

Willow Creek Subbasin: Water Quality Objectives for Temperature, pH and Bacteria

Water Quality Concerns

Willow Creek does not meet water quality standards for temperature in the summer. Bacteria concentrations and pH levels in the subbasin have exceeded standards as well. The resulting impaired beneficial uses of area streams are (1) contact recreation such as fishing, wading and swimming, and (2) healthy populations of fish and other aquatic life.

Willow Creek and its tributaries are not cool enough in the summer to fully support resident redband trout and other species. At temperatures above 65-70 °F, redband trout and other cold water fish are inefficient at hunting, hiding and processing food. In addition, warmer water can also harm these fish by increasing the incidence of disease, impairing their ability to spawn, reducing growth rates, and decreasing survival of eggs.

Wide daily pH fluctuations are also dangerous to fish in Willow Creek. And the third impairment being addressed, elevated bacteria levels, can make contact recreation unsafe. Balm Fork, the stream assessed as having high coliform bacteria levels, drains into Willow Creek Reservoir, which is used for recreational purposes.

High temperature is associated with solar radiation. Large daily changes in pH are related to heat and light as well. Bacteria can be introduced by various human and animal sources, including natural, livestock and septic and sewer sources.

Total Maximum Daily Load

Water body pollution assessment and mitigation is carried out through the Total Maximum Daily Load (TMDL) process. When water quality standards are not met on an ongoing basis, the federal Clean Water Act requires a TMDL to be established. A TMDL is the maximum amount of pollution that can be present in a water body while meeting standards. It identifies where pollution comes from and limits the amount of pollutant, such as heat, allowed to enter a water body.

Temperature Standard

The applicable target in the Oregon water quality standard for temperature (revised in 2004) for the

Willow Creek TMDL is referred to as the *natural condition criteria*. The TMDL assessment found that natural temperatures would be several degrees cooler than the present condition (Figure 1).

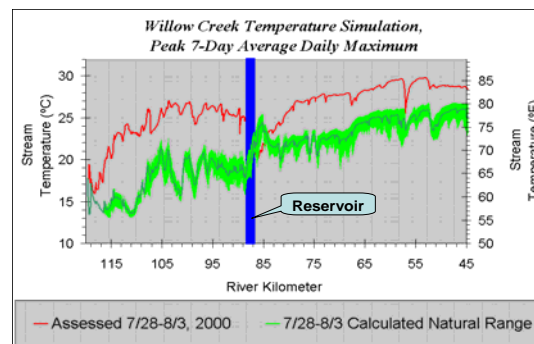


Figure 1. Typical July/August Afternoon Peak Temperature. Current temperature (upper line) and the estimated natural temperature (lower line with range for uncertainty) are shown.

Other Standards

In the Willow Creek Subbasin, the applicable numeric targets from the pH and bacteria standards are 6.0-9.0 standard units for pH and a 30-day log mean (minimum of 5 samples) of 126 *E. coli* per 100 milliliters for bacteria.

Addressing the Problem

The TMDL addresses the problem in several ways:

1. Provides an estimate of natural temperatures along much of Willow Creek. This allows managers to see where the greatest room for improvement is.
2. Establishes numeric goals for on-the-ground conditions that would lead to more natural temperatures and bacteria and pH levels. Along much of Willow Creek, the TMDL identifies vegetation heights and stable channel widths that would provide for lessened, more natural, heating. Potential increased flow in Willow Creek is also estimated, along with a resultant temperature profile. However, it is important to recognize that DEQ does not regulate flow, nor is the TMDL intended to diminish existing water rights. Bacteria reduction is called for in the Balm Fork watershed. Reservoir and point source controls will lead to decreased summer



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afternoon pH in and below the Willow Creek Reservoir.

3. *The TMDL is accompanied by a management plan designed to establish bacteria and heat reduction trends, and pH stabilization.* A TMDL Water Quality Management Plan (WQMP) provides a framework with placeholders for various authorities: Oregon Departments of Agriculture and Forestry, the US Forest Service and US Army Corps of Engineers. These designated management agencies (DMAs) will provide TMDL water quality management planning for the area each administers. Cities are also asked to minimize stream heating. In this initial effort, formal planning and evaluation is not expected of them.

TMDL Analysis

DEQ has worked in partnership with the Morrow Soil and Water Conservation District and in collaboration with the various affected organizations and watershed managers. This effort advanced the understanding of Willow Creek.

Natural temperature conditions were estimated for 77 miles of Willow Creek. This was based on historical information, literature and existing areas with little disturbance. Temperature profiles were generated to account for varying quantities of shade, channel width and flow. Seasonal and stream-length patterns were assessed for bacteria on Balm Fork and pH on Willow Creek. Highlights of the study are summarized here:

- Increased vegetation, increased flow and decreased channel width would all lead to reductions in stream heating. Stream shade plays the largest role. Shade-producing vegetation has been compromised or removed along 90% of the length of Willow Creek.
- Substantial solar heating occurs from Heppner to several miles below Ione, partly related to an unusually wide channel in this section.
- Typically during late July through August, Willow Creek becomes a dry streambed at some point below Lexington or Ione. Increased Reservoir outflow for irrigation has occurred in recent years, pushing this point further downstream, and giving the flowing stream more thermal assimilative capacity.
- Approximately 57 percent of the existing solar heating of the River is caused by human activities such as vegetation and bank disturbance.
- Reservoir mixing through its aeration program can eliminate the pH problem in Willow Creek near Heppner, where the 303(d) listing originated. Deeper withdrawal can eliminate

the temperature concern in the Reservoir outflow – however, the latter is only true without mixing via aeration. Strategic timing of these controls is needed to address both pH and temperature.

- Bacteria appear to be multi-sourced and controlled by timing and type of land use within the Balm Fork watershed rather than precipitation events or flow levels.

Meeting the TMDL allocations will require effort associated with agriculture, forestry, and Reservoir operations. In general, this means (1) restoring stream-side areas so that banks are stable and vegetated, (2) decreasing Balm Fork's exposure to livestock, runoff and residential sources of bacteria and (3) controlling Reservoir outflow properties through methods such as in-Reservoir artificial aeration and selective depth withdrawal. Where feasible, floodplains, sinuosity and channel complexity should be restored to more natural conditions. The TMDL management plans and land use authorities should provide guidance, planning, incentives and rules to implement these measures.

TMDL Documentation & Implementation

The TMDL and management plan is a single document, about 125 pages in length. The technical appendix for temperature is a separate electronic file, 86 pages in length. The TMDL document can be viewed at the Department's website (www.oregon.gov/DEQ/).

Designated management agencies are generally expected to respond within 18 months of TMDL issuance, with implementation plans.

The TMDL was issued by DEQ on January 31, 2007 and approved by the US EPA on February 19, 2007.

Adaptive Management

"Adaptive management" involves ongoing tracking and evaluation of actions taken to reduce pollution. If TMDL implementation efforts prove to be inadequate, DMAs will need to revise their TMDL Implementation Plans.

If DEQ, in consultation with DMAs, concludes that all feasible steps have been taken to meet the TMDL and attainment of a standard is not practicable, DEQ will reopen and revise the TMDL as appropriate. DEQ will also reopen the TMDL if new information indicates that updating is needed.

For more information

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