Land use and Nonpoint Source Phosphorus Pollution in the Dairy-McKay Hydrologic Unit Area of the Tualatin River Basin, Oregon[1]

Donald W. Wolf and John C. Buckhouse

Water quality is of increasing concern to society. Supplies of water are for all practical purposes static, while the demand for high quality water for industry, agriculture, population and recreation steadily increases. Currently, Oregon's Tualatin River is the center of a controversy relating to this concern for water that is clean and usable for a variety of purposes.

The Tualatin River originates in the Oregon Coast Range and runs east 40 miles to join the Willamette River. Along its way, it meanders through roughly 86 miles of channel and drains 711 square miles of land with varied topography and use (Carter, 1975). For most of its last 40 miles, the channel has little drop in elevation, giving it a slow-moving, almost lake-like character during the summer low flow period. During the summer, this stretch may experience periods of eutrophication when, to put it simply, the river "stinks" (Castle, 1991).

Although the quality of water in the Tualatin River has been of concern to some for a long time, concern was focused in 1986 when the Northwest Environmental Defense Center filed suit against the Environmental Protection Agency (EPA) (Castle, 1991; Cleland, 1991). The suit sought to force the adoption and enforcement of pollutant limits for Oregon streams in general and the Tualatin specifically. It was decided that these limits, called total maximum daily load or TMDL, should have more local input than the Federal government could provide, so the task was passed to the Oregon Department of Environmental Quality (DEQ) (Castle, 1991).

In 1987, DEQ conducted a statewide assessment of nonpoint source (NPS) pollution problems. As a result of this assessment, the Tualatin River Basin became the DEQ's priority surface water concern. The Tualatin was defined as "water quality limited," a designation that has specific meaning in relating to practices required to reduce pollutants (Cleland, 1991: Soil Conservation Service, 1990). For the Tualatin, studies showed that both ammonia and phosphorus (P) were factors limiting water quality, but P was considered to be the key limiting factor and a stringent TMDL, 0.07 mg/l (70 ug/l) of total P was set for the Tualatin River Basin. It is estimated that of the total P contributed to the Tualatin on a yearly basis, 85 percent is from point sources such as sewage treatment plants and 15 percent is from nonpoint sources (Castle, 1991). As a water quality-limited basin, all sources that contribute to the problem are responsible for bringing the problem under control.

---

[1] This work funded by USDA Hydrologic Unit 17090010-030 and 17090010-040.

Of the subbasins comprising the Tualatin drainage, the Dairy-McKay subbasin (or hydrologic unit) was identified as a major contributor to the water quality problems of the Tualatin River. Termed a hydrologic unit area (HUA) by USDA, this subbasin contains only about one-third of the total area (256 square miles) of the Tualatin Basin, but about half of the forested land and half of the agricultural land. These land uses contribute sediments and sediment-related nutrients to surface waters, with about 60 percent of agricultural lands

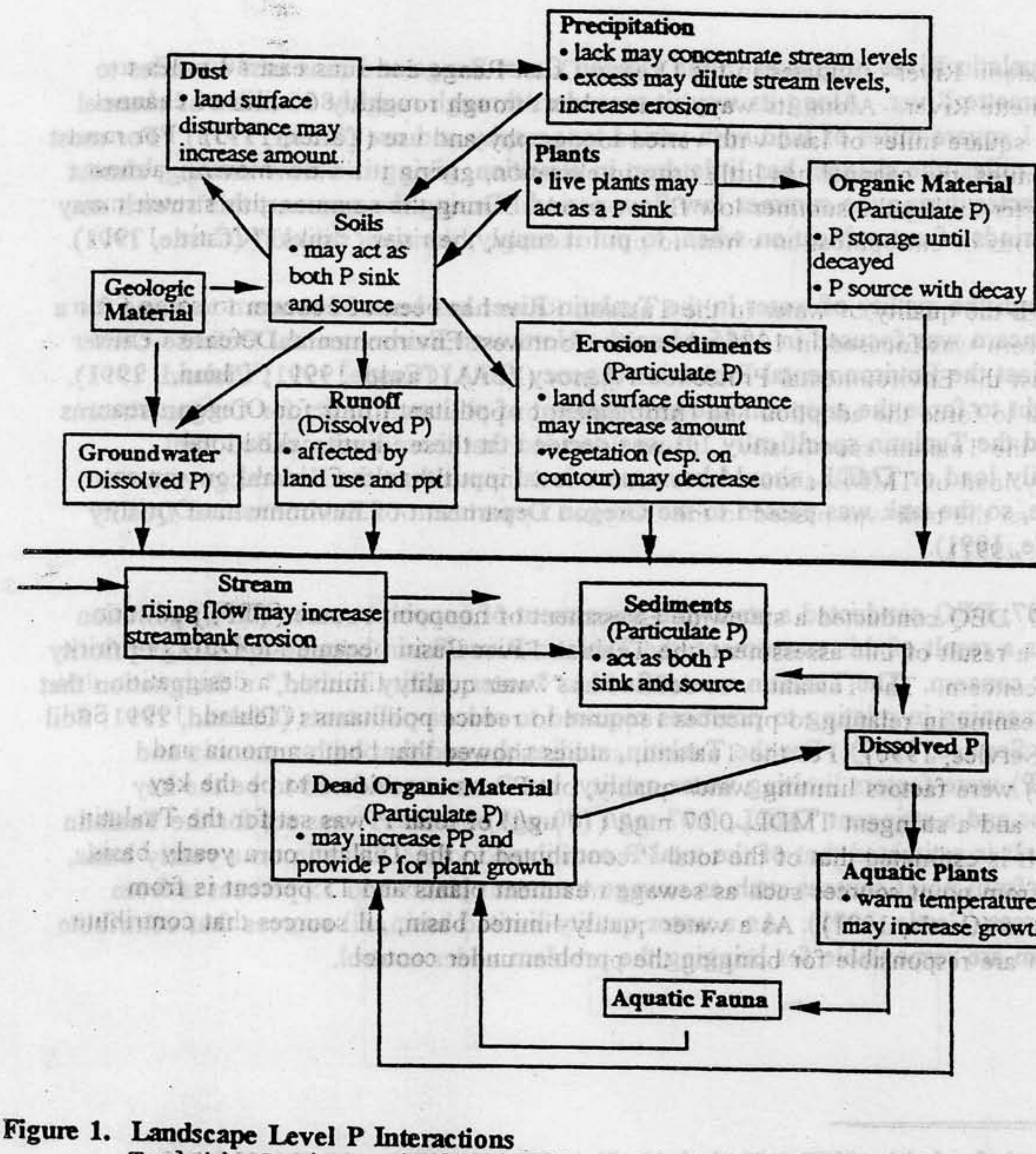

Figure 1. Landscape Level P Interactions
Tualatin Drainage (Wolf, 1993).

eroding at three times the rate considered acceptable by the Soil Conservation Service (Soil Conservation Service, 1990). On Dairy and McKay Creeks, the TMDL for P is frequently exceeded upstream of any known point sources, indicating that a portion of the problem is from nonpoint sources (Soil Conservation Service, 1990). Non-point pollution problems have focused attention on all land management activities in the basin.

The levels of P in a stream are influenced by a variety of influences that occur across the landscape (Figure 1). The data presented on the influence of particulate P to the total P concentrations in the Dairy-McKay HUA supports the contention that a land use is one major factor determining the P content of streams. It is apparent, and not unexpected, that the influence of particulate P on total P is much greater at downstream sites than at upstream sites. If the mouth of a stream is considered as the mouth of a funnel, collecting and concentrating materials gathered from upstream, it is logical that the downstream reaches would have much greater levels of particulates. The materials from all such streams enter the river and become the contributions to a much larger funnel. In this way, whatever land use takes place near the upstream reaches of Dairy Creek eventually influence the P concentrations at Lake Oswego, the mouth of the Tualatin River, the Willamette River, and eventually the Columbia River.

Considering a number of indicators -- the soils of the bottomlands, the greater likelihood of sediments being transported from areas adjacent to streams, and the trends from linear forecasting indicating that both temperature and sediments are very influential in determining P concentrations -- it is apparent that the management of areas near streams is likely to have the greatest effect on the P content of streams. The establishment of riparian buffers for both sediment filtering and to provide shade to help maintain cooler streamwater temperatures would appear to be one practice with particular merit.

The transport and movement of P is a complex process involving a variety of interactions. No single factor or theory satisfactorily accounts for and predicts its movements. Managing a watershed containing a waterway of concern in a manner that reduces nonpoint source P inputs, especially particulate forms, will be more assured of success than management with an instream focus.

Literature Cited

Carter, L.M. 1975. The effect of human activity on the middle course of the Tualatin River, Oregon. PhD dissertation. Portland State University. Portland, Oregon. 166p.

Castle, E. 1991. Costs of administering the Clean Water Act: The case of the Tualatin River. Seminar on the Economics of Environmental Policy, Oregon State University. Corvallis, Oregon. Presented Feb. 26, 1991.

Cleland, B.W. 1991. Total watershed management: A problem-solving focus through Total Maximum Daily Loads. Page 24 in EPA. Nonpoint Source Watershed Workshop. EPA. Cincinnati, Ohio.

Soil Conservation Service. 1990. USDA Water Quality Hydrologic Unit Area proposal: Tualatin River Basin, Dairy-McKay Hydrologic Unit, Washington County, Oregon. United States Department of Agriculture, Soil Conservation Service. Portland, Oregon.

Wolf, D.W. 1993. Land use and nonpoint source phosphorus pollution in the Dairy-McKay Hydrologic Unit Area of the Tualatin River Basin, Oregon. M.S. Thesis, Dept. Rangeland Resources. Oregon State University. Corvallis, OR 97331. 166 numbered leaves.