Draft: Balsam Lake, Polk County (WBIC 322800),
Dipotassium Salt of Endothall Herbicide Concentration Monitoring Summary, 2014

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Balsam Lake is listed as a eutrophic drainage lake on the WI DNR web site. The lake has an area of 1901 acres, and maximum depth of 37 ft. On 28 May 2014, five areas on the east side of Balsam Lake were treated with a liquid formulation of dipotassium salt of endothall (endothall) applied as Aquathol K to control curly-leaf pondweed (*Potamogeton crispus*) (Chemical Aquatic Plant Control Permit Application and Aquatic Plant Management Herbicide Treatment Record) (Figure 1). The target concentration (application rate) was 1.5 mg/L active ingredient (ai). Water sample sites were established at 4 locations to monitor endothall concentrations (Figure 2).

Treatment Site	Treatment Area, acres	Herbicide Sample Sites
12	10.37	Bal1, Bal2
13	38.66	Bal3
14	4.37	Bal4
14A	9.91	none
14B	0.01	none

The water temperature at the time of herbicide application was reported in the Aquatic Plant Management Herbicide Treatment Record to be 71.4^{o}F (21.9^{o}C). The wind was reported to be 1 to 3 mph from the S. Wind speed and direction was reported to be 0 mph from the north by volunteer water sample collectors. Weather data for Cumberland, WI (www.wunderground.com) indicated that wind velocity was 0 to 8 mph beginning from the south and changing to the north on 28 May (Appendix). Winds then shifted to the south or were calm on 29 May.

Water samples were collected using an integrated water sampler which collects a water sample from the entire water column. Water samples were collected from sample sites at time intervals of approximately 1, 2, 4, 6, 9, 24, 36, and 48 hours after treatment (HAT). Water samples were taken to shore after completion of each sample interval, and 3 drops of sulfuric acid were added to each sample bottle to fix the herbicide and prevent degradation. Samples were then stored in a refrigerator, until shipped to the State Laboratory of Hygiene (SLOH), Madison, WI for analysis of endothall. Endothall application rates are based on mg/L active ingredient (ai), while herbicide concentrations in water samples are reported as mg/L or ug/L acid equivalent (ae). An endothall concentration of 1.5 mg/L ai is equal to 1.06 mg/L ae or 1060 ug/L ae.

Peak endothall concentrations in samples collected from sample sites Bal1 and Bal2 (Treatment Area 13) were 4400 and 2600 ug/L ae at 3.75 HAT compared to the target concentration of 1060 ug/L ae (Figure 3). The endothall concentration at sample site Bal2 then declined to less than the detection limit (10 ug/L ae) at 5.75 HAT and peaked again at 4300 ug/L ae at 8.75 HAT. Endothall concentrations at both sample sites were near a baseline concentration of 100 ug/L ae by 48 HAT. Endothall was applied using the Littoral Zone Treatment Technology (LittLine) which injects

herbicide at low pressure to a single select depth. Based on data collected here and in other lakes, herbicide applied using the LittLine appears to dissipate or mix slowly through the treatment target area. Herbicide can still move more quickly though and out of a target area as blocks via advection so that herbicide concentrations can vary from one sample interval to another and exposure times may still be short in small spot treatments.

Peak endothall concentrations in samples collected from sample site Bal3 (Treatment Area 12) were 2300 ug/L ae at 5.5 HAT and 8600 ug/L ae at 36 HAT compared to the target concentration of 1060 ug/L ae (Figure 4). Endothall concentrations were less than a baseline 100 ug/L ae by 48 HAT. Endothall concentration results appear confusing and difficult to understand. Based on more detailed dye studies, treatment area configurations in Balsam Lake, and wind data the herbicide applied to treatment area 12 and 14B likely merged into a larger treatment resulting in a peak at 5.5 HAT and overall longer exposure times. Herbicide from treatment area 13 likely moved through treatment areas 12, 14B, and 14 C by 36 HAT resulting in a second peak at herbicide sample site Bal3 at that time.

Peak endothall concentrations in samples collected from sample site Bal4 (Treatment Area 14) was 340 ug/L ae at 1 HAT compared to the target concentration of 1060 ug/L ae (Figure 5). Endothall concentrations were less than a baseline 100 ug/L ae by 2 HAT. Endothall exposure times at sample site Bal4 are more typical of exposure times seen in other isolated spot treatments less than 5 acres in size. Endothall was mostly moved out of the target site by 1 to 2 HAT.

Endothall concentration monitoring in Balsam Lake exemplifies the difficulties of predicting and managing herbicide spot treatments. Movement of herbicides from target areas is rapid but can be increased by treatment area size such as treatment area 13 which maintained an exposure time of between 24 and 48 HAT. Endothall concentration exposure times in treatment areas 12 and 14B were likely impacted by endothall from each other as well as treatment area 13. Endothall applied to treatment area 14C, not monitored, likely resulted in an exposure time of 1 HAT at most. Endothall applied to treatment areas 12, 13, 14, and 14B likely resulted in an exposure time in treatment area 12C of 36 to 48 HAT.

Figure 1. Balsam Lake 2014 Endothall Treatment Locations

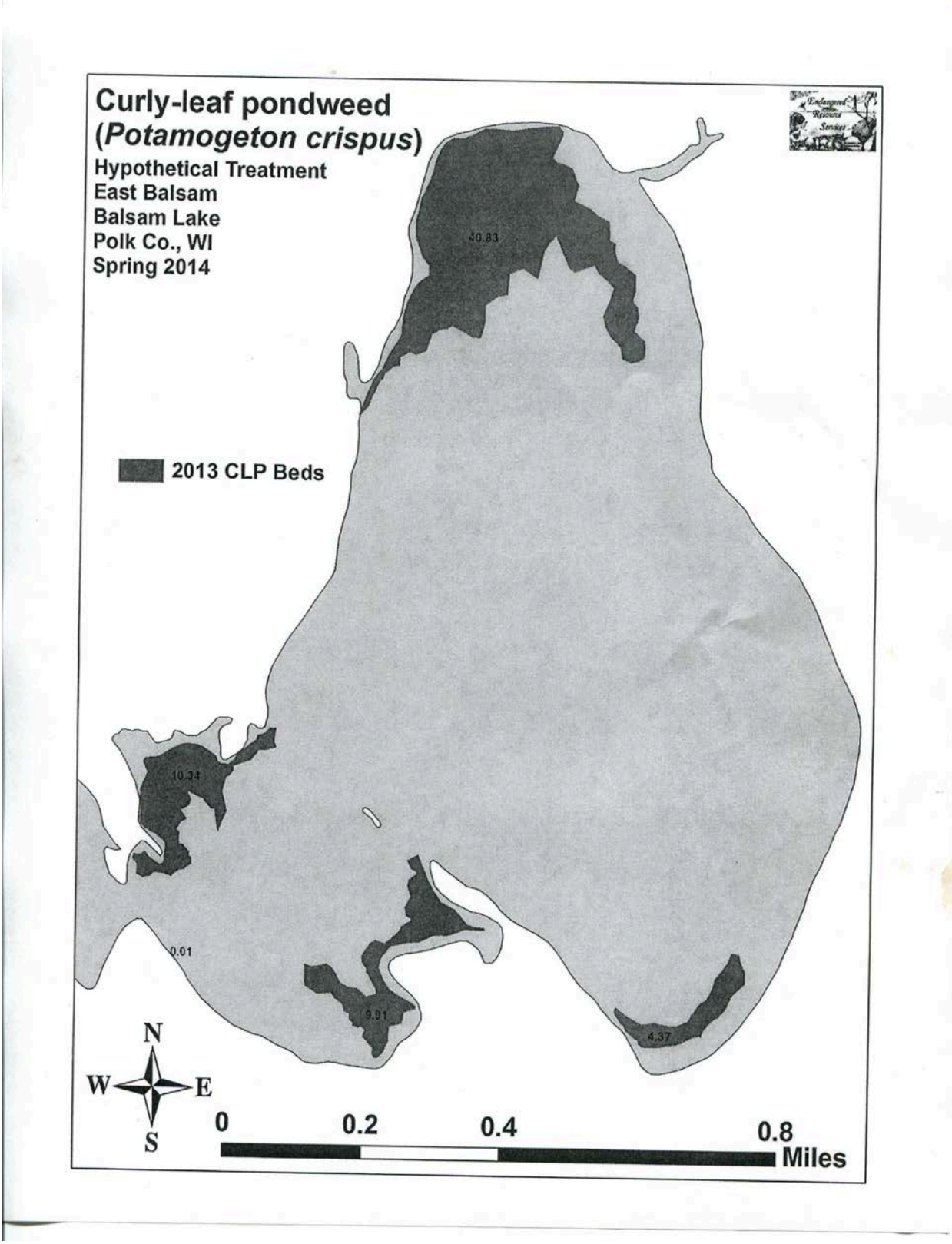


Figure 2. Balsam Lake 2014 Endothall Sample Locations

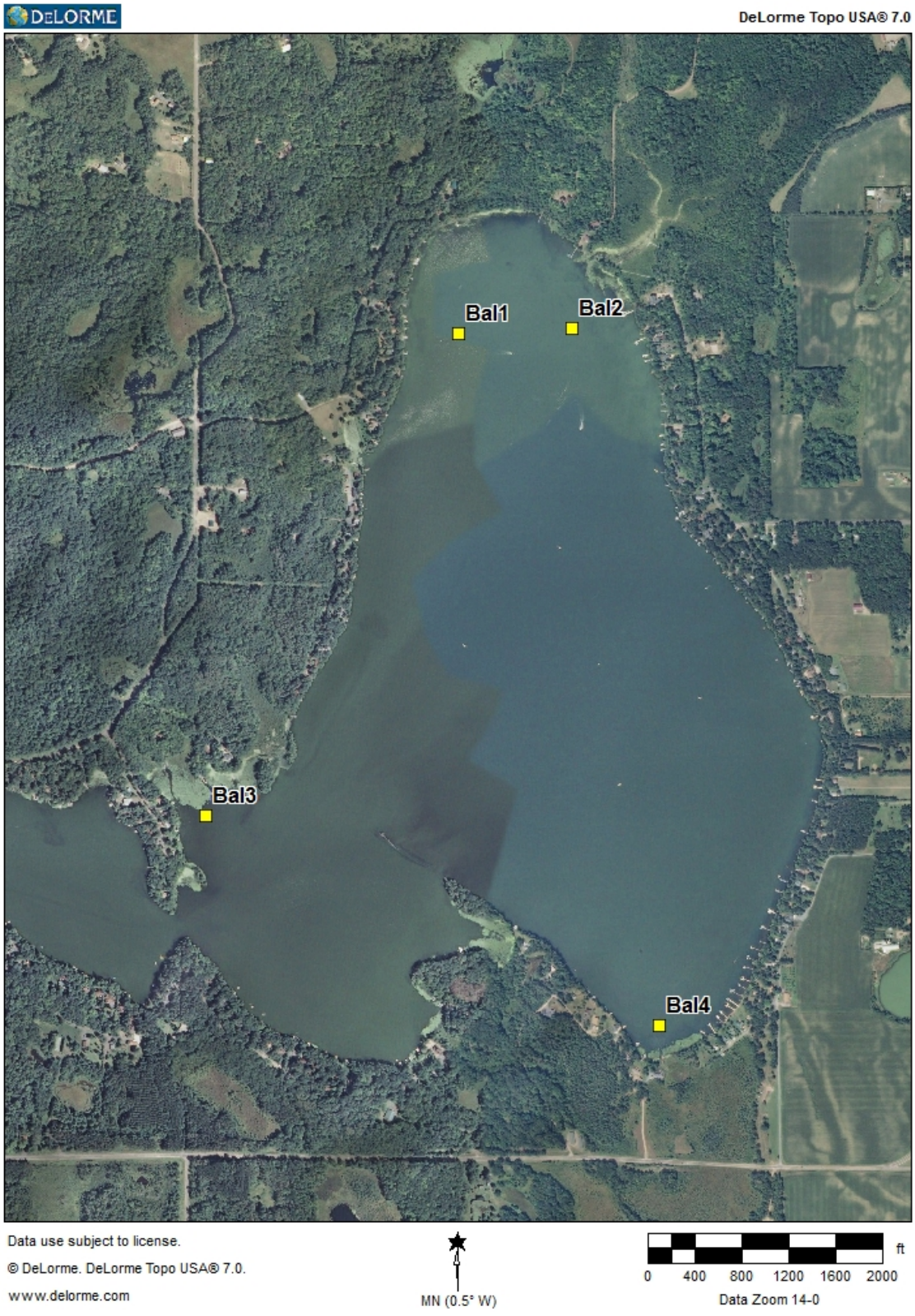


Figure 3

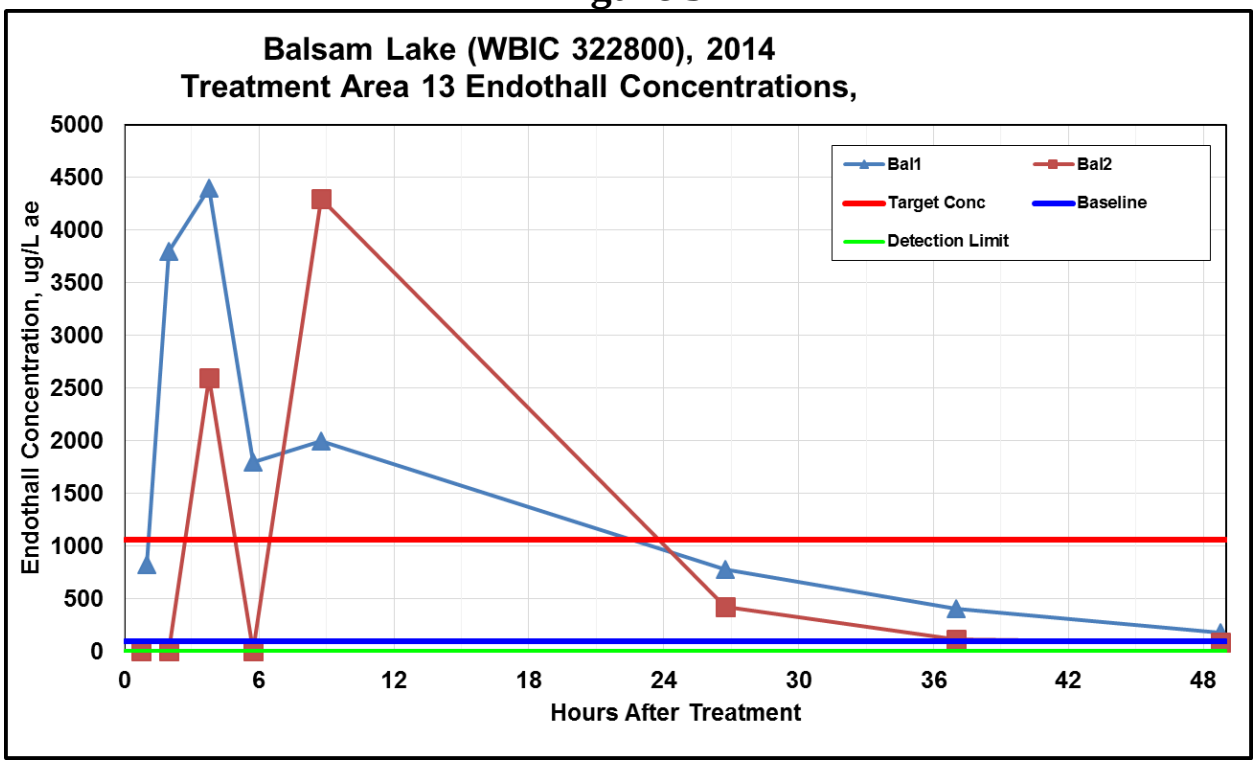


Figure 4

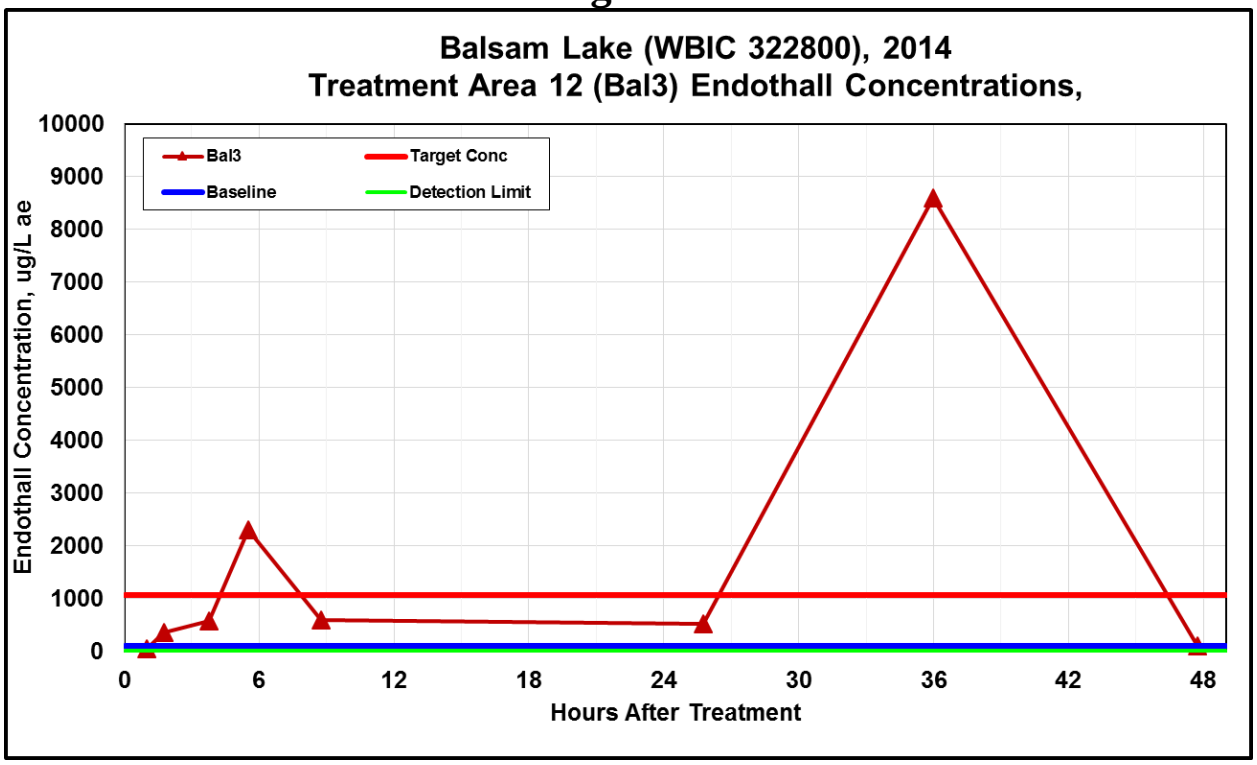
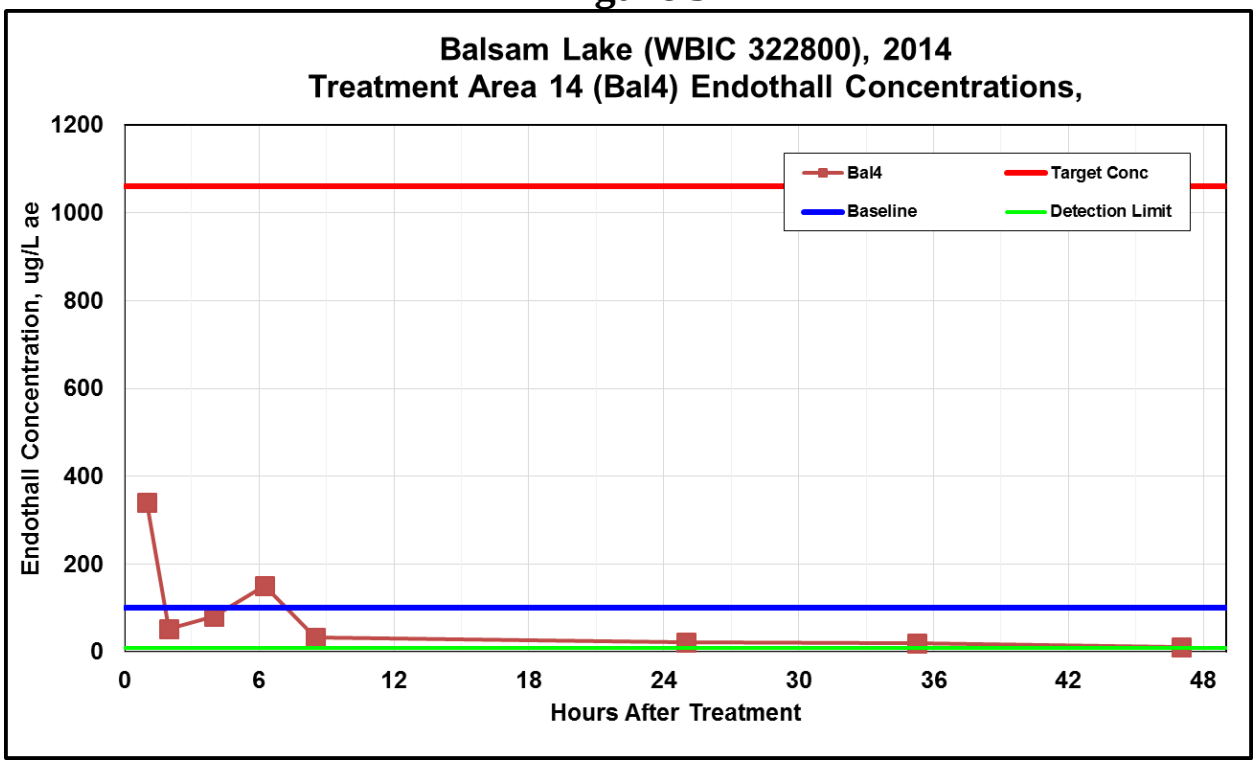
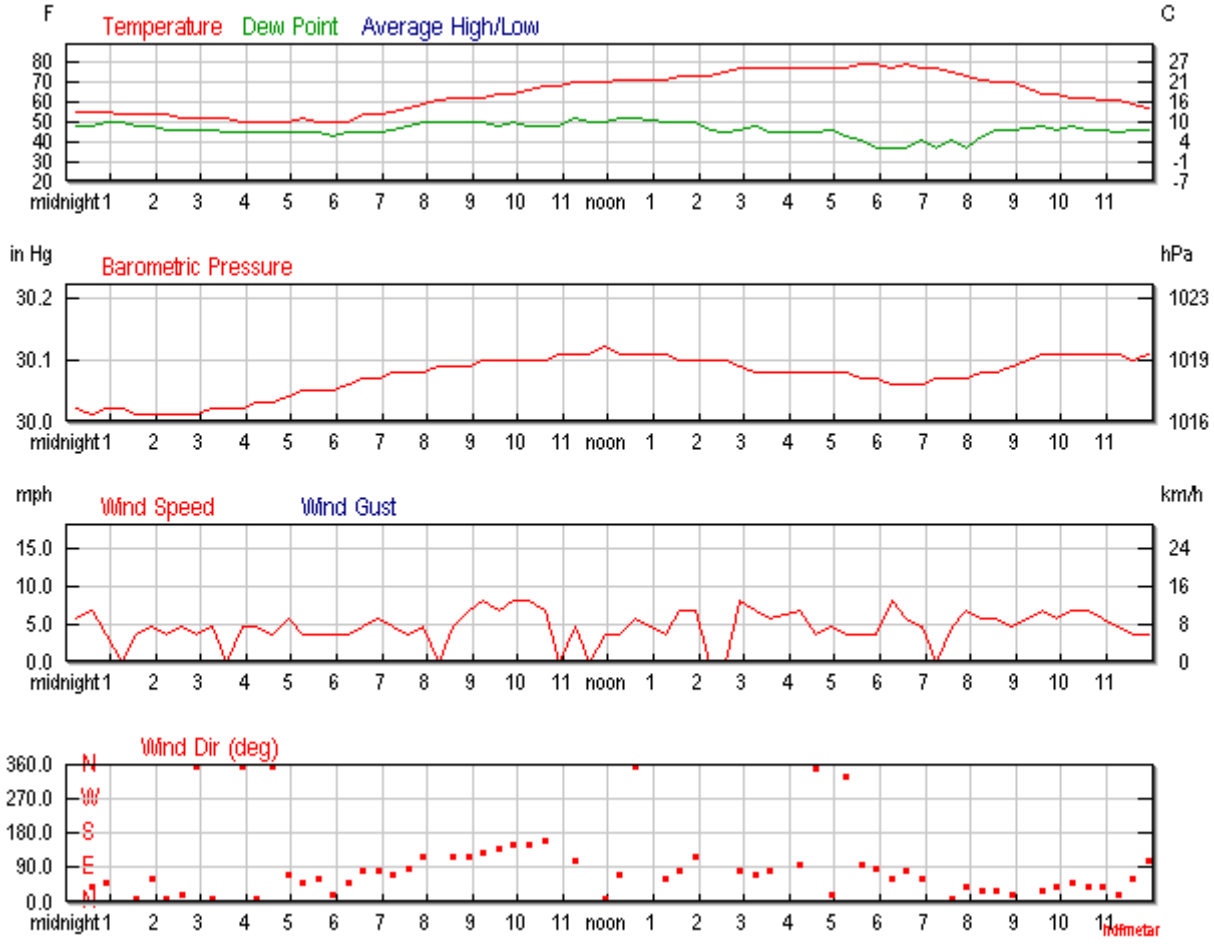


Figure 5

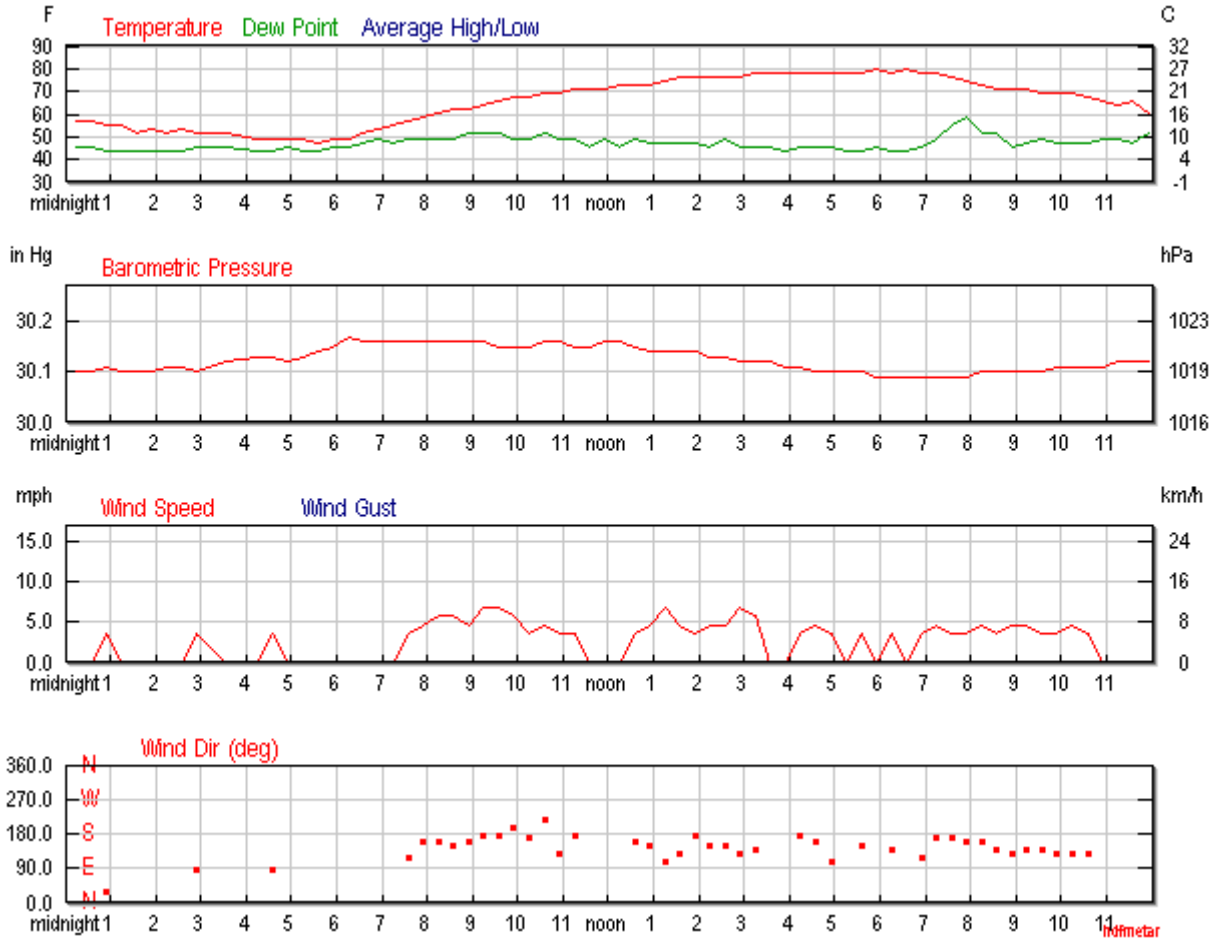

Balsam Lake (WBIC 322800), 2014
Treatment Area 14 (Bal4) Endothall Concentrations,
Endothall Concentration, ug/L ae
1200
1000
800
600
400
200
0
0
6
12
18
24
30
36
42
48
Hours After Treatment
Bal4
Target Conc
Baseline
Detection Limit

Appendix

Cumberland, WI, 5/28/14



Cumberland, WI, 29 May 14



Cumberland, WI, 30 May 14