

Oct. 23, 2012

Idaho Rivers United

Lower Boise River Phosphorus TMDL Target and Metric Recommendations

As requested, Idaho Rivers United submits the following information that we believe should be used to develop a total maximum daily load for phosphorus in the Lower Boise River and its tributaries in order to 1) eliminate excess phosphorus loads in impaired reaches as required by state and federal law, and 2) maintain or reduce phosphorus loads in non-listed reaches to prevent degradation of water quality as required by state and federal law.

Introduction

Idaho Rivers United maintains that all reaches of lower Boise River and most, if not all, of its tributaries, are water quality-limited for phosphorus. They are impaired or threatened with impairment because the application of technology-based effluent limitations is not sufficient to prevent discharge of phosphorus in excess of Idaho water quality standards. A TMDL is required for these water bodies according to the Clean Water Act.

CWA, 40 CFR, 130.2 (j) *Water quality limited segment*. Any segment where it is known that water quality does not meet applicable water quality standards, and/or is not expected to meet applicable water quality standards, even after the application of the technology-based effluent limitations required by sections 301(b) and 306 of the Act.

CWA, 40 CFR 130.7.c. (1) Each State shall establish TMDLs for the water quality limited segments identified in paragraph (b)(1) of this section, and in accordance with the priority ranking. For pollutants other than heat, TMDLs shall be established at levels necessary to attain and maintain the applicable narrative and numerical WQS with seasonal variations and a margin of safety which takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality. Determinations of TMDLs shall take into account critical conditions for stream flow, loading, and water quality parameters.

Idaho Rivers United supports the determination of the total phosphorus assimilative capacity for the river from Lucky Peak Dam to the Snake River and for its tributaries, and the allocation of total load among the point and non-point sources of pollution.

TMDL Target Recommendations

Setting a numerical target requires identifying a specific value, the appropriate statistic to use in evaluating compliance, the location where the target applies, and the period of the year.

Existing TMDL Target

The current SR-HC Phosphorus TMDL target, 0.07 mg/L (70 µg/L) total phosphorus (TP), was established for the Boise River at the mouth to reduce nutrient impacts on the Snake River (IDEQ and ODEQ 2003). The target was limited to May through September based on the

rationale that this is the period favorable to algal growing conditions and this period would reduce the dominant sources of phosphorus from irrigation return flows.

EPA has since reviewed the TMDL and “found that the SR-HC TMDL does not provide an adequate basis for limiting the phosphorus target to the May through September time period.” (Boise Wastewater Discharge Permits Response to Comments, IRU Response 7). Because of the complex cycling processes between phosphorus in the water, living algae, dead algae, macrophytes and phosphorus bound in the bottom sediment, EPA has determined that phosphorus discharge throughout the year contributes to water impairment.

USGS (Wood and Etheridge, 2011) reported that the Boise River has high loads of total phosphorus and dissolved orthophosphorus at Parma every month of the year. Loads of both are lowest in July and August; the orthophosphorus load is much higher in the winter months than the summer months.

The SR-HC TMDL has not been reviewed or updated in over nine years. The effectiveness of the allocations has not been evaluated, and no improvement in water quality has been demonstrated.

Despite these obvious problems, the SR-HC seasonal TP target has been applied to NPDES permits in the Boise River and has become the current nutrient target by default for the Boise River.

Idaho Rivers United suggests that a TMDL that limits phosphorus loading year-round will be necessary to 1) eliminate excess phosphorus loads in listed reaches as required by state and federal law, and 2) maintain or reduce phosphorus loads in non-listed reaches to prevent degradation of water quality as required by state and federal law.

Expanding Targets to include Nitrogen

The specific 303(d) listing is for total phosphorus (TP) in two river segments that encompass the lower reach of the river from Middleton (RM 29.1) to the mouth. Although the specific listing is for total phosphorus, it is recognized that the TMDL needs to address the narrative standard for nutrients as well as protection of aquatic life and salmonid spawning (TMDL Strategy Paper, IDEQ 2012).

The EPA publication addressing nutrient criteria (U.S. EPA 2000) made the useful distinction between *causal* variables (e.g. total nitrogen and total phosphorus) and *response* variables (e.g. turbidity and chlorophyll *a*). Both causal and response variables can be used as targets for the Lower Boise River TMDL. These potential targets include total phosphorus, a measure of bioavailable phosphorus (soluble reactive phosphorus, orthophosphate or total dissolved phosphorus), nitrogen parameters, periphyton biomass (chlorophyll *a* or Ash Free Dry Mass or both), macrophyte biomass and turbidity.

It is important to control both phosphorus and nitrogen to meet water quality objectives. Either phosphorus or nitrogen can limit algal growth in rivers and therefore nitrogen (N) needs to be

included as a target. Marcarelli and others (2009) found that biofilms (experimental algal preparations) in southeast Idaho rivers were primarily limited by N, and that nutrient limitation was more frequent at sites with good water quality than at those with poor water quality. The concept of limiting factor (P vs N) is not particularly relevant in the listed sections of the Boise River due to the overabundance of both P and N in the lower river, thus making a case for establishing both P and N targets.

A workshop of recognized experts on aquatic ecology was conducted in New Zealand to address the question of managing nutrients to prevent excess algal/macrophyte growth (Wilcock and others 2007). Selected conclusions from this workshop relevant to the Boise River are paraphrased below:

- Both N and P need to be managed because of the interconnectivity of waterways.
- Periphyton growth and vigor are determined by antecedent water quality. Lengthy exposure to high concentrations of nutrients gives rise to periphyton that will respond more quickly than if it had been grown in low nutrient waters. For this reason, year round control of both N and P is important.
- N:P ratios are a useful tool for exploring identification of limiting factors but are not as robust (not as reliable) as nutrient diffusing substrate (NDS). (N:P ratios have been used in the Boise River to identify P as the limiting factor.)
- Applying controls only to the “limiting” nutrient is not recommended.

There is also precedence for setting targets for both P and N in western rivers. The Truckee River is one example. The Truckee River flows from the outlet of Lake Tahoe through the city of Reno and empties into Pyramid Lake. TMDL targets have been set for Total Nitrogen (TN), Ortho-Phosphorus, and TP and vary by the different segments of the Truckee River (WQS Review Justification powerpoint, TRIG 2012).

The take away message from the above discussion is that both N and P need to be controlled and should have TMDL targets. The second observation, based on both the existing Snake River TMDL (Page 315-316, IDEQ/ODEQ 2003) and the workshop described in Wilcock 2007, is that the export of nutrients from the Boise River to the Snake River needs to be controlled throughout the year. The general paradigm for reservoirs is that P and N can be recycled in the ecosystem and therefore it is necessary to control inputs of nutrients throughout the year. Winter sources of P and N can inevitably become available during the growing season to aquatic plants.

Use of the Literature in Developing Specific Targets

Several WAG members have summarized numeric targets from the literature and agency documents that are included on the WAG website: 1) EPA in their decision letter on the 303-d listing (U.S. EPA 2009), 2) IDEQ in the compilation of references (Idaho DEQ August 27, 2012), 3) the city of Boise (Boise August 12, 2012), and 4) HDR in their powerpoint presentation at the September 27, 2012 WAG meeting. Target values vary but consistently are in the range from 10 – 100 µg/L for TP, 3 – 60 µg/L for soluble reactive phosphorus, and 100 – 200 mg/m² for periphyton chlorophyll-a.

Reviewing the literature values is useful for establishing some reasonable sideboards; but literature values are of limited use for establishing TMDL targets in a specific waterbody such as the Boise River.

Reference Condition Approach

The overall goal for the Boise River TMDL should be to protect existing high water quality where it exists and establish targets and implementation programs to restore impaired sections. A reasonable approach to setting criteria for the listed section of the Boise River (below Middleton) is to emulate the healthy sections of the Boise River upstream.

The upper section of lower Boise River (Lucky Peak Dam to RM 50) provides a suitable reference reach for the TMDL. This upper section is above any major point and nonpoint sources of pollution, and although not pristine, the river section has “clean” water characteristics – low summer turbidity, a gravel/cobble substrate that supports a healthy aquatic invertebrate population, a robust wild rainbow trout population, and lower nutrient concentrations. The section from RM 50 to Middleton (RM 29) is intermediate in quality due to a number of sources such as wastewater treatment plants, stormwater, irrigation withdrawals and the beginning of irrigation return flows.

The EPA document for nutrient criteria (U.S. EPA 2000) describes a useful process for establishing water quality criteria. The current ecoregional criteria of 42.5 µg/L (Nutrient Ecoregion III) can be used as a starting point. However, the process used to establish this target can be improved by using only data from the high quality section of the Boise River (above RM 50). The EPA target of 42.5 µg/L was based on using the 25th percentile of all aggregate nutrient data from the ecoregion – not specifically reference or “least impacted” sites. The EPA document specifically states *“States and Tribes are urged to determine their own reference sites for rivers and streams within the ecoregion at different geographic scales and to compare them to EPA’s reference conditions.”*

The EPA reference site process should be used to establish targets for the Boise River. The upper section of the river below Lucky Peak Dam provides an applicable reference condition for establishing TMDL targets. DEQ should evaluate this data and agree on what is an appropriate statistic (25th, 50th or 75th percentile) to use for setting TMDL targets.

The following parameters should be included.

Total Phosphorus (TP). TP is an accepted target for the TMDL. TP represents all the phosphorus in a water quality sample, both the P in suspended solids and P in dissolved form. TP is particularly important as a target for the export of nutrient to the Snake River since all forms of phosphorus (suspended, organic, dissolved) can be converted within the reservoir ecosystem to bioavailable forms and stimulate aquatic plant growth (periphyton, phytoplankton and macrophytes).

Bioavailable Phosphorus. Agencies have used several laboratory analytical methods to represent bioavailable phosphorus (SRP, orthophosphate, dissolved phosphorus). What specific parameter is used as a target for the Boise River becomes a practical matter of sufficient data

availability. USGS has identified using both dissolved orthophosphorus and total dissolved phosphorus in their March 9, 2012 study plan. DEQ and the LBWC need to agree on what parameter is going to be used to represent bioavailable phosphorus.

Nitrogen (TN and DIN). Both Total Nitrogen (TN) and Dissolved Inorganic Nitrogen (DIN) have been used as measures of nitrogen in river nutrient studies. DIN, comprised of nitrate, nitrite and ammonia, is used as a measure of nitrogen that is in a bioavailable form for stimulation of periphyton and macrophyte growth. TN like TP is useful for evaluating the total nitrogen load that can be available within a waterbody for conversion to bioavailable forms.

Periphyton Chlorophyll *a*. Chlorophyll *a* is recognized as a useful measure of algal periphyton biomass and should be used as a target in the upper reaches of the Boise River.

Periphyton will not be a useful parameter in the lower reaches of the river during the irrigation season at the existing levels of suspended sediment. The river is too turbid to provide sufficient light to grow periphyton. In addition, suitable substrate has been buried by fine sediments. Fine sediments are deposited at any observed velocity break (eddies and backwaters) and would provide typical soft substrate for macrophyte growth. However, the current growth of macrophytes in the section of the river also appears to be limited by excessive turbidity that reduces light penetration.

Dissolved Oxygen (DO). Dissolved oxygen is a critical component of water quality that is influenced by the biochemical oxygen demand of all aerobic organisms. Although DO is an assumed water quality criterion, specifically identifying DO as a target for the TMDL would assure that diel monitoring is instigated and maintained for DO. Diel monitoring in the Boise River to date has been sporadic and inconsistent.

Turbidity. It is important to maintain the clarity of the water as an aesthetic quality of the Boise River. The river starts out very clear (low turbidity) below Lucky Peak and through town during the summer period, but gets very turbid as irrigation return flows enter the river. The turbidity target should be established as a water clarity measure using the reference data approach, not as a surrogate for suspended sediment.

References

Boise, City of. August 12, 2012. Nutrient target development approach for the Lower Boise River. (Uploaded to LBR WAG website <http://www.deq.idaho.gov/regional-offices-issues/boise/basin-watershed-advisory-groups/lower-boise-river-wag.aspx>)

Etheridge, A. April 6, 2012. What Does USGS Research Tell Us About Phosphorus in the Boise River? Powerpoint Presentation. USGS, Boise, Idaho.

Idaho DEQ and Oregon DEQ. 2003. Snake River – Hells Canyon Total Maximum Daily Load (TMDL). IDEQ, Boise Regional Office, Boise, Idaho. (ODEQ, Pendleton, Oregon).

Idaho DEQ and Oregon DEQ, 2003 Appendix F. 1995 Brownlee Reservoir Model Simulations using Draft Subbasin Assessment Target of 70 ug/L

- Idaho DEQ August 27, 2012. Some initial nitrogen, phosphorus, and algae references compiled by DEQ. Boise Regional Office, Boise, Idaho. (Uploaded to LBR WAG website <http://www.deq.idaho.gov/regional-offices-issues/boise/basin-watershed-advisory-groups/lower-boise-river-wag.aspx>)
- Idaho DEQ September 5, 2012. Lower Boise Watershed Phosphorus TMDL Addendum Strategy Paper. Boise Regional Office, Boise, Idaho.
- MacCoy, D.E., 2004, Water-Quality and Biological Conditions in the Lower Boise River, Ada and Canyon Counties, Idaho, 1994–2002: U.S. Geological Survey Scientific Investigations Report 2004–5128, 80 p
- Marcarelli, A.M., H.A. Bechtold, A.T. Rugenski and R. S. Inouye. Nutrient limitation of biofilm biomass and metabolism in the Upper Snake River basin, southeast Idaho, USA, *Hydrobiologia*, 620:63-76.
- Truckee River Info Gateway (TRIG). Website October 2012. <http://www.truckeeriverinfo.org/tmdl> Powerpoint presentation: *WQS Review Justification.pptx*
- Wood, M.S., and Etheridge, A.B., 2011, Water-quality conditions near the confluence of the Snake and Boise Rivers, Canyon County, Idaho: U.S. Geological Survey Scientific Investigations Report 2011–5217, 70 p.
- U.S. EPA. 2000. Ambient Water Quality Criteria Recommendations Information Supporting the Development of State and Tribal Nutrient Criteria Rivers and Streams in Nutrient Ecoregion III. EPA 822-B-00-016, EPA Office of Water, Washington, DC.
- U.S. EPA. October 13, 2009. Letter from Michael Bussell, Director, Office of Water and Watersheds, U. S. EPA to Barry Burnell, Administrator, Water Quality Program, Idaho DEQ regarding disapproval of the State’s decision to not list the Lower Boise River (ID17050114SW001_06). U.S. EPA, Region 10, Seattle, Wa.
- U.S. EPA, March 16, 2011, Memorandum from Nancy Stoner and Recommended Elements of a State Framework for Managing Nitrogen and Phosphorus Pollution
- U.S. EPA, March 12, 2012, West Boise Wastewater Treatment Facility, City of Boise, NPDES Permit Response to Comments Document, Response to IRU 7
- Wilcock, R. J., B. Biggs, R. Death, C. Hickey, S. Larned and J. Quinn. 2007. Limiting nutrients for controlling undesirable periphyton growth. Nat. Institute Water Atmospheric Research Ltd (NIWA), Hamilton, New Zealand.