

## **Alberta Conservation Association 2017/18 Project Summary Report**

**Project Name:** Winter Water Quality Assessment of the Whitemud River and Willow Creek Watersheds

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### **Partnerships**

Alberta Environment and Parks  
Cooperating landowners

### **Key Findings**

- Winter dissolved oxygen levels were unsuitable for trout survival at five of seven datasonde stations in the Whitemud River watershed and three of five in the Willow Creek watershed.
- Low flows and complete freezing of the water column at some sampling sites seemed to lessen the availability of suitable overwintering habitat for salmonids.
- Methods for anchoring datasondes were successful but selection of water quality monitoring locations requires further investigation.

### **Introduction**

Cumulative landscape disturbances have resulted in widespread declines of lotic fisheries across Alberta (Stevens et al. 2010, Norris 2012, AECOM 2009). Inputs of phosphorus from surrounding land management practices have been linked to anoxic conditions in several rivers across the province (Norris 2012, Redwillow Watershed Restoration Team 2015, AECOM 2009). Winter dissolved oxygen (DO) deficit has been hypothesized as a potential cause of Arctic grayling (*Thymallus arcticus*) extirpations (Norris 2012), and a significant limiting factor for fish production.

The provincial scope of lotic winter oxygen deficit is unknown. Concentrations of DO below 6.5 mg/L are believed to impair freshwater aquatic life and chronic effects may occur after seven days below the threshold (AEP 1997, CCME 1999). Concentrations below 5.0 and 3.5 mg/L for a one day minimum represent the acute effects threshold for aquatic life and salmonids, respectively (AEP 1997).

To better understand the potential impacts to priority cold-water fish species such as Arctic grayling, bull trout (*Salvelinus confluentus*), Athabasca rainbow trout (*Onchorynchus mykiss*) and Westslope Cutthroat Trout (*Oncorhynchus clarkii lewisi*), investigation into longitudinal trends in winter DO is required. We conducted broad scale measures of winter DO within two HUC 8 watersheds, one on the Whitemud River in northwestern Alberta and another on Willow Creek in southwestern Alberta, to determine if winter oxygen deficit occurs and identify locations approaching or beyond thresholds that impair cold-water fish species survival.

## Methods

Prior to ice-over in fall of 2016, we installed temperature-oxygen data loggers (datasonde) between major tributaries that spanned the length of both watersheds, at eight overwintering pool locations on the Whitemud River and six on Willow Creek. Each datasonde was tethered to a shore-based anchor and affixed to a steel t-bar embedded into the substrate. Datasondes were positioned just above the streambed to measure continuous temperature and DO data at 15-minute intervals from October 2016 through April 2017. We also collected bi-weekly instantaneous DO and temperature measurements using handheld meters at all datasonde stations, as well six additional overwintering pool locations in the Whitemud River watershed and eleven in the Willow Creek watershed. We determined daily mean, minimum, and maximum DO and temperature at all datasonde stations. We determined winter water quality suitability for trout based on DO concentrations <6.5, <5.0, and <3.5 mg/L. We retrieved datasondes at spring breakup.

## Results

Methods for securing datasondes below the ice were successful as we retrieved all but two; one on Willow Creek was lost to theft/vandalism, and another on the Whitemud River to a flood event, during which all other datasondes remained secure. Overwintering habitat based on winter DO concentrations varied greatly on a site by site basis (Table 1). We also observed additional unsuitable overwintering conditions other than low DO levels, which included low flows and complete freezing of the water column. Winter DO levels were unsuitable for trout survival at five of seven stations in the Whitemud River watershed and three of five stations in the Willow Creek watershed (Figure 1).

Table 1. Maximum number of consecutive days when daily dissolved oxygen concentrations remained below the salmonid acute effects, aquatic life acute effects, and aquatic life chronic effects thresholds on the Whitemud River and Willow Creek, between December 2016 and April 2017.

Watershed	Datasonde ID	Number of days below dissolved oxygen threshold		
		<3.5 mg/L	<5.0 mg/L	<6.5 mg/L
Whitemud River	DS - 1	20	27	35
	DS - 2	0	0	0
	DS - 3	96	97	99
	DS - 4	0	0	0
	DS - 5	105	112	115
	DS - 7	17	23	24
	DS - 8	56	58	61
Willow Creek	DS - 1	0	0	0
	DS - 2	14	27	47
	DS - 3	4	4	5
	DS - 4	0	0	1
	DS - 6	25	26	45

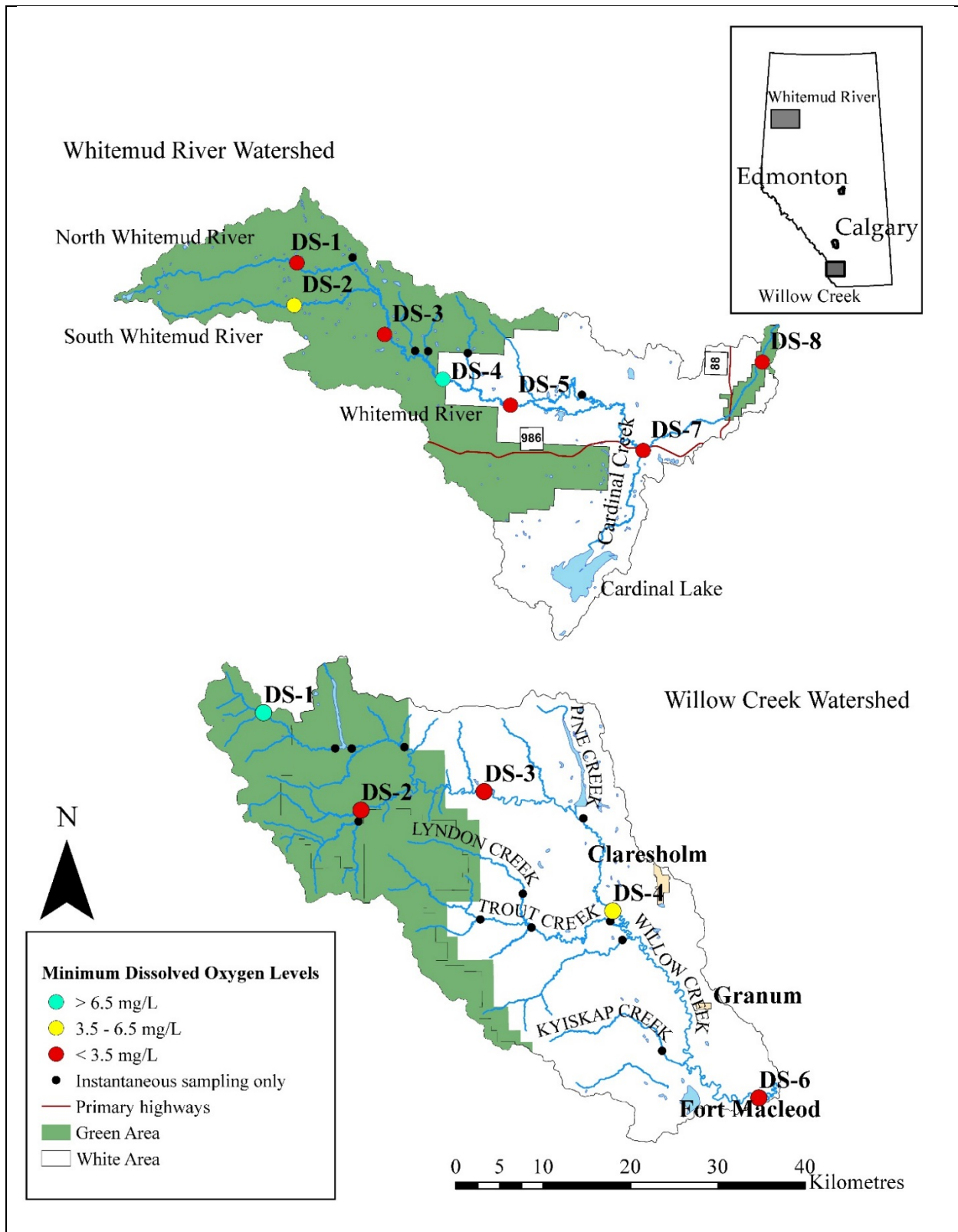


Figure 1. Minimum dissolved oxygen levels on the Whitemud River and Willow Creek between December 2016 and April 2017, colours depicted represent varying dissolved oxygen concentrations.

## **Conclusion**

Overall, winter DO levels were unsuitable for trout survival at the majority of our study sites in the Whitemud River and the Willow Creek watersheds. In addition, low flows and complete freezing of the water column seem to exacerbate availability of suitable overwintering habitat.

## **Communications**

- ACA data report: Winter water quality assessment of the Whitemud River and Willow Creek HUC (in prep).
- Regional presentations by Fisheries Program Manager.

## **Literature Cited**

- Alberta Sustainable Resource Development. 2009. Redwillow Watershed: an Overview of the History and Present Status of Fish Populations and Fish Habitat and Recommendations for Restoration. Prepared by AECOM Canada Ltd. Project number 110991. Burnaby, BC, Canada.
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- Norris, A. P. (2012). Cumulative effects thresholds for arctic grayling in the Wapiti River watershed (Doctoral dissertation, Royal Roads University).
- Redwillow Watershed Restoration Team. 2015. Bring Back the Grayling! 2015 – 2040 Redwillow Watershed Restoration Plan. 35 pp + App.
- Stevens, C., T. Council, and M. Sullivan. 2010. Influences of human stressors on fish-based metrics for assessing river condition in central Alberta. Water Quality Research Journal of Canada. Volume 45, No. 1, 35-46.

## Photos



Sampling dissolved oxygen concentrations on Willow Creek.  
Photo: Logan Redman



Breaking ice to access a datasonde install location on the Whitemud River.  
Photo: Nikita Lebedynski



A datasonde below the ice on the Whitemud River. Photo: Nikita Lebedynski