Memorandum

To: Brian Christianson

From: Rob Montgomery

Date: February 16, 2011

Re: Stage frequency analysis for Lake Koshkonong

As requested, attached are two plots (Figures 1 and 2) that describe the stage frequency for Lake Koshkonong during the boating season (April 1-October 31). These plots show the duration of time (on the x-axis) that water levels are higher than a particular Lake water surface elevation (on the y-axis). I know you requested these plots for use in discussing slow-no-wake rules, but they also illustrate a number of interesting issues about how Lake Koshkonong water levels have varied over the past 25 years.

The source of data for these plots is the USGS Gage on the "Oxbow" at Bingham point -- USGS Gage 05427235, Lake Koshkonong near Newville, WI. The flow data discussed is from the USGS Gage 05427570 on the Rock River at Indianford. All of the elevation data in our analysis are reported to the "old" NGVD 1929 sea level datum that specifies gage height 0.00 equals 770.01. Note that after 2008, the USGS is reporting that gage height 0.00 corresponds to 769.77 ft. above sea level, NAVD88 datum, which is the latest sea-level datum in the area. I don't believe the operating orders for the dam have been adjusted to account for the change from NGVD 1929 to NAVD88, so the NGVD 1929 datum, which we have used, is consistent with everyone's general understanding of the Lake elevation and the Indianford Dam operating order requirements.

This datum issue can be confusing. The RKLD website correctly describes the conversion of gage height to the old NGVD 1929 sea level elevation, but it is not consistent with the currently described gage datum on the USGS website (http://waterdata.usgs.gov/nwis/uv?05427235). If your work on the slow-no-wake rules will involve outside parties watching the USGS Gage website to set slow no-wake orders, we should make sure that everyone understands the difference between the two datum's, and everyone agrees on the datum that will be used for calling out changes in boating rules. The most foolproof approach would be to use the gage height directly, which is the data that is reported on the website, rather than make the conversion to a sea level elevation. Please call to discuss this further if needed.

Our observations from the attached Figures are summarized below:

Figure 1 shows the boating season (April 1 through October 31) stage frequency for Lake Koshkonong for various periods of record: the full gage record of 1987 through 2010, the period 2003 through 2010, when all wicket gates were operational, year 2008 of the big floods, and years 2009 and 2010. The results were somewhat surprising:

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1. The stage-frequency plot based on the full Lake Koshkonong gage record, 1987 - 2010, is shown as the blue trace on Figure 1. Although this trace includes the flood conditions experienced in several years, it shows the lowest frequency of water levels -- approximately 18% of the boating season -- at the prospective slow-no-wake elevation of 778.0. This is because the many of the years from 1987 through 2010 were relatively low discharge with corresponding low water levels. The average Rock River discharge for the boating season for 1987-2010 is slightly more than 2,000 CFS, the lowest of any of the periods of record we evaluated.
2. We plotted the stage frequency for years 2003-2010 (pink trace on Figure 1) to show the more recent Lake level data, for the period after the wicket gates at Indianford Dam became fully operational. For this period, Lake levels exceeded 778.0 for approximately 25% of the boating season. Given the same discharge in the Rock River, having the wicket gates operational should create slightly lower water levels elevations near the crest of the dam, because more flow can be passed through the gates. However, this theoretical impact has been overwhelmed by the fact that years 2003-2010 had considerably higher discharge (average of approximately 2,500 CFS) than the average over the full period of record.
3. We plotted year 2008 on its own (orange trace on Figure 1) to show the long duration of extremely high water levels that occurred during that year. In 2008, water levels exceeded 778.0 approximately 50% of the boating season. Rock River discharge was nearly 5,000 cfs for 2008, significantly higher than in the other analyzed periods of record.
4. The two most recent years, 2009 – 2010, did not have the extremely high flood elevations that were experienced in 2008, but they were nevertheless quite wet years with relatively high flow on the Rock River. The stage frequency relation for 2009-2010 is shown on the green trace on Figure 1, and indicates that Lake levels exceeded 778.00 for 40% of the boating season. The average discharge of the Rock River for 2009 2010 during the boating season was slightly over 3,000 CFS, 50% greater than the long-term average from 1987 through 2010. So, years 2009-2010 had substantially higher water levels for much of the boating season than the average of long-term conditions, and probably should not be used to be representative of the expected future condition.

Figure 2 shows the stage frequency for each month individually from April through October, for the period 2003 through 2010. This data includes the multiple large flood year 2008. The data illustrate large differences in likelihood of high water through the months from spring to fall. During April, water levels exceeded 778.0 approximately 55% of the time, during May, June and July, approximately 30%, and during October, 0% of the time.

Call with any questions.

Attachments:

Figure 1: Stage frequency analysis for Lake Koshkonong, selected time periods, during boating season

Figure 2: Stage frequency analysis for Lake Koshkonong, months April through October, years 2003-2010

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Figure 1: Stage Frequency Analysis for Lake Koshkonong,
for Selected Time Periods during the Boating Season (April-October)

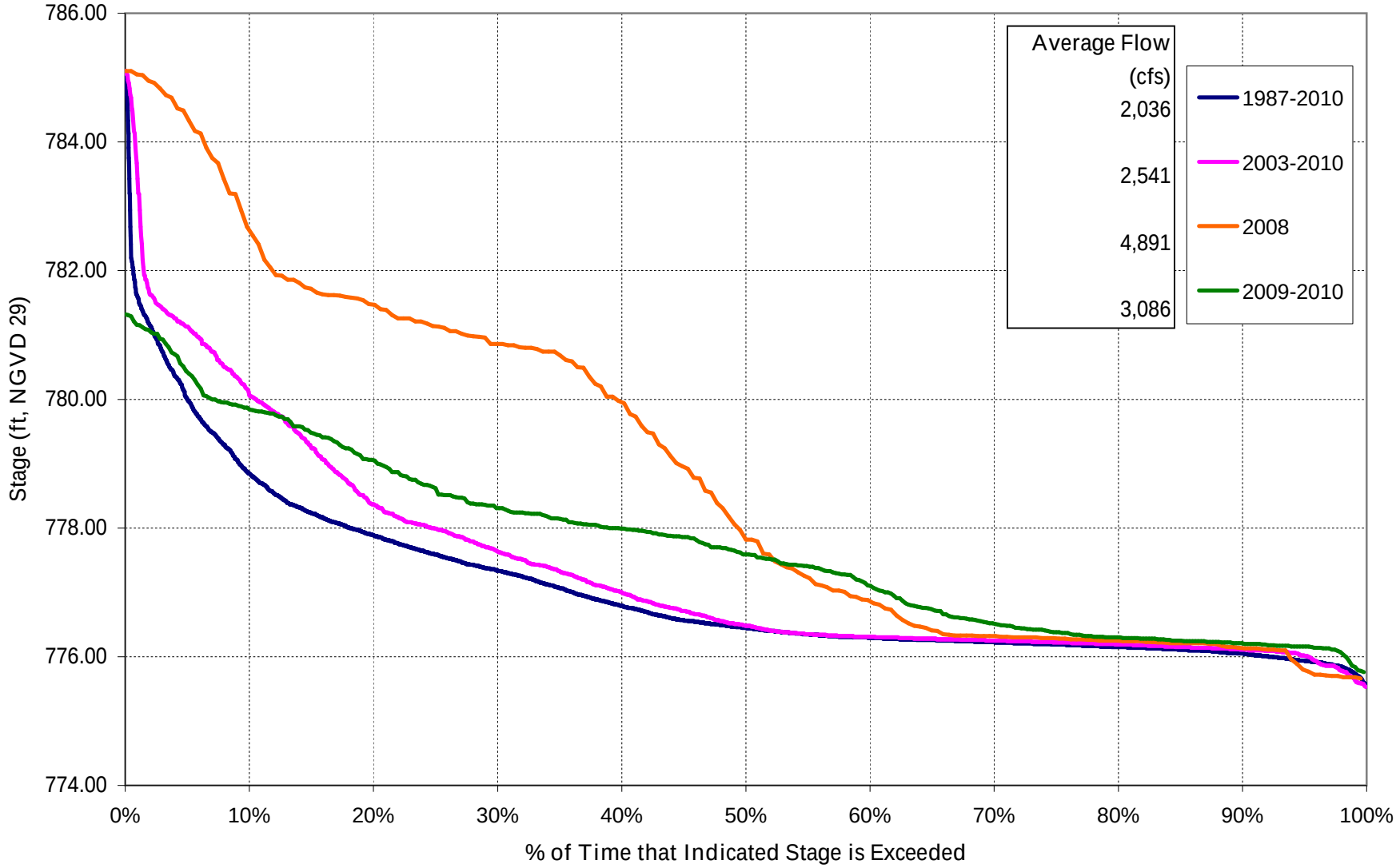

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Figure 2: Stage Frequency Analysis for Lake Koshkonong,
for Months April-October Using Years 2003-2010