Comparing Shade Provided by Grassy and Woody Riparian Vegetation as a Control for Stream Temperature

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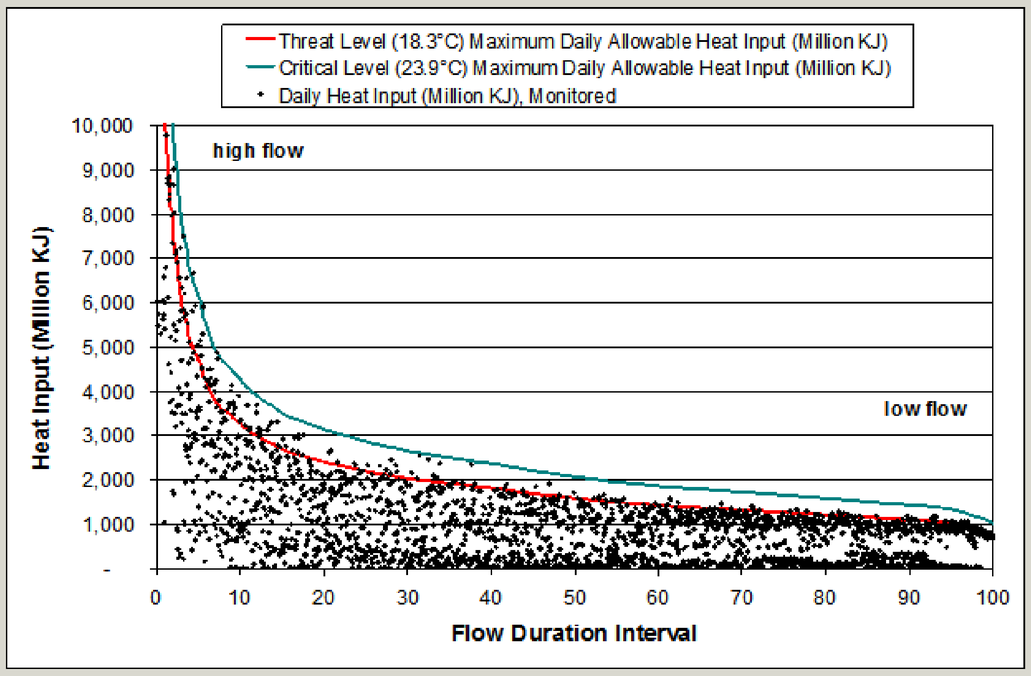

Figure 1: Heat Load Duration Curve 2000-2007 WOMP Site[1].

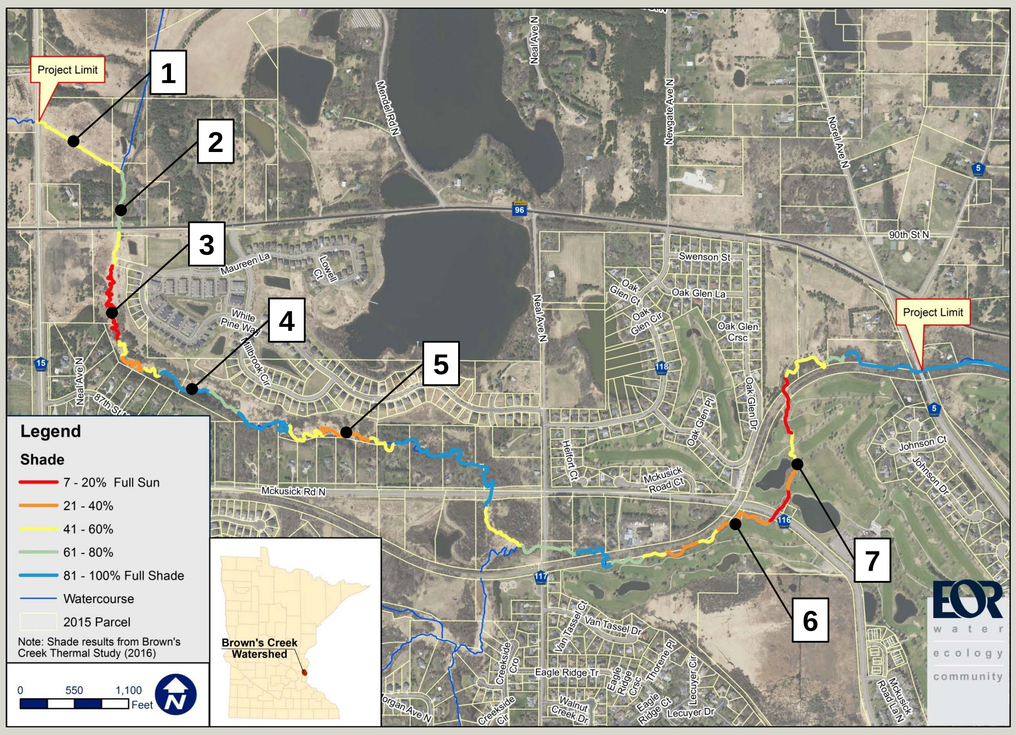

Figure 2: Representative Reaches by Shade & Channel Type.

Project Need: Watershed Background

- Brown's Creek is a designated trout stream in Stillwater, MN impaired for aquatic life due to lack of coldwater assemblage and high turbidity.
- High water temperatures are a primary stressor to biota, exceeding threat level for brown trout during high flows (stormwater driven) and low flows (Fig 1).
- Thermal buffer and stream geomorphology improvements identified in TMDL Implementation Plan to reduce thermal exceedances[2]. Remaining 2.5 miles of improvements are in the current Watershed Management Plan for 2017-2026.
- Previous riparian shading analysis was limited by LiDAR collected after leaf-off in 2012 and before the Oak Glen Golf Course stream restoration project[3].
- Restoring riparian shade could lower monthly mean baseflow temperatures by 0.5 to 1.0°C but specific locations need to be targeted[3].

Project Goal: Identify the type and location of riparian vegetation shade restoration improvements needed to reduce monthly mean baseflow temperatures in Brown's Creek by 0.5 to 1.0°C.

Project Area:

- 7 representative reaches identified with unique shade and channel type (Fig 2).
- 11 transects monitored per reach[4].
- 2 additional transects for shade extrapolation.

Figure 3: Typical Reaches.

Data Collection:

- 3 skyward hemispherical photos per transect using DSLR with fisheye lens.
- Other factors affecting shade, e.g. vegetation height, wetted width, etc.
- Solar radiation using pyranometers above and below canopy at different heights above stream.

Preliminary Analysis: Simulating solar paths in WinSCANOPY and estimating average growing season shade.

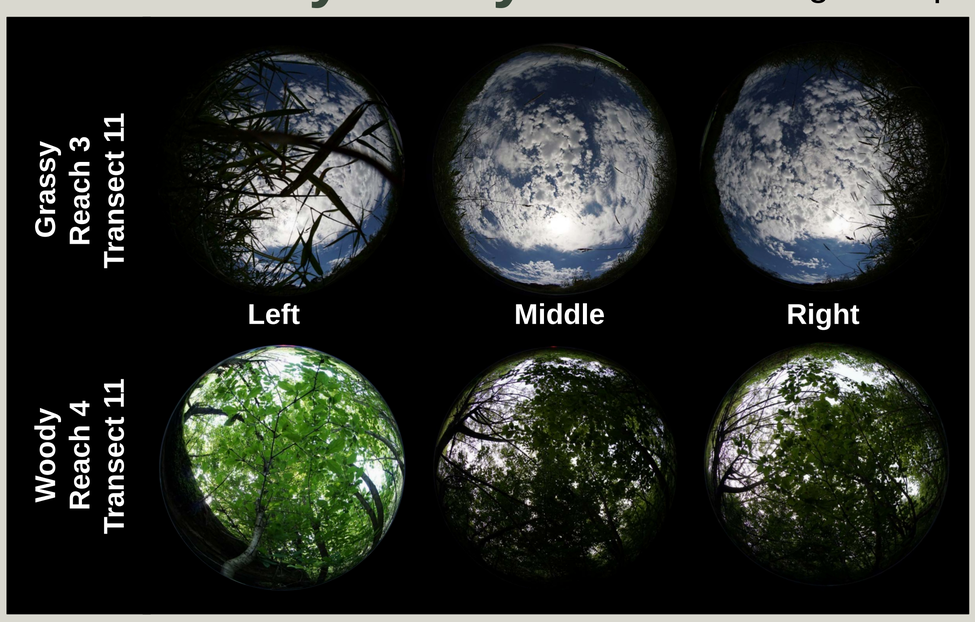

Figure 4: Hemispherical Photographs.

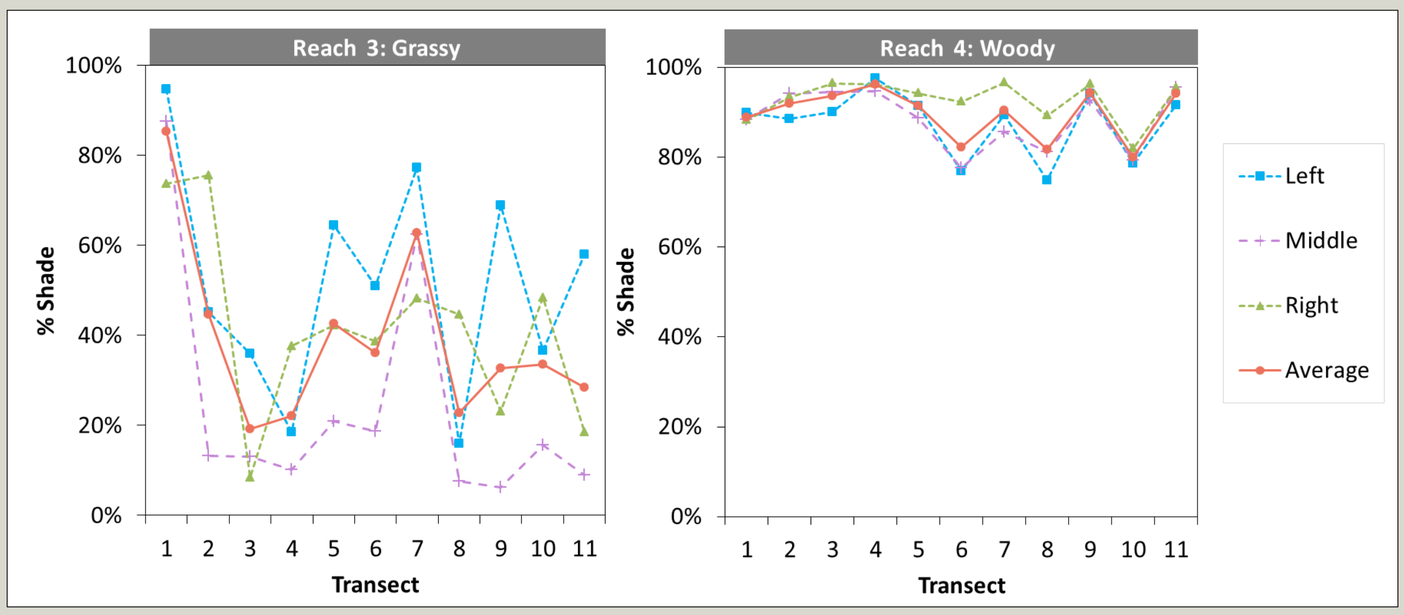

Figure 5: Average Daily Shade Estimated for 2017 Growing Season.

Next Steps:

- Complete photo analysis and validate WinSCANOPY model with solar radiation measurements.
- Regression analysis of shade, vegetation, & channel characteristics.
- Update shade in stream temperature model (CE-QUAL-W2) under existing and alternative restored conditions.
- Develop alternative shade scenarios using a cost-benefit analysis of trade-offs, e.g. grassy reaches have less shade but are deeper and narrower than woody reaches.
- Recommend location and type of shade restoration for implementation activities called for in the District's 2017-2026 Watershed Management Plan.

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References:

1. Emmons & Olivier Resources. (2010). *Brown's Creek Impaired Biota TMDL.*
2. Emmons & Olivier Resources. (2012). *Brown's Creek TMDL Implementation Plan.*
3. Herb, W., & Correll, C. (2016). *Brown's Creek Thermal Study.*
4. Dent, L., Mulvey, M., Ades, D., Thom, B., Clinton, J., Godwin, D., … Pettit, G. (2000). *Stream Shade and Canopy Cover Monitoring Methods. Water Quality Monitoring: Technical Guidebook*.