Sources of phosphorus to Moses Lake

By Gene Welch

The public should know that there is a rich data source from past and current studies of Moses Lake. Major sources of phosphorus (P) are known. Low nutrient Columbia River water (CRW) has effectively diluted these sources, more so some years than others.

1. Rocky Ford Creek is the major external source, having averaged 40% of external P inputs during 1984-1988 (after sewage diversion), 2001, and 2017-2018. Its average P concentration has remained about 165 ppb (parts per billion) since the 1970s, 80% of which is soluble and instantly available to algae. It accounts for most of the algal mass that accumulates in Rocky Ford Arm.
2. Crab Creek's P concentration, without Rocky Coulee Wasteway spring, hatchery and CRW, averaged only about 4% of total external inputs. Its P concentration has decreased from about 100 ppb in 1969-1970 to around 60 ppb now, and the soluble fraction has been about 40%, much less than RFC.
3. Groundwater has been about one-third of external inputs. Groundwater P is mostly soluble and readily available to algae, and some sources, especially around Pelican Horn, have very high concentrations (DOE, 2001).
4. Inputs from internal sources have been variable, averaging about 40% of total external plus internal during 1984-1988, after sewage diversion. Internal was estimated at 14% in 2017 and 47% in 2018.

Rocky Ford Creek and internal recycling are clearly the major sources causing algal blooms. Rocky Ford Creek input has been rather constant, with the internal source(s) varying due to the wind that mixes the water column transporting more P from bottom sediment.

Inflow P concentration is often more important than mass loading (concentration X flow volume) because the lake concentration reflects the inflow concentration. For example, high inputs of CRW produces high mass loading, but the resulting lake P concentration would not exceed the 7 ppb in CRW if that were the only source to the lake. CRW is highly effective at reducing the lake's high P concentration because of its low P concentration. Results show that lake P was reduced to 25 ppb or less if CRW input were 250,000 acre-feet or more, which occurred in 11 of the past 35 years. Lake P was below 25 ppb in 4 other years when CRW input was less than 250,000 acre-feet. An average lake P concentration of 25 ppb is a useful goal to achieve acceptable water quality and minimize HABs.

Recovery of other lakes from very poor water quality has been accomplished by, 1) sewage effluent diversion (L. Washington), which occurred in middle Pelican Horn in 1984 and P declined from about 900 ppb in 1969-1970 to 60 ppb in 2017-2018; 2) reducing wastewater P concentration (L. Spokane, inflow TP from Spokane River was reduced from 86 to 15 ppb); inactivation of sediment P content, usually with alum (Green Lake, Seattle, three treatments over 24 years); and 3) altering fish stocks to increase grazing on algae, usually by adding pike (walleye pike have already increased in Moses Lake as a result of improved water quality by dilution – evidence from Department of Fish & Wildlife data).

There are other methods to improve lake water quality that are not applicable to Moses Lake. Best management practices (BMPs) have been discussed in committee meetings, but there is no evidence that BMPs have recovered lakes that are already eutrophic, especially those with a high internal source, as a recent analysis of BMPs attests (Osgood's abstract is attached). Other than reducing inputs from

Rocky Ford Creek and internal recycling, groundwater is the next important input to Moses Lake. Recent and past monitoring of a groundwater source on the east side of Pelican Horn showed very high nitrate nitrogen concentrations, even higher than in sewage effluent, and high sodium at about the level in sewage. That source had only moderate P content, although DOE found some very high P concentrations in groundwater on both sides of Pelican Horn (Pitz, 2003).

Richard A. Osgood (2017): Inadequacy of best management practices for restoring eutrophic lakes in the United States: guidance for policy and practice, Inland Waters, DOI: 10.1080/20442041.2017.1368881

ABSTRACT

The policy and practice of restoring eutrophic or phosphorus (P)-impaired lakes that relies heavily on watershed best management practices (BMPs) is mostly inadequate. This strategy has been prevalent in the United States for several decades, but there are few documented positive outcomes. To restore most eutrophic lakes requires external P reductions >80% in the United States. A review of BMP performance literature with respect to P removal indicates the maximum expected P removal under ideal conditions on a watershed-wide basis approaches 50%, however in practice reductions in P load may be <25%. The discrepancy between required P reductions and BMP performance explains the observed paucity of positive outcomes. BMPs may be sufficient in cases where watershed size is small (i.e., <10-times lake surface area) and external and internal P loading rates are modest, or where incremental water quality improvement rather than restoration is the management goal. Guidance for restoring eutrophic lakes is provided here. In cases where BMPs are inadequate as the sole restoration strategy, alternative or supplemental approaches are available. In many cases, effective P inactivation methods to mitigate internal P loading and to intercept dissolved P in inflowing waters are required to restore lakes. Engineering approaches or chemical treatment systems can feasibly, reliably, and effectively provide sufficient external or internal P load reductions.

Pitz, C.F. 2003. Moses Lake Total Maximum Daily Load Groundwater Study. WA DOE Pub. No. 03-03-005.