

Faecal bacteria monitoring in the River Wharfe upstream and downstream of Ashlands STW, Ilkley in 2020

Report from the Ilkley Clean River Group, December 2020

Summary

1. We present the results of surveys carried out on four occasions in 2020 of *Escherichia coli* (*E. coli*) and intestinal enterococci (IE) concentrations at selected sites on the River Wharfe between Bolton Bridge and Burley Weir.
2. Four of the sites are located within the newly designated bathing water stretch of the river close to Ashlands Sewage Treatment Works.
3. The data confirm results of previous surveys conducted in 2019 highlighting the influence of both treated and untreated effluent discharges from Ashlands STW on the high bacterial concentrations in the river downstream.
4. Whilst bacterial pollution from Ashlands is likely to reach downstream as far as Burley Weir, it is probable that discharges from Ben Rhydding STW contribute most to the bacterial load at Burley.
5. The results also indicate that spills of untreated effluent during and immediately after heavy rainfall events from the Addingham Pumping station are the main cause of pollution arriving at the designated Ilkley beach from sources upstream.
6. Although point source discharges from STWs are by far the most important sources of faecal bacteria in the river, background levels are sufficiently high to indicate that faecal pollution from agricultural livestock and septic tanks in rural areas upstream will also need to be controlled if bathing water standards are to be achieved at the designated site in Ilkley.

Introduction

We began monitoring faecal bacteria populations in the River Wharfe upstream and downstream of the Sewage Treatment Works (STW) at Ashlands in Ilkley in May 2019. Surveys were conducted on five dates, approximately monthly from May to December. Here we report on the continuation of the project in 2020.

The results of the 2019 surveys were presented in a series of reports to Ilkley Town Council (<https://sites.google.com/view/cleanwharfeilkley/home>). The data were used to support Ilkley's campaign to improve water quality in the river and to support an application for Bathing Water status to be designated for the stretch of river from Ilkley New Bridge to Beanlands Island.

The 2019 results showed there were: (i) high concentrations of *Escherichia coli* at Beanlands Island on all occasions due to the continuous discharge of treated effluent from Ashlands STW upstream; (ii) intermittent but very high concentrations of *E. coli* downstream of the

Ashlands combined sewer overflow (CSO) after wet weather events; (iii) relatively low concentrations immediately upstream of Ashlands in dry weather conditions; and (iv) relatively high concentrations immediately upstream after very wet weather. These high concentrations were assumed to be caused by intermittent discharges of untreated effluent into the Wharfe from the Addingham Pumping Station CSO, three km upstream.

In early 2020, before the first national coronavirus lockdown and in anticipation of the Bathing Water application being successful, we applied for funds to Ilkley Town Council to continue monitoring. Our objectives were: (i) to monitor populations of intestinal enterococci (IE) as well as *E.coli*, the target organisms used by the Bathing Water Directive to classify the quality of European bathing waters; (ii) to monitor faecal bacteria populations at the Ilkley Suspension Bridge site, the site likely to be chosen by the Environment Agency (EA) for monitoring should the application to Defra be successful; and (iii) to monitor populations upstream and downstream of the Addingham Pumping Station during and after storm events. An additional objective established in August, following Burley Parish Council’s expression of interest in our project, was to establish faecal bacteria concentrations further downstream at Burley Weir.

	Level (m)
20 th July 2020	0.33
24 th Aug 2020	0.83
10 th Sept 2020	0.61
29 th Oct 2020	0.88
Min	0.17
Max	2.63

The sampling programme in 2020 began on July 20th. It included samples collected as part of the iWharfe project on August 24th, and on two subsequent occasions, September 10th and October 29th.

River levels at the Environment Agency’s Addingham monitoring station for the different sampling occasions, compared with the minimum and maximum values for the site are shown in Table 1.

Table 1. River Wharfe levels on sampling days at Addingham

Sites

The location of all sites referred to in this report is shown in Figure 1. Sites located within the boundary of the proposed bathing waters are highlighted in yellow. These include Ilkley New Bridge, Ilkley Suspension Bridge, a site we have called “Ashlands below the storm overflow” and Beanlands Island situated a short distance downstream from the Ashlands STW final effluent outfall. The Suspension Bridge and Beanlands Island sites were sampled on all four dates.

Sites sampled further downstream include the Denton Bridge site approximately one km east of Ashlands and Burley Weir Stepping Stones. The Denton Bridge site is strongly influenced by effluent from the Ashlands STW although concentrations of faecal bacteria there are typically much lower than at Beanlands Island, mainly as a result of die-off in the water column between the two sites. The Burley Weir site is approximately another four km downstream. It was sampled once in 2019. The concentration of *E. coli* on that occasion was

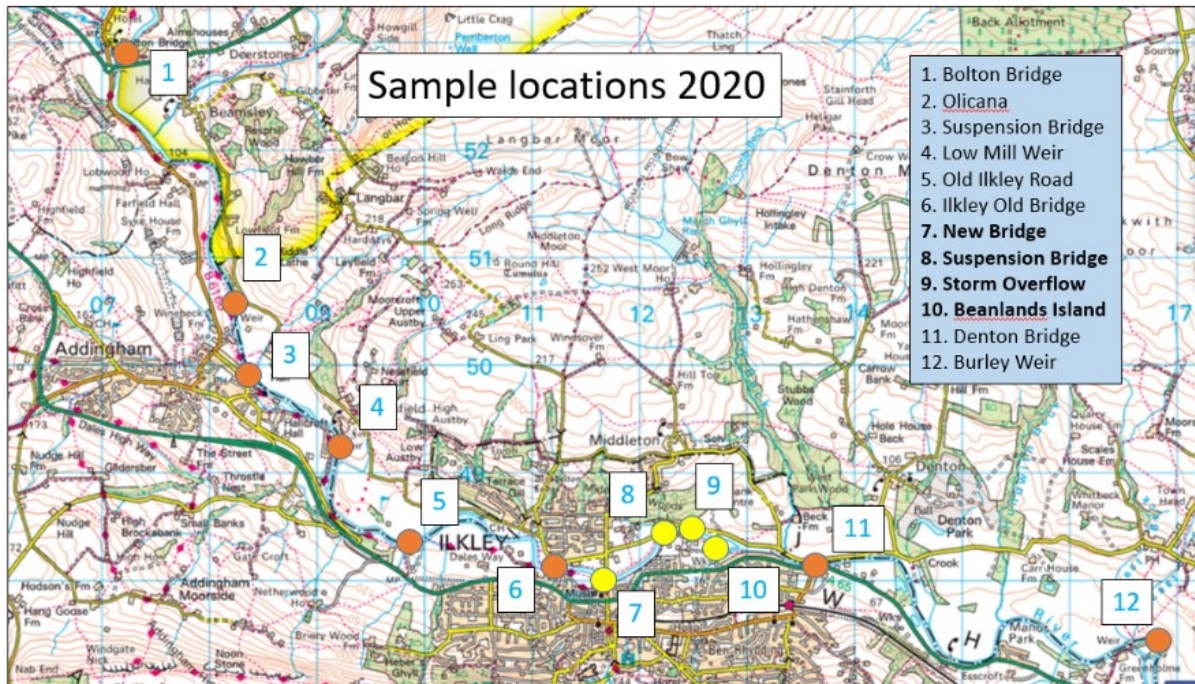


Figure 1. Map of sample locations in 2020. Not all sites were sampled on each occasion. Yellow markers indicate sites within the newly designated bathing water stretch

higher than upstream at Denton Bridge indicating that most bacteria at Burley Weir were not derived from Ashlands STW but from Ben Rhydding STW that is situated between the two sites. These two sites were sampled on three occasions in 2020.

The main site sampled upstream of Ilkley in 2020 was Low Mill Weir in Addingham. This site was selected as it lies immediately upstream of the Addingham Pumping Station and can thereby be used as a control site to identify the impact of faecal bacteria sources in the river between Addingham and Ilkley. It was sampled on all four occasions.

Other sites sampled included Addingham Suspension Bridge, Olicana and Bolton Bridge, which were part of the iWharfe project (<http://www.yorkshiredalesrivertrust.com/projects/iwharfe/>) on the 24th August and an intermediate site between Addingham and Ilkley, called Addingham Ilkley Road, sampled on the 29th October.

Methods

The methods used in 2020 were identical to those used in 2019 (July 2019 report). However, as our intention in 2020 was to follow the protocol set out in the Bathing Waters Directive, counts were made on all occasions of intestinal enterococci (IE) as well as *E. coli*.

In the field, samples were collected from bridges or from the river bank using 350 ml sterile bottles provided by ALS Ltd. Samples were kept in a cool bag and taken to the ALS collection point in Wakefield on the same day to be delivered to the ALS Ltd Coventry laboratory overnight. All counts were made within 24 hours of collection.

ALS Ltd is an accredited laboratory for microbiological analyses. A description of the methods used for counting can be found on the ALS website (<https://www.alsenvironmental.co.uk/client-services/method-statements/coventry-microbiology>).

Results

We present the results for all sampling occasions using bar charts to show the data site by site (Fig. 2 and 3) and for two of those occasions we also show the data on maps of the river (Figs. 4 and 6). On the maps the concentration values are shown as numbers of colony forming units (cfu) in 100 ml. However, because of the very wide range of concentrations in the data the values in the bar charts (Figs 2 and 3) are \log_{10} transformed. Corresponding arithmetic values are shown on the right hand axes.

In Figs 2 and 3 the sites sampled that fall inside the boundaries of the proposed bathing water beach in Ilkley are indicated by the horizontal green lines. These green lines also indicate the position on the y axis of a concentration value of 1000 cfu/100 ml for *E. coli* (Fig. 2) and 400 cfu/100 ml for IE (Fig. 3). In both cases these values are those used in the EU Bathing Waters Directive to define “good” water quality status for bathing. However, we do not use them here as intended by the Directive. In the Directive these are values that are statistically derived from a detailed monitoring programme carried out over the different seasons of the year where 95% of the counts made must not exceed these values to achieve good status. We have insufficient data points to make such calculations. We use the values here in the figures simple as a useful guide to relative water quality.

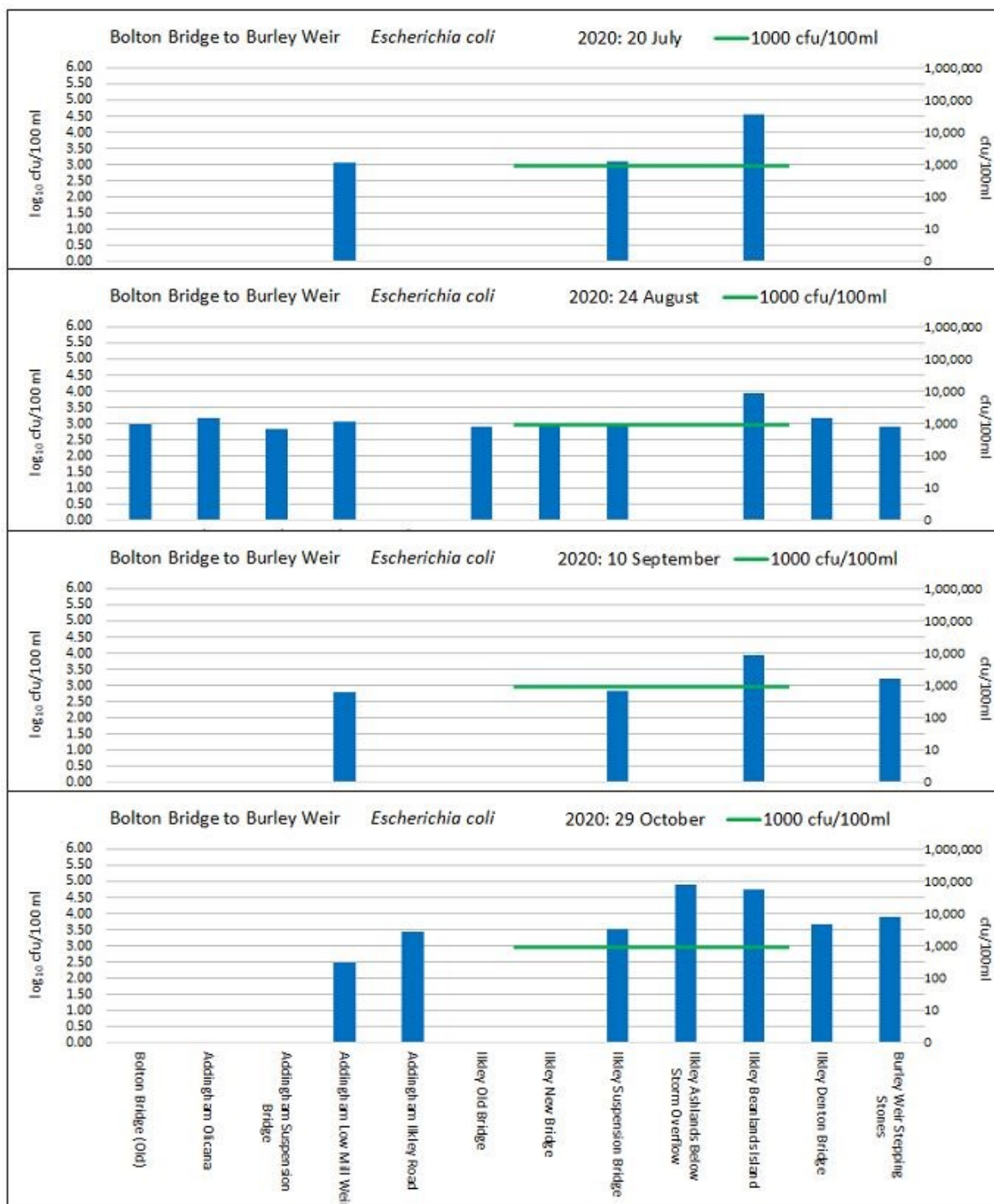


Figure 2. Concentrations of *E. coli* at all sites sampled on four dates in 2020. The horizontal green line indicates the sites lying within the designated beach stretch and the 1000 cfu/100 ml threshold value

1. July 20th, 2020

On July 20th river flow was low (Table 1). Samples were taken at the three principal sites, Low Mill Weir, Ilkley Suspension Bridge and Beanlands Island (Fig 1). Values for both *E. coli* and IE (Fig. 2) were relatively low upstream of Ashlands at Low Mill Weir (1,100 and 600 cfu/100 ml respectively) and the Ilkley Suspension Bridge (1300 and 500 cfu/100 ml respectively), and high, 37,000 and 3,500 cfu/100 ml respectively, downstream at Beanlands Island, situated below the storm overflow site and the final effluent outfall. The high concentration at Beanlands was due to the discharge from the final effluent outfall.

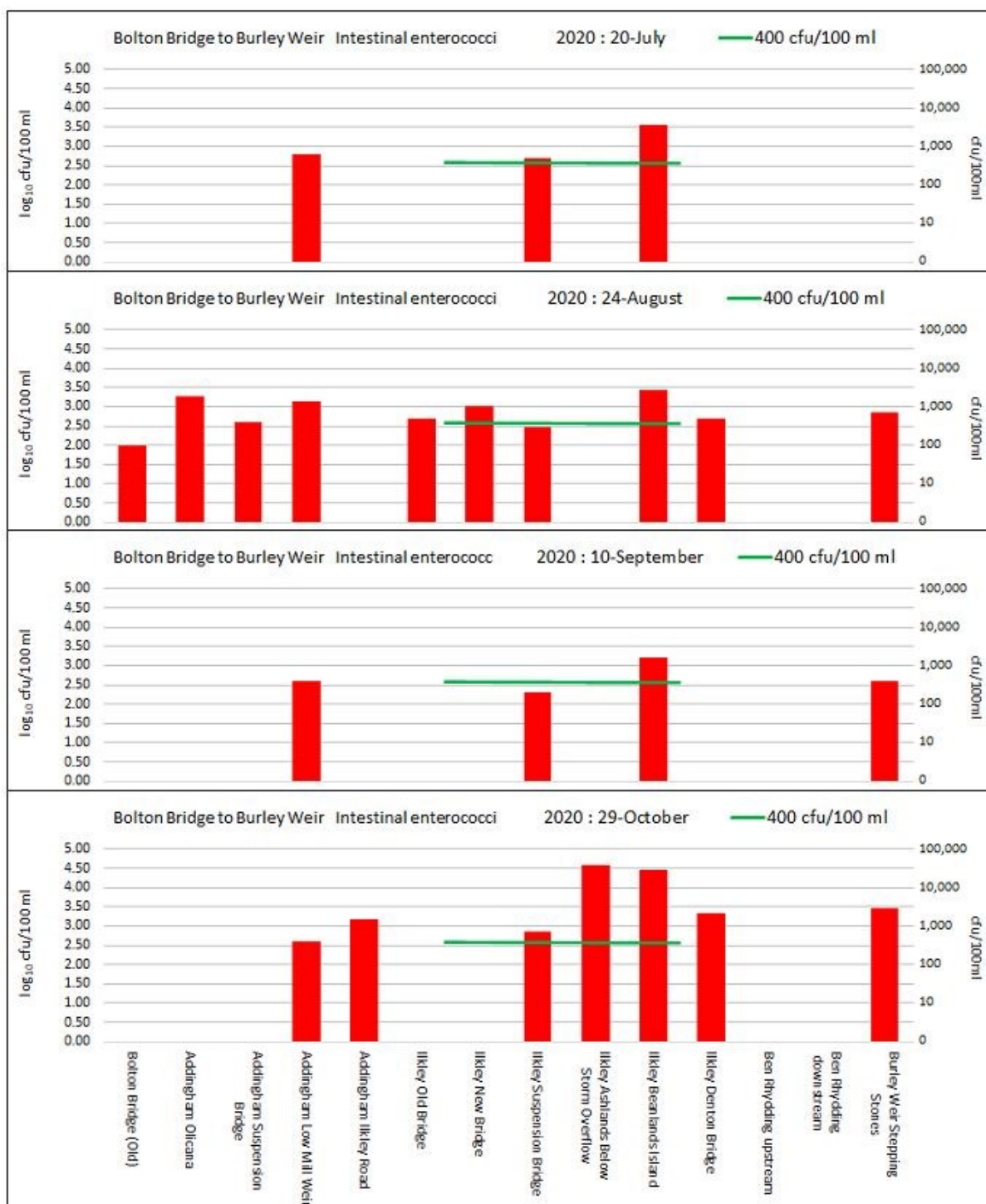


Figure 3. Concentrations of intestinal enterococci at all sites sampled on four dates in 2020. The horizontal green line indicates the sites lying within the newly designated beach stretch and the 400 cfu/100 ml threshold value

2. August 24th 2020

On August 24th the river levels were high (Table 1) following heavy rainfall two days previously but the storm overflow at Ashlands was not running. Samples were taken between Bolton Bridge and Burley Weir as part of the iWharfe project, a project that involved taking samples from the river along its entire length from Langstrothsdale to the confluence of the Wharfe with the Ouse at Cawood, near York. The results for the stretch of river from Bolton Bridge to Burley Weir are shown in Figs 2 and 3. Figure 4 shows the same data on the map.

Values for both *E. coli* and IE for the seven sites upstream of Ashlands are relatively low. In the case of *E. coli* these are mainly under the 1000 cfu/100 ml threshold. IE values are more variable with the concentrations at two sites, Olicana and Low Mill Weir, being significantly higher than the equivalent threshold for IE of 400 cfu/100 ml. At both these sites IE values are higher than those for *E. coli*. The reason for this is unknown.

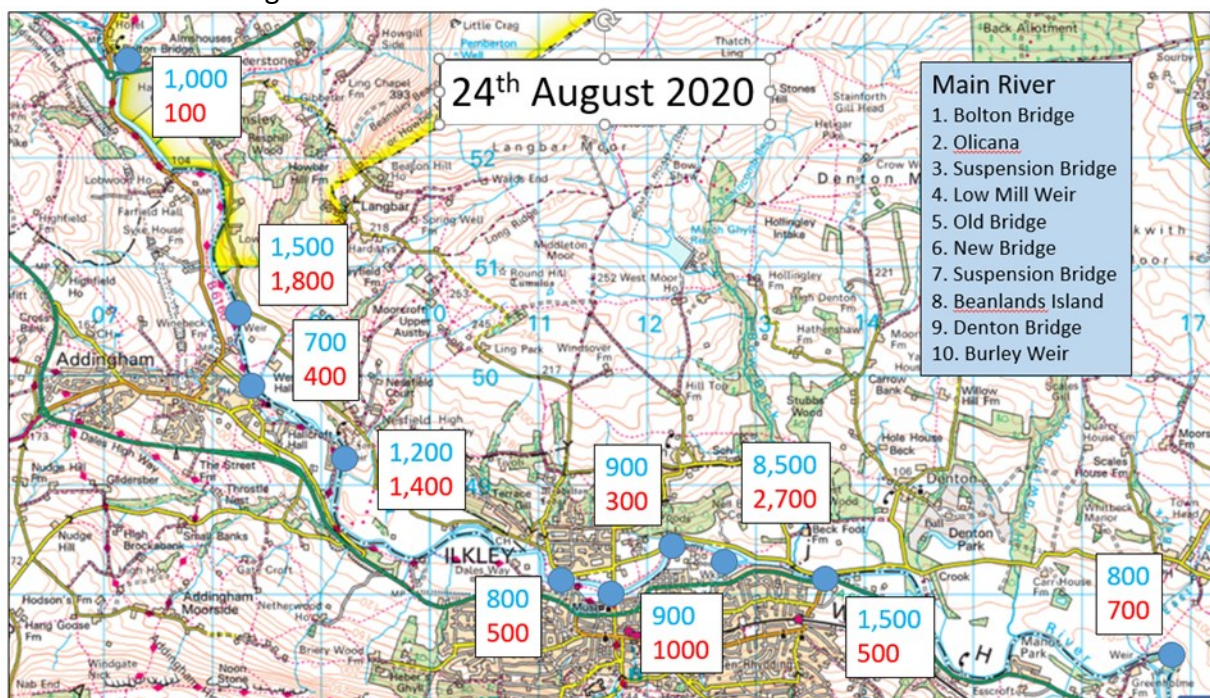


Figure 4. Concentrations of *E. coli* (blue) and intestinal enterococci (red) on the 24th August for the R. Wharfe from Bolton Bridge to Burley Weir (data from the iWharfe project)

Concentrations for both *E. coli* and IE at Beanlands Island are high, although not as high as on previous occasions at this site. This is probably due to the greater dilution provided by the river on this occasion, being a day of high flow (Table 1).

The Denton Bridge site has relatively low concentrations of *E. coli* and IE compared to Beanlands Island upstream probably reflecting the rate of faecal bacteria die-off between the two sites. Values for Burley Weir Stepping Stones are below the 1000 cfu/100 ml threshold for *E. coli* (Fig. 2) but above the 400 cfu/100 ml threshold for IE (Fig. 3).

3. September 10th 2020

On the 10th September the river level was medium (Table 1). Samples were taken at four sites (Addingham Low Mill Weir, Ilkley Suspension Bridge, Beanlands Island and Burley Weir Stepping Stones (Fig. 1).

The concentrations of both *E. coli* and IE for the two sites upstream of Ashlands are relatively low, at or below the threshold values for good status. The concentrations at Beanlands Island are both relatively high reflecting the input of treated effluent from Ashlands STW a short distance upstream. Values at Burley Weir Stepping Stones downstream are considerably lower than for Beanlands Island although the concentration of *E. coli* remains above the threshold level of 1000 cfu/100 ml.

4. October 29th 2020

As rainfall events prior to samples being taken on the three previous sampling occasions in 2020 were not sufficiently heavy or persistent to cause untreated effluent discharges occurring from either the Addingham or Ashlands CSOs we delayed the timing of our final sampling excursion until such an event occurred. Heavy rainfall occurred at the end of October and sampling consequently took place on the 29th October, a day when spills were taking place at both sites. To document fully the impact of the spills on faecal bacteria



Figure 5. Untreated effluent overflow from Addingham Pumping Station on 29th October 2010

concentrations we sampled at additional sites including Addingham Mill Stream, an intermediate site between Addingham and Ilkley (called “Old Ilkley Road”), a site between the Ashlands storm overflow discharge point and the final effluent point (called “Below Storm Overflow”) and Denton Bridge (Fig. 1).

Figure 5 shows untreated wastewater being discharged from the Addingham Pumping Station CSO into the Mill Stream at Addingham Low Mill on the day of sampling.

The sample from the Mill Stream was taken at a point immediately before the stream enters the culvert under Old Lane (Fig. 6). As the Mill Stream is now a dry channel, little or no dilution of the effluent occurs. Although the effluent itself is relatively dilute being a mixture of foul water and surface runoff from Addingham streets the concentrations of both *E. coli* and IE in the Mill Stream is extremely high at 780,000 and 220,000 cfu/100 ml respectively (Fig. 6).

The main river at the point the Mill Stream enters has a low concentration of *E. coli* of approximately 300 cfu/100 ml (measured at Low Mill Weir). Despite the hundredfold dilution offered by the river in high flow the discharge of effluent from the Mill Stream results in an increase in the concentration of *E. coli* to 2,800 cfu/100 ml (measured at Old

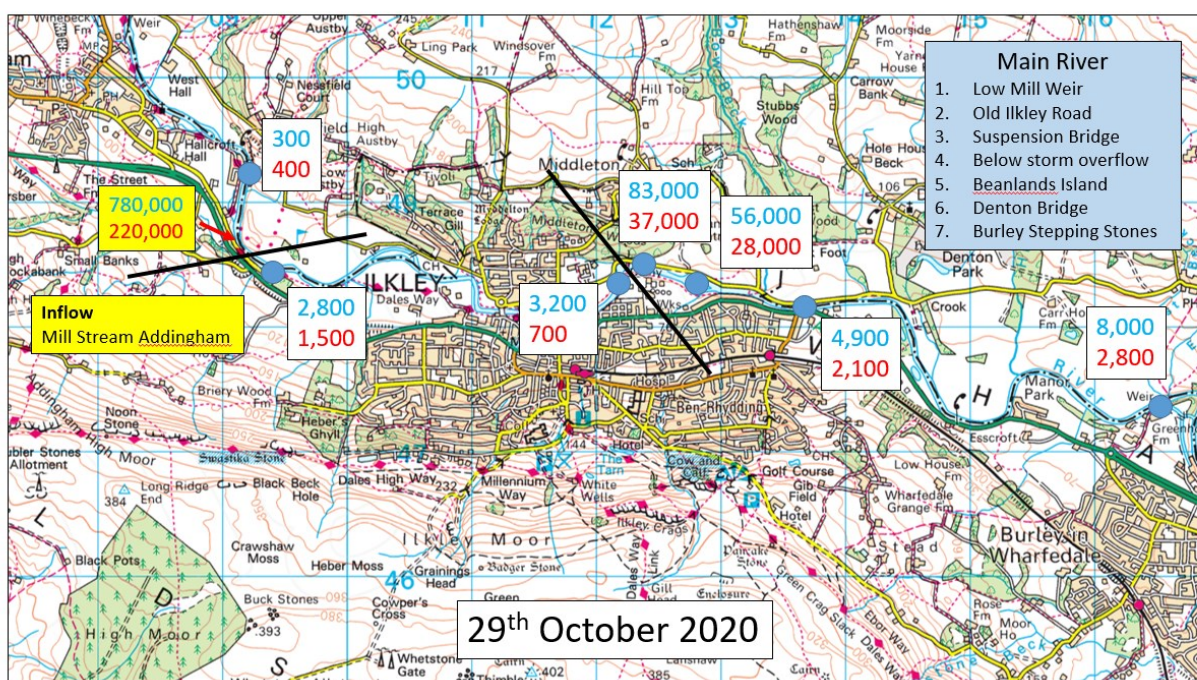


Figure 6. Concentrations of *E. coli* (blue) and intestinal enterococci (red) on the 29th October at sample sites on the River Wharfe from Addingham Low Mill Weir to Burley Weir Stepping Stones.

Ilkley Road). These high concentrations are maintained downstream to Ashlands. Values at the Suspension Bridge in Ilkley at 3,200 cfu/100 ml for *E. coli* and 700 for IE are similar to those at the Old Ilkley Road site (Fig. 6).

At Ashlands the input of untreated effluent from the CSO boosts the concentration of *E. coli* from 3,200 to 83,000 cfu/100 ml. The concentration at Beanlands Island is 56,000 cfu/100 ml. The decrease from the CSO to Beanlands Island may indicate very rapid die-off between the two sampling points but it is more probable that the difference is due to

sample site location. Concentrations of bacteria are likely to be very variable across the water column close to the outfall as the plumes from the waste-water and final effluent discharges are poorly mixed. Full mixing with river water is unlikely until some distance downstream.

The concentrations of *E.coli* and IE at Denton Bridge, approximately one km downstream, are considerably lower than Beanlands Island. Faecal bacteria will be well-mixed with the river water at this stage, so in this case the decrease from Beanlands Island to Denton Bridge will be influenced by die-off. Such a decrease between these two sampling points has been observed on all previous occasions when both sites have been sampled.

The final sample in the sequence at Burley Weir Stepping Stones shows higher concentrations than at Denton Bridge. Whilst this contrasts to the situation on 24th August 2020 it matches observations from 7th August 2019. Almost certainly these higher values at Burley Weir are due to the input of high concentrations of faecal bacteria from the Ben Rhydding STW. The final effluent outfall occurs midway between these two sites. We cannot be sure, however, whether the injection of additional faecal bacteria at this point is caused by discharges from the treated effluent or from an untreated spill as both discharges use the same sewer pipe.

Conclusions

Observations from sampling in 2020 are in close agreement with those made in 2019 in confirming:

- Low or relatively low values of faecal bacteria upstream of Ashlands STW during low flow conditions;
- High values downstream as a result of the continuous discharge of treated effluent from Ashlands STW;
- Very high values downstream as a result of intermittent discharges from the Ashlands storm overflow;
- Die-off of faecal bacteria between Beanlands Island and Denton Bridge; and
- The influence not only of Ashlands STW but also of the Ben Rhydding STW in explaining high faecal bacteria concentrations at Burley Weir.

The observations from 2020 also add to the 2019 conclusions in several respects:

- Data on intestinal enterococci (IE) show similar patterns to *E. coli*, at almost all sites where the two have been analysed;
- Data from samples taken during a heavy rainfall event on the 29th October confirm the retention of untreated effluent in the Mill Stream at Addingham Low Mill before its slow release into the main river;
- Data from the Mill Stream in Addingham and differences between the concentrations of faecal bacteria at Low Mill Weir and the Old Ilkley Road site confirms that spills from Addingham during heavy rainfall are the primary cause of high concentrations downstream in Ilkley above the Ashlands STW;
- Although always relatively low, faecal bacteria concentrations in the main river can exceed threshold levels for “good quality” upstream of Ashlands in the absence of a spill from Addingham; and

- Consequently, reducing faecal bacteria concentrations to the standards required by the Bathing Water Directive will almost certainly require measures not only to control discharges from the sewerage network but also from agricultural livestock and/or septic tanks in rural areas upstream.

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