

## MEMORANDUM

To: Rick Raymondi  
Fr: Bryce Contor  
Stacey Taylor  
Date: 6 December 2010

Re: KEK201 Task 12, Egin Return Flow Monitoring

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### **BACKGROUND**

This memo is the final deliverable for Task 12, monitoring of Egin return flows. It accompanies the following files:

1. ***Microsoft Word - MEMORANDUM\_Install\_Returnflows.pdf***

This describes the installation of the data logger and stilling well. It is a copy of the memo that was delivered to IDWR in July 2010.

2. ***END\_OF\_CANAL.xls***

This file contains the following worksheets and data:

a) ***CALCS***

This worksheet contains the calculations of barometric correction and some of the graphics used in this memo.

Worksheet columns I and J contain the barometric-corrected logger readings to be used in developing a rating and calculating flow.

b) ***WeatherStationBaro***

This contains altimeter pressure data obtained from the University of Utah's weather website, MesoWest (<http://mesowest.utah.edu/index.html>), used for the period 18 November 2010 through 24 November 2010. The data are for Rexburg, Idaho.

c) ***Egin\_endofcanal 2010-11-24 19-2***

This worksheet contains the raw data downloaded from the

transducer placed at the return-flow measurement site. Note that the first reading was obtained before the logger was placed and the last one was obtained after the logger was removed. Note also that the site was dry when the logger was removed.

d) ***7N39EBaro20101005 2010-11-18***

These are the barometric pressure data for October 5 through November 18.

e) ***baro6hr\_7n39e16\_20100716 2010-1***

These are the barometric data for July 16 through October 5.

f) ***WeirStick***

This worksheet contains the staff gage readings, weir stick readings and current meter readings associated with this project.

## **CALCULATIONS**

IWRRI has calculated the barometric-pressure corrected head recorded at the return-flow site, as well as the flow associated with the weir stick and current meter measurements. The last six days of barometric pressure data were obtained from weather station data due to a failure in downloading from the barometric logger on 24 November 2010.

Altimeter data recorded at a weather station in Rexburg (station KRXE) were collected from University of Utah's MesoWest website. The pressure data collected at this station were recorded in units of inches of Mercury (in Hg) and converted to feet of water to compare to data collected from the barometric logger. Since the barometric logger records absolute pressure and weather-station data are adjusted to sea level equivalent, the weather station data needed to be adjusted by 5.45 feet of water to be comparable and appropriately adjust stage levels in the stilling well.

No rating calculations have been made.

## **DATA**

Figure 1 shows the time series of barometric-corrected stage data. Figure 2 shows the flow measurements for 2010, including one flow measurement made

before the installation of the instrument.<sup>1</sup> Figure 3 shows the stage data along with the flow measurements.

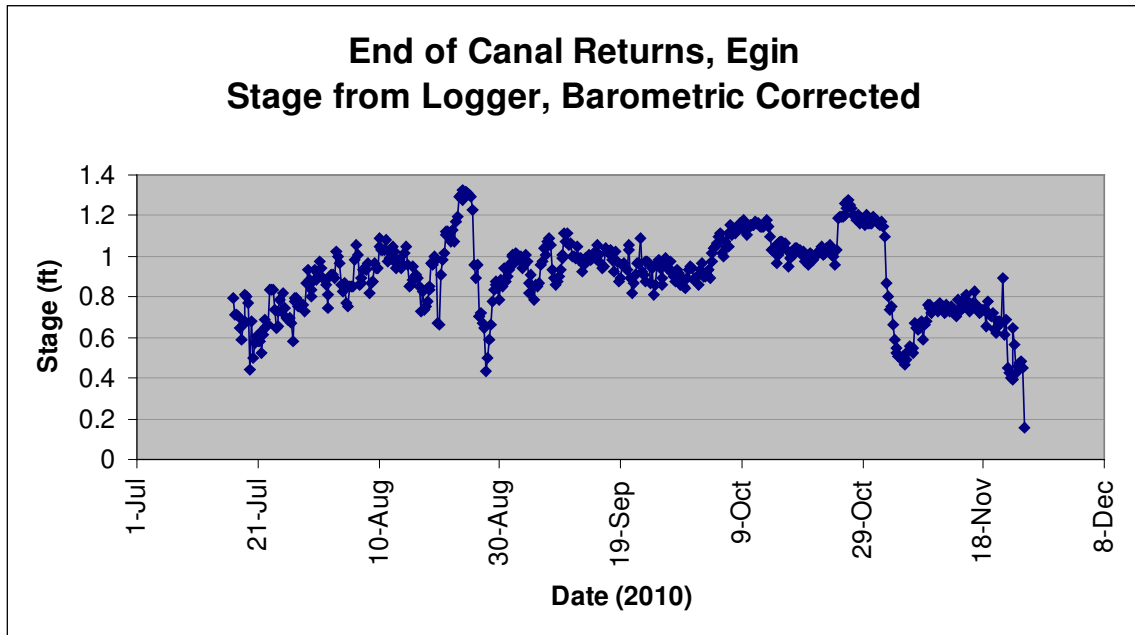


Figure 1. Barometric corrected stage data from Egin return flow site data logger, 2010.

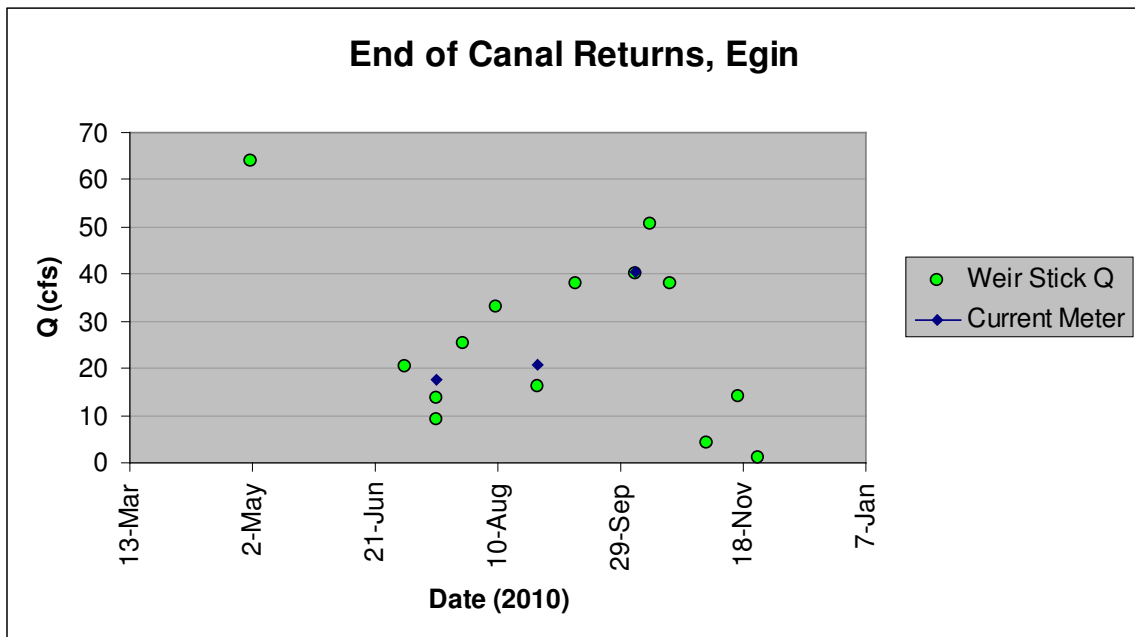


Figure 2. Flow measurements at Egin return flow site, 2010.

<sup>1</sup> Worksheet **WeirStick** in the data spreadsheet also includes flow measurements from 2009.

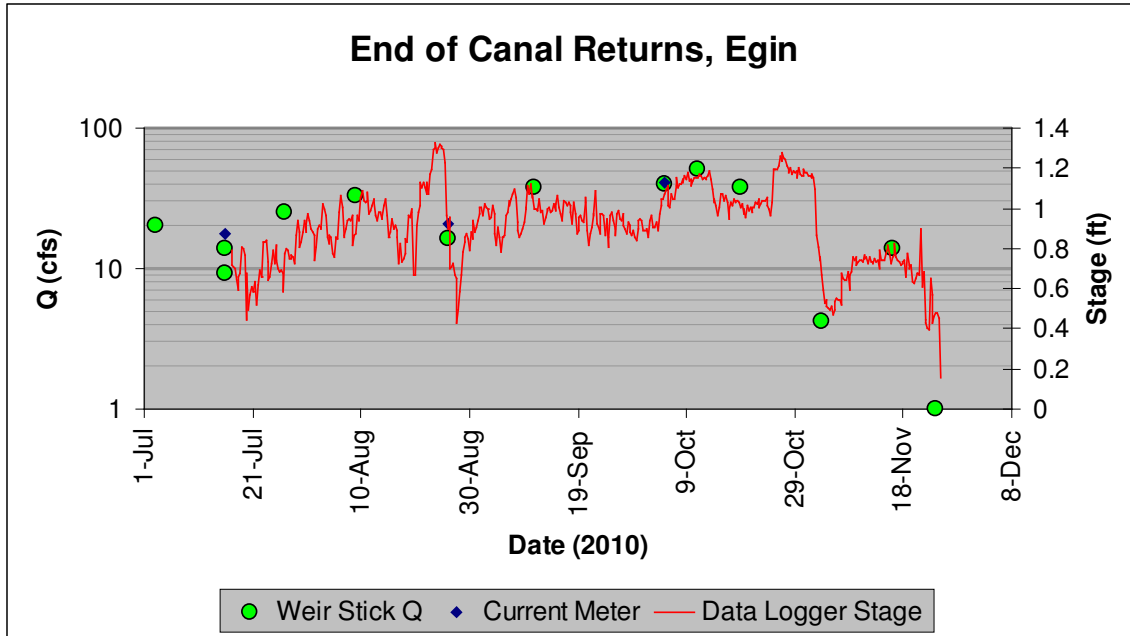


Figure 3. Stage data plotted with flow data. Note that flow data are plotted using a logarithmic scale.

## DATA CONCERNS AND ISSUES

There are a few data concerns and issues. These are:

1. There is a time discrepancy between the pressure transducer data logger and the barometric logger. This likely has to do with daylight savings time; when both loggers were installed, the time was set to six hour increments starting at midnight. However, the loggers were programmed with different computers and downloaded with yet another. The data for the barometric logger reports six hour increments starting at 11:00 PM, but the stage logger reports increments starting at midnight as programmed. It is not known whether the collections occurred at the same times and the time stamps are offset, or whether the time stamps are correct and the collections are off by one hour.
2. This time discrepancy may also affect correlation of staff-gage readings with the datalogger readings. All staff gage readings were recorded with current local time. It is not completely clear whether the datalogger times are with or without the daylight savings adjustment.
3. There is some imprecision and one apparent blunder in the recorded staff-gage readings or weir-stick readings, as shown in Figure 4. This imprecision carries forward into the correlation of flow measurements with stage, as shown in Figure 5.

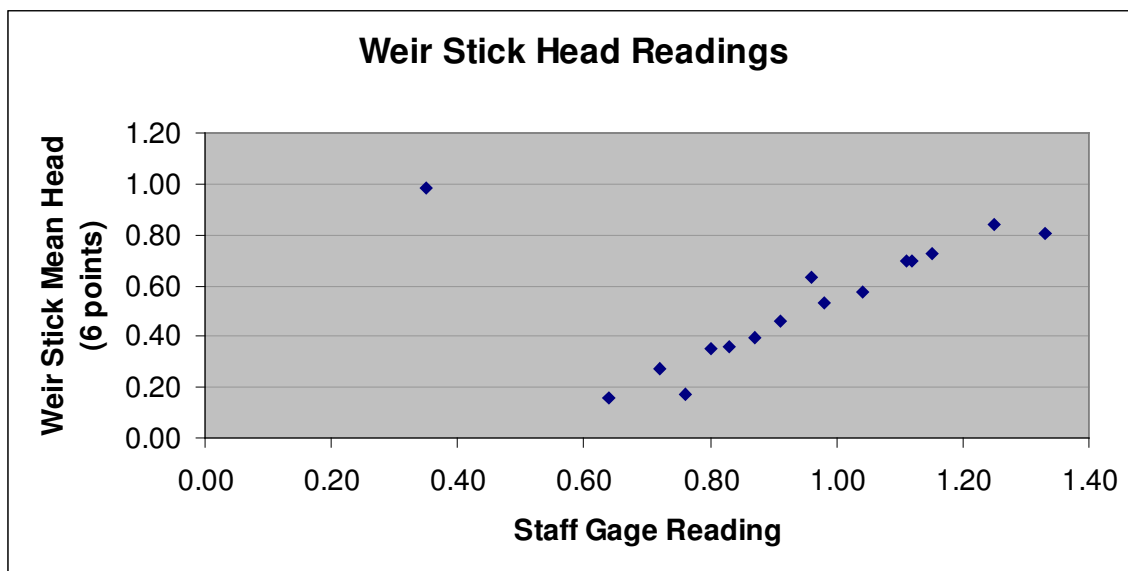


Figure 4. Weir stick and staff-gage readings.

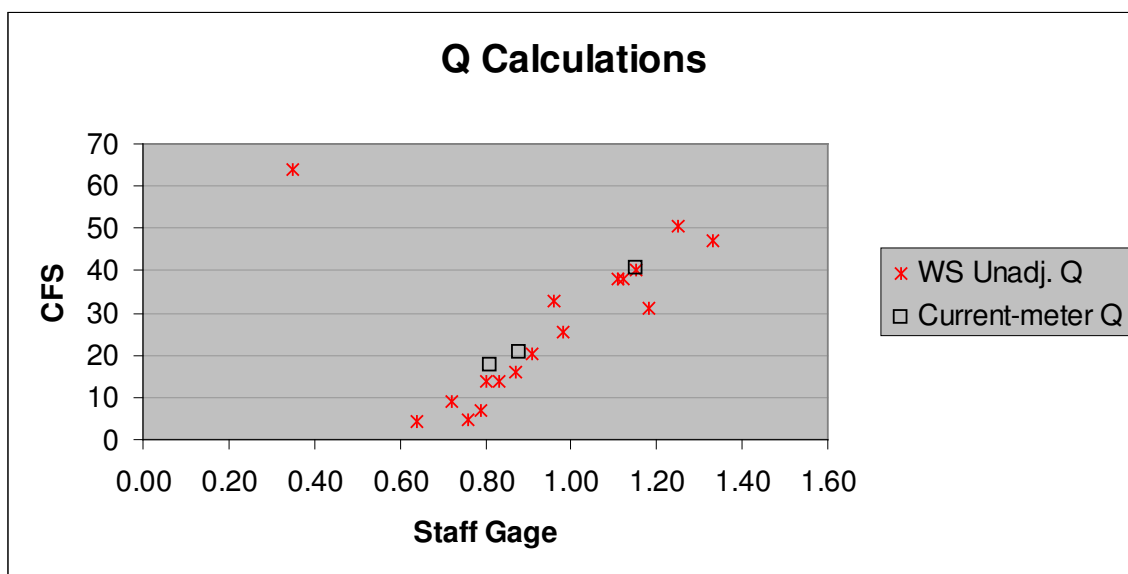


Figure 5. Flow calculations and stage readings.

- Figure 5 also illustrates that there is general but not perfect agreement between the current meter and weir stick readings. Because the check boards used for weir stick readings do not meet standard conditions, one would expect the weir stick to underestimate actual flow. This corresponds to the two current-meter readings obtained at about 20 cfs, but not to the reading obtained at 40 cfs.

During 2009 it appeared that the check boards were generally kept clean of weeds and trash. However in 2010, often weeds or trash were observed during the weir-stick measurements. Table 1 shows the change

in stage observed when the weeds were cleaned.

The implication of this is that if the rating curve is developed using the post-cleaning stages presented in these data, the calculated flows will be an upper limit. Table 1 could be used with the rating curve to estimate how much the actual flow may be less than the calculated flow on an average basis. Alternately, Table 1 could perhaps be used to estimate some kind of "net of trash" average rating. In any case, there will always be uncertainty about the degree of trash and the frequency of cleaning. This will always translate into some imprecision in the measurement of returns.

An effort was made to check the flow near the times of data-logger readings. However the uncertainty in the time stamp described above, along with the change in stage associated with cleaning the check boards, will make it difficult sometimes to correlate the staff-gage readings with the recorded stage. Note that the staff-gage readings in cells B3:B24 of worksheet **WeirStick** are the post-cleaning readings, except for the one boxed in a heavy outline (18 August 2010).

Table 1  
Change in Stage Associated With Cleaning  
Weeds From Check Boards

Date	Stage With Trash (ft)	Stage Cleaned (ft)	Difference (ft)
26-Aug-10	1.03	0.89	0.14
11-Sep-10	1.17	1.12	0.05
5-Oct-10	1.21	1.15	0.06
11-Oct-10	1.27	1.25	0.02
19-Oct-10	1.13	1.11	0.02
3-Nov-10	0.65	0.64	0.01
16-Nov-10	0.88	0.85	0.03

## CONCLUSION AND RECOMMENDATIONS

These data provide far greater temporal resolution than has ever been available for return flows at this site. However, the challenges posed by trash, time discrepancies and the correlation between the weir stick readings and current-meter readings indicate that there is still some uncertainty and lack of precision in these data. Recommendations for 2011 are as follows:

1. This site should be retained as part of the return-flows network.
2. The logger should be placed in antifreeze as before. The manufacturer should be contacted to see if the wetted materials are compatible with recreational-vehicle antifreeze, which is non-toxic.<sup>2</sup>
3. Permission should be obtained from the adjoining landowners for an exploration downstream from this site to the river, for a potential rated section that will not suffer from trash buildup on the check boards. If a suitable site is found, the stilling well and transducer should be moved.
4. With manual cleaning at the time of measurement, the check boards should still be adequate for rating measurements.
5. Based on theoretical conditions and the two current-meter readings near 20 cfs, all weir-stick readings should be adjusted upwards by 10 percent. These adjusted readings and the three current-meter readings should be used to calibrate the rating curve.
6. The barologger and the data logger should be programmed and downloaded with the same computer. It should be noted whether the computer is set on daylight savings time at both the time of programming and the time of downloading data.
7. Rating measurements with the weir stick should be made approximately every six weeks during the entire irrigation season. While the weir stick is perhaps not as precise as current-meter measurements, this recommendation is based upon the following:
  - a) This is a challenging location for current meter measurement and the confidence in current-meter data is not particularly high;
  - b) The imprecision associated with varying degrees of trash overshadow any potential imprecision in the weir stick rating;
  - c) Current metering is significantly more costly and time consuming than weir-stick measurements.
8. Rating measurements should include a before-cleaning and after-cleaning staff gage reading, and a photograph of the amount of trash.
9. The 2010 and 2011 data may provide enough data for a solid correlation between the staff gage and weir stick readings, and in future years only staff-gage readings may be needed.
10. Due to storms and road closures, the logger was not retrieved before water went out of the canal. It was frozen in the stilling well, but fortunately five gallons of warm water thawed it enough for retrieval.

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<sup>2</sup> Automotive antifreeze was used in 2010, after consultation with InSitu technical support.

For 2011, it may be well to retrieve the logger early and estimate the last week or two of data, or else plan on leaving the logger deployed all winter and downloading data in the spring.