**BPLA 2020 Season – Lake Elevation Summary Charts Descriptions**

**Prepared by Dennis Bengtson**

**Slide 1:** This is a seasonal summary of all elevations measured and reported in 2020 from April 7 through November 13. It combines the data from all previous monthly reports with data from the partial month of November (there is no separate monthly report for November).

**Slide 2:** As expected, our lake elevation continues to correlate directly with the outflow of the upstream USACE Pine River Dam and this relationship should hold since the new structure is virtually immune to erosion and breaching caused by high outflows. Recorded lake elevations all fell within our desired minimum and maximum elevations with the exception of five days in August when it was slightly above desired maximum due to a significant rain event. The most important result to current lake property owners was the ability of the new structure to maintain a usable lake elevation (roughly 3 inches above our desired minimum) during sustained periods of minimum outflow (33 cfs) in early July. This "hard bottom" elevation capability means our lake property owners can now set their docks and boat lifts at elevations in the spring without fear of having a dry lake bed under their dock or a boat stuck on their lift. Quantitative performance of the new structure is covered in Slides 6-8.

**Slide 3:** Although outflows from the Pine Rive Dam varied widely with frequent precipitation events, including one brief period of "no wake" request, none of them created excessively low or high elevations that would cause alarm among lake property owners.

**Slide 4:** The year-to-year comparison with 2019 shows a 7.2" reduction in seasonal bounce from 22.8" to 15.6" (the lowest observed in the past 10 years). As previously mentioned, there were no recorded elevations below our desired minimum and only 5 slightly above our desired maximum.

**Slide 5:** Our daily elevation measurements are reported monthly to the MNDNR as part of our Lake Level MN program participation. They then report it under the Water Level tab of Lake Finder for Big Pine Lake (ID - 18026100). Their Hydrograph clearly shows the improvement in 2020 seasonal bounce compared to seven of the past ten years.

**Slide 6:** Outflows from the USACE Pine River Dam were the result of daily operations in response to frequent precipitation events in order to keep the Whitefish reservoir's pool elevation within their 6 inch "Summer Band". The higher outflows in April were necessary to manage snow melt while raising the pool elevation and to begin their "fall drawdown" in mid-October and November.

**Slide 7:** This is a composite of correlation analyses showing three performance aspects of the new structure at Weir 6 and the Fish Passage:

- The **blue** line is the linear relationship between all Pine River Dam outflows and our measured lake elevations for each day of the season. Note that it includes measurements during all outflows, whether rising, steady and falling, and reflects the influence of our lake's surge capacity on daily elevations.
- The **green** line is a similar linear relationship but includes only data for days when the outflows were at a steady level for three days or more. When compared to similar analyses of the old rock dam, this relationship is "flatter" due primarily to the longer 315' control surface of Weir Six.
- The **red** line is a similar linear relationship that includes only data for outflows below 100 cfs when the Fish Passage was the primary control structure.

**Slide 8:** This shows that the linear relationship of the green line mentioned above for stable outflow conditions (note tighter clustering of data points) is exactly the same with the full season data set as it was for the initial analysis period of April 7 - May 31. For all outflows from 100 cfs or more, the new structure will deliver slightly lower lake elevations respectively than any prior configuration of the old rock dam (except when it was severely breached, of course). This partially mitigates the flooding exposure to south-side lake properties.

**Slide 9:** This chart clearly shows the influence of our lake's surge capacity on daily elevations under all conditions of Pine Rive Dam outflows, whether rising, steady or falling (note wider scattering of data points). The marked difference in the slopes of the linear relationships (between the blue and green lines) indicates that our lake elevations will be relatively higher with increased frequency and amplitude of daily outflows and "settle back down" in periods of steady outflows at any level. Of course, we have no control over upstream dam outflows which are driven by operational decisions to control the pool elevation of the Whitefish reservoir.