

**FINAL
Water Year 2012
Bacteria Sampling Report
for the
Klamath River Estuary**



Prepared by: Patrick Fox
Yurok Tribe Environmental Program
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Acknowledgements

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I. Introduction

Since time immemorial the Klamath River has been the source of life and the primary influence and focus of Yurok Culture. Though current reservation boundaries are confined to a strip of land a mile wide on either side of the Lower Klamath River, ancestral territory encompassed land many times this area. Because of the central role the river has always played in their life ways, the health and preservation of the river system has become an essential part of contemporary Yurok culture. Today the Yurok people continue to use local waters for ceremonial and subsistence activities that can be impacted by poor water quality. This report summarizes the bacteria sampling performed in the Klamath River Estuary in Water Year 2012 (WY2012).

Escherichia coli and Enterococci

Escherichia coli (*E. coli*) and enterococci are two types of fecal coliform bacteria. They reside in and originate from the intestinal tracts of warm-blooded animals with primary sources being human and livestock excrement. Contact with high levels of these bacteria can lead to a variety of health complications ranging from mild cramps to severe gastrointestinal distress and death in extreme, untreated cases. Primary sources of contamination on the Klamath River Estuary include human activity, failing septic systems and livestock that have free access to waterways within the watershed. In compliance with the Yurok Tribe Coastal Monitoring Program Sampling and Analysis Plan, if the level of *E. coli* exceeds 235 Most Probable Number (MPN), or 61 MPN for enterococci, per 100 ml sample, immediate retesting is to be performed. If further samples indicate elevated levels still exist the waterbody will be posted to advise the public avoid contact with surface waters in the Klamath River Estuary.

Total Coliforms

Coliform is a family of bacteria common to soils, plants and animals. It encompasses numerous genera, only some of which are a threat to human health. As fecal coliforms are a sub-group of total coliforms, the presence and concentration of total coliforms is used as a relative indicator of fecal coliform levels. Primary sources of total coliforms on the Klamath River Estuary include the degradation and decomposition of organic plant and animal matter in the surrounding environment. Normal bioprocessing occurring in local soils provides for the reproduction of non-fecal coliform bacteria, and thus an increase of total coliforms in the summer months is seen during this season of increased biological activity. In compliance with the Yurok Tribe Coastal Monitoring Program Sampling and Analysis Plan if the level of total coliform exceeds 10,000 MPN/100ml sample, immediate retesting is to be performed.

II. Methods

At each sampling site 100 milliliter (ml) grab samples were collected in sterile, sealed sample bottles provided by Humboldt County Department of Public Health Lab. While wearing sterile Nitrile gloves, the seal and lid were removed from the bottle ensuring that the inside of the lid and no portion of the threaded opening of the bottle came into contact with any surface other than the water being sampled. The sample bottle was then submerged one foot below the surface while angled 45 degrees upstream. At one foot below the surface the bottle was rotated vertical and brought to the surface. The cap was replaced and the sample was placed on wet ice in an insulated cooler for same day transportation to the lab. Sample location, sampling time, and bottle number were recorded for lab records. Sampling location, name of sampler, number of bathers present at sampling location, runoff quantity, amount and type of debris present in the water, tide information, length of beach, time and any additional pertinent information were recorded for departmental records. Samples were delivered the same day to the Humboldt County Department of Public Health laboratory in Eureka, CA following appropriate and documented chain of custody procedures.

III. Site Selection

YTEP collected water samples for bacterial analysis at the following locations (Figure 1).

- **Klamath River Estuary (KE)**
- **Klamath River Above KCSD Waste Water Treatment Plant (KR>WTP)**
- **Klamath River Below KCSD Waste Water Treatment Plant (KR<WTP)**

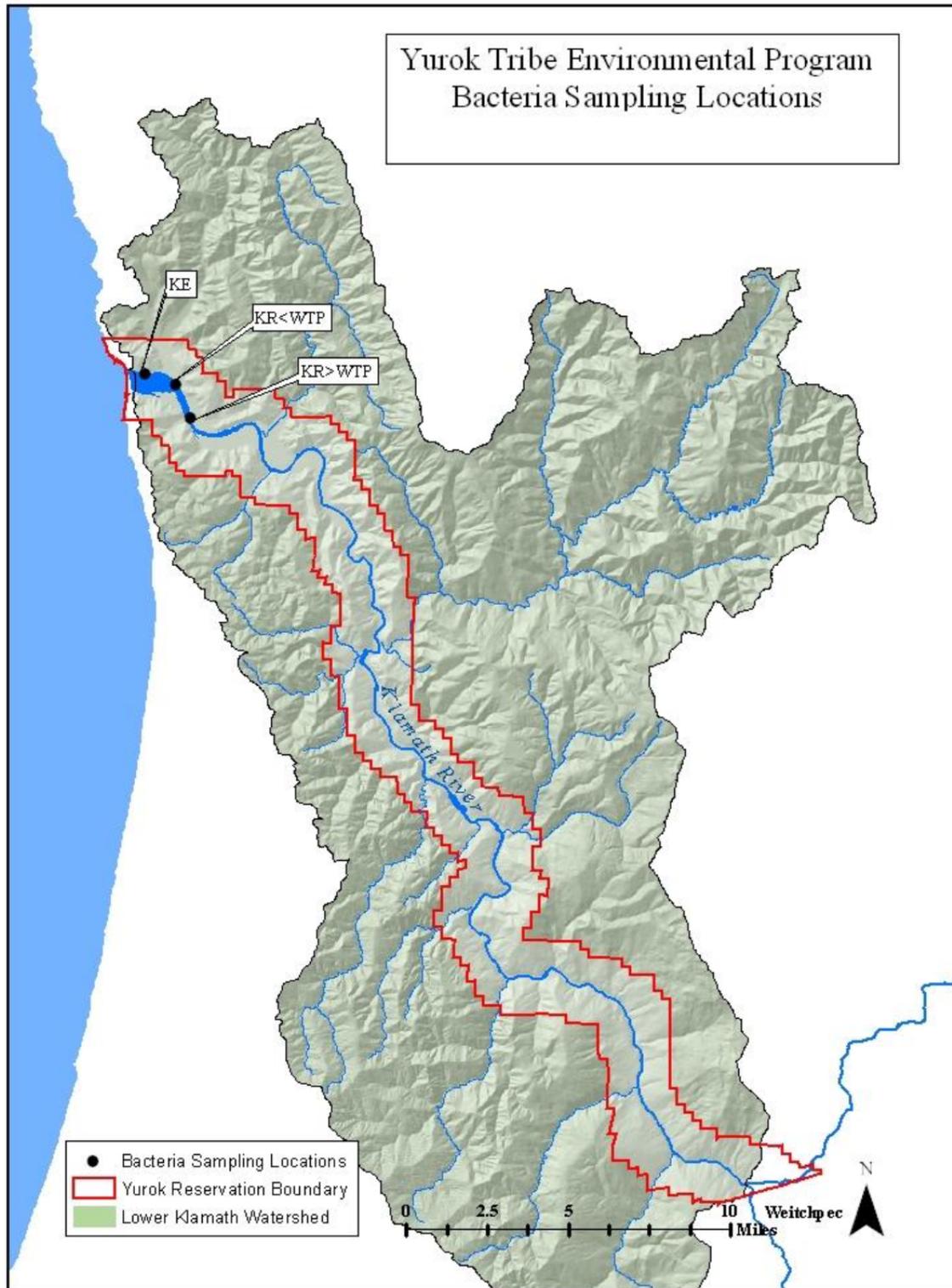


Figure 1. YTEP Bacteria Sampling Locations.



Figure 2. Bacteria sample collection site at Klamath River Estuary (KE).



Figure 3. Bacteria sample collection site at Klamath River above Water Treatment Plant (KR>WTP).



Figure 4. Bacteria sample collection site at Klamath River below Water Treatment Plant (KR<WTP).

IV. Results

Table 1. Bacteria sampling results: WY2012

<i>E. Coli</i> Most Probable Number Report Limit: 10 YTWQCP: <i>E. coli</i> single sample maximum 235 MPN/100ml	Site	10/19/11	11/16/11	12/14/12	1/23/12	2/29/12	3/21/12	4/18/12	5/16/12	5/30/12	6/12/12	7/10/12	8/7/12	9/18/12
	KE	ND	20	10	41	52	ND	20	20	ND	ND	75	ND	10
	KR<WTP	10	ND	10	20	52	10	ND	10	10	ND	30	10	169
	KR>WTP	10	109	31	20	63	10	ND	ND	ND	10	10	ND	10
<i>Strep. Faecalis (enterococci)</i> Most Probable Number Report Limit: 10 YTWQCP: <i>Strep. faecalis</i> single sample maximum 61 MPN/100ml	Site	10/19/11	11/16/11	12/14/11	1/23/12	2/29/12	3/21/12	4/18/12	5/16/12	5/30/12	6/12/12	7/10/12	8/7/12	9/18/12
	KE	ND	ND	ND	10	ND	41	ND						
	KR<WTP	ND	ND	ND	41	ND	ND	31						
	KR>WTP	ND	ND	10	ND	10	10	ND						
<i>Total Coliform</i> Most Probable Number Report Limit: 10 CSWRCB: Total Coliform single sample maximum 10,000 MPN/100ml	Site	10/19/11	11/16/11	12/14/11	1/23/12	2/29/12	3/21/12	4/18/12	5/16/12	5/30/12	6/12/12	7/10/12	8/7/12	9/18/12
	KE	450	305	345	598	288	231	399	299	279	122	1782	2613	1956
	KR<WTP	749	340	148	457	301	259	520	388	309	132	1354	1421	4106
	KR>WTP	1145	520	323	473	249	243	336	272	249	75	1607	1789	1789

* ND (No Detect) = Samples collected were below the reporting limit of 10 MPN. For graphing purposes all results below the reporting limit were given a value of one half the reporting limit.

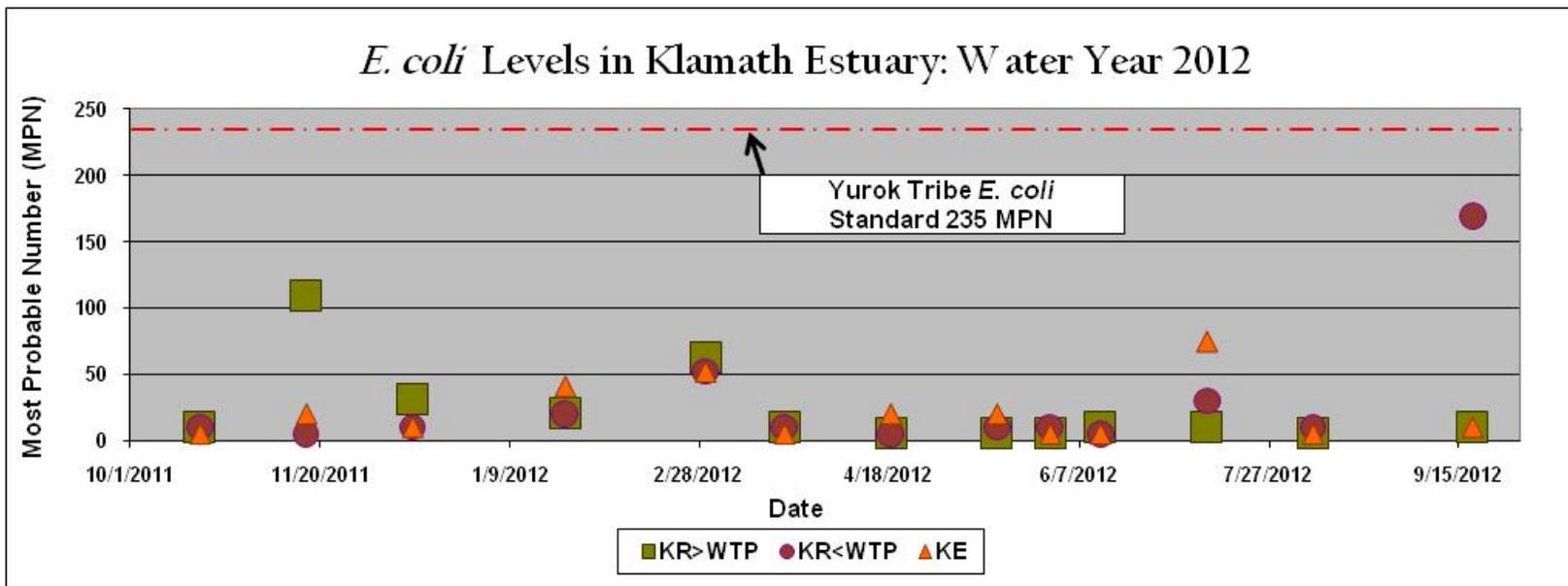


Figure 5. *E. coli* results: WY2012

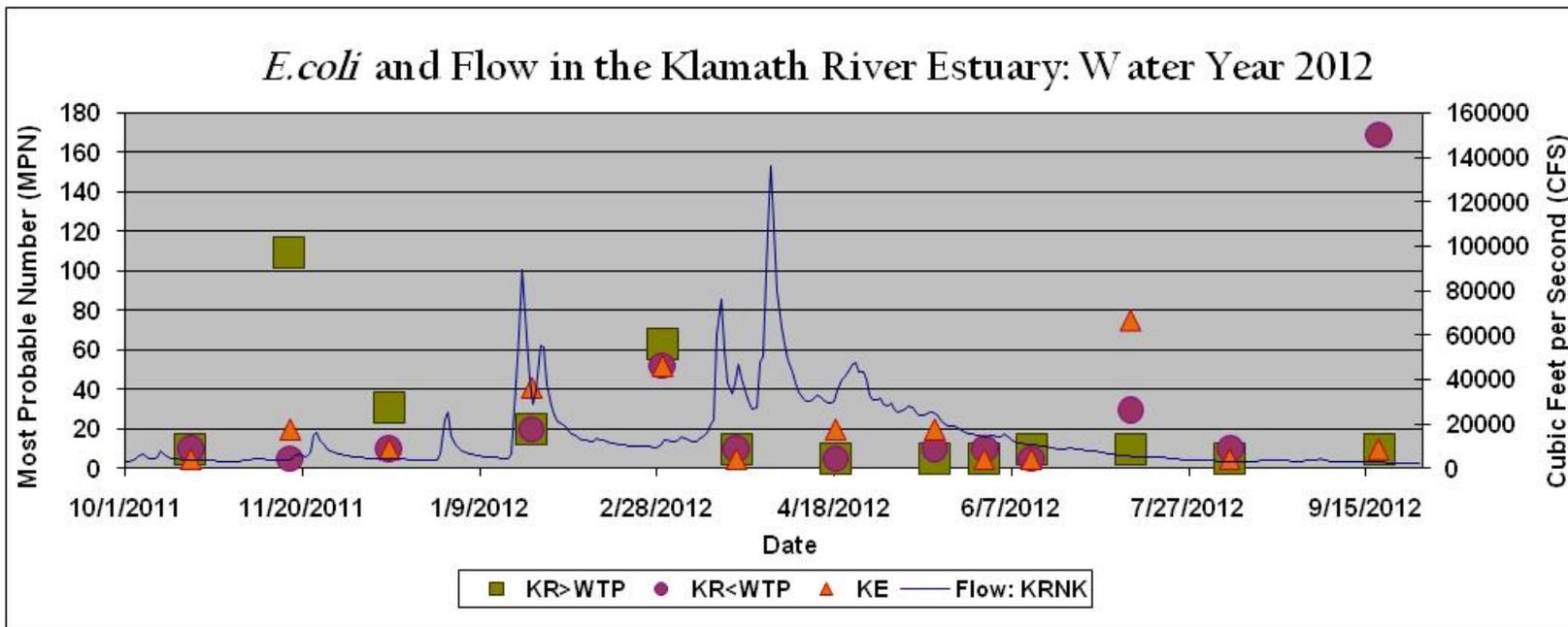


Figure 6. *E. coli* levels and Flow*: WY2012

*Flow from USGS Gage: Klamath River Near Klamath (KRNK)

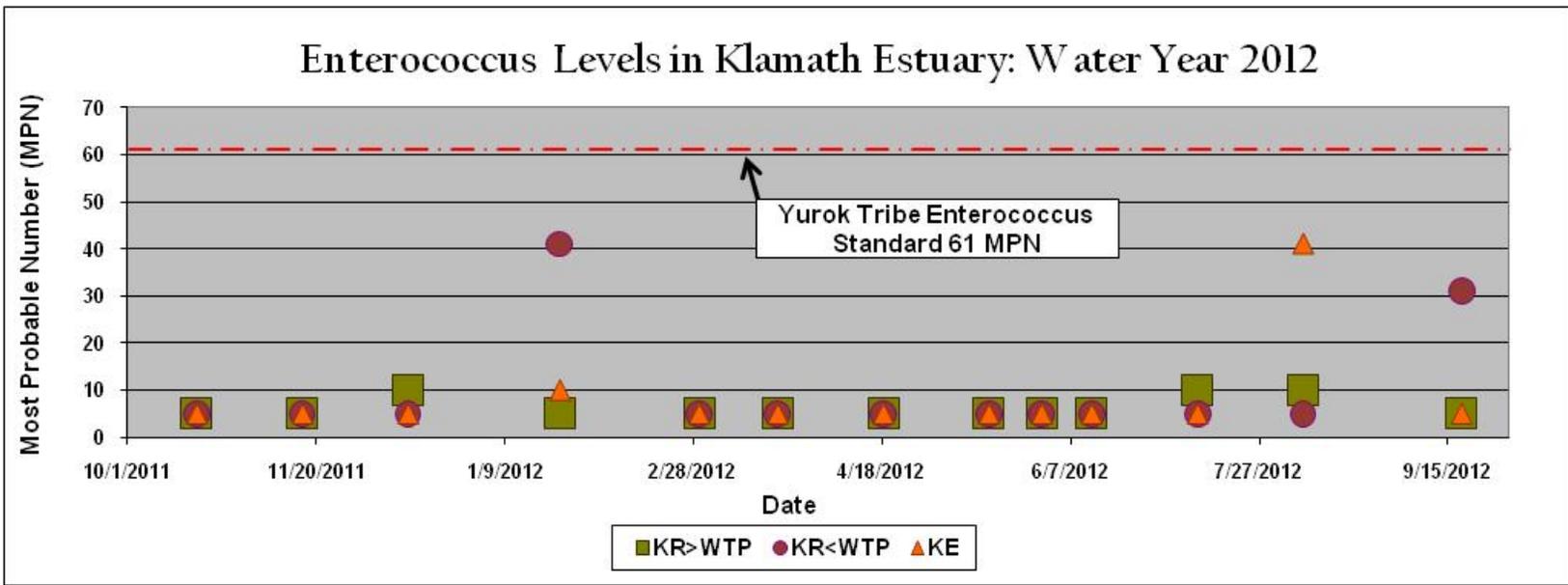


Figure 7. Enterococcus results: WY2012

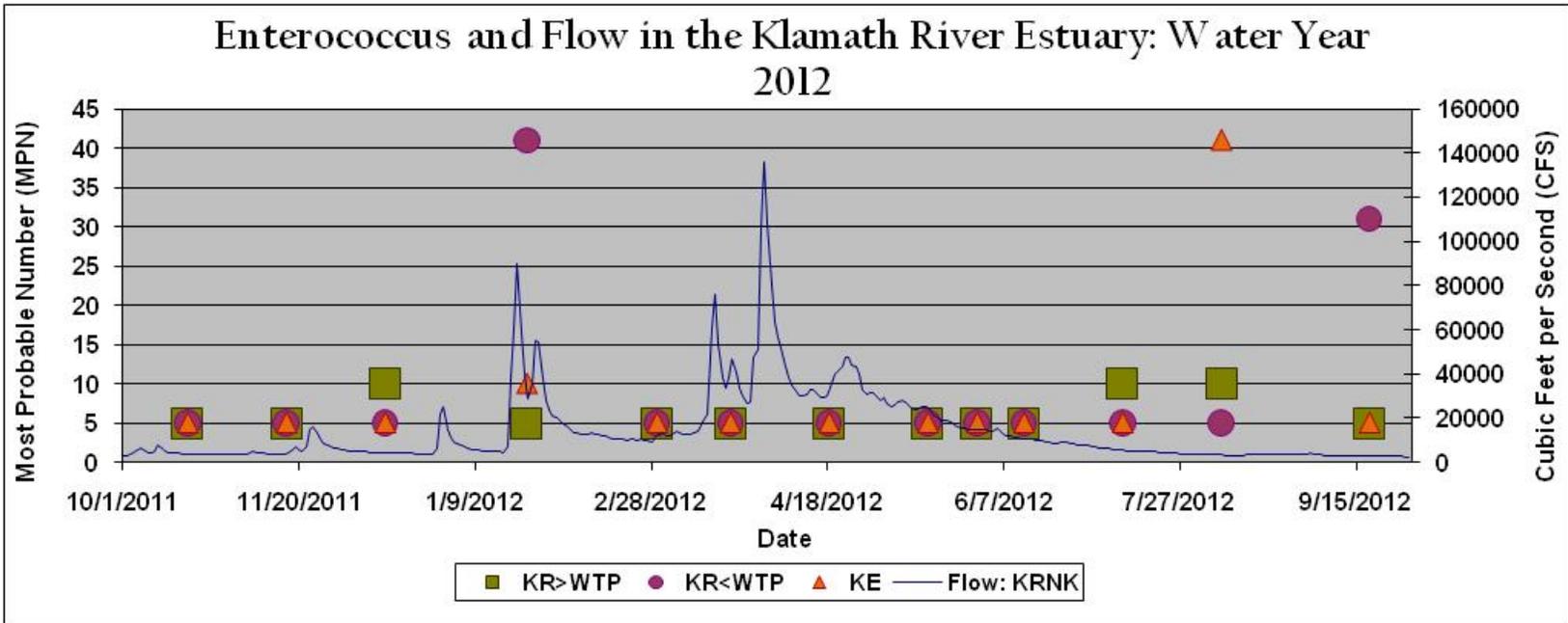


Figure 8. Enterococcus levels and Flow*: WY2012
 *Flow from USGS Gage: Klamath River Near Klamath (KRNK)

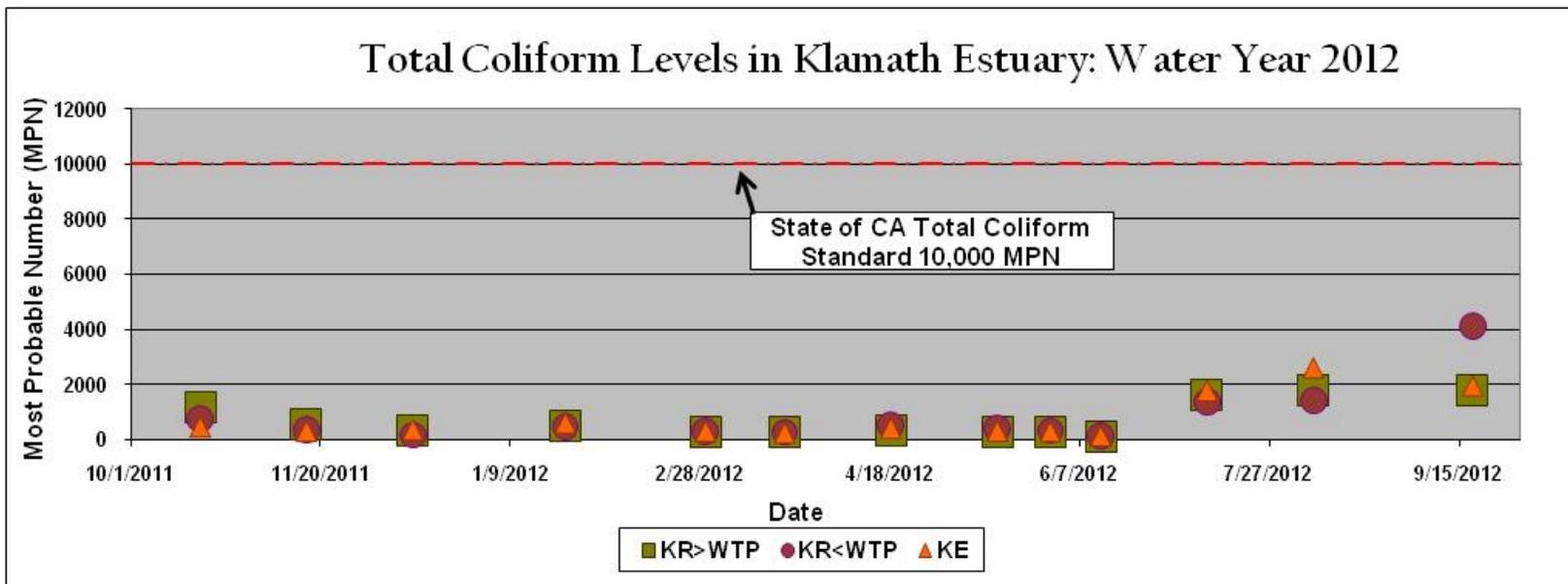


Figure 9. Total Coliform results: WY2012

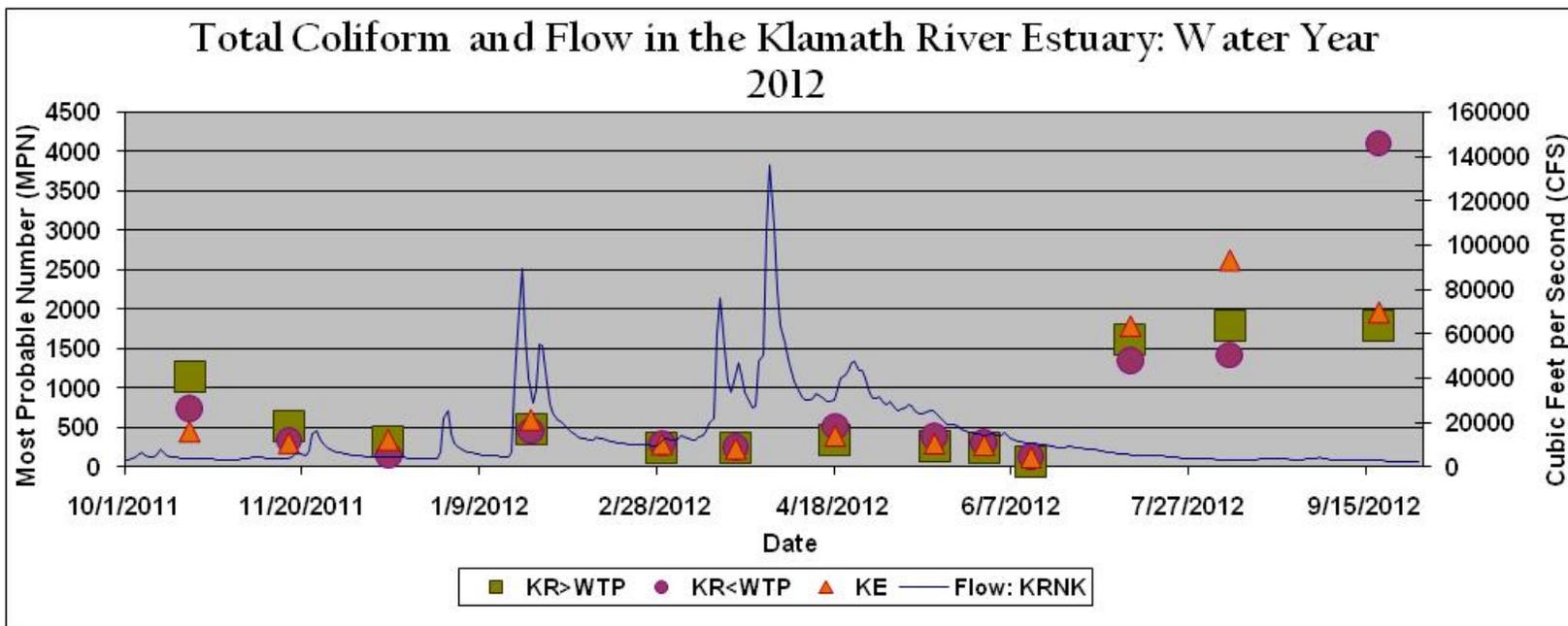


Figure 10. Total Coliform levels and Flow*: WY2012
 *Flow from USGS Gage: Klamath River Near Klamath (KRNK)

V. Discussion

General

KR<WTP returned the highest single sample level for each of the tests during WY2012. However sample maximums from all parameters varied between sites month to month, indicating no specific spatial trend among sites. For all sites and all parameters, higher levels occurred during the drier summer months (Figures 6, 8, & 10). This temporal trend was especially pronounced in the total coliform parameter, and less so in the other parameters. This time period contains generally lower flows, higher water temperatures, and increased human fishing activity, for each site; as well as increased biological activity in the watershed in general. It should be noted that all samples prior to 6/12/2012 were collected between 7:00 and 8:00 in the morning, and samples after 6/12/2012 were collected between 2:00 and 3:00 in the afternoon. This difference in collection times could result in natural diurnal changes in bacteria levels being reflected in the results.

Total Coliform

Throughout WY2012, all total coliform samples were measured at detectable levels that were well below the water quality standard single sample maximum of 10,000 MPN/100 ml set forth in the California Water Quality Control Board's California Ocean Plan. The highest concentration measured was 4,106 MPN on 9/18/2012 at KR<WTP (Figure 9, Table 1). The lowest concentration of 75 MPN was recorded on 6/12/2012 at KR>WTP. Overall, total coliform concentrations were inversely proportional to flow (Figure 10). Total coliform levels tend to increase through the summer months due to increased biological activity and lower water volumes within the watershed, then decrease during the winter months as biological activity within the watershed decreases and water volume increases. From October through June total coliform levels were very low. They stayed very low throughout the rainy season and began to increase slightly in July as water flow in the Klamath River decreased. On average, KR<WTP had the highest concentrations of total coliform, at 806 MPN. KE had the second highest average levels at 744 MPN, and KR>WTP had the lowest average at 698 MPN.

Escherichia coli

Throughout WY2012, all *E. coli* samples collected showed results were below the water quality standard single sample maximum of 235 MPN/100 ml set forth by the Yurok Tribe's Water Quality Control Plan for the Yurok Reservation. 12 of the 39 samples collected, or approximately 30 percent, tested below the minimum detection limit of 10 MPN/100 ml (Figure 5, Table 1). The highest *E. coli* level, 169 MPN, was measured at KR<WTP on 9/18/2012. This spike in *E. coli* levels at KR<WTP on 9/18/2012 was not reflected in the other sampling sites. A similar single site spike of 109 occurred at KR>WTP on 11/16/2011. While detectable concentrations of *E. coli* averaged 23.39 MPN for the year, the sampling date of 2/29/2012 shows concentrations from 52 to 63 MPN. This is around twice the average. This spike could be explained by the first rain after a small dry period (Figure 6).

Enterococcus

Throughout WY2012, enterococci levels were well below the water quality standard of single sample maximum of 61 MPN/100 ml set forth by the Yurok Tribe's Water Quality Control Plan for the Yurok Reservation. 32 of the 39 samples collected, or 82 percent, tested below the minimum detection level of 10 MPN/100 ml (Figure 7, Table 1). The highest enterococcus level, 41 MPN, was measured twice at KR<WTP on 1/23/2012 and at KE on 8/7/2012. The spikes at these sites aren't reflected at the other sites on the respective dates. The spike on 1/23/2012 is likely due to a large rain event following a dry period (Figure 8). As a whole, enterococci levels during WY2011 were inversely proportional to flow.