

United States Department of the Interior

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July 15, 2024

Brent Brown
Jacobs Engineering
1610 N. 2nd Street
Suite 201
Milwaukee, WI 53212

RE: Summary comparison between City of Waukesha Clean Water Plant and USGS return flow Monitoring

Dear Brent,

I am pleased to provide a summary of the City of Waukesha's return flow monitoring at the facility located on W. Oakwood Rd in Franklin, WI for the period **April through June 2024**. Localized flooding of the Root River in early April created a backwater condition in the return flow discharge pipe that affected estimates of discharge on April 3rd and 4th. Daily volumes measured by the USGS for all other dates were within 1% of those measured by the Clean Water Plant (CWP) maintained by the City of Waukesha. Additional detail is provided below for your review. Please do not hesitate to contact me should you have any questions.

Sincerely,

William R Selbig

William Selbig
Research Hydrologist
USGS – Upper Midwest Water Science Center

Waukesha Clean Water Plant Flow Monitoring: APRIL – JUNE, 2024

Flooding of the Root River in early April created backwater conditions near the City's return flow discharge structure at 60th Street and Oakwood Avenue causing water levels at the USGS monitoring location to erroneously increase (figures 1 and 2). The regression used to compute instantaneous discharge by the USGS assumes free flowing conditions and does not adjust for changes in velocity. This approach to computing discharge was selected to limit the influence of velocity sensors that can be prone to error and are difficult to calibrate. However, during periods of backwater, an increase in water level without correction for reduced velocity will produce erroneous discharge values when using a stage-discharge regression. Therefore, USGS measured discharge and calculated volume were considered unreliable on April 3rd and 4th. They were subsequently censored when comparing to daily CWP mag meter values. USGS measurements of discharge returned to normal after flood waters receded later in the day on April 4th. The backwater conditions did not impact the CWP mag meter flow measurements.



Figure 1. Photo of water levels in the Root R. encroaching upon the return flow discharge structure. Photo taken on April 4, 2024 at 12:40 pm.

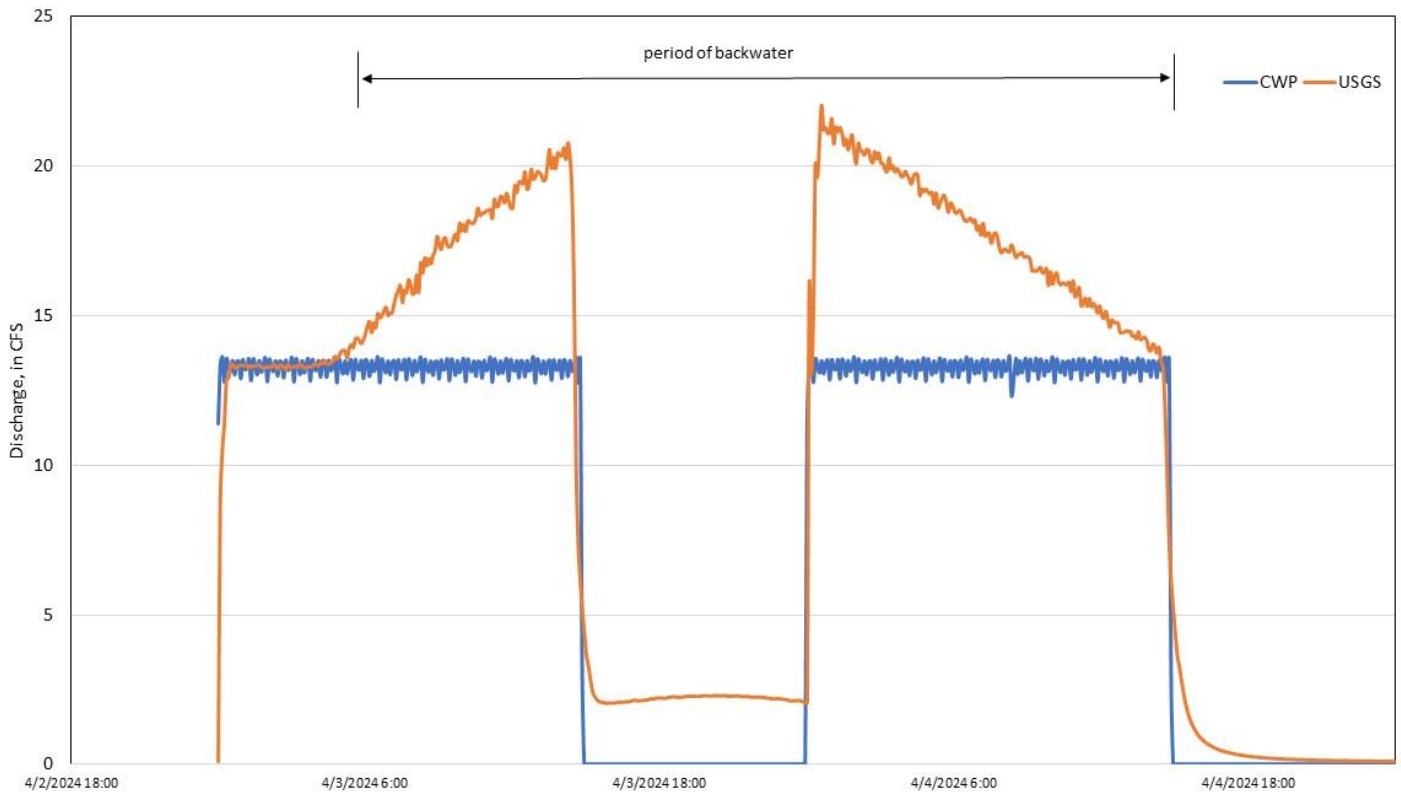


Figure 2. Backwater from the Root R. created erroneous measurements of discharge by USGS on April 3rd and 4th. Note how USGS and CWP measurements were in close agreement prior to the effect of backwater on April 3rd. Measurements returned to normal later in the day on April 4 as flood waters receded.

Except for April 3rd and 4th, daily volumes measured by the USGS were generally within 1 percent of those measured by the CWP mag meter (figure 3). There was little variation in daily volume among and between each month with median values ranging from approximately 710,000 to 717,000 cubic feet and coefficients of variation less than or equal to 0.01 (table 1). Monthly sums were similarly consistent with May having slightly more volume than April and June. April, having two less days than May or June due to the influence of backwater, had the lowest monthly volume. Like daily volumes, differences between monthly sums were within 1 percent (table 1). The range of percent differences presented in figure 3 and table 1 is considered acceptable and within the accuracy of the meter used to measure discharge at +/- 2 percent.

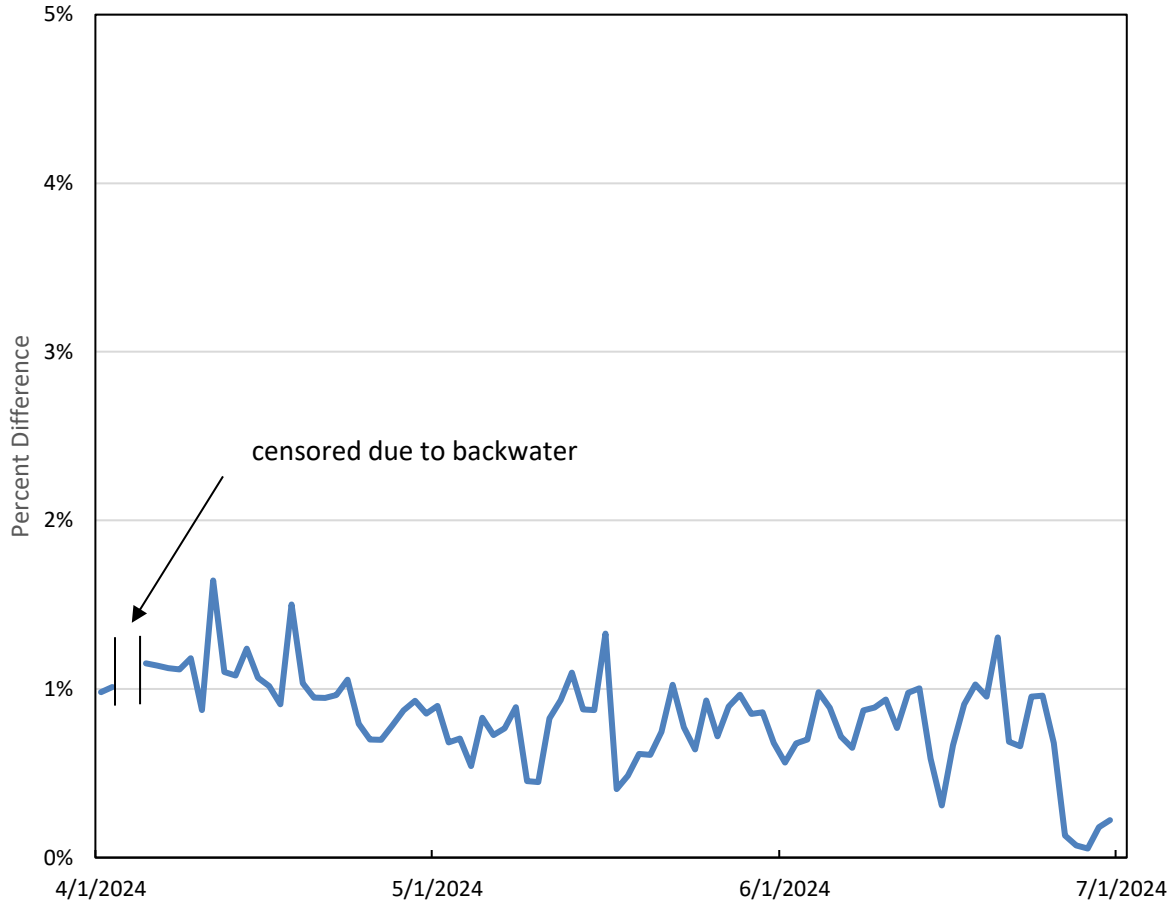


Figure 3. Percent difference between the USGS and CWP daily volume in April through June 2024. A positive value indicates USGS flow measurement is greater than the CWP’s measurement. Flooding of the Root R. in early April caused backwater conditions near the CWP making measurements unreliable.

Table 1. Summary statistics for daily return flow volumes measured by USGS and CWP, April – June 2024. All values rounded to the nearest 1,000 cubic feet unless otherwise noted.

Statistic	APRIL		MAY		JUNE	
	USGS	CWP	USGS	CWP	USGS	CWP
Days	28 ^a	28 ^a	31	31	30	30
Minimum	714,831	705,860	713,129	705,491	709,937	706,819
Maximum	720,651	710,019	717,726	710,403	717,211	710,138
Median	717,144	709,914	715,380	709,908	715,010	709,905
Mean	717,082	709,764	715,325	709,785	714,714	709,726
Standard deviation	1,232	767	1,202	807	2,261	641
Variation coefficient	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Sum	20,078,287	19,873,379	22,175,082	22,003,350	21,441,413	21,291,782
Sum, % difference	1.0%		0.8%		0.7%	

a – does not include April 3-4