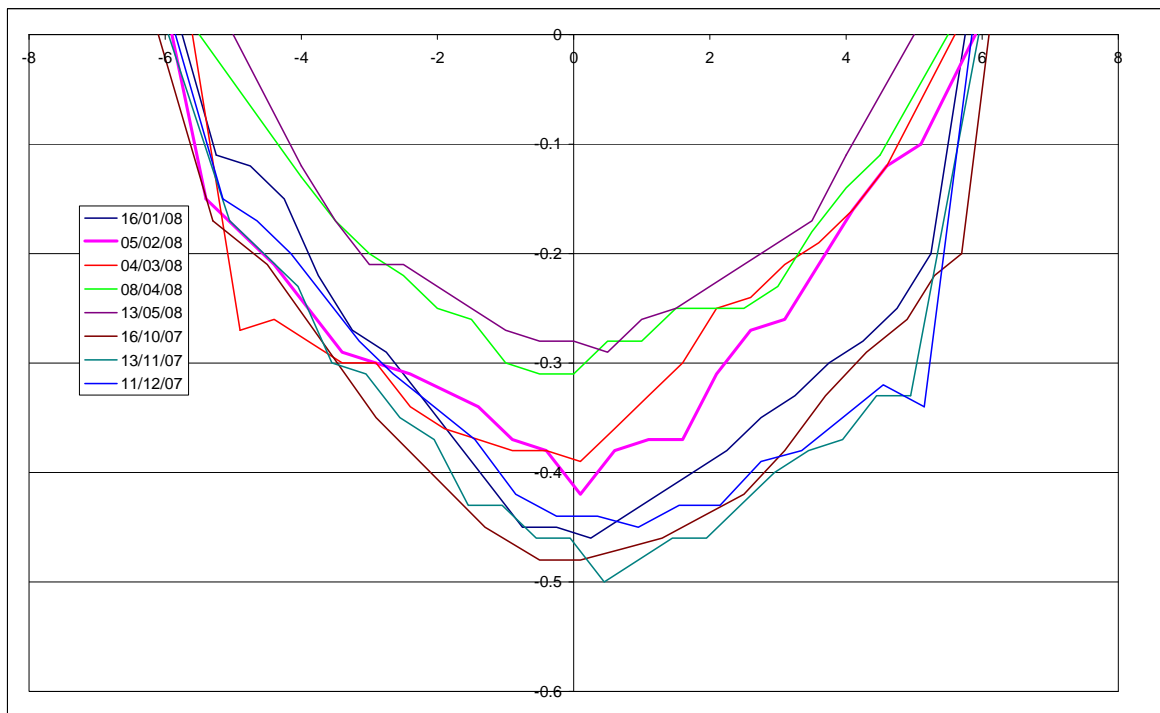


COMMENTS ON GRAYS RIVER FLOW DATA AND ESTIMATES OF MALF

Further to my previous email dated 26 July 2009, I have obtained the gauging details for the measurements taken by Environment Canterbury for the Grays River at Days Bridge. Data for the 2007/08 gaugings were supplied in "glogger" file format. A summary of all gaugings had previously been provided by Tony Gray.

I have reviewed the gauging data for Days Bridge and looked specifically at the relation between flow rates, maximum depth, area and mean velocity. The purpose of doing this is to check whether the gaugings carried out at the site are all consistent with the expected hydraulic properties of the site. Figure 1 shows the plot of cross-section and depth for the 2007/08 gaugings.

Figure 1 : 2007/08 Gaugings at Days Bridge



Figures 2 and 3 shows the relevant area and mean velocity plots for all gaugings.

The data shows that there is a significant change in the relation between flow rate and area, and flow rate and mean velocity. These changes can be attributed to a change in channel dimensions and shape, similar to rating changes.

Gaugings removed from the analysis

There are 2 noticeable outliers to the data – notably the gaugings carried out 4 December 1972 and 14 April 1981 are extremely suspect. The 4 December 1972 mean velocity value of 1.085 m/s grossly higher than any other gauging. The 14 April 1981 mean velocity is twice the expected value, and the area is only half the expected value. Both gaugings have been removed from the dataset.

In addition to the 2 gaugings referred to above, I have removed the gauging carried out on 6 October 2007 for the same reason that Suzanne has done (forks / Mary Burn held up by snow melt).

I have also removed the gauging carried out on 5 February 2008. That gauging has a flow value of 1050 l/s which is grossly lower than any measured flow. The recorded velocities are significantly lower than other gaugings with comparable depths and areas (see figure 1).

Figure 2 – Flow / Area plots for Grays River at Days Bridge

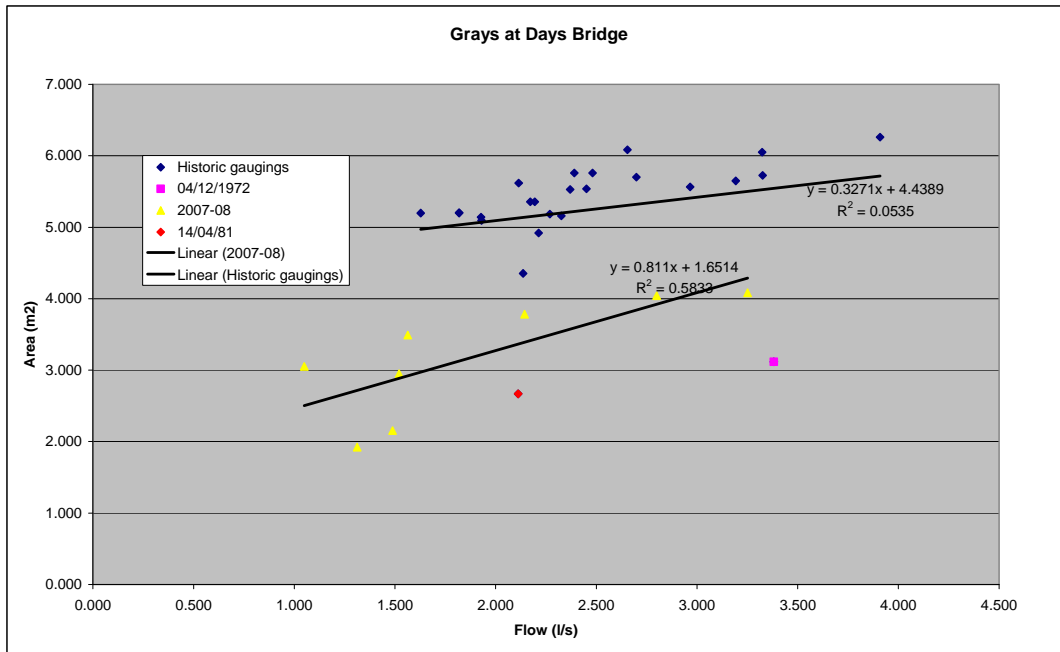


Figure 3 – Flow / Mean velocity plots for Grays River at Days Bridge

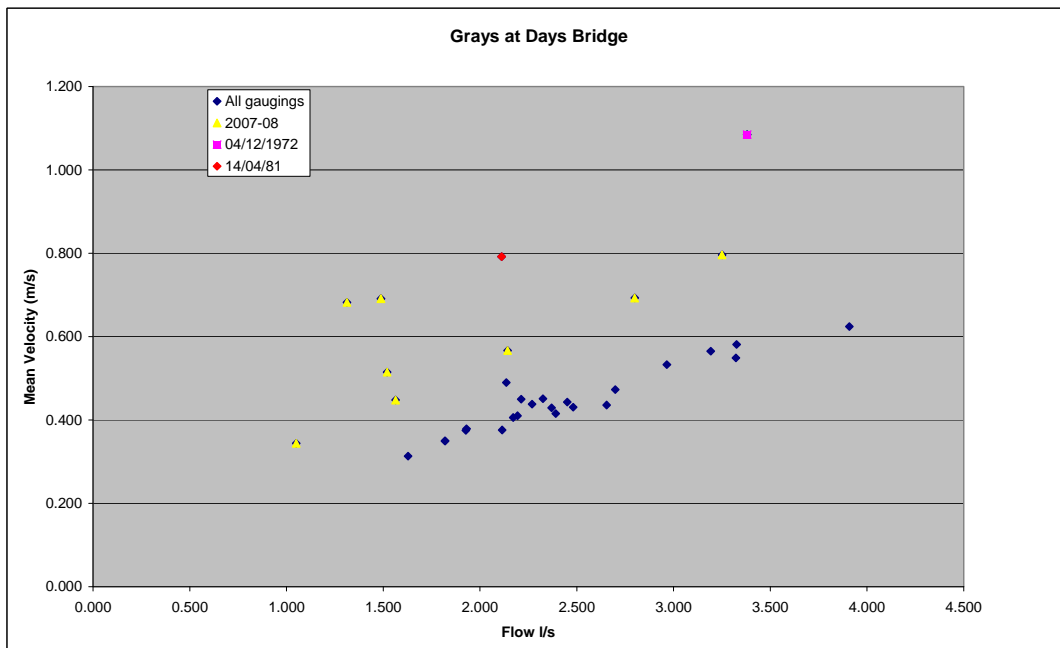
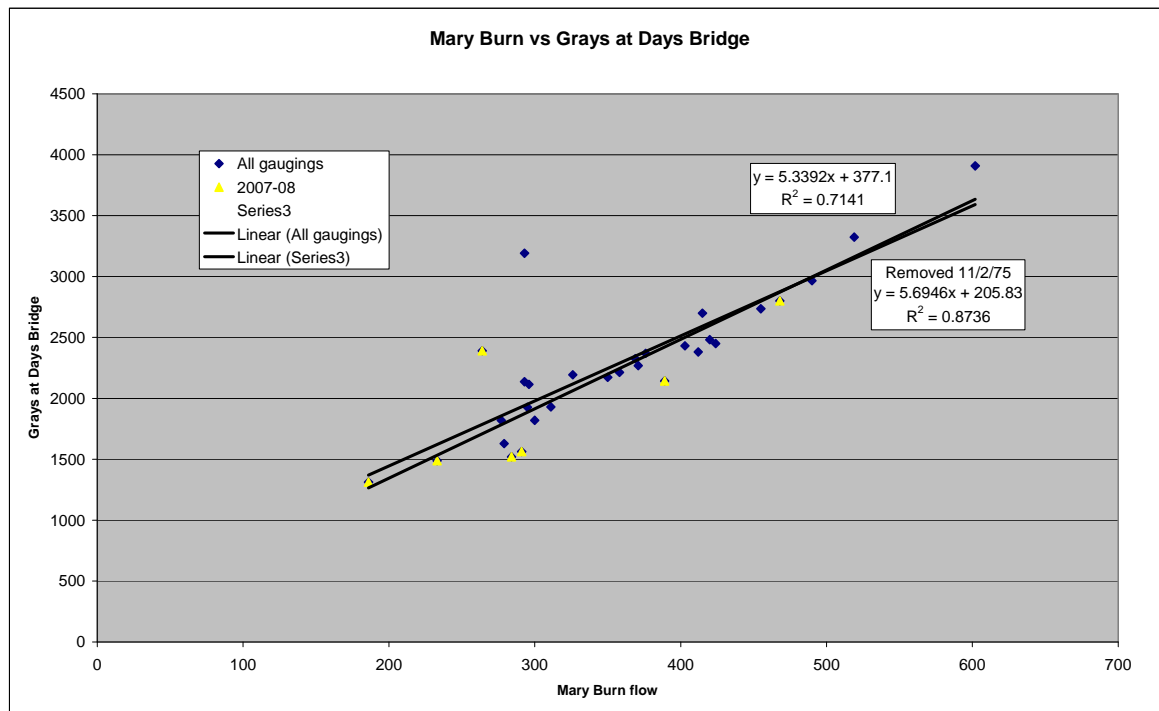


Figure 4 shows the regression plots of all the retained gaugings. The regression analysis shows that the gauging carried out on 11 February 1975 is also an outlier. The area / mean velocity plots indicate that this gauging is consistent with the other Days Bridge gaugings, therefore I suspect the discrepancy must be at the Mary Burn. With the removal of that gauging, the correlation coefficient changes from 0.7141 to 0.8736.

Figure 4 : Mary Burn regression using all retained gaugings



Removal of the gauging dated 11 February 1975 alters the regression to

$$y = 5.6946 \times \text{Mary Burn} + 205.83, r^2 = 0.8736$$

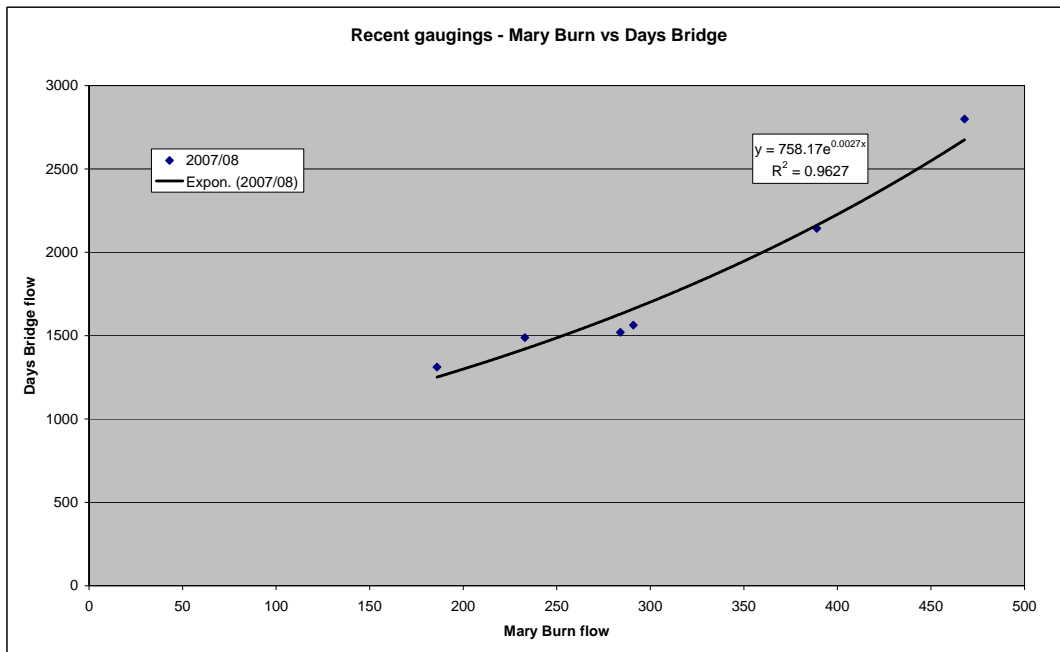
The calculated 1:5yr 7DMALF using all gaugings is 1570 l/s.

My previous comments refer to the fact that irrespective of the reasons, the gaugings carried out in 2007-08 all show that the Grays River flows at Days Bridge are less than they were historically. With that knowledge in mind it is not justifiable to include the older flow measurements when trying to determine a 1:5yr 7DMALF, which needs to be based on the present situation.

Figure 5 shows a plot of the 2007 / 08 gaugings. The measurements cover a good range of flows within the low to median flows range and the regression provides a correlation coefficient of 0.9627, which is far superior to any of the previously mentioned correlations. The regression is :

$$y = 758.17 e^{0.0027 \text{Mary Burn}} \quad r^2 = 0.9627$$

Figure 5 : Mary Burn regression using recent gaugings



Using this regression the 1:5 yr 7DMALF for Days Bridge is 1450 l/s. I understand that this value is similar to one that David Stewart obtained, and I believe it is a better estimation of the low flows that can be expected to occur within the Grays River under the existing flow regime.

An email attachment file (Grays glogger files.xls), which provides the gauging data accompanies this message.

Richard de Joux
28 July 2009.