Draft Discussion Paper on Location Ratios

The Ratio Concept

The actual phosphorus load reduction associated with a specific implementation activity is determined by several factors including, source characteristics, the type of best management practice (BMP) proposed, its scale of application, its proximity, among other considerations. Consider proximity. An implementation activity located in the far regions of the Spokane River basin, with no direct drainage to the river, will likely have a lower effect on phosphorus concentrations entering Lake Spokane than those situated in closer proximity and entering the river via surface drainage. Proximity and other factors that affect the magnitude of phosphorus transferred from the point of source reduction, as a consequence of a BMP, to the compliance location, are accounted for through the application of ratios. Ratios provide a simplified means of determining the net reduction in phosphorus loading based on a number of physical, chemical, and biological considerations.

A 'gross credit' is the level of pollutant load reduction provided by a BMP estimated (or measured) at the source location. While, in terms of the TMDL, the 'net' load reduction is the pollutant load reduction estimated at the Lake Spokane assessment point as a consequence of that action. In terms of 'pollutant trading', the actual credit awarded is the 'net' phosphorus load reduction and how that is determined is through the use of ratios.

In application, ratios are factors, between 0 and 1, that are multiplied by the 'gross' phosphorus credit, associated with implementing an eligible BMP, that potentially modifies the actual amount of the phosphorus credit awarded. For example, again considering the case of proximity, for comparable implementation activities, one located in the upper basin, further from the compliance location, may have a ratio of 0.1 (90% decrease in net credit) applied to the load reduction while an activity in the lower basin, closer to the compliance location, could have a ratio of 0.7 (30% decrease).

This memorandum outlines the initial analysis process proposed to generate ratios. The focus here is on how loading to Lake Spokane, and its dissolved oxygen levels, are affected by varying magnitudes of phosphorus loads based on their point of entry to the Spokane River. The approach outlines a method for assessing this 'river-based' proximity ratio. The ratios generated only apply once phosphorus loads enter the Spokane River.

Analysis Approach

The original Spokane River TMDL's CE-QUAL W2 water quality model will be used to determine the river-based proximity ratios. These ratios provide a first level assessment in the determination of the phosphorus credit awarded from an implementation activity that is directed at reducing phosphorus loading. It is important to recognize that other ratios will also apply in the actual determination of the credit. This is because this river-based ratio assessment will only reflect the effect of reductions in

phosphorus loading occurring within specific reaches of the Spokane River on the ultimate phosphorus load observed at the compliance point (above Lake Spokane). An assessment of other ratios will be necessary to account for physical and environmental phosphorus attenuation processes potentially occurring between the implementation activity site and its entry to the Spokane River.

Methods and Initial Assumptions

The analysis process described here will be used to determine the effect of reducing phosphorus loading, within specific reaches of the Spokane River, and the effect of that reduction on phosphorus loads at the TMDL compliance location.

The original TMDL CE-QUAL W2 model will be used to generate river-based ratios though modified based on these initial assumptions:

- Waste load allocations have been achieved. Point source discharges have met anticipated phosphorus reduction levels.
- Load allocations have been achieved. TMDL-based nonpoint phosphorus loads associated with tributary inflow and storm-water have been achieved.
- The assessment period, used to generate the ratios, will conform to the critical period defined in the TMDL.
- The analysis period will remain the same as that used in the TMDL.
- The TMDL total phosphorus and dissolved oxygen compliance locations will be the ratio assessment points as opposed to specific NPDES permit discharge locations.

Identification of Model Reaches

For analysis purposes, it is anticipated that the main-stem Spokane River (study area) will be divided into several reaches based on common hydrogeology and morphological characteristics in addition to considerations of existing point source discharge locations. Important in defining assessment reaches is the consideration of groundwater interaction (both inflow and outflow) because it is a dominant feature of the Spokane River's hydrology through much of the study area. (Surface water inflow is only represented, to a significant level, lower in the study area by Latah Creek and the Little Spokane River.) These hydraulic interactions have been described within the TMDL model and it is anticipated that this analysis will continue to rely on the original model setup. Therefore, the original framework of the model will be considered in establishing the assessment reaches. In application, the effect of phosphorus reductions will be conducted selectively with only one reach analyzed at a time.

Model Runs

The initial model assumptions (outlined above) will serve to describe the 'current' phosphorus condition for the river. With these initial conditions in place, the TMDL model will be run, selectively reducing the phosphorus loading occurring within the assessment reaches and examining its effect on phosphorus

loading at the compliance location. Likely a series of models runs will be necessary, reducing the 'current' inflow phosphorus concentrations, within each assessment reach, by set percentages (e.g. 20%). The actual reduction increment level used will depend on the magnitude of effect and associated costs of each model run. It cannot be assumed that the response between decreasing inflow concentrations will have a linear effect on the loads observed at the compliance location and, for this reason, it is anticipated that several runs will be required for each reach examined.

Model results will be used to generate ratios

Potentially two types of assessments will be determined from the model runs. The primary one will be the generation of a set of ratios based on the level of phosphorus load reduction, occurring at select locations in the river, as it relates to the phosphorus load observed at the compliance location (above Lake Spokane). However, these load reductions can also be tied to changes in the level of dissolved oxygen observed in the reservoir. Therefore, it is anticipated that dissolved oxygen will also be considered. In terms of trading, only the reduction in the phosphorus load determined at the compliance location will be used to set the river-based ratio.

This ratio will be determined based on the change in the phosphorus load observed at the compliance location (base minus scenario) divided by the assessment reach load reduction (refer to equation below). As previously discussed, the original or base phosphorus load is that derived assuming that the TMDL load and waste-load allocations have been achieved.

$$\textit{River Reach A Ratio} = \frac{[\textit{Base Load} - \textit{Scenario Load}]\left(\frac{kg}{d}\right)}{\textit{Reach A Load Reduction}\left(\frac{kg}{d}\right)}$$

The phosphorus loads used as input to these relationships will be applied to the entire analysis period though the assessment of the loads used to derive the ratios will be those occurring during the critical period as indentified in the Spokane River TMDL study.

Ratios assist with BMP implementation

The establishment of Spokane River proximity-based phosphorus loading ratios streamlines the implementation process. The analysis is conducted up-front reducing the analysis burden on phosphorus trading participation. Also, the analysis provides a 'reality check' on what level of phosphorus loading reduction, for specific stretches of the river, are necessary to provide an effect at the TMDL compliance location. So it is a method of optimizing the location of BMP implementation in addition to providing information on the scale or level of implementation (phosphorus load reduction) required to affect a change at the compliance location.

Base Load *= Phosphorus load determined at the TMDL assessment location assuming the load and waste-load allocations have been met.*

Scenario Load *= Phosphorus load determined at the TMDL assessment location assuming the load and waste-load allocations have been met and an addition decrease in the load associated with a particular reach.*