is about 40 mi^2, and the creek is 20 ft wide with areas of exposed bedrock. Vegetation is dense along the channel near the monitoring sites. Maximum temperatures measured were 67, 67, and 68.5° F. Seven-day maximum temperatures for the three probes were 66.5, 66.3, and 68.1° F. The higher temperatures were recorded in a backwater pool, while the other probes were in glides downstream from riffles. None of these sites would have achieved the criteria for Oregon.

Lochsa River and Tributaries, ID

HDR Engineering (2002) recently prepared a report for the Idaho Department of Environmental Quality assessing water temperatures in the Lochsa River and selected tributaries. This involved calibration of the Stream Network Temperature Model (SNTEMP) (Theurer et al. 1984) with existing stream temperature data and interpretation of potential and existing canopy cover. The Lochsa River is one of two branches that join to form the Middle Fork of the Clearwater River. The Lochsa flows 70 river miles to the junction with the Middle Fork through forests and canyons and drains an area of around 1,500 mi^2. During snowmelt runoff, flows at the mouth of the Lochsa River can be several thousand cfs, but flows are far lower during critical water temperature periods. The report concluded that the Lochsa cannot now, nor is it likely that it ever will, achieve the state cold-water biota (CWB) criteria of 71.6° F instantaneous maximum and 66.2° F daily average maximum (for 90th percentile air temperature day). Temperature reductions appear to be possible with increased shade along the Lochsa, but the model indicates that neither increased shade nor reduced tributary temperatures are likely to reduce stream temperatures enough to meet the CWB criteria. Regarding the role of tributaries, the report states that ". . . many of the tributaries to the Lochsa River drain wilderness areas or unmanaged watersheds, and an [14.4° F] 8° C decrease in water temperature [necessary to achieve CWB criteria in the Lochsa River] is likely not physically possible in these areas." In fact, the measured stream temperature for Boulder Creek, a tributary to the Lochsa that drains a wilderness area of about 50 mi^2, is itself above the CWB criteria. After reviewing the factors causing reduced canopy cover the report finds that ". . . between 75% and 97% of the differences in water temperature between the existing and full potential canopy cover conditions in the Lochsa River basin is due to natural disturbances."

Olympic Peninsula Small Streams, WA

Black (2001) measured summer temperatures for headwater streams in the Olympic Peninsula, WA. These nonfish-bearing headwater streams were ≤2 ft wide. She found that streams with diffuse marshy sources tended to be warmer than streams with concentrated sources (springs). Black concluded that "a majority of sources and streams in this study do not comply with current or proposed standards for mean weekly maximum temperature (MWMT). This is true for streams in unlogged as well as logged units." No streams or sources exceeded 68° F, but streams with marsh sources regularly had water temperatures exceeding 61° F.

USGS Western Oregon Small Reference Stream Temperature Project

Because of concerns about stream temperature impacts on cold-water fisheries and the proliferation of TMDL assessments in Oregon, the US Geological Survey (USGS) initiated a project to estimate "... physically achievable water temperatures that reflect 'natural' or undisturbed conditions. . ."; (Risley and Roehl 2002). Data for 148 sites on first-, second-, and third-order streams in western Oregon are being used to develop neural network models of estimated "natural" water temperatures for small streams. Data for about half of these streams are available on the World Wide Web, and we analyzed the data to determine compliance with Oregon water-quality standards. About one-third of the 73 sites tested exceeded the 64° F general temperature standard for salmonid streams in Oregon. Risley (USGS, July 30, 2002) noted that some of these streams have experienced some management, but they reflect the best reference streams available.

Table 2 summarizes the results from monitoring of reference streams in Oregon, Washington, and Idaho for 7-day maximum stream temperatures (City Creek is not included). This shows that some least-impacted streams exceeded the applicable state water temperature criteria.

These data are not a random sample. Streams where VEMCO probes were deployed in 2001 were expected to be warm. Data from other studies were selected because they display naturally high temperatures. Still, this indicates that we have an intuitive understanding of where we can expect warm stream temperatures.

Are Current Temperature Standards Achievable for Forest Streams?

No one who has experience with forested watersheds is surprised that some streams are naturally warmer than others. Watershed specialists are beginning to explain these patterns based on elevation, latitude, flow path (short pathway to return flow or delayed, deep groundwater source), natural channel exposure to solar radiation, and residence time of water in the channel. These patterns are well known and can be incorporated into regulations. For example, the Washington Forest Practices Board (WFPB) adopted forest practice rules that require greater shade on low elevation streams than on high elevation streams because higher elevation streams tended to be cooler initially (Washington Forest Practices Board 1997). In Montana, Isaak and Hubert (2001) found a similar relationship. They explained 82% of variations in maximum stream temperatures for 26 sites on second- to fourth-order streams using elevation, canopy, and grazing intensity.

Geology also plays an important role in moderating stream temperatures. Research by Grant and Tague (as summarized by Duncan 2002) has shown a significant influence of geology on stream temperatures in the Oregon Cascades. These streams spanned a wide range of sizes, from headwaters to large rivers. Groundwater inputs in the High Cascades geologic region are characterized by strong springs or "gushers." Flows tend to be relatively "steady," allowing development of near-channel vegetation. Higher flows and shade lead to lower stream temperatures in the summer. In contrast, Western or Middle Cascades geology has shallow subsurface runoff and a dense stream network that creates flashy runoff. Stream temperatures are characteristically higher in this region.

An exhaustive compilation of regional stream temperature data across northern California found that a single stream temperature pattern is difficult to apply across a broad region because of variations in stream size, drainage area, geographical location, prevailing climatic conditions, stream orientation, natural riparian vegetation diversity, and other factors (Lewis et al. 2000). Based on this extensive data set and reviews of past research, they concluded that air temperature affects stream temperature and stream water temperatures tend to increase with distance from the watershed divide. Given these patterns, lower-elevation streams located far from their headwaters were expected to be warmer than higher-elevation, headwater streams in the region. However, Lewis et al. (2000) pointed out the importance of understanding local climatic influences. In northern California, the coastal fog belt can result in lower-elevation, higher-order streams actually experiencing cooler maximum temperatures than the headwater tributary streams outside the fog belt.

In British Columbia, Mellina et al. (2002) found that streams with their headwaters in small lakes or swamps tended to cool as they flowed downstream. In contrast, headwater streams without these features warmed as they flowed downstream regardless of whether streamside timber harvesting had taken place.

Disturbance history can include not only forest management but also natural disturbances such as debris torrents,

Table 2. Stream temperatures for wilderness and least-impaired streams in the Pacific Northwest. Seven-day maximum stream temperatures (°F), unless otherwise indicated.

Stream	Temperature (°F)
Boulder Creek, OR (2001)	69.3–70.6
Drift Creek, OR (2001)	65.5–66.7
Mule Creek, OR (2001)	66.3–68.1
USGS reference streams for western Oregon	One-third cannot meet 64
Olympic Peninsula small streams, WA (2000)	Marsh source streams without harvesting regularly exceed 60.8
Lochsa River, ID (1994)	77.4 instantaneous maximum
Boulder Creek, ID (1994)	68.2 maximum daily average

ice flows and floods, insect outbreaks, windthrow, and wildfire (Ice and Schoenholtz 2003). These events can remove riparian vegetation and expose channels to direct solar radiation. McGreer (1996) describes photographs of the North Fork of the Clearwater River 21 years after the 1919 reburn of the 1910 wildfire. The photos show a river nearly totally exposed to the sun, with only low brush and an occasional snag near the river. Vanderheyden et al. (1989) used Brown's (1969) equation to calculate how stream temperatures responded to the Silver Fire in southwestern Oregon. The Alsea Watershed Study, which studied the effects of logging and prescribed fire in Needle Branch Creek, showed the potential for large increases in maximum stream temperatures with removal of riparian vegetation near small streams regardless of the cause (Moring and Lantz 1975).

These observations demonstrate that disturbance can affect stream temperature regimes, but long-term patterns are sometimes unexpected. As part of a Watershed Analysis, Weyerhaeuser Company (1995) found a temperature difference between Wet Gulch (about a 5-mi^2 watershed with a bankfull width of 20.5 ft), a relatively unmanaged watershed, and nearby Johnson Creek (about a 7-mi^2 watershed with a bankfull width of 21.5 ft), a stream that experienced debris torrents in 1986. The debris torrents in Johnson Creek resulted in extensive impacts to the channel and riparian vegetation. Nevertheless, monitoring now shows that stream temperatures are lower in the recently disturbed Johnson Creek than in the unmanaged Wet Gulch. In 2002, maximum stream temperatures were 64.2° F for the unmanaged Wet Gulch and 62.8° F for Johnson Creek. Rapid regrowth of riparian vegetation (red alder, *Alnus rubra*) is presumed to be the cause of the lower water temperatures in Johnson Creek. In forested watersheds, unlike point sources, disturbance effects can moderate over time.

These findings show that we should not expect stream temperatures to be uniformly cool. There are natural patterns as a result of climate, geology, geography, vegetation, and hydrology that determine stream temperatures. Even these patterns may change over time with disturbance to the channel and riparian vegetation and subsequent recovery. The findings from least-impaired streams along with the patterns described here show that stream systems can experience temperatures that exceed temperature criteria due to natural causes. How often this occurs is not known, but the situation suggests that some streams in managed areas are erroneously being labeled as impaired, solely because an inappropriate standard is being applied. This diverts attention from larger problems and wastes limited monitoring and restoration resources.

Discussion and Conclusions

How can natural variability be incorporated into water-quality standards? To some degree it already is, as evidenced by the allowances made for unusually warm weather or for naturally warm streams draining undisturbed lands. However, these allowances only partly account for spatial and temporal variance in thermal regimes. We believe that standards could fit their landscapes even better through a combination of physical modeling of temperatures that incorporates local and regional patterns and information on the biology of beneficial uses. To begin with, no temperature standards should be based solely on the needs of beneficial uses or simply on what is physically attainable. The biology-only approach lacks context for determining achievability, and the physical-only approach lacks relevance to beneficial uses.

Biologically Relevant Water-Quality Criteria

Land managers want to know that regulations affecting their operations are meaningful and reasonable. Water temperature criteria that accurately reflect the needs of fish or other aquatic organisms are therefore important. Of the many ways that biologically based criteria are selected, those that employ risk assessment tools are preferred. Methods like this have the advantage of being objective and repeatable, and they allow quantification of the effect of different temperatures on aquatic organisms. One such approach was recently developed and tested by Sullivan et al. (2000). They used growth loss as an indicator of the prolonged sublethal effects of temperature on fish. Growth is a reliable and measurable integrator of a variety of physiological responses to temperature (Brett 1971, Iverson 1972, Brungs and Jones 1977). Sullivan et al. (2000) proposed that temperatures associated with either a 10 or 20% growth loss in fish could be used as an index for deriving chronic temperature criteria. This type of approach for setting criteria may also help identify an acceptable frequency of exceedences (years) during unusually warm weather (i.e., to address temporal variability in thermal regimes).

Identifying Natural Temperature Patterns

Once the temperature needs of beneficial uses have been established, some form of physical model should be used to identify what thermal regimes are possible for streams in an area. Several models are available (e.g., SNTEMP, Heat Source, QUAL2K, BasinTemp), and others are being developed that can, under some circumstances, predict with reasonable error bounds what the expected temperatures would be in a given stream reach. It is beyond the scope of this article to discuss the assumptions, strengths, and weaknesses of these models, but readers are encouraged to read reports by Sullivan et al. (1990) and HDR Inc. (2002) for a comparison of several available models. Ideally, these models would be applied to every watershed in a state or region, and the "thermal potentials" so derived would set expectations for every reach or basin (US EPA, www.epa.gov/r10earth/water.htm, Nov. 28, 2001). However, this would probably be cost prohibitive and unnecessary.

An alternative approach would be to start with criteria developed to protect beneficial uses and then use models to refine where to expect such criteria to be attainable. Thus, the need for modeling would be much reduced. The temperature criteria in Washington's revised standards are well suited for this type of model application. A second alternative would be to use models for specific instances; for example, for general stream temperature patterns such as those described by Isaak and Hubert (2001), Duncan (2002), and Risley and Roehle (2002). Only where significant departures from expected temperature patterns are found would a detailed Use Attainability Analysis (UAA) be triggered. Major departures from expected patterns could ultimately trigger either more detailed thermal potential modeling or a TMDL assessment. Thermal modeling for TMDL development is already occurring in Oregon, California, Idaho, and Washington (Park and Boyd 1998, US EPA 1999, HDR 2002, Whiley and Cleland 2003). With prudent use of temperature prediction models and information on temperature requirements of beneficial uses, some common patterns of stream temperature variability could be woven into water-quality standards.

Temporal variability is another facet of stream temperatures that should be better addressed in water-quality standards. As shown in the review of state standards, some allowance for this is given, usually to acknowledge unusually warm weather. This is appropriate, but seldom are the allowances directly linked to the health of fish populations or other beneficial uses. Where a statistical "one in ten" year exceedence of criteria is allowed without claiming a water body is impaired, the beneficial uses may fully tolerate "two in ten" or "three in ten" year exceedences. To better judge how often a water body could be out of compliance without adversely affecting the beneficial uses, quantitative risk assessments are needed. This would help produce more objective and reproducible guidelines for "duration of exposure" across multiple years

These ideas are not new or unique to forest watershed specialists. The National Academy of Science report on TMDLs (National Research Council 2001) recognized that "all chemical criteria and some biological criteria should be defined in terms of magnitude, frequency, and duration" and that ". . . use attainability analysis should be considered for all waterbodies before a TMDL is developed." Similarly, the EPA (www.epa.gov/r10earth/water.htm, Nov. 28, 2001) recognizes that some streams may not be capable of meeting current or proposed water-quality criteria because of natural conditions or changes (such as construction of dams or stream channelization) that are functionally irreversible, necessitating assessment of a stream's thermal potential. These are important findings, but they may be difficult and expensive to apply. UAA inherently is expensive and controversial. Despite the National Academy of Science recommendations citing the need for UAAs, environmental organizations have called UAAs a "polluter tactic to watch out for. . . " (Clean Water Network 2001). Temperature modeling, called for by the EPA to predict thermal potential, is data-intensive and can be expensive (www.epa.gov/r10earth/water.htm, Nov. 28, 2001). If a full TMDL is required the costs are even greater.

Antidegradation elements in state water-quality standards for temperature create another problem in assessing even well-designed forest operations. As described earlier, some states allow a *deminimus* increase in stream temperatures from management activities of 0.5° F. This is probably achievable for larger fish-bearing streams. In nonfish-bearing streams increases in stream temperatures associated with timber harvesting can exceed this value. For small forest streams it is likely that these standards cannot be achieved even for unmanaged watersheds because of natural disturbances to streams (Ice and Schoenholtz 2003). Interpreting the biological implications of changes in headwater stream temperatures is not easy and largely has been ignored. In some cases, increases in headwater stream temperatures following timber harvesting are compensated for with reduced temperatures downstream due to increased flows with reduced evapotranspiration. Jackson et al. (2001) found the reverse trend during monitoring of headwater streams in Washington, with cooler water upstream and warmer water downstream. Holaday (1992), Zwieniecki and Newton (1999), and Johnson and Jones (2000) have shown that maximum temperature increases do not transport downstream unabated, especially for small streams. Furthermore, these small streams can experience very rapid recovery from lost shade (Andrus and Froehlich 1988). Temperature changes of 2–4° F for small headwater streams once every 30–50 years are likely to have little cumulative effect on fish populations and should not be considered equivalent to permanent changes due to other land uses or industrial discharges.

At a June 19, 2003, House subcommittee meeting, Bruninga (2003) reported that several witnesses called for EPA to issue guidance to clarify and streamline the process for revising water-quality criteria. John Stephenson, director of the Government Accounting Office Natural Resources and Environment Division, is quoted as stating that, "the nation risks wasting valuable resources by overprotecting some waters while overlooking others." Linda Eichmiller, deputy director of the Association of State and Interstate Water Pollution Control Administrators, reported to the subcommittee that changing standards is a lightning rod for controversy but that the states are making progress. She indicated that this is important so that "we can end up spending money on real problems where there is a real risk involved." We agree that setting unachievable water-quality standards has the potential to frustrate effective nonpoint source control programs like the forest practice programs of the West.

Literature Cited

ANDRUS, C.W., AND H.A. FROEHLICH. 1988. Riparian forest development after logging or fire in Oregon Coast Range: Wildlife habitat and timber value. P. 139–152 *in* Streamside management: Riparian wildlife and fisheries interactions. Raedeke, K.J. (ed.). Inst. of For. Resources, Contr. no. 59. Univ. of Washington, Seattle, WA.

BESCHTA, R.L., AND J. WEATHERRED. 1984. TEMP-84: A computer model for predicting stream temperatures resulting from the management of streamside vegetation. Watershed Systems Development Group. USDA For. Serv., Report WSDG-AD-00009, Fort Collins, CO. 76 p.

BJORNN, T.C., AND D.W. REISER. 1991. Habitat requirements of salmonids in streams. P. 83–138 *in* Influences of forest and rangeland management on salmonid fishes and their habitats, Meehan, W.R. (ed.). Special Pub. 19, Am. Fisheries Soc., Bethesda, MD.

BLACK, J. 2001. Summer temperatures in small stream sources on managed Olympic Peninsula timberlands. M.S. thesis, Univ. of Washington, Seattle, WA. 208 p.

BOYD, M.S. 1996. Heat Source©: Stream, river, and open channel temperature prediction. M.S. thesis, Oregon State Univ., Corvallis, OR. 148 p.

BRETT, J.R. 1952. Temperature tolerance in young Pacific salmon, genus *Oncorhynchus*. J. Fisheries Res. Brd. of Can. 9:265–323.

BRETT, J.R. 1971. Energetic responses of salmon to temperature. A study of some thermal relations in the physiology and freshwater ecology of sockeye salmon (*Oncorhynchus nerka*). Amer. Zool. 11(1):99–113.

BROWN, G.W. 1969. Predicting temperatures of small streams. Water Resour. Res. 5(1):68–75.

BRUNGS, W., AND B. JONES. 1977. Temperature criteria for freshwater fish: Protocol and procedures. Ecological Research Series. US Environ. Prot. Agency, EPA-600/3-77-061. Deluth, MN. 130 p.

BRUNINGA, S. 2003. Guidance needed to improve process for revising standards, House hearing told. Environmental Reporter 34(26):1449–1451.

CLEAN WATER NETWORK (CWN). 2001. The ripple effect: How to make waves in the turbulent world of watershed cleanup plans. Clean Water Network, Washington, DC. 78 p.

DISSMEYER, G.E. 1994. Evaluation of effectiveness of forestry best management practices in meeting water quality goals or standards. Misc. Publ. 1520, USDA For. Serv., Atlanta, GA. 178 p. + appendix.

DUNCAN, S. 2002. Geology as destiny: Cold waters run deep in western Oregon. USDA For. Serv. Science Findings Issue 49, Portland, OR. 5 p.

GILBERT, C.H., AND B.W. EVERMANN. 1895. A report upon investigations in the Columbia River Basin, with descriptions of four new species of fish. P. 169–207 *in* Bulletin of the US Fish Commission for 1894. Vol. 14. House of Representatives Misc. Doc. 86. US Gov. Printing Office, Washington, DC.

HARPER, W.C. 1987. Best management practices and water quality standards relationships. *In* Forestry and water quality: A strategy and policy workshop for state foresters. Davis, R.L. (ed.). Nat. Assoc. of State Foresters, Washington, DC. 6 p.

HDR ENGINEERING, INC. 2002. Lochsa River temperature model. Idaho Dept. of Environ. Quality, Boise, ID. 45 p.

HOLADAY, S.A. 1992. Summertime water temperature trends in Steamboat Creek Basin, Umpqua National Forest. M. S. thesis, Oregon State Univ., Corvallis, OR. 128 p.

ICE, G.G., W.F. MEGAHAN, D.J. MCGREER, AND G.H. BELT. 1994. Streamside management in Northwest forests. P. 293–298 *in* Managing forests to meet people's needs: Proc. of the 1994 SAF/CIF Convention. Soc. of Am. For., Bethesda, MD.

ICE, G.G., AND S. SCHOENHOLTZ. 2003. Understanding how extremes influence water quality: Experience from forest watersheds. Hydrologic Sci. Tech. 19(1–4):99–107.

ISAAK, D.J., AND W.A. HUBERT. 2001. A hypothesis about factors that affect maximum summer stream temperatures across montane landscapes. J. Amer. Water Resour. Assoc. 37(2):351–366.

IVERSON, R.A. 1972. Effects of elevated temperature on juvenile coho salmon and benthic invertebrates in model stream communities. Ph.D. dissertation, Oregon State Univ., Corvallis, OR. 98 p.

JACKSON, C.R., C.A. STRUM, AND J.M. WARD. 2001. Timber harvest impacts on small headwater stream channels in the coast ranges of Washington. J. Am. Water Resources Assoc. 37(16):1533–1549.

JOHNSON, S.L., AND J.A. JONES. 2000. Stream temperature response to forest harvest and debris flows in western Cascades, Oregon. Can. J. Fisheries Aquatic Sci. 57(Suppl. 2):30–39.

LANTZ, R.L. 1971. Influence of water temperature on fish survival, growth and behavior. P. 182–193 *in* Proceedings of a symposium: Forest land uses and stream environment, Krygier, J.T., and J.D. Hall (eds.). Oregon State Univ., Corvallis, OR.

LEWIS, T.E., D.W. LAMPHEAR, D.R. MCCANNE, A.S. WEBB, J.P. KRIETER, AND W.D. CONROY. 2000. Regional assessment of stream temperatures across northern California and their relationship to various landscape-level and site-specific attributes. For. Sci. Project, Humboldt State Univ. Foundation, Arcata, CA. 420 p.

MCGREER, D. 1996. Considerations in development of riparian management strategies: Potential consequences of wildfire on riparian and aquatic systems. Western Watershed Analysts, Lewiston, ID. 37 p.

MELLINA, E., R.D. MOORE, S.G. HINCH, J.S. MACDONALD, AND G. PEARSON. 2002. Stream temperature response to clearcut logging in British Columbia: The moderating influences of groundwater and headwater lakes. Can. J. Fisheries Aquatic Sci. 59:1886–1900.

MORING, J.R., AND R.L. LANTZ. 1975. The Alsea watershed study: Effects of logging on the aquatic resources of three headwater streams of the Alsea River, Oregon. Part I: Biological studies. Fishery Res. Rept. 9. Oregon Dept. of Fish and Wildlife, Corvallis, OR. 66 p.

NATIONAL RESEARCH COUNCIL. 2001. Assessing the TMDL approach to water quality management. Committee to Assess the Scientific Basis of the Total Maximum Daily Load Approach to Water Pollution Reduction, Water Science and Technology Board, National Academy Press, Washington, DC. 102 p. + appendices.

PARK, C., AND C. BOYD. 1998. Sucker/Grayback total maximum daily load (TMDL). Oregon Dept. of Environ. Quality, Salem, OR. 33 p.

RISLEY, J.C., AND E.A. ROEHL. 2002. Using artificial neural network models to estimate water temperatures in small streams in western Oregon. P. *in* Proc. of the Second Federal Interagency Hydrologic Modeling Conference, on CD-ROM. Available from Office of Water Quality, Reston, VA. 12 p.

SELONG, J.H., T.E. MCMAHON, A.V. ZALE, AND F.T. BARROWS. 2001. Effect of temperature on growth and survival of bull trout, with application of an improved method of determining thermal tolerance in fishes. Trans. Amer. Fisheries Soc. 130:1026–37.

SPANGRUDE, G. 2003. Water temperature history. Columbia Basin Bulletin (May 23, 2003). Intermountain Communications: Bend, OR. www.bluefish.org/temphist.htm. August 5, 2003.

STONE, L. 1878. The salmon fisheries of the Columbia River. P. 801–823 *in* Part IV. Report of the Commissioner of Fish and Fisheries for 1875–1876. Appendix B. Inland Fisheries. Part III Inquiry into the decrease of the food-fishes. US Commission of Fish and Fisheries. US Gov. Printing Office, Washington, DC.

SULLIVAN, K., D.J. MARTIN, R.D. CARDWELL, J.E. TOLL, AND S. DUKE. 2000. An analysis of the effects of temperature on salmonids of the Pacific Northwest with implications for selecting temperature criteria. Sustainable Ecosystem Institute, Portland, OR. 192 p.

SULLIVAN, K., J. TOOLEY, K. DOUGHTY, J.E. CALDWELL, AND P. KNUDSEN. 1990. Evaluation of prediction models and characterization of stream temperature regimes in Washington. Timber/Fish/Wildlife Report No. TFW-WQ-90-006. Washington Dept. of Nat. Res., Olympia, WA. 229 p.

THEURER, F.D., K.A. VOOS, AND W.J. MILLER. 1984. Instream water temperature model. Instream Flow Inf. Paper 16. FWS/OBS-84/15, Instream Flow and Aquatic System Group, US Fish and Wildlife Serv., Fort Collins, CO. 200 p.

US ENVIRONMENTAL PROTECTION AGENCY. 1999. South Fork Eel River Total Maximum Daily Loads for sediment and temperature. US Environ. Prot. Agency Region IX, San Francisco, CA. 59 p.

VANDERHEYDEN, J., L. JOHNSON, M. AMAARANTHUS, AND L. BATTEN. 1989. Modeling fire and timber salvage effects for the Silver Fire Recovery Project in southwestern Oregon. P. 157 *in* Proceedings of the symposium on fire and watershed management. USDA For. Serv. Gen. Tech. Rept. PSW-109.

WASHINGTON FOREST PRACTICES BOARD. 1997. Board manual: Standard methodology for conducting watershed analysis—Version 4.0. Washington Dept. of Nat. Res., Olympia, WA. 112 p. + appendices.

WEYERHAEUSER CO. 1995. Watershed analysis for the McKenzie River. Weyerhaeuser Co., Springfield, OR. 389 p.

WHILEY, A.J., AND B. CLELAND. 2003. Wenatchee National Forest water temperature total maximum daily load: Technical report draft. Washington Dept. of Ecol. Publ. 03-10-063. Olympia, WA. 58 p. + appendices.

ZWIENIECKI, M.A., AND M. NEWTON. 1999. Influence of streamside cover and stream features on temperature tends in forested streams of western Oregon. West. J. Appl. For. 14(2):106–113.

News Release

For release: March 2, 2004

Contacts:
Mark MacIntyre, EPA Region 10 Communications, Seattle, (206) 553-7302
Mark Charles, DEQ Water Quality Division, Portland, (503) 229-5589
Brian White, Communications & Outreach, DEQ, Portland, (503) 229-6044

Information on the new Oregon water quality standards is available at:
DEQ Web site: http://www.deq.state.or.us/wq/standards/wqstdshome.htm
EPA Web site: www.epa.gov/r10earth/oregonwqs.htm

DEQ
State of Oregon
Department of
Environmental
Quality

Communications
& Outreach
811 SW 6th Ave.
Portland, OR 97204
Phone: (503) 229-5696
Toll free in OR
(800) 452-4011
Fax: (503) 229-5850

EPA Approves Oregon Water Quality Standards

The new standards represent a comprehensive revision of state guidelines for temperature and of policies aimed at preventing degradation of state waters

The U.S. Environmental Protection Agency (EPA) and Oregon Department of Environmental Quality (DEQ) jointly announced today that EPA has approved DEQ's water quality standards for the state of Oregon. The revisions, which include a complete update of water temperature standards to protect salmon and trout, are the result of years of work among federal, state and tribal officials, scientists, industry, and public interest groups. The new standards go into effect immediately.

As a result of the new standards, all water quality permits in Oregon will, upon renewal, need to meet more protective targets for temperature. DEQ will also use the new temperature standards in its future listing of impaired water bodies in the state and for its issuance of pollution load limits (known as Total Maximum Daily Loads/TMDLs) for Oregon rivers and streams. The new standards will affect virtually all "point of discharge" pollution (point source) and nonpoint pollution sources in the state, including agriculture and forestry.

In addition to temperature, the new standards include methods that implement Oregon's "anti-degradation" policy. Under this policy, proposed new or increased pollution discharges must go through a water degradation review by DEQ before they're allowed to occur. The review balances the need for the discharge against the water quality degradation that might occur as a result of the discharge. The revised standards approved today clarify that policy. In addition, the new standards include revisions to criteria for inter-gravel dissolved oxygen levels for further protection of salmon and trout spawning.

(More/over)

The new temperature standards lower the acceptable temperature in many rivers and streams, and raise the temperature limit for other streams, based on the latest reliable scientific data. Previously, DEQ used a temperature standard of 64 degrees Fahrenheit on most of the state's streams and rivers.

These new standards are the result of extensive public review and consultation with the U.S. Fish and Wildlife Service, National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service, Pacific Northwest tribal governments, Oregon Department of Fish and Wildlife and DEQ.

EPA's approval of the DEQ standards, which were adopted by the Oregon Environmental Quality Commission last Dec. 4, means that EPA does not need to issue final water quality standards for the state. In response to a March 2003 court decision, EPA was directed to either approve revised state standards or issue federal standards by March 2, 2004.

"These standards provide a state-of-the-art tool for local communities and watersheds. They're firmly grounded in current science, easier to understand, and will continue the protection and recovery of the state's endangered salmon and trout species," said Holly Schroeder, administrator of DEQ's Water Quality Division. "These new standards are an important step in addressing the endangered species issue and improving water quality overall in Oregon."

One new feature of the new water quality temperature standards is that DEQ will now be able to work with comprehensive watershed maps that identify temperature requirements for each water body in the state. This will enable water quality officials get a better handle on when and where the new temperature rules are in effect for specific sections of rivers and streams. In the past, this link between specific water bodies and temperature requirements was vague. The maps are accessible on DEQ's Web site. DEQ worked closely with EPA, NOAA and the U.S. Fish and Wildlife Service in compiling the maps, with much of the data coming from information provided by the Oregon Department of Fish and Wildlife.

DEQ Director Stephanie Hallock: "Today's action is the culmination of long-term efforts between EPA, federal fisheries agencies, DEQ and others to address serious water quality and fish habitat issues in Oregon and make significant improvements. Our work in improving water quality in Oregon is a continuing challenge, and we're happy that EPA has approved these standards and hope to build on this as a model for future water quality improvement projects."

EPA Regional Administrator John Iani (Region 10 – Seattle): "I salute the scientists, agency staff, environmental groups, industry, tribes and all those who have worked on the temperature problem for the past several years. Their combined efforts have brought Oregon these new water quality/ temperature standards that are truly 'the best in the business.' Now it's time to put the debate over standards to rest, and get on with the even more important task of making improvements in water temperatures to meet these new standards. That work will again demand the best of all of us."

Timeline of actions leading to today's approval of state water quality standards

- **1967:** State Sanitary Authority (now DEQ) first uses temperature standards as a means of monitoring water quality in the Willamette River.
- **Mid 1970s:** Oregon Environmental Quality Commission (EQC) adopts first statewide

(More/over)

temperature standards for water quality.

- **January 1996:** EQC adopts revised DEQ temperature water quality standards for state waters.
- **July 1999:** EPA approves DEQ water quality standards for temperature.
- **April 2001:** Northwest Environmental Advocates files a lawsuit in federal district court, alleging that EPA improperly approved DEQ's temperature standards in 1999 and claiming that the standards do not meet requirements of the federal Endangered Species Act and federal Clean Water Act.
- **March 2003:** Court agrees with Northwest Environmental Advocates and orders EPA to adopt revised water quality standards by approving revised DEQ standards or its own revised standards by March 2, 2004.
- **April 2003:** EPA Region 10 Office issues guidance to Pacific Northwest state agencies and tribes for developing water temperature standards. This guidance was based on three years of work by EPA, DEQ and other state, federal and tribal parties to develop a better understanding of the science of water temperature and salmon in the Northwest.
- **May 2003:** DEQ holds informational meetings with the public statewide to get feedback on the need for revising the water quality standards.
- **June 2003:** DEQ begins its rule-writing process for revising existing water quality standards.
- **September 2003:** DEQ holds 10 public hearings throughout Oregon to gather public comment on its proposed water quality standard revisions. Official public comment period runs from Aug. 15 through Oct. 3, 2003.
- **October 2003:** EPA holds public hearings and opens public comment period on its own proposed revisions of state water quality standards in Oregon.
- **Dec. 4, 2003:** (After DEQ makes final changes to its proposed revisions), the Oregon Environmental Quality Commission unanimously approves DEQ's proposed water quality standards.
- **Dec. 10, 2003:** DEQ submits its proposed water quality standards to EPA for final review.
- **Feb. 23-24, 2004:** National Marine Fisheries Service and U.S. Fish and Wildlife Service issue biological opinions stating that the new Oregon water quality standards meet federal Endangered Species Act requirements.
- **March 2, 2004:** EPA approves revised water quality standards that mainly address temperature and anti-degradation policy changes.

###

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue
Seattle, WA 98101

Reply To
Attn Of: OW-131

Stephanie Hallock, Director
Oregon Department of Environmental Quality
811 S.W. Sixth Avenue
Portland, OR 97204-1390

Re: Approval of Oregon State Water Quality Standards (OAR 340-041) for Temperature, Inter-Gravel Dissolved Oxygen and Antidegradation

Dear Ms. Hallock:

Thank you for your letter of December 10, 2003, on behalf of the Oregon Department of Environmental Quality (ODEQ) submitting new and revised water quality standards for Temperature, Inter-Gravel Dissolved Oxygen and Antidegradation to the U.S. Environmental Protection Agency (EPA) in accordance with section 303(c)(2)(A) of the Clean Water Act (CWA).

Based on a review of the ODEQ submission and supporting documentation, EPA finds the new or revised provisions that we reviewed are consistent with the CWA and EPA's implementing regulation at 40 CFR Part 131. The enclosure to this letter (*Support Document for EPA's Action Reviewing New Or Revised Water Quality Standards for the State of Oregon, March, 2, 2004*) lists, in Section 1, the provisions EPA is approving today, and, in Section 4, other provisions that ODEQ revised and submitted to EPA but upon which EPA is not acting for reasons explained in that document. This enclosure also discusses the bases for EPA's approval of the provisions upon which we are acting. Other support for EPA's action today is contained in the record for the approval.

In addition, EPA's approval action today fulfills EPA's obligations in Northwest Environmental Advocates vs U.S. EPA, et al., Civil No. 01-510 HA. On August 13, 2003, the U.S. District Court for the District of Oregon directed EPA either to promulgate a federal rule or to approve final state regulations by March 2, 2004, regarding the following water quality standards: (1) numeric water quality criteria for temperature for the protection of salmonid rearing and bull trout spawning in Oregon waters; (2) an intergravel dissolved oxygen criterion to protect salmonid spawning in Oregon waters; (3) water quality criteria for temperature for the lower Willamette River; and (4) methods to implement Oregon's existing antidegradation policy. Oregon's revised water quality standards, as approved today by EPA, fulfill the requirements of the U.S. District Court, so EPA does not intend to promulgate federal standards.

Pursuant to Section 7 of the Endangered Species Act (ESA), EPA has consulted on this federal approval action of Oregon Water Quality Standards. In December 2003, EPA provided to NOAA's National Marine Fisheries Service (NOAA Fisheries) and the U.S. Fish and Wildlife Service (USFWS) a biological evaluation regarding EPA's approval action. In January 2004, EPA provided to NOAA Fisheries an Essential Fish Habitat (EFH) Assessment of EPA's approval action, pursuant to Section 305(b)(2) of the Magnuson-Stevens Fishery Management and Conservation Act (MSFM Act). Final Biological Opinions under

Printed on Recycled Paper

ESA authorities were provided to EPA by NOAA Fisheries on February 23, 2004, and by USFWS on February 24, 2004. After receiving NOAA Fisheries' conservation recommendations under the MSFM Act, EPA responded to NOAA Fisheries under the MSFM Act on February 24, 2004, indicating EPA's intent to implement those recommendations.

I want to congratulate both ODEQ and others in the State for the development of these water quality standards. These standards will provide an important contribution to salmonid protection and recovery efforts in the Pacific Northwest. These standards and the associated maps showing designated uses and life species timing provide "state of the art" tools and a national model for protecting Oregon waters and aquatic species, especially Pacific salmon, cared for so deeply by the citizens of Oregon and the Pacific Northwest. Protection and restoration of Pacific salmon is highly dependent on water temperature. Progress toward CWA standards attainment is critical to recover, restore and protect salmon populations. These standards provide important benchmarks to state, tribal, local and federal governments, watershed councils and citizens as communities move forward on watershed recovery efforts.

ODEQ is also to be commended for the extensive public outreach you held during 2003 as part of your rule making. We also thank you for your support of the Regional Temperature Guidance work during the preceding years; that scientific and policy work, and outreach to stakeholders, served as an important foundation for the ODEQ rules that we are approving today.

I would like to extend my deep appreciation to you and your staff for ODEQ's exceptional efforts and commitment to work with EPA, NOAA Fisheries and USFWS to meet our CWA and ESA responsibilities. If you have any questions concerning this letter please contact me at (206) 553-1234 or have your staff contact Mary Lou Soscia at (503) 326-5873.

Sincerely,

L. John Iani
Regional Administrator

Enclosure

cc: Michael Tehan, NOAA Fisheries
Kemper McMaster, U.S. Fish and Wildlife Service
Holly Schroeder, Oregon DEQ
Robert Baumgartner, Oregon DEQ
Mark Charles, Oregon DEQ

U.S. Environmental Protection Agency

Region 10: The Pacific Northwest

EPA Approval of Water Quality Standards for the State of Oregon

Technical Support Document (pdf, 110 pp, 328 Kb) EPA Approval Letter (pdf, 2 pp, 17 Kb) EPA Press Release (pdf, 3 pp 47 Kb)	EPA's Proposed Rule (html) or (pdf) and Official Administrative Record/Docket
Administrative Record for Approval *Coming Soon*	EPA Region 10 Water Temperature Guidance
Final Salmon and Trout Time and Place Use Designations For Each Oregon Basin	EPA 1998 Advanced Notice of Proposed Rulemaking for Water Quality Standards
Federal Court Opinions and Orders	Water Quality Standards Handbook
Public Participation	EPA Region 10 Water Quality Standards
Tribal Consultation and Involvement	OR DEQ's Water Temperature Criteria EXIT disclaimer

The U.S. Environmental Protection Agency announced on March 2, 2004, approval of new or revised Oregon Water Quality Standards for Temperature, Inter-Gravel Dissolved Oxygen and Antidegradation in accordance with section 303(c)(2)(A) of the Clean Water Act.

Background

An Order by the U.S. District Court for the District of Oregon (Northwest Environmental Advocates v. EPA & the National Marine Fisheries Service directed EPA to sign proposed rules by October 1, 2003 and promulgate or approve final state regulations by March 2, 2004, regarding the following water quality standards:

(1) numeric water quality criteria for temperature for the protection of salmonid rearing and bull trout spawning in Oregon waters;
(2) an intergravel dissolved oxygen (IGDO) criterion to protect salmonid spawning in Oregon waters;
(3) water quality criteria for the lower Willamette River; and
(4) methods to implement Oregon's existing antidegradation policy.

More information on the decisions of the court can be found in the Federal Court Opinions and Orders documents located on this website.

On August 15, 2003, the Oregon Department of Environmental Quality (ODEQ) published proposed revisions to its water quality standards. EPA published proposed water quality standards regulations for the State of Oregon on October 10, 2003. Oregon submitted its final standards to EPA for review on December 10, 2003. After reviewing the standards for compliance with the Clean Water Act and its implementing provisions, and consulting with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service under the Endangered Species Act, EPA approved Oregon's standards on March 2, 2004. EPA approved certain provisions of the State's rule, finding that Oregon's new or revised standards are consistent with the Clean Water Act.

Public Participation

Over the past 3 years, ODEQ worked extensively with Policy and Technical Advisory Committees to develop drafts of these rules. These discussions included detailed descriptions of how the beneficial use maps and tables were compiled. The basis for the numeric temperature criteria were well documented by DEQ in 1995, and the technical supporting documents were placed on the DEQ webpage (and remain available there). A significant portion of Oregon's water quality standards has already been the subject of considerable public input in connection with the EPA Region 10 Temperature Guidance for the Pacific Northwest State and Tribal Temperature Water Quality Standards, which EPA Region 10 issued in April 2003.

Prior to initial rule making, in May 2003, DEQ sponsored 10 listening "sessions" around the state of Oregon to discuss the litigation, the existing rule, the EPA Temperature Guidance and rulemaking options available to the State with Oregonians.
In addition to the standard 45-day comment period, ODEQ sponsored 10 public hearings workshops in September 2003 around the State to discuss the proposed time and place use designations. The Environmental Quality Commission approved the Oregon proposed standards on December 4, 2003. On December 10, 2003, ODEQ submitted the proposed standards to EPA for approval action.

Federal Court Opinions and Orders

Initial summary judgment ruling (March 31, 2003) (pdf file, 19 KB)

Ruling on motion for summary judgement and amend complaint (March 31, 2003) (pdf file, 63 KB)

Stipulated Compliance Schedule, CV-01-510-HA (May 7, 2003) (pdf file, 35KB)

Ruling on proposed schedule and request for clarification (June 11, 2003)(pdf file, 60K KB)

Ruling on the plaintiff's request for additional relief (July 14, 2003) (pdf file, 32KB)

Final judgment (August 13, 2003) (pdf file, 135 KB)

Status Report (August 29, 2003) (pdf file, 30KB)

You will need Adobe Acrobat Reader, available as a free download, to view some of the files on this page. See EPA's PDF page to learn more about PDF, and for a link to the free Acrobat Reader.

Unit: Water Quality Standards
Point of contact: Mary Lou Soscia
Email: soscia.marylou@epa.gov
Phone Number: (503) 326-5873
Last Updated: 03/02/2004 02:34:11 PM

could include standards for additional pollutant parameters, pollutant discharge load limitations, and other such provisions as may be appropriate. Where natural conditions are responsible for exceedance of the values in section (1) of this rule or beneficial uses are not impaired, the values in section (1) of this rule may be modified to an appropriate value for that water body;
(b) Conduct necessary public hearings preliminary to adoption of a control strategy, standards or modified values after obtaining Commission authorization;
(c) Implement the strategy upon adoption by the Commission.
(3) In cases where waters exceed the values in section (1) of this rule and the necessary studies are not completed, the Department may approve new activities (which require Department approval), new or additional (above currently approved permit limits) discharge loadings from point sources provided that it is determined that beneficial uses would not be significantly impaired by the new activity or discharge.
Stat. Auth.: ORS 468.020, ORS 468B.030, ORS 468B.035, ORS 468B.048
Stats. Implemented: ORS 468B.030, ORS 468B.035, ORS 468B.048

340-041-0021
pH
(1) Unless otherwise specified in OAR 340-041-0101 through 340-041-0350, pH values (Hydrogen ion concentrations) may not fall outside the following ranges:
(a) Marine waters: 7.0 – 8.5;
(b) Estuarine and fresh waters: 6.5 – 8.5.
(2) Waters impounded by dams existing on January 1, 1996, which have pHs that exceed the criteria are not in violation of the standard, if the Department determines that the exceedance would not occur without the impoundment and that all practicable measures have been taken to bring the pH in the impounded waters into compliance with the criteria.
Stat. Auth.: ORS 468.020, ORS 468B.030, ORS 468B.035, ORS 468B.048
Stats. Implemented: ORS 468B.030, ORS 468B.035, ORS 468B.048

340-041-0028
Temperature
(1) Background. Water temperatures affect the biological cycles of aquatic species and are a critical factor in maintaining and restoring healthy salmonid populations throughout the State. Water temperatures are influenced by solar radiation, stream shade, ambient air temperatures, channel morphology, groundwater inflows, and stream velocity, volume, and flow. Surface water temperatures may also be warmed by anthropogenic activities such as discharging heated water, changing stream width or depth, reducing stream shading, and water withdrawals.
(2) Policy. It is the policy of the Commission to protect aquatic ecosystems from adverse warming and cooling caused by anthropogenic activities. The Commission intends to minimize the risk to cold-water aquatic ecosystems from anthropogenic warming, to encourage the restoration and protection of critical aquatic habitat, and to control extremes in temperature fluctuations due to

anthropogenic activities. The Commission recognizes that some of the State's waters will, in their natural condition, not provide optimal thermal conditions at all places and at all times that salmonid use occurs. Therefore, it is especially important to minimize additional warming due to anthropogenic sources. In addition, the Commission acknowledges that control technologies, best management practices and other measures to reduce anthropogenic warming are evolving and that the implementation to meet these criteria will be an iterative process. Finally, the Commission notes that it will reconsider beneficial use designations in the event that man-made obstructions or barriers to anadromous fish passage are removed and may justify a change to the beneficial use for that water body.

(3) Purpose. The purpose of the temperature criteria in this rule is to protect designated temperature-sensitive, beneficial uses, including specific salmonid life cycle stages in waters of the State.

(4) Biologically Based Numeric Criteria. Unless superseded by the natural conditions criteria described in section (8) of this rule, or by subsequently adopted site-specific criteria approved by EPA, the temperature criteria for State waters supporting salmonid fishes are as follows:

(a) The seven-day-average maximum temperature of a stream identified as having salmon and steelhead spawning use on subbasin maps and tables set out in OAR 340-041-0101 to OAR 340-041-0340: Tables 101B, and 121B, and Figures 130B, 151B, 160B, 170B, 220B, 230B, 271B, 286B, 300B, 310B, 320B, and 340B, may not exceed 13.0 degrees Celsius (55.4 degrees Fahrenheit) at the times indicated on these maps and tables;

(b) The seven-day-average maximum temperature of a stream identified as having core cold water habitat use on subbasin maps set out in OAR 340-041-101 to OAR 340-041-340: Figures 130A, 151A, 160A, 170A, 220A, 230A, 271A, 286A, 300A, 310A, 320A, and 340A, may not exceed 16.0 degrees Celsius (60.8 degrees Fahrenheit);

(c) The seven-day-average maximum temperature of a stream identified as having salmon and trout rearing and migration use on subbasin maps set out at OAR 340-041-0101 to OAR 340-041-0340: Figures 130A, 151A, 160A, 170A, 220A, 230A, 271A, 286A, 300A, 310A, 320A, and 340A, may not exceed 18.0 degrees Celsius (64.4 degrees Fahrenheit);

(d) The seven-day-average maximum temperature of a stream identified as having a migration corridor use on subbasin maps and tables OAR 340-041-0101 to OAR 340-041-0340: Tables 101B, and 121B, and Figures 151A, 170A, and 340A, may not exceed 20.0 degrees Celsius (68.0 degrees Fahrenheit). In addition, these water bodies must have coldwater refugia that's sufficiently distributed so as to allow salmon and steelhead migration without significant adverse effects from higher water temperatures elsewhere in the water body. Finally, the seasonal thermal pattern in Columbia and Snake Rivers must reflect the natural seasonal thermal pattern;

(e) The seven-day-average maximum temperature of a stream identified as having Lahontan cutthroat trout or redband trout use on subbasin maps and tables set out in OAR 340-041-0101 to OAR 340-041-0340: Tables 120B, 140B,

190B, and 250B, and Figures 180A, 201A, and 260A may not exceed 20.0 degrees Celsius (68.0 degrees Fahrenheit);
(f) The seven-day-average maximum temperature of a stream identified as having bull trout spawning and juvenile rearing use on subbasin maps set out at OAR 340-041-0101 to OAR 340-041-0340: Figures 130B, 151B, 160B, 170B, 180A, 201A, 260A, 310B, and 340B, may not exceed 12.0 degrees Celsius (53.6 degrees Fahrenheit). From August 15 through May 15, in bull trout spawning waters below Clear Creek and Mehlhorn reservoirs on Upper Clear Creek (Pine Subbasin), below Laurance Lake on the Middle Fork Hood River, and below Carmen reservoir on the Upper McKenzie River, there may be no more than a 0.3 degrees Celsius (0.5 Fahrenheit) increase between the water temperature immediately upstream of the reservoir and the water temperature immediately downstream of the spillway when the ambient seven-day-average maximum stream temperature is 9.0 degrees Celsius (48 degrees Fahrenheit) or greater, and no more than a 1.0 degree Celsius (1.8 degrees Fahrenheit) increase when the seven-day-average stream temperature is less than 9 degrees Celsius.
(5) Unidentified Tributaries. For waters that are not identified on the fish use maps and tables referenced in section (4) of this rule, the applicable criteria for these waters are the same criteria as is applicable to the nearest downstream water body depicted on the applicable map.
(6) Natural Lakes. Natural lakes may not be warmed by more than 0.3 degrees Celsius (0.5 degrees Fahrenheit) above the ambient condition unless a greater increase would not reasonably be expected to adversely affect fish or other aquatic life.
(7) Oceans and Bays. Except for the Columbia River above river mile 7, ocean and bay waters may not be warmed by more than 0.3 degrees Celsius (0.5 degrees Fahrenheit) above the ambient condition unless a greater increase would not reasonably be expected to adversely affect fish or other aquatic life.
(8) Natural Conditions Criteria. Where the department determines that the natural thermal potential of all or a portion of a water body exceeds the biologically-based criteria in section (4) of this rule, the natural thermal potential temperatures supersede the biologically-based criteria, and are deemed to be the applicable temperature criteria for that water body.
(9) Cool Water Species. Waters that support cool water species may not be warmed by more than 0.3 degrees Celsius (0.5 degrees Fahrenheit) above the ambient condition unless a greater increase would not reasonably be expected to adversely affect fish or other aquatic life. Cool waters of the State are described on subbasin tables set out in OAR 340-041-0101 to OAR 340-041-0340: Tables 140B, 180B, 201B, and 250B.
(10) Borax Lake Chub. State waters in the Malheur Lake Basin supporting the borax lake chub may not be cooled more than 0.3 degrees Celsius (0.5 degrees Fahrenheit) below the ambient condition.
(11) Protecting Cold Water.
(a) Except as described in subsection (c) of this rule, waters of the State that have summer seven-day-average maximum ambient temperatures that are colder than the biologically based criteria in section (4) of this rule, may not be

warmed by more than 0.3 degrees Celsius (0.5 degrees Fahrenheit) above the colder water ambient temperature. This provision applies to all sources taken together at the point of maximum impact where salmon, steelhead or bull trout are present.

(b) A point source that discharges into or above salmon & steelhead spawning waters that are colder than the spawning criterion, may not cause the water temperature in the spawning reach where the physical habitat for spawning exists during the time spawning through emergence use occurs, to increase more than the following amounts after complete mixing of the effluent with the river:

(A) If the rolling 60 day average maximum ambient water temperature, between the dates of spawning use as designated under subsection (4)(a) of this rule, is 10 to 12.8 degrees Celsius, the allowable increase is 0.5 Celsius above the 60 day average; or

(B) If the rolling 60 day average maximum ambient water temperature, between the dates of spawning use as designated under subsection (4)(a) of this rule, is less than 10 degrees Celsius, the allowable increase is 1.0 Celsius above the 60 day average, unless the source provides analysis showing that a greater increase will not significantly impact the survival of salmon or steelhead eggs or the timing of salmon or steelhead fry emergence from the gravels in downstream spawning reach.

(c) The cold water protection narrative criteria in subsection (a) does not apply if:

(A) There are no threatened or endangered salmonids currently inhabiting the water body;

(B) The water body has not been designated as critical habitat; and

(C) The colder water is not necessary to ensure that downstream temperatures achieve and maintain compliance with the applicable temperature criteria.

(12) Implementation of the Temperature Criteria.

(a) Minimum Duties. There is no duty for anthropogenic sources to reduce heating of the waters of the State below their natural condition. Similarly, each anthropogenic point and nonpoint source is responsible only for controlling the thermal effects of its own discharge or activity in accordance with its overall heat contribution. In no case may a source cause more warming than that allowed by the human use allowance provided in subsection (b) of this rule.

(b) Human Use Allowance. Insignificant additions of heat are authorized in waters that exceed the applicable temperature criteria as follows:

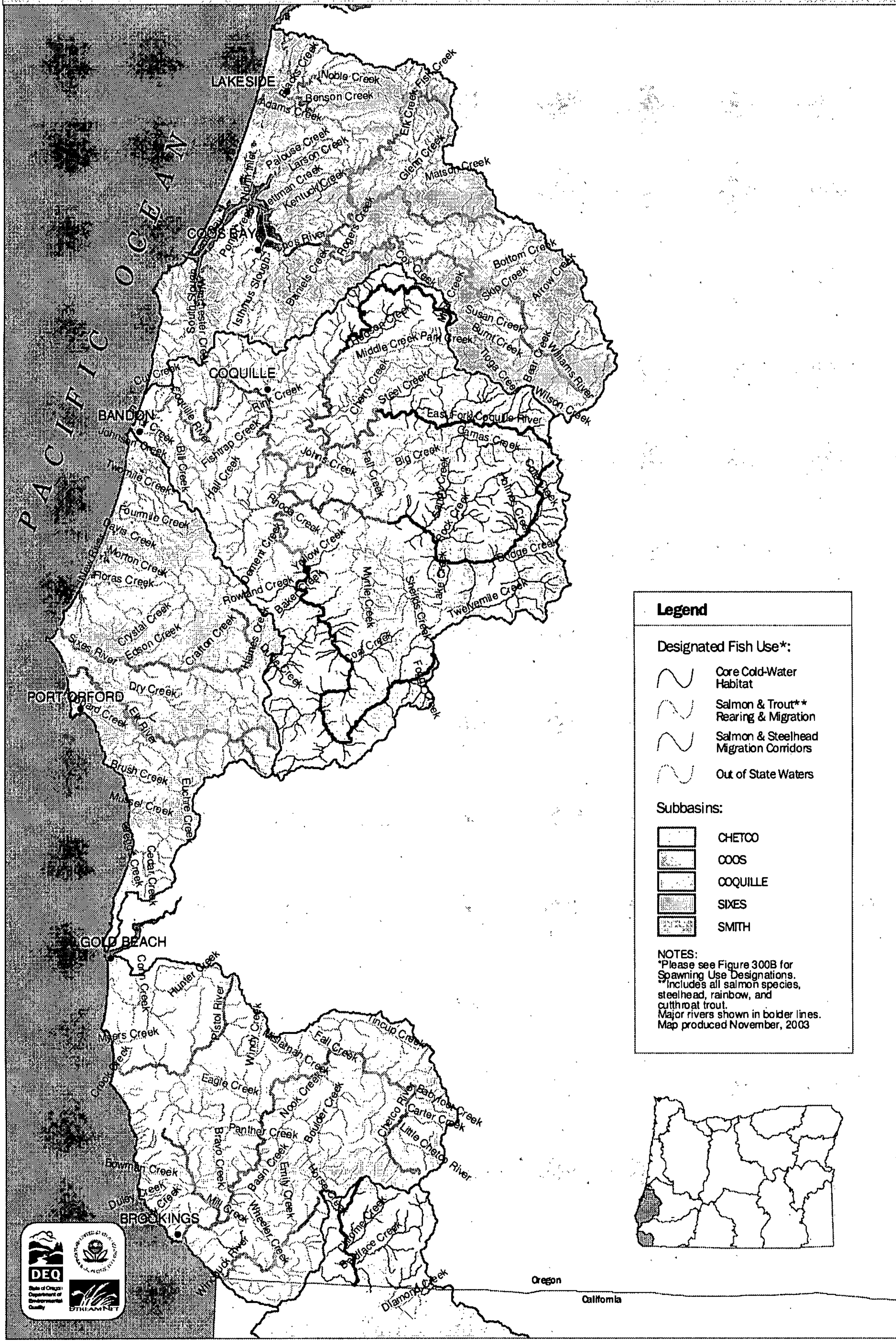
(A) Prior to the completion of a temperature TMDL or other cumulative effects analysis, no single NPDES point source that discharges into a temperature water quality limited water may cause the temperature of the water body to increase more than 0.3 degrees Celsius (0.5 Fahrenheit) above the applicable criteria after mixing with either twenty five
(25) percent of the stream flow, or the temperature mixing zone, whichever is more restrictive; or

(B) Following a temperature TMDL or other cumulative effects analysis, waste load and load allocations will restrict all NPDES point sources and nonpoint sources to a cumulative increase of no greater than 0.3 degrees Celsius (0.5

Fahrenheit) above the applicable criteria after complete mixing in the water body, and at the point of maximum impact.
(C) Point sources must be in compliance with the additional mixing zone requirements set out in OAR 340-041-0053(2)(d).
(D) A point source in compliance with the temperature conditions of its NPDES permit is deemed in compliance with the applicable criteria.
(c) Air Temperature Exclusion. A water body that only exceeds the criteria set out in this rule when the exceedance is attributed to daily maximum air temperatures that exceed the 90th percentile value of annual maximum seven-day average maximum air temperatures calculated using at least 10 years of air temperature data, will not be listed on the section 303(d) list of impaired waters and sources will not be considered in violation of this rule.
(d) Low Flow Conditions. An exceedance of the biologically-based numeric criteria in section (4) of this rule, or an exceedance of the natural condition criteria in section (8) of this rule will not be considered a permit violation during stream flows that are less than the 7Q10 low flow condition for that water body.
(e) Forestry on State and Private Lands. For forest operations on State or private lands, water quality standards are intended to be attained and are implemented through best management practices and other control mechanisms established under the Forest Practices Act (ORS 527.610 to 527.992) and rules thereunder, administered by the Oregon Department of Forestry. Therefore, forest operations that are in compliance with the Forest Practices Act requirements are (except for the limits set out in ORS 527.770) deemed in compliance with this rule. DEQ will work with the Oregon Department of Forestry to revise the Forest Practices program to attain water quality standards.
(f) Agriculture on State and Private Lands. For farming or ranching operations on State or private lands, water quality standards are intended to be attained and are implemented through the Agricultural Water Quality Management Act (ORS 568.900 to 568.933) and rules thereunder, administered by the Oregon Department of Agriculture. Therefore, farming and ranching operations that are in compliance with the Agricultural Water Quality Management Act requirements will not be subject to DEQ enforcement under this rule. DEQ will work with the Oregon Department of Agriculture to revise the Agricultural Water Quality Management program to attain water quality standards.
(g) Agriculture and Forestry on Federal Lands. Agriculture and forestry activities conducted on federal land must meet the requirements of this rule and are subject to the department's jurisdiction. Pursuant to Memoranda of Agreement with the U.S. Forest Service and the Bureau of Land Management, water quality standards are expected to be met through the development and implementation of water quality restoration plans, best management practices and aquatic conservation strategies. Where a Federal Agency is a Designated Management Agency by the Department, implementation of these plans, practices and strategies is deemed compliance with this rule.
(h) Other Nonpoint Sources. The department may, on a case-by-case basis, require nonpoint sources (other than forestry and agriculture), including private hydropower facilities regulated by a 401 water quality certification, that may

contribute to warming of State waters beyond 0.3 degrees Celsius (0.5 degrees Fahrenheit), and are therefore designated as water-quality limited, to develop and implement a temperature management plan to achieve compliance with applicable temperature criteria or an applicable load allocation in a TMDL pursuant to OAR 340-042-0080.
(A) Each plan must ensure that the nonpoint source controls its heat load contribution to water temperatures such that the water body experiences no more than a 0.3 degrees Celsius (0.5 degree Fahrenheit) increase above the applicable criteria from all sources taken together at the maximum point of impact.
(B) Each plan must include a description of best management practices, measures, effluent trading, and control technologies (including eliminating the heat impact on the stream) that the nonpoint source intends to use to reduce its temperature effect, a monitoring plan, and a compliance schedule for undertaking each measure.
(C) The Department may periodically require a nonpoint source to revise its temperature management plan to ensure that all practical steps have been taken to mitigate or eliminate the temperature effect of the source on the water body.
(D) Once approved, a nonpoint source complying with its temperature management plan is deemed in compliance with this rule.
(i) Compliance Methods. Anthropogenic sources may engage in thermal water quality trading in whole or in part to offset its temperature discharge, so long as the trade results in at least a net thermal loading decrease in anthropogenic warming of the water body, and does not adversely affect a threatened or endangered species. Sources may also achieve compliance, in whole or in part, by flow augmentation, hyporheic exchange flows, outfall relocation, or other measures that reduce the temperature increase caused by the discharge.
(ii) Release of Stored Water. Stored cold water may be released from reservoirs to cool downstream waters in order to achieve compliance with the applicable numeric criteria. However, there can be no significant adverse impact to downstream designated beneficial uses as a result of the releases of this cold water, and the release may not contribute to violations of other water quality criteria. Where the Department determines that the release of cold water is resulting in a significant adverse impact, the Department may require the elimination or mitigation of the adverse impact.
(13) Site-Specific Criteria. The Department may establish, by separate rulemaking, alternative site-specific criteria for all or a portion of a water body that fully protects the designated use.
(a) These site-specific criteria may be set on a seasonal basis as appropriate.
(b) The Department may use, but is not limited by the following considerations when calculating site-specific criteria:
(A) Stream flow;
(B) Riparian vegetation potential;
(C) Channel morphology modifications;
(D) Cold water tributaries and groundwater;
(E) Natural physical features and geology influencing stream temperatures; and

Figure 300A: Fish Use Designations*
South Coast Basin, Oregon



NOTES:
*Please see Figure 300B for Spawning Use Designations.
**Includes all salmon species, steelhead, rainbow, and cutthroat trout.
Major rivers shown in bolder lines.
Map produced November, 2003

*Figure 300B: Salmon and Steelhead Spawning Use Designations**
South Coast Basin, Oregon

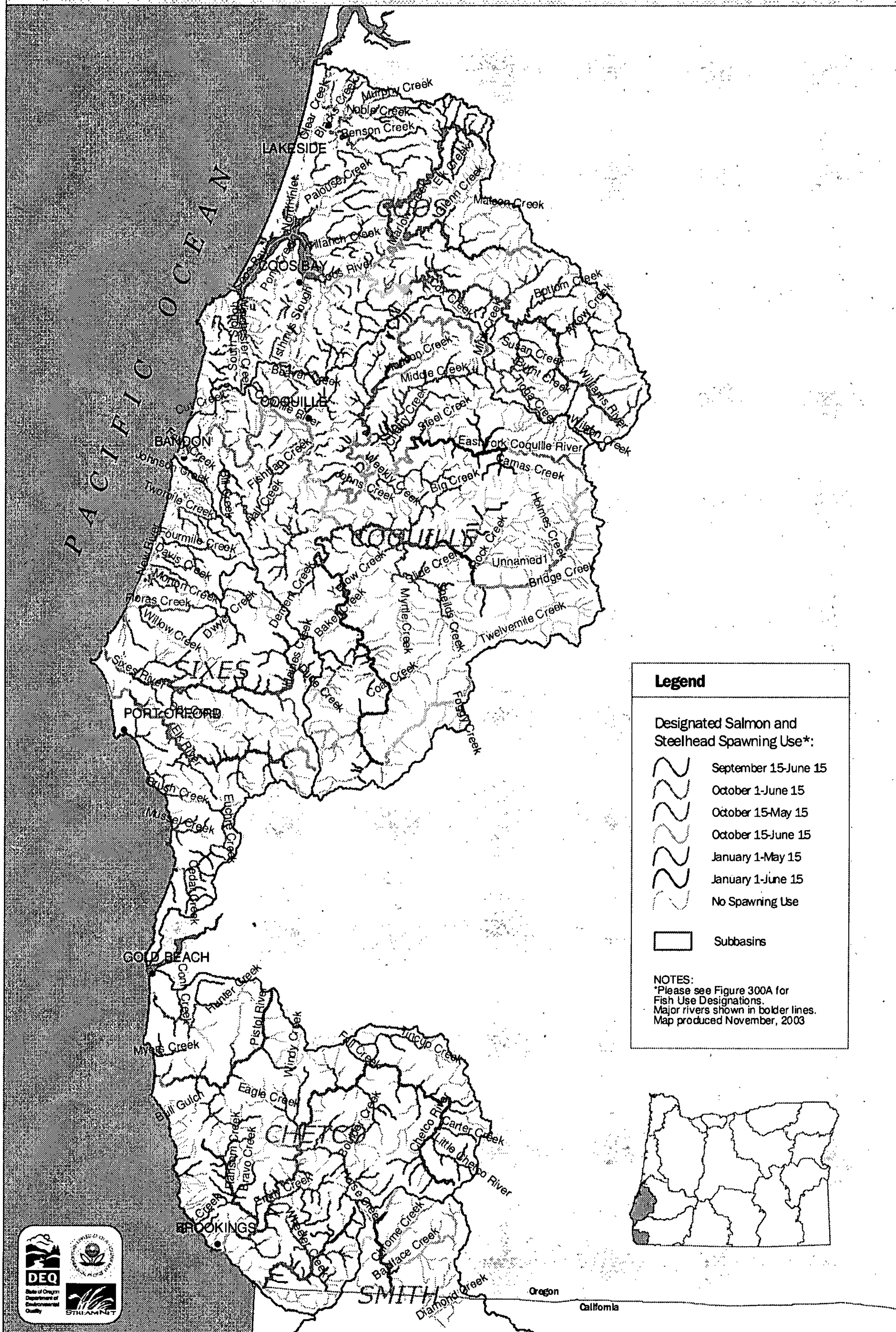


Figure 180A: Fish Use Designations
Klamath Basin, Oregon