

WATER QUALITY AND PHOSPHORUS



WHAT IS PHOSPHORUS?

Phosphorus is a key nutrient for plant growth. It is naturally found in the environment, but can become a nutrient pollutant when there is excess phosphorus in the water. There are naturally occurring sources of phosphorus such as decaying organic matter and eroding rocks and soils, but phosphorus can also be found in anthropogenic sources such as detergents, lubricants, human/animal waste, pesticides and fertilizers. Runoff from agricultural and urban land, airborne particles and municipal/industrial discharges can all contribute to phosphorus addition in aquatic ecosystems such as the Bow River.

While there are a number of ways to measure phosphorus, total phosphorus (TP) provides a good overview of how much phosphorus is in the water as it includes both the dissolved fraction (which can be measured as Total Dissolved Phosphorus, TDP) that is available for plant uptake, as well as any particulate phosphorus bound to suspended particles.



Image: Blue-Green Algae
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WHAT WERE PHOSPHORUS LEVELS LIKE IN THE BOW RIVER FROM 2010-2015?

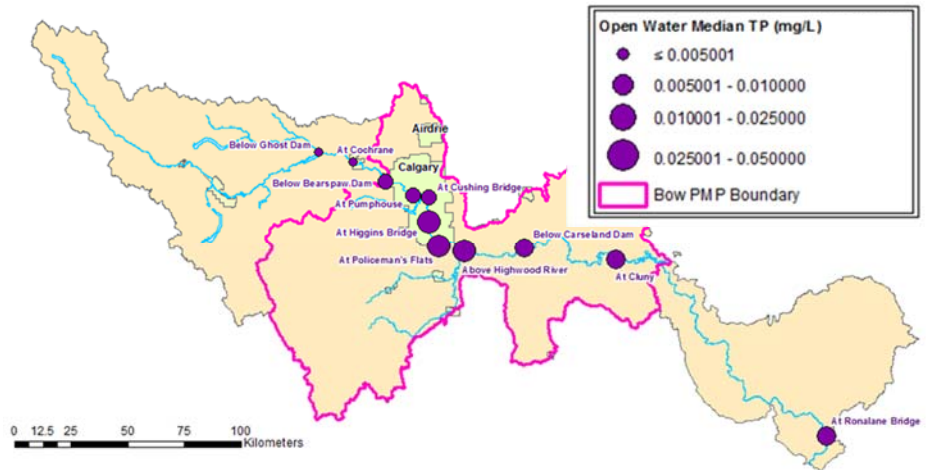


Figure 1. TP concentrations during open water season, as a median over five years (2010-2015). Data from Alberta Environment and Parks Long-Term River Network sites and City of Calgary monitoring sites.

Phosphorus concentrations generally increase from upstream to downstream and decrease again (due to dilution and assimilation) downstream of the City of Calgary. The key loading is generated by the treated municipal wastewater effluent from within the City of Calgary. The City operates three highly advanced treatment facilities, but with a population of over one million, there will be an observable impact. Urban and rural, diffuse runoff also adds to the phosphorus load. There is no provincial guideline for phosphorus, but the South Saskatchewan Region Surface Water Quality Management Framework for the Mainstem Bow, Milk, Oldman and South Saskatchewan Rivers (Alberta) (printed July 2014; online edition ISBN: 978-1-4601-1861-0) provides water quality triggers for the provincial Long-Term River Network (LTRN) sites.

Phosphorus is not considered toxic in aquatic environments. The problem with phosphorus is that high concentrations heighten potential for increased biological productivity and may lead to more frequent and widespread occurrences of algal and aquatic plant growth. These changes will also effect changes in other water quality components (e.g., dissolved oxygen – see p. 2 of this fact sheet) and result in possible losses in the beneficial use of the river (e.g., reduced river recreation, loss of aesthetics and fish kills).

WHAT IS THE RELATIONSHIP BETWEEN DISSOLVED OXYGEN AND PHOSPHORUS?

Dissolved Oxygen (DO) is a measure of how much oxygen is present in the water. Dissolved oxygen is crucial for aquatic life; below certain concentrations, organisms experience stress and even mortality. DO levels are normally high during the daylight hours due to photosynthesis. At night time, however, DO can dip to very low levels due to respiration (oxygen consumption) by all aquatic organisms. Phosphorous in water acts as a nutrient and at high levels encourages aquatic plant and algal growth with a subsequent potential negative impact on DO concentrations.

WHAT WERE DISSOLVED OXYGEN CONCENTRATIONS LIKE IN THE BOW RIVER IN 2015?

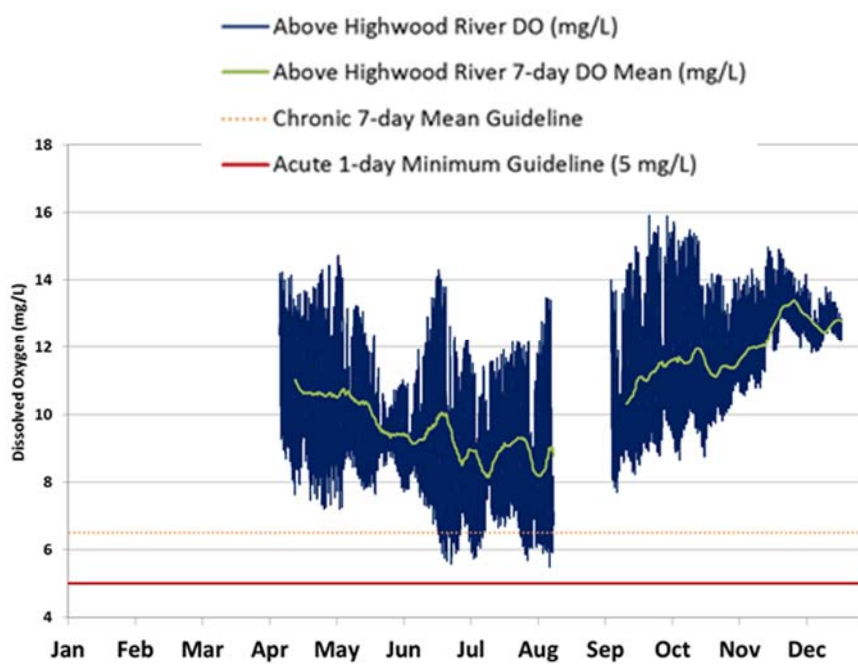


Figure 2. Continuous dissolved oxygen data at Bow River above Highwood River confluence, right downstream bank, in 2015. Data and figure provided by the City of Calgary. Guidelines shown are from *Environmental Quality Guidelines for Alberta Surface Waters* (publ. by AEP, July 2014).

DO is measured continuously during open water season with an instream water quality instrument, downstream of the City of Calgary just above the confluence with the Highwood River. Concentrations measured in 2015 show healthy DO concentrations that are consistently above the acute DO guideline (5 mg O₂/L). There are a few dips in DO concentration below the chronic guideline (6.5 mg O₂/L) during late August, but the chronic 7-day mean remains above the chronic guideline.

EMERGING ISSUES, OPPORTUNITIES & INFORMATION GAPS

Knowing the constituent phosphorus load (e.g., kg/day) from various sources provides very useful information on what is entering the river. However, loading calculations require corresponding flow (e.g., m³/day) and concentration (e.g., mg/L) data, which are not always available at the same time and location. Additional flow monitoring is encouraged in order to better understand phosphorous loadings at various sites in the Bow basin. AEP and the City of Calgary will continue to find ways to work more closely together to monitor and manage phosphorus in the Bow River.

Additional information

Bow River Phosphorus Management Plan
<http://aep.alberta.ca/>

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