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SUSTAINABLE AGRICULTURE TECHNIQUES

TMDLs and Water Quality in the Malheur Basin:
A Guide for Agriculture

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Figure 1. Malheur River and Malheur Butte.

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In September 2010, the Oregon Department of Environmental Quality (DEQ) issued a series of Total Maximum Daily Load (TMDL) calculations for rivers and streams in the Malheur Basin. This publication explains TMDLs and suggests ways that farmers and ranchers can work to improve water quality.

What are TMDLs and why do we have them?

Section 303(d) of the federal Clean Water Act requires each state to develop a list of water bodies that do not meet water quality standards. Standards for each water body depend on how the water is used (drinking water, fish populations, recreation, etc.). An entire water body or stream segment can be listed for one or more specific water quality problems, e.g., high temperature or bacterial contamination. In Oregon, this list is developed by DEQ.

Once a water body is on the 303(d) list, DEQ develops a plan for improving its water quality. To do so, DEQ establishes Total Maximum Daily Loads (TMDLs) for each pollutant of concern. A TMDL is a calculation of the amount of a specific pollutant a waterway can receive and still meet water quality standards.

What TMDLs affect the Malheur Basin?

In the Malheur Basin, TMDLs have been established for three water quality parameters: chlorophyll, temperature, and bacteria. Each of these is discussed below.

TMDLs do not identify specific actions that individuals must take or avoid. Nonetheless, the actions of each agricultural producer or land manager can contribute to improved water quality. For suggested ways to improve water quality in each of the three areas, see "What can farmers and ranchers do?" (pages 3–4).

Chlorophyll

Chlorophyll is a measure of algal growth. Excess populations of algae can reduce dissolved oxygen levels in the water to levels that are harmful for fish and other aquatic life. When oxygen levels drop too low, fish may die.

During the day, algae produce oxygen through photosynthesis and help keep the water oxygenated. During the night, however, they remove oxygen from the water because they continue to respire but no sunlight is available for photosynthesis. Oxygen is reduced further after algae die. When a large mass of algae dies, a vast amount of oxygen is used in its decomposition, leaving little or no oxygen for fish. This process is called eutrophication. Eutrophication can also occur when the upper, algae-laden layers of water in a lake or reservoir become inverted with deeper water, resulting in rapidly increasing demand for oxygen.

Algal growth is promoted by high levels of phosphorus in the water. When too much phosphorus finds its way into freshwater, it can cause a sharp increase in algal production, known as an algal bloom (Figure 2).

Phosphorus is attached to soil particles and can easily move to streams from surrounding lands. The runoff created by the surface irrigation of pastures and furrow irrigation of row crop land washes soil and phosphorus out of fields and into the tailwater, which in turn can be flushed into nearby streams, rivers, and reservoirs where phosphorus promotes algal growth.

Temperature

Cool-water fish species are unable to survive where stream temperatures exceed tolerated maximums. In many streams, cool-water areas provide refuge during times of higher water temperatures, allowing fish to survive in a specific stream when the overall stream temperatures are too warm. Nonetheless, reducing overall stream temperatures is key to enhancing survival of these species.

The principal human-caused source of stream heating is the removal of trees and other shade-producing vegetation from streambanks. This allows more direct sunlight to heat the water. Removing riparian vegetation can also cause streambank erosion. As banks erode, the stream channel may widen and become disconnected from its floodplain. These conditions can also lead to higher water temperatures.

Figure 2. Phosphorus-laden runoff from irrigation ditches promotes algal growth in nearby streams, rivers, and reservoirs. This photo is not representative of water in the Malheur River Basin, but was chosen to illustrate an extreme case.

Many factors can lead to vegetation loss, including agricultural activities, grazing, western juniper expansion, and hydrologic modifications. A major source of loss of riparian vegetation in Malheur County is recurrent scouring of streambanks. The establishment of reservoirs has tended to stabilize water flows below the reservoirs, reduce scouring, and promote riparian vegetation.

It is hard to know precisely how much riparian vegetation existed along the rivers in Malheur County at the time of early Euro-American contact with native peoples. The best records that we have are journals of trappers and pioneers, which were written with motives other than to document riparian conditions. The entries in these journals do suggest that in the first half of the 1800s, large woody riparian vegetation was scarce in the lower Malheur and Owyhee Basins and along the Snake River in what is today Malheur County, much less than at present.[1]

[1]See, for example, E.E. Rich (ed.), *Peter Ogden's Snake Country Journals* (Hudson's Bay Record Society, London); S.M. Smucker, *The Life of Col. John Charles Fremont* (Miller, Orton & Mulligan, New York & Auburn); P. Rollins (ed.), *The Discovery of the Oregon Trail* (University of Nebraska Press); and *The Journals of Captain Nathaniel J. Wyeth's Expeditions to the Oregon Country* (http://www.xmission.com/~drudy/mtman/html/wyeth1.html).

Many of the streams in the Malheur and Owyhee Basins have been substantially modified from presettlement conditions. The establishment and protection of robust riparian vegetation in these systems helps to reduce bank erosion and protect water quality and wildlife habitat.

Bacteria

Fecal coliform bacteria contamination limits water-contact recreation (e.g., wading, swimming, and fishing) and other beneficial uses. *E. coli*, which is carried by warm-blooded animals, is one type of fecal coliform bacteria. Principle sources of fecal coliform bacteria in the Malheur River Basin are livestock and wildlife.

What can farmers and ranchers do?

Individual producers can play a key role in improving water quality, either by adopting specific best management practices appropriate to their operation or by developing a comprehensive Conservation Plan.

Practices that minimize runoff and reduce the amount of phosphorus-laden sediment in tailwater will reduce phosphorus loading and algal growth in streams.

Management strategies designed to protect (or restore) streamside vegetation and to minimize water withdrawals can reduce stream temperatures. Water withdrawals are essential for agriculture, employment, and public welfare of Malheur County.

Fecal coliform contamination can be reduced by limiting livestock access to streams.

Adopt best management practices

The following best management practices (BMPs) are recommended for flood-irrigated lands, dryland cropping systems, and ranches. In many cases, BMPs will improve water quality in more than one way. For example, sprinkler, drip, or surge irrigation, by reducing water use and runoff, can reduce both water withdrawals from streams and phosphorus loading. Likewise, carefully managed riparian grazing can minimize both streambank erosion and fecal coliform contamination.

For more information about these BMPs, visit the Malheur Experiment Station website (http://www.cropinfo.net/bestpractices/mainpagebmp.html). To explore the feasibility of these practices on your land, and for information about cost-share assistance, see "Where can I get help?" on page 4.

Flood-irrigated lands

- Optimize irrigation scheduling.
- Construct sediment ponds with pumpback systems to collect and reuse nutrient-rich runoff.
- Use polyacrylamide (Figure 3).
- Use mechanical straw mulching.
- Plant filter strips.
- Use gated pipe.
- Convert to sprinkler, drip, or surge irrigation.
- Laser-level fields.
- Install turbulent fountain weed screens.
- Develop underground outlets for field tailwater.

Flood- and sprinkler-irrigated lands

- Reduce irrigation applications through water conservation methods.
- Band phosphorus instead of broadcasting.
- Adopt minimum tillage practices (strip tillage or no-till).
- Use soil testing to avoid excess fertilization.
- Use direct seeding where possible.

Figure 3. Sediment is reduced in ditches treated with polyacrylamide (left), compared to untreated ditches (right).

Dryland cropping systems

- Minimize tillage.
- Leave crop residue on the field.
- Use soil testing to avoid excess fertilization.
- Band phosphorus instead of broadcasting.

Ranches

- Manage pasture irrigation to minimize runoff.
- Carefully manage riparian grazing.
- Manage livestock access to surface water through fencing and cattle guards.
- Place livestock salt and water away from riparian areas.
- Minimize runoff from manure piles.
- Maintain soil cover.
- Remove juniper where it has expanded outside of its natural range.

Irrigation districts, utilities, and agencies

- Redesign irrigation canal structure and management to avoid spillage of excess water.
- Develop constructed wetlands.
- Support cost-share for capital improvements on private lands.

Develop a voluntary Conservation Plan

Landowners may choose to go beyond adopting specific BMPs by developing a comprehensive Conservation Plan. A Conservation Plan identifies a broad range of strategies to conserve soil, water, plant, and animal resources on the farm. For assistance in developing a Conservation Plan, see “Where can I get help?”

Convert flood irrigation to sprinkler or drip

Conversion of cropland from flood irrigation to sprinkler or drip irrigation can reduce runoff and soil erosion, thus reducing the amount of sediment, bacteria, nutrients, and pesticides that reaches streams. To explore the feasibility of converting an irrigation system, and for information about cost-share assistance, see “Where can I get help?”

Figure 4. Livestock grazing is conducted in much of the Malheur River Basin using practices that protect riparian vegetation. At this location on the North Fork of the Malheur River, grazing practices fail to protect riparian vegetation and water quality.

Where can I learn more?

Malheur Basin TMDLs: http://www.deq.state.or.us/wq/tmdls/malheurriver.htm

BMPs for irrigated cropland: http://www.cropinfo.net/bestpractices/mainpagebmp.html

Where can I get help?

The Natural Resources Conservation Service, along with local Soil and Water Conservation Districts, provides education and technical assistance to help farmers, ranchers, and other agricultural land users implement specific BMPs, develop Conservation Plans, and secure cost-share funding.

The Malheur Watershed Council, the Lower Willow Creek Working Group, the Owyhee Watershed Council, and the Malheur County Soil and Water Conservation District are active in designing and implementing piping projects needed for conversion of irrigation systems and in the construction of wetlands to treat irrigation return water. The Owyhee Irrigation District is an active partner in these projects.

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How can I have input?

TMDLs continue to be reviewed, based on implementation effectiveness, availability of new data, new 303(d) listings, and improved understanding of watershed and management processes. The 303(d) list is updated every 2 years.

To receive news about the TMDL process and opportunities for public input, contact John Dadoly, DEQ Basin Coordinator (541-278-4616 or dadoly.john@deq.state.or.us).

All photos by C.C. Shock

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