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The Future of a Cold Regions Deltaic Ecosystem Influenced by Multiple Hydrological Stressors

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The Peace-Athabasca Delta (PAD) is one of the largest (~6000 km²) freshwater deltaic ecosystems in the world. This low relief, deltaic floodplain formed at the confluence of the Peace-Athabasca-Birch rivers at the west end of Lake Athabasca in northwestern Canada. Small changes in water level/depth have important implications for surface water connectivity and associated habitat quality. The floodplains contain more than 1000 wetland-lake basins with varying degrees of connectivity to the main flow system. Hydroperiod is influenced by occasional ice-jam and open-water inundations that recharge wetland basins. This culturally important and biologically rich delta is a Ramsar Convention Wetland Site of International Importance, and is a key feature of the Wood Buffalo National Park (WBNP) that is listed as a UNESCO World Heritage Site. The PAD ecosystem is influenced by contributing basin and local scale hydrological stressors from flow regulation (eg, hydroelectric dam, weirs), water and land use (eg, oil sands mining) and climate change.

Growing concern regarding increased cumulative effects on the delta led Indigenous Peoples petitioning UNESCO World Heritage Committee (WNC) to reassess the protection status of the park. The WBNP Action Plan was developed to address 17 UNESCO WHC recommendations to ensure maintenance of Outstanding Universal Value of the Park. One key set of recommendations is to: 1) Conduct environmental flows assessments, to the highest international standard, in order to identify water flows needed to sustain the ecological functioning of the PAD under current and projected development and climate change; 2) Establish adequate baseline hydrological information for PAD assessments.

A significant scientific effort has been invested in the last four decades, particularly since 2010, in improving our understanding of the relationship between streamflow, landscape controls and aquatic ecology in this cold-regions delta. This information is key to assess historical and present states, learn from past development to inform planned development, and prepare for anticipated future hydro-ecological changes. However, several key questions arise regarding what is the best approach to preparing for the future and managing such a complex system, what management options are possible within an environmental flow framework given known hydrological stressors, and what future ecosystem state does society want for the delta. The goal of this presentation

focused on the PAD is threefold: i) Provide an overview of major hydro-ecological research and water management; ii) Assess the potential applicability of riverine environmental flow frameworks to deltaic floodplain environments; and iii) Explore the development of an environmental flow/water level framework and tools necessary to assess and manage changes to the aquatic ecology of this internationally important deltaic ecosystem.