Evaluating the Thermal and Hydrological Impacts of Kinnickinnic River Hydropower Impoundments in River Falls, WI

Summary of Monitoring Results

Thermal:

Since 1992, the Kiap-TU-Wish Chapter of Trout Unlimited has been conducting temperature monitoring of the Kinnickinnic River and three tributaries (Sumner Creek, South Fork of the Kinnickinnic River, and Rocky Branch Creek) in the vicinity of River Falls, Wisconsin (Figure 1).

Figure 1. Kiap-TU-Wish temperature monitoring sites on the Kinnickinnic River and tributaries in River Falls, WI.

Temperature monitoring at these eight sites has typically been conducted during the mid-April to mid-October period each year, using electronic instrumentation that continuously measures river temperatures at 10-minute intervals. The temperature data obtained at each monitoring site can be compared to critical temperature thresholds that must be maintained to support healthy coldwater communities in the Kinnickinnic River and its tributaries. These thresholds[1] are as follows:

Temperatures ≤ 17º C = river temperatures optimal for macroinvertebrate survival
Temperatures ≤ 19º C = river temperatures optimal for brown trout growth
Temperatures ≤ 20º C = river temperatures optimal for brown trout survival

Temperatures > 19º C = river temperatures exceed physiological limit for brown trout
Temperatures > 22º C = river temperatures exceed the survival tolerance threshold and upper metabolic limit for brown trout
Temperatures > 25º C = river temperatures exceed the lethal threshold for brown trout

The temperature monitoring data obtained at four Kinnickinnic River monitoring sites can be used to evaluate the thermal impacts of the two impoundments (Lake George and Lake Louise) created by the City of River Falls hydropower facilities. The two monitoring sites at Quarry Road and Division Street are reference or control sites located upstream from the two hydropower impoundments. The two monitoring sites at Upper and Lower Glen Park are possible impact sites situated downstream from the two hydropower impoundments.

An assessment by Kiap-TU-Wish of the temperature monitoring data obtained at the Quarry Road, Division Street, and Upper and Lower Glen Park monitoring sites indicates that summer (June-August) river temperatures are notably higher downstream from the two hydropower impoundments. On average during the 1993-2018 period of record, downstream summer average temperatures at Upper and Lower Glen Park are 2.1-2.4º C (3.8-4.2° F) warmer than the upstream summer average temperatures at Quarry Road and Division Street. This temperature differential is even greater in July (the warmest summer month), with downstream temperatures 2.3-2.7º C (4.2-4.7° F) higher than upstream temperatures. Furthermore, throughout the summer period, the downstream temperatures at Upper and Lower Glen Park more frequently exceed the critical temperature thresholds that support healthy coldwater macroinvertebrate and brown trout communities in the Kinnickinnic River. For instance, during the summer of 2012, the temperature threshold of 19º C was exceeded for a cumulative total of 8.8 days (10% of the summer period) at Division Street. In comparison, this threshold was exceeded for a cumulative total of 38.9 days (42% of the summer period) at Upper Glen Park, thereby posing a much greater thermal risk to the downstream coldwater community.

The Wisconsin Department of Natural Resources has conducted assessments of Kiap-TU-Wish's Kinnickinnic River temperature monitoring data in 2011[2] and 2019 (Figure 2). Both assessments have noted that a warming trend in water temperature has been occurring at the Quarry Road and

[1] Bell, J.M. 2006. The assessment of thermal impacts on habitat selection, growth, reproduction, and mortality in brown trout (*Salmo trutta* L): A review of the literature. Report prepared for the Vermillion River Watershed Joint Powers Board, by Applied Ecological Services, Inc. Brodhead, WI. 23 p.
[2] Mitro, M., J. Lyons, and S. Sharma 2011. Wisconsin Initiative on Climate Change Impacts: Coldwater Fish and Fisheries Working Group Report. 31 p.

Upper and Lower Glen Park monitoring sites, consistent with the observed warming trend in Wisconsin air temperature during the same time periods. However, the warming trends at the Upper and Lower Glen Park monitoring sites begin at a much higher baseline temperature, indicating that these downstream monitoring sites will be much more sensitive to any future impacts of climate change.

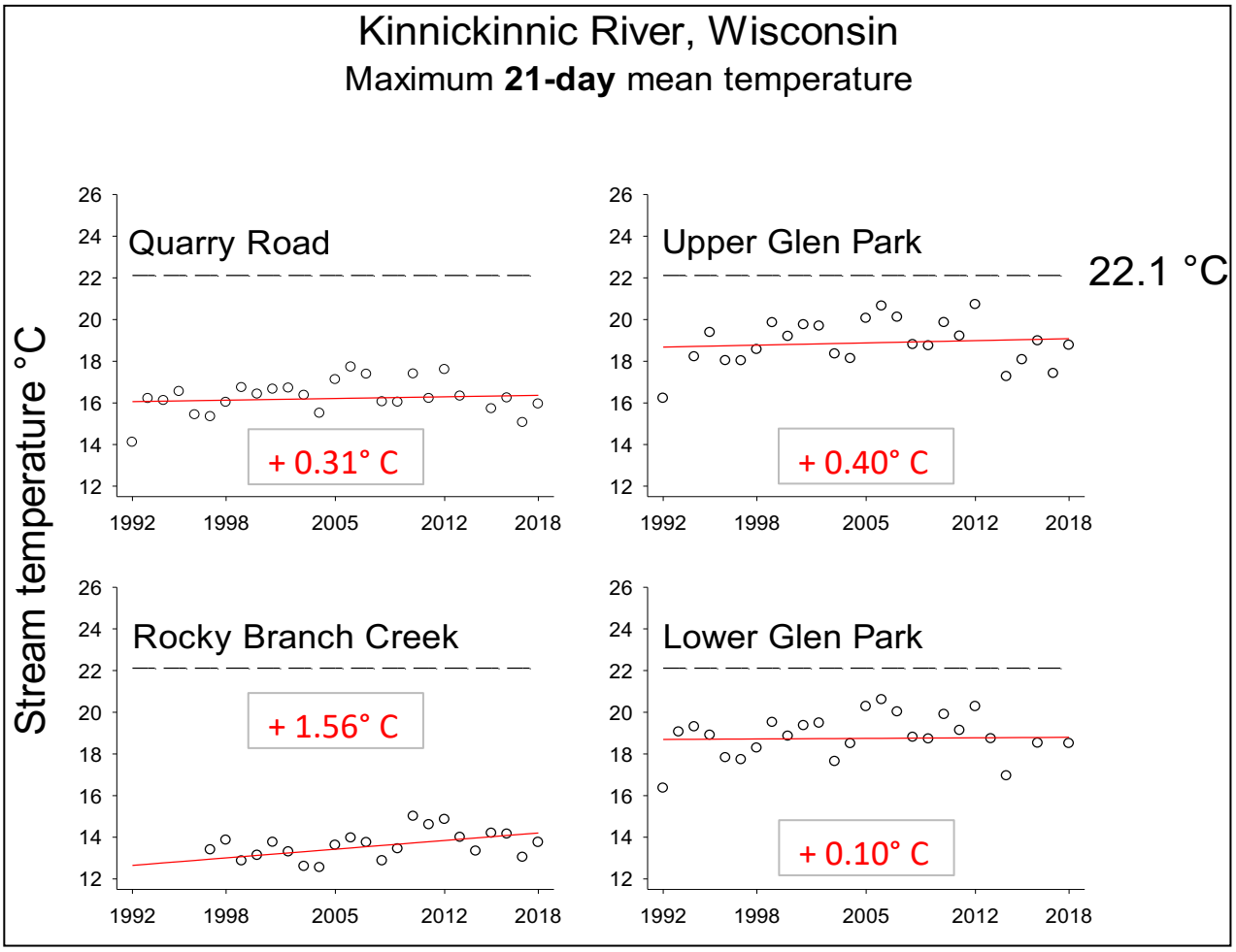

Figure 2. Maximum 21-day mean temperature by year (1992-2018) at three Kinnickinnic River sites (Quarry Road, Upper Glen Park, and Lower Glen Park) and one Rocky Branch Creek site. The regression line (solid line) for each river site shows the extent of river warming during the monitoring period, with a comparison to the critical 21-day temperature threshold for brown trout[3] (dashed black line at 22.1° C). Analysis by Matt Mitro, WDNR Coldwater Fisheries Research Scientist.

[3] Wehrly, K., L. Wang, and M. Mitro. 2007. Field-based estimates of thermal tolerance limits for trout: Incorporating exposure time and temperature fluctuation. Transactions of the American Fisheries Society 136: 365-374.

The increased sensitivity of downstream water temperatures to air temperature has also been documented by a Kiap-TU-Wish regression analysis of April-September 2012 water temperatures vs. April-September 2012 air temperatures at the four upstream and downstream Kinnickinnic River monitoring sites.

Hydrological:

The United States Geological Survey (USGS) operates a Kinnickinnic River monitoring station (number 05342000) at County Highway F, near Kinnickinnic State Park, approximately five miles west of River Falls. The station measures river stage (water height) and flow at 15-minute intervals, and 15-minute precipitation amounts in 0.01-inch increments. The City of River Falls, Kinnickinnic River Land Trust, and the Kiap-TU-Wish Chapter of Trout Unlimited provide annual cost-share funding to help support the operation of this USGS monitoring station, which has been operating continuously since July 2002.

During periods of stable river flow (baseflow), when precipitation and runoff are not occurring, the Kinnickinnic River hydrograph can be examined to determine whether the City of River Falls hydropower facilities are operating in a "run-of-river" mode, as required by the FERC Permit. The "run-of-river" condition is critical for maintaining the Kinnickinnic River habitats that support healthy coldwater macroinvertebrate and brown trout communities. Sudden decreases in water flow can de-water macroinvertebrate habitats and trout redds, while sudden increases in water flow can de-stabilize the river channel, thereby increasing bank erosion, decreasing water clarity, and damaging in-stream habitat.

On a number of occasions, recreational users along the lower Kinnickinnic River (downstream from River Falls) have noted sudden flow fluctuations that are likely attributed to irregular operation of the City of River Falls hydropower facilities. For instance, a Kiap-TU-Wish Chapter member observed a dramatic decrease in Kinnickinnic River flow (from 126 cfs to 53 cfs) on July 11, 2008, during the 15:00-18:45 CDT time period. The Wisconsin Department of Natural Resources (WDNR) subsequently linked this flow irregularity to a gate malfunction at the lower hydropower facility. Given these observations of irregular flows, the Kiap-TU-Wish Chapter of Trout Unlimited recommends that a thorough assessment be conducted (using USGS Kinnickinnic River flow data) of the extent to which the City of River Falls hydropower facilities have maintained a "run-of-river" condition during the 2002-2013 period.

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