Russian River First Flush 2008

Table of Contents

Russian River First Flush 2008 Summary Report

Prepared by:
Don McEnhill, Russian Riverkeeper
Sierra Cantor & Valerie Sherron, Sotoyome Resource Conservation District;
Layout: Kate Wilson, Russian Riverkeeper

Russian River First Flush 2008 was made possible with help from: Brelje & Race Labs, EPA Region 9, University of North Carolina Asheville EQI, North Coast Regional Water Quality Control Board, Cities of Santa Rosa and Rohnert Park, Cotati Creek Critters, and Community Clean Water Institute and countless community volunteers!

Russian River First Flush was funded by Sonoma County Water Agency and Russian Riverkeeper.

1 Executive Summary

The 2008 Russian River First Flush sampling event occurred on the evening of October 3rd and into early hours of the 4th. Donning rain gear and sampling equipment, 34 participants sampled 17 stations on 11 urban creeks and adjacent storm drain outfalls throughout the Russian River watershed. The sampled sites included Piner, Santa Rosa, Matanzas, Colgan, Calder, Fife, Copeland, Hinebaugh, Foss, Orrs, Gibson Creeks and the Laguna-Cotati Channel and represented stormwater runoff from the Cities of Santa Rosa, Rohnert Park, Cotati, Sebastopol, Healdsburg, Ukiah and the town of Guerneville. Pool Creek in Windsor was slated for sampling but flow was not present.

This largely volunteer effort, supported by donated laboratory analysis, was a collaborative effort from a variety of individuals and organizations including community volunteers, the Sotoyome RCD, Russian Riverkeeper, North Coast Regional Water Quality Control Board, Sonoma County Water Agency, EPA Region 9, Brelje & Race Laboratories, Inc., University of

North Carolina Asheville EQI, Cities of Santa Rosa, Rohnert Park, and Healdsburg, Cotati Creek Critters, and Gold Ridge RCD. Russian River First Flush 2008 would not be possible without the donations from our lab and agency partners, support from our funders Sonoma County Water Agency, Russian Riverkeeper and Russian River Watershed Association and all the people who volunteered their time on a dark rainy night to support this project – Thank You!

Table 1: Russian River First Flush 2008 Range of Results & Water Quality Objectives

Parameter	Range of Results	Water Quality Objective*
Temperature	12 to 19 ^{0}C	< 21 ^{0}C
pH	6 to 8.43	6.5 to 8.5
Conductivity	16 to 490 us/cm	>375 us/cm
Orthophosphate as P	ND to 1.0 mg/L	0.1 mg/L
Ammonia-Nitrogen	0.38 to 3.6 mg/L	0.5 mg/L
Nitrate as N	ND to 2.0 mg/L	1.0 mg/L
Total Coliform Bacteria	>1,600 to >24,192 MPN/100ml	> 1000 MPN/100ml
Escherichia Coli. (E. Coli) bacteria	2,104 to >24,192 MPN/ 100ml	>235 MPN/100ml
Total Copper	6.8 to 398.4 ug/L	Metals Standards vary with hardness- see section on metals results
Total Zinc	47.3 to 1427.8 ug/L	
Total Lead	1.5 to 93.0 ug/L	
Turbidity	8.83 to 642 NTU	No standard
Total Suspended Solids	6.5 to 1100 mg/L	>100 mg/L

From USEPA, CA SWRCB & NCRWQCB published water quality objectives or water quality standards

1.0 Study Objectives and Questions

Some pollutants are extremely toxic to aquatic wildlife, even for brief exposure at very small concentrations. First Flush water quality monitoring can measure a stream's health under a worst-case scenario. Our long dry summers allow a cocktail of pollutants and toxins to accumulate on impervious surfaces like parking lots and rooftops that make up a large percentage of urban areas and our first significant rainfall of the season efficiently delivers these pollutants to urban creeks, hence the name First Flush.

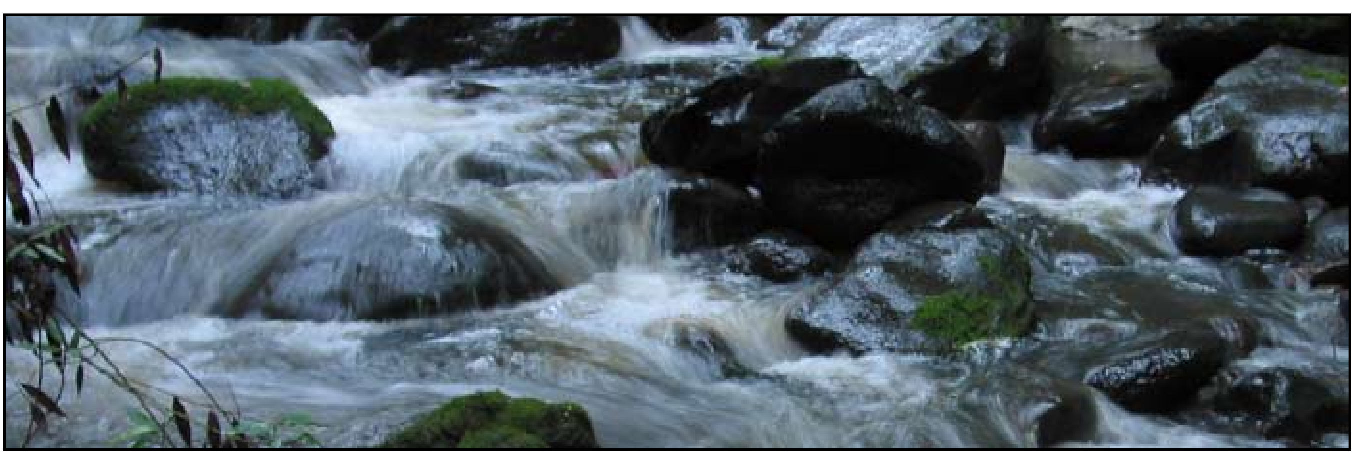
The goals of Russian River First Flush sampling are to:

1. Characterize the quality of the storm water runoff flowing from our urban landscape into the tributary creeks that run through these urban areas, which is contributed to the Russian River during the first significant storm of the season.
2. Measure the pollutant loads in storm water runoff and evaluate the effect of these pollutants on the water quality of our creeks.
3. Identify which pollutants are present in storm water runoff and of the greatest threat to water quality and stream health.
4. Develop recommendations to reduce the accumulation of these pollutants to our landscape and eventually, to our creeks.
5. Develop a core dataset that can be used for trend analysis and identification of "hot spots" that require follow-up efforts. Analysis of the 2002-2008 First Flush datasets can be used as a feedback mechanism on current urban runoff reduction efforts and to evaluate whether storm water quality is improving through efforts such as the National Pollution Discharge Elimination System (NPDES) measures being enacted by local municipalities throughout the Russian River watershed.

The Russian River First Flush 2008 event, coordinated by the Sotoyome Resource Conservation District and the Russian Riverkeeper and funded in part by the Russian River Watershed Association, Sonoma County Water Agency and Russian Riverkeeper, featured a pared down sampling design established in 2007 that measured selected pollutants in both urban storm drain outfalls and receiving waters, while eliminating more rural stations that had continually failed to show a runoff response to the first flush in previous sampling events.

This synoptic, watershed-wide, storm-based sampling event mobilizes participants to capture the effects of a single storm event throughout a wide geographic scope. The concurrent sampling effort captures storm water runoff to selected creeks that run though urban areas of Sonoma and Mendocino Counties. The paired storm drain outfall and creek surface water sampling design employed for the 2007 RRFF event was continued in 2008 and allowed for the evaluation of the pollutant concentrations in the storm runoff as well as its affect on the stream flow that receives it.

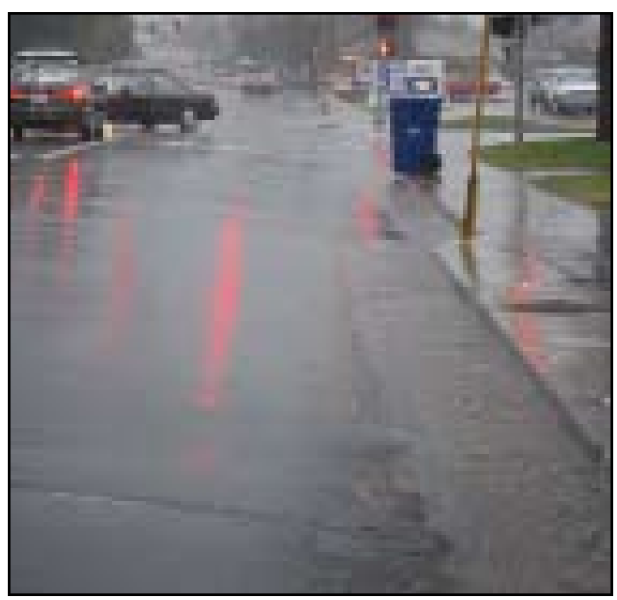
In addition to sampling the surface water from each creek to characterize the impact of storm water on the creek, storm flows entering creeks through large diameter culvert outlets, just upstream of the creek sampling sites, were sampled to characterize the pollutant levels in the storm water that enters the creeks. In 2008 funding and resources were not available to conduct pre-Flush or dry weather sampling. Dry weather or baseline sampling of the water quality conditions prior to the input of storm runoff is a critical link to evaluating the effects of the storm water on creeks so it is our goal to seek funding for dry weather sampling in 2009.



Building a multi-year data record by gathering first flush water quality data throughout a watershed gives municipal officials, regulatory agencies and citizens pertinent information on how the sum of all our activities impacts our waterways. It should also be pertinent to everyone who lives, works, drives, or spends time in any of these areas, since we all contribute pollutants to the landscape. The data collected can help us all understand some of the most pressing impacts to our creeks and investigate ways we can modify our behavior to lessen these effects.

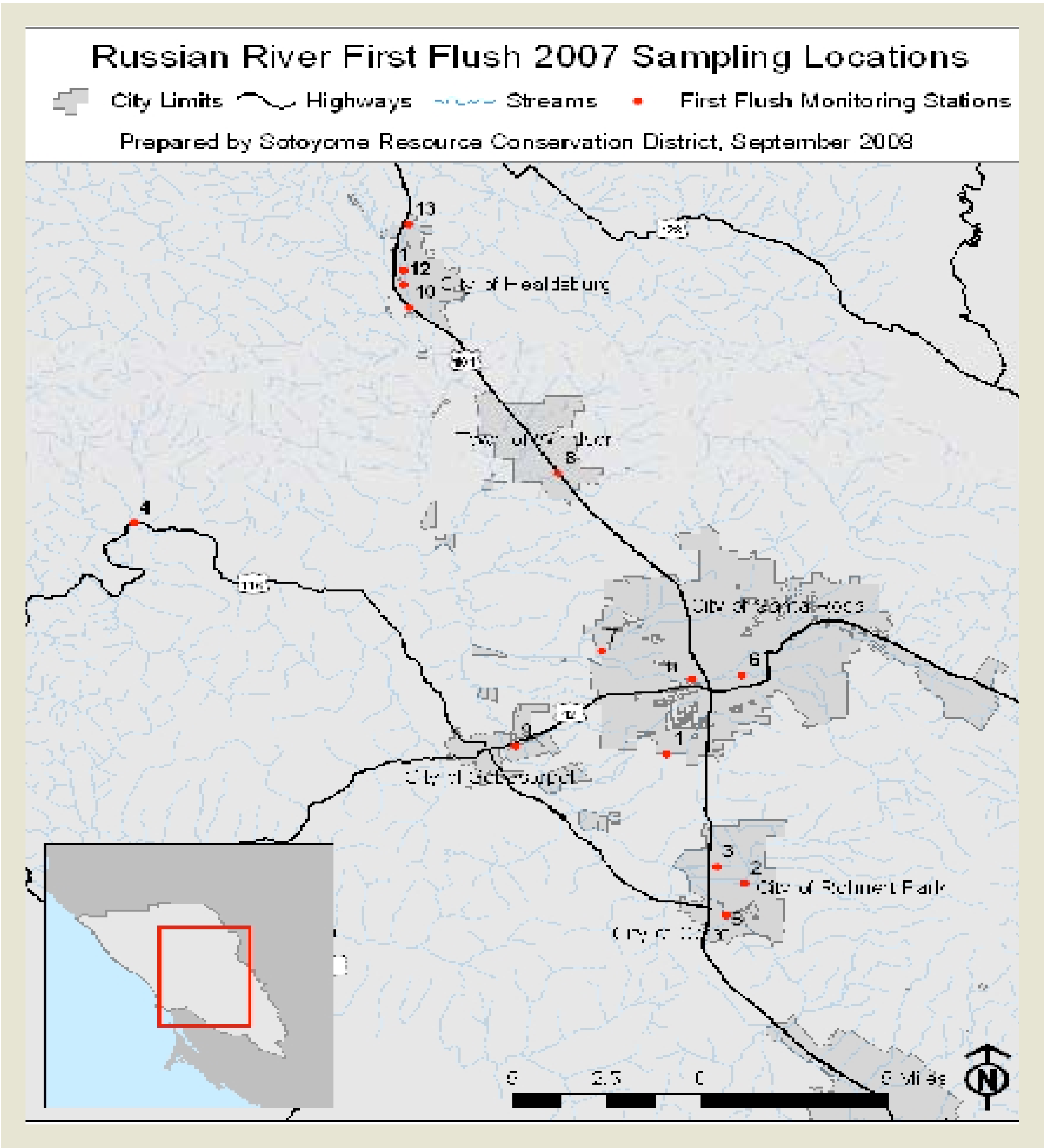
It is important to note that as with all questions, you can only get answers to the things you ask and in a monitoring context, you can only get information about the pollutants you choose to measure for. Additionally, First Flush sampling can only capture pollutants that are dislodged, mobilized and entrained by the rainfall/runoff process. Since Russian River First Flush is a largely unfunded event, we rely on donations from local laboratories for the water quality analysis. Due to generous donations of analysis from Brelje and Race Laboratories, Russian Riverkeeper, and the Environmental Protection Agency (EPA) Lab in Richmond, analysis was conducted on creek and outfall samples for nutrients, metals, and bacteria. The City of Santa Rosa lent use of equipment to analyze for turbidity as well. Field parameters measured on site by event participants include Temperature, pH and Conductivity.

By no means is this an exhaustive list of potential pollutants, but results from these constituents can give insight into the sources of the pollutants entering the waterways (for example: metals from brake pads, bacteria from pet waste, nutrients from fertilizers applied to lawns and gardens, etc.). The pollutants sampled do represent most of the common stormwater pollutants. By understanding the pollutants of concern, Best Management Practices (BMPs) can be proposed that can most effectively target the input of these pollutants. The community can then adopt these BMPs to improve water quality and aquatic habitat.



2 Study Design

Figure 2.1 Map of 2008 Russian River First Flush Monitoring Stations



2.1 Sampling Locations

Figure 2.2: Russian River First Flush Monitoring Stations 2008 List

Map ID #	Station ID	Waterbody	Station Type	Station City	Latitude	Longitude
1	LCC38	Laguna Cotati Channel	Creek	Cotati	38.32793	-122.70365
1	LCC40	Laguna Cotati Channel	**Outfall**	Cotati	38.32821	-122.70393
2	COP41	Copeland Creek	**Outfall**	Rohnert Park	38.34319	-122.69557
3	HIN40	Hinbaugh	Creek	Rohnert Park	38.35049	-122.70837
3	HIN42	Hinbaugh	**Outfall**	Rohnert Park	38.35045	-122.70856
4	CG28	Colgan Creek	Creek	Santa Rosa	38.40163	-122.73646
4	CG29	Colgan Creek	**Outfall**	Santa Rosa	38.40177	-122.73620
5	CAL10	Calder Creek	Creek	Sebastopol	38.40391	-122.81021
6	MAT14	Santa Rosa Creek	Creek	Santa Rosa	38.43901	-122.69336
6	MAT15	Santa Rosa Creek	**Outfall**	Santa Rosa	38.43920	-122.69358
7	PN08	Piner Creek	Creek	Santa Rosa	38.44853	-122.76941
7	PN09	Piner Creek	Outfall	Santa Rosa	38.44854	-122.76962
8	SR18	Santa Rosa Creek	Creek	Santa Rosa	38.43675	-122.72463
8	SR19	Santa Rosa Creek	**Outfall**	Santa Rosa	38.43686	-122.72479
9	FIF10	Fife Creek	**Outfall**	Guerneville	38.50210	-123.00190
10	FOS21	Foss Creek	Creek	Healdsburg	38.61578	-122.87325
10	FOS22	Foss Creek	**Outfall**	Healdsburg	38.61578	-122.87325

2.2 Sampling methodology

In past RRFF events, generally only the surface water in the creek (also called receiving water) was sampled. The goal was to evaluate the quality of the surface water once it had received the storm water, thereby showing the effects of storm runoff on the creek's water and habitat quality. The problem with this sampling design was that no monitoring information was collected on either the storm water run-off before it entered creeks or the creek surface water prior to the input of the storm water making it impossible to evaluate the effect of the storm runoff on the water quality of the creek.

As mentioned previously rural areas are not sampled since they typically do not yield run-off in the First Flush due to lower amounts of paved and impervious surfaces. Due to the high percentage of impervious surfaces in an urban environment, the hydrologic response to rainfall is rapid, high volume delivery of storm water to creeks. These conditions allow for efficient delivery of pollutants to urban creeks and are in no way indicative of rainfall response in less urban waterways. Even Fife Creek, which is in a more rural area, has a small urban area in downtown Guerneville that produces run-off during First Flush due to concentrated impervious surfaces downtown that drain to the outfall sampled on Fife Creek.

In previous RRFF sampling efforts, a series of three samples were collected at each station (at both creek and outfall locations), taken at half-hour intervals and labeled with a corresponding 1, 2 or 3. Due to funding and resource limitations only two samples were collected at each station in 2008 and taken one hour apart.

The purpose of taking multiple samples at each station is to measure changes in water quality over time, ideally during the rising limb of the hydrograph (i.e. the rapid increase in streamflow resulting from rainfall causing surface runoff to streams prior to peak discharge which occurs when the stream reaches its highest level) and to track each pollutant after 60 minutes during the course of the storm once the rainfall criteria has been met.

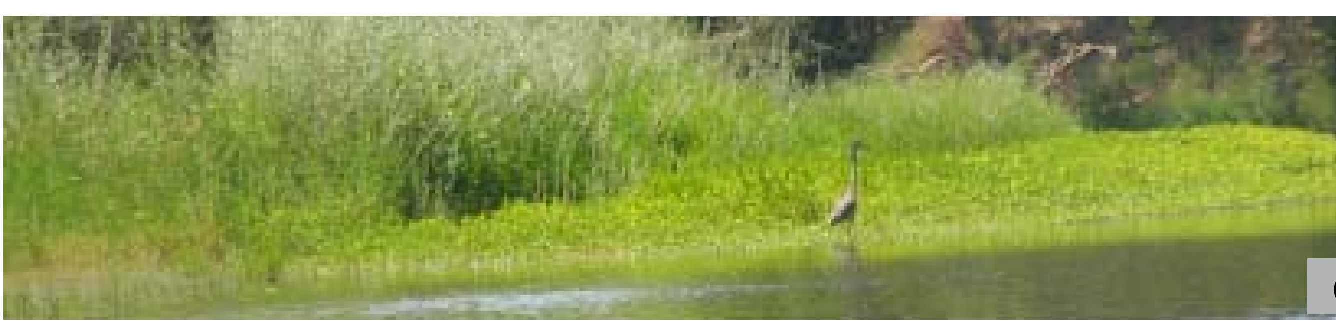
3 Results

Since First Flush aims to characterize the worst-case scenario of landscape pollution washing into the creek via the storm drain system, the data depicted in the following graphs represents only the highest concentration result in the two samples collected for each pollutant. For example, if the highest concentration of nitrate measured on Colgan Creek occurred during the first sample in the series, then the concentration in the first sample is depicted in the graph; whereas the highest concentration of nitrate measured on Matanzas Creek occurred during the second sample of the series, the concentration from the second sample is shown on the graph. The numbers above each bar in the graph represent which sample in the series had the highest concentration, and thus which sample is depicted.

Results are compared against Water Quality Objectives (WQOs) wherever they are established. See Table 1 on page 1 for the WQO table.

3.1 Event Result Graphs

Each graph shows the results for one parameter, representing the stream samples in blue and the paired outfall samples in green. The red horizontal line depicts the Water Quality Objective, when established, for each parameter. The field parameters, Temperature, pH and Conductivity (except for four conductivity and pH results) fell within the Water Quality Objectives (WQOs, see Table 1) and are not depicted in this section. The raw data table that depicts all of the results at each station can be found in Appendix 1.



3.2 Bacteria

Bacteria concentrations were measured using Total coliform and Escherichia coli (E. coli) as representative indicators of bacterial contamination. The presence of E. coli indicates that bacteria that originates primarily from digestive tracts of animals and humans, assumedly through fecal matter, is present in measurable concentrations. Sources for E. coli in stormwater are leaking sewer or septics, wild animals, pets, soils and sediments. While exposure to waters with high concentrations of E. coli doesn't necessarily cause disease in humans, presence of these bacteria indicate the potential presence of waste and the pathogens associated with it and therefore indicates a potential threat to animal, including human, health. Bacteria concentrations are measured in MPN/100ml or Most Probable Number (of bacterial colonies) per 100ml of sample water.

All samples in both creeks and stormdrain outfalls exceeded the E. coli WQO, with 18 out of 32 of the results exceeding the analytical methods maximum result of 24,000 MPN/100ml indicating higher concentrations of unknown levels. The two station pairs that didn't exceed the maximum limit showed that E. coli was higher in streams than outfalls by a significant amount at HIN-40/42 and SR-18/19. All total coliform results depicted in the graph exceeded the WQO as well as the analytical method limit of 24,000 MPN/100ml indicating higher concentrations of unknown levels.

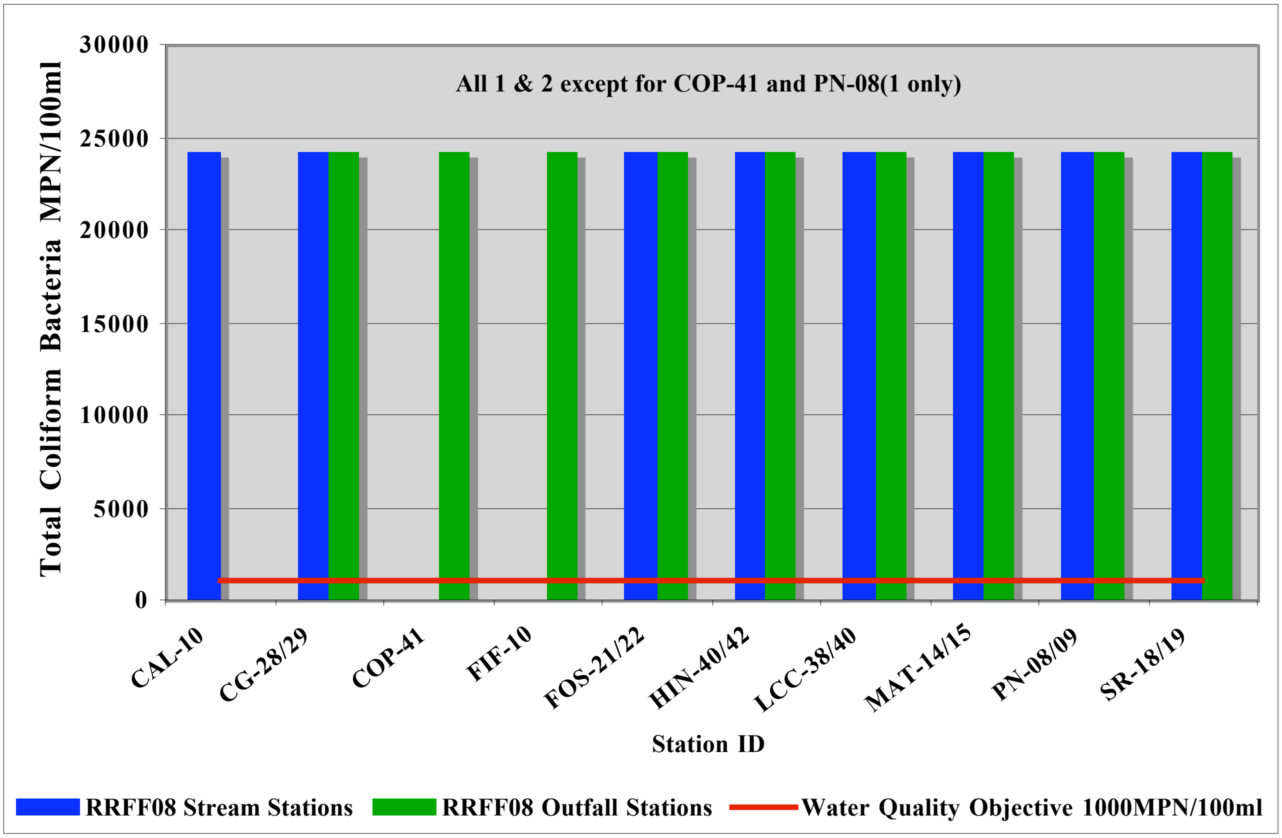


Figure 3.1: Total Coliform concentrations by Station

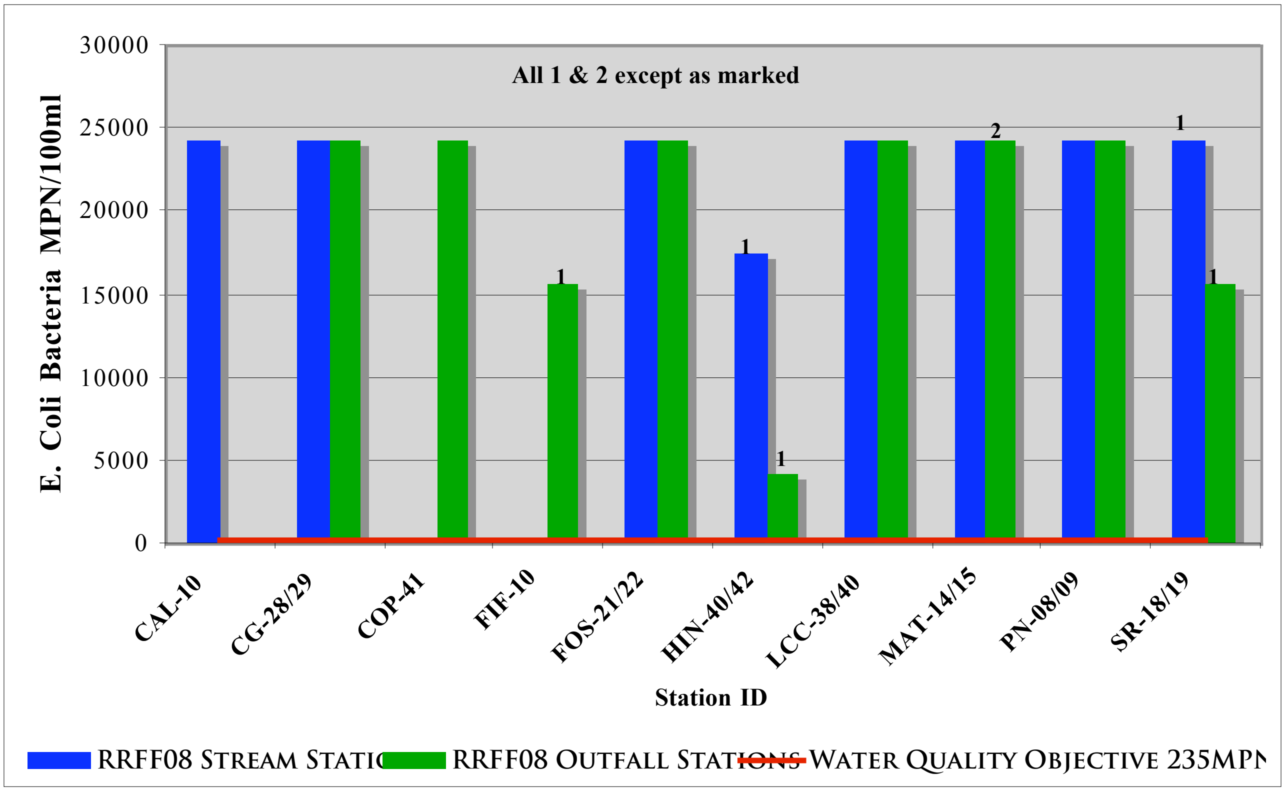


Figure 3.2: E. coli concentrations by station

3.3 Nutrients

Nutrients are essential elements for plant growth, but in fresh water systems, elevated levels of nutrients like ammonia can be toxic for aquatic organisms and others like phosphate and nitrate promote the growth of aquatic plants to the detriment of aquatic organisms like fish. Nutrient concentrations are closely tied to pH and can have both direct and indirect physiological effects on aquatic organisms. Excessive nutrients lead to indirect impacts relating to excessive algae and aquatic plant growth and contribute to dissolved oxygen fluctuations that harm fish and degrade general water quality conditions. Some examples of non-natural sources of nutrients include fertilizer runoff, yard waste, construction site runoff, pet waste, septic and sewer system leachate, soaps and detergents.

All samples collected exceeded the WQO for Ammonia except one sample from Piner Creek and the average of all samples, 2.48mg/L, was almost three times the Water Quality Objective of 0.50mg/L. Only 3 of 32 samples for nitrate-nitrogen exceeded the WQO's and in four samples no nitrate was detected. In 2008 the analytical method used for measuring phosphate gave results in Phosphorous (P) as opposed to Ortho-Phosphate (PO4) which has been used in previous First Flush events. Additionally, the detection limit was higher at 0.50mg/L versus 0.10mg/L in previous years. The net effect of this analytical change is that results for Ortho-phosphate as PO4 are significantly lower in 2008 than in past years and many 2008 samples yielded a result of non-detect (ND) instead of a numeric value. Ortho-phosphate results measured in as P yield three times lower numeric values than PO4, for example the FOS21-1 result of 0.62 P would yield 1.86 as PO4. The 2008 results for Ortho-Phosphate as P showed that 26 of 32 samples were non-detect that could have been due to improved water quality or the higher detection limit and change to Total Phosphate analytical method. The 6 samples that yielded results were lower than previous year's results but were all above WQO levels for Ortho-phosphate. The results for nitrate and ammonia both displayed a trend towards higher concentrations in stormwater via stormdrain outfalls than their paired stream stations, with higher results in 5 outfalls and higher results in only 2 stream stations. It is interesting to note that LCC38/39 had higher results for all nutrients from the stormdrain outfalls than the stream stations.

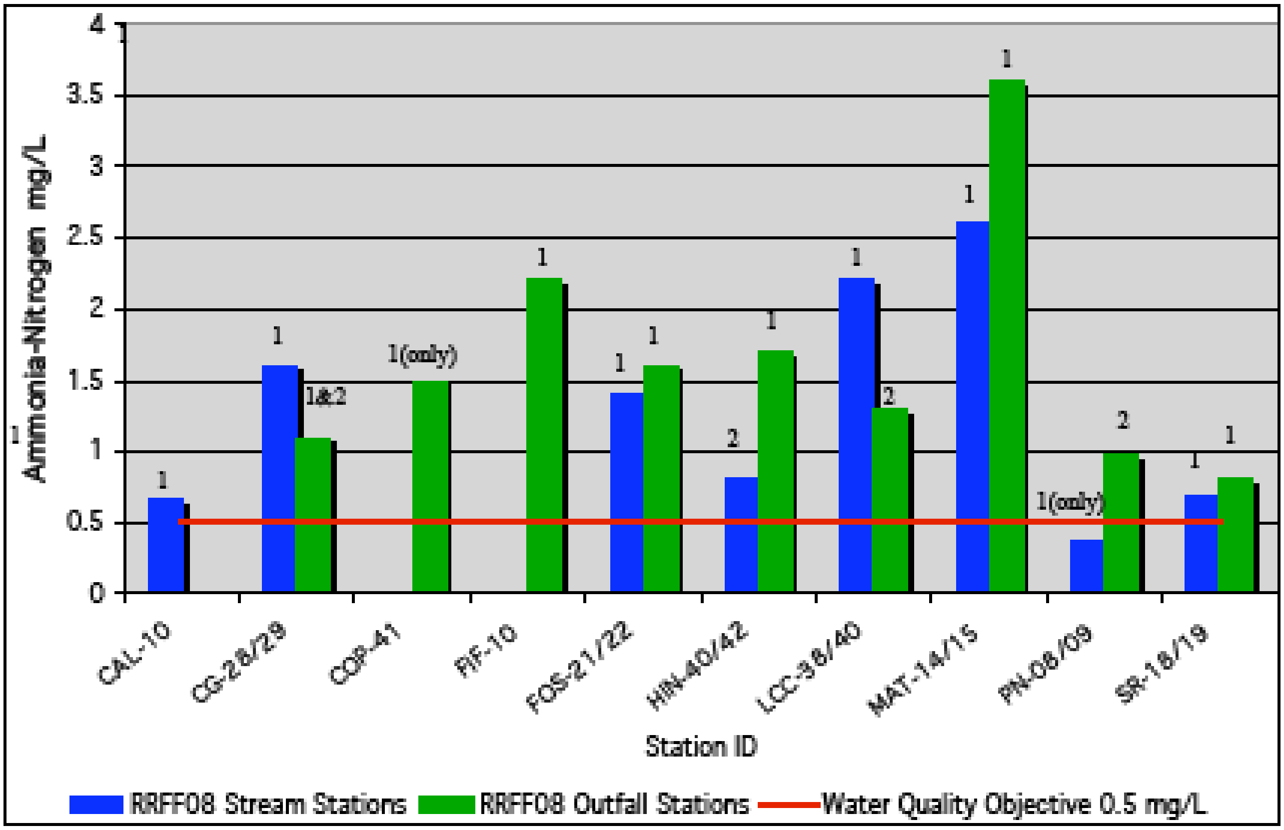


Figure 3.3: Ammonia-Nitrogen concentration by station

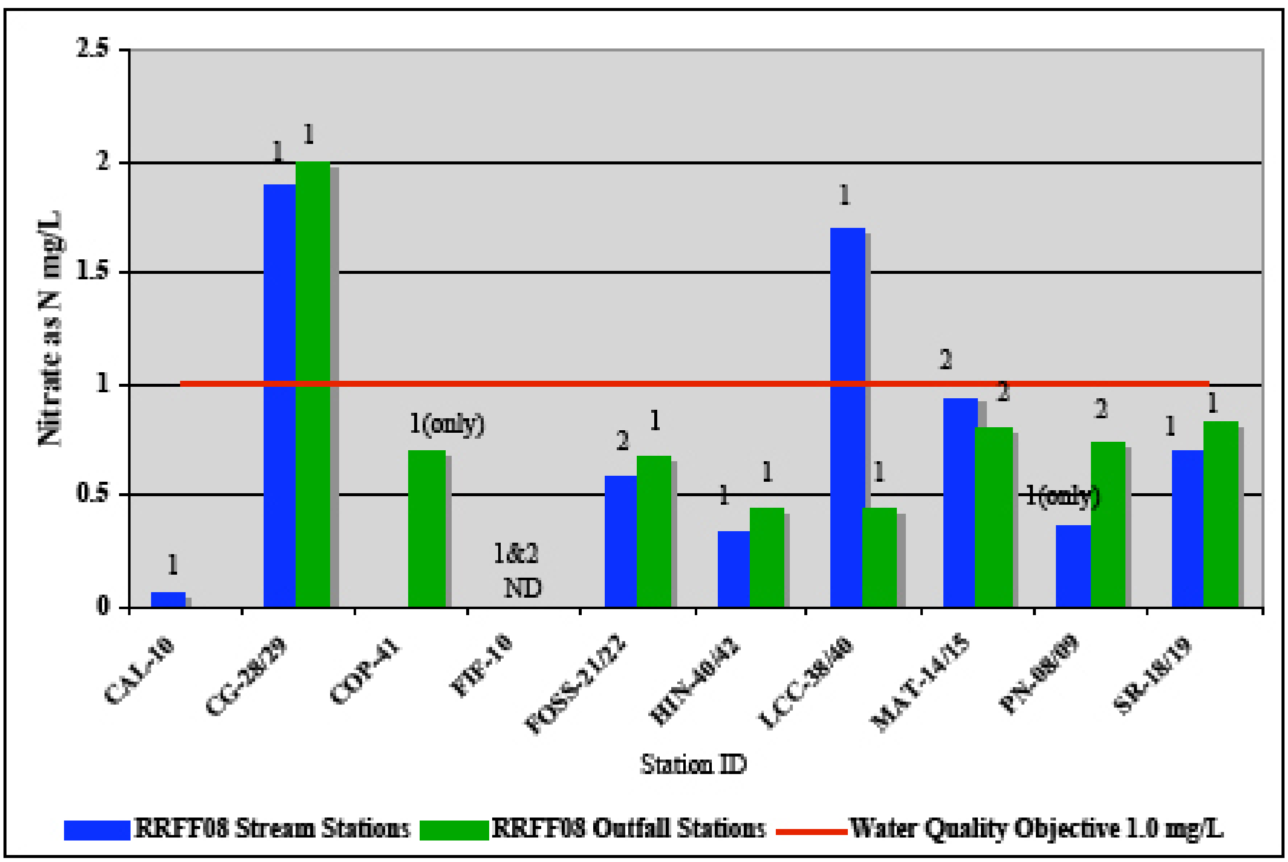


Figure 3.4: Nitrate as (N) concentrations by station

3.4 Metals

The presence of elevated concentrations of heavy metals in surface waters can produce significant toxicity to early life stages of aquatic organisms. Metals bioaccumulate in aquatic animals over their lifetimes and can lead to effects including reduced reproduction, developmental deformities, and mortality. Metals can be a persistent pollutant since they are elements and by definition don't break down. F

or RRFF08 sampling, samples were analyzed for total lead, copper and zinc; the results are represented by total metal concentration numbers. Due to lack of funding, paired water hardness data was not obtained in 2008. Toxicity is a function of the value of dissolved metals concentration paired with Hardness (CaCO3) as hardness levels control the uptake of metals in organisms so it is a priority to seek funding to support measuring hardness in 2009 and future First Flush events.

In general high concentrations of total or dissolved metals are toxic - dissolved since they are more easily absorbed and total since it normally contains the portion that is dissolved and the un-dissolved fraction that can eventually dissolve in aquatic environments.

The total lead results are quite high compared to previous years, for example in 2007 only 6 out of 57 samples (10%) exceeded the WQO for lead of 20mg/L, in 2008 11 out of 32 samples (34%) exceeded the 20mg/L WQO. Zinc showed a significant trend toward higher concentrations in outfall stations as compared to adjacent stream stations results at 6 of 7 outfall station pairs. Copper results were higher in outfall stations in 4 of 6 pairs. Lead was fairly even with higher outfall results in 4 of 7 pairs. Metals in stormwater mostly originate from vehicles, paints; zinc galvanized building materials, preservatives, motor oil, construction and other urban activities.

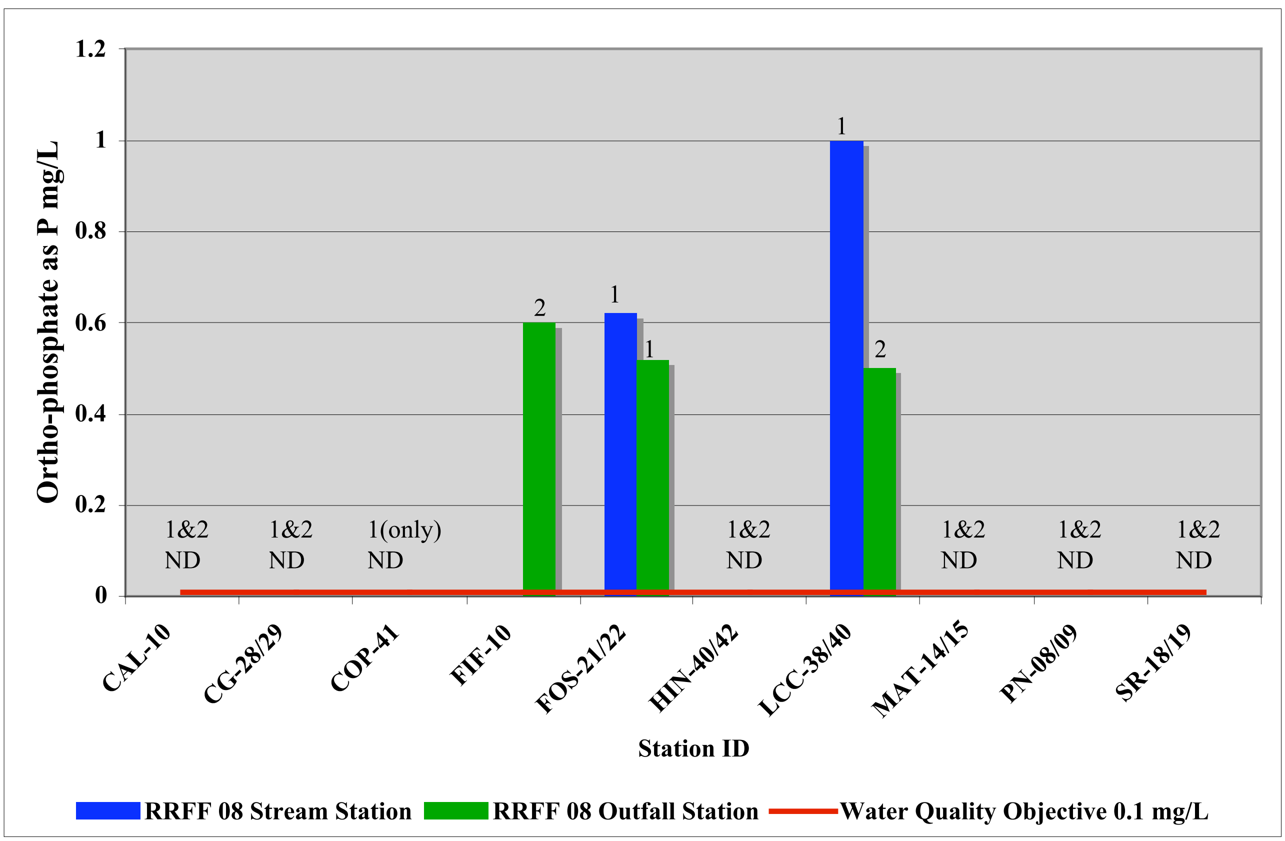


Figure3.5: Ortho-phosphate as (P) concentrations by station

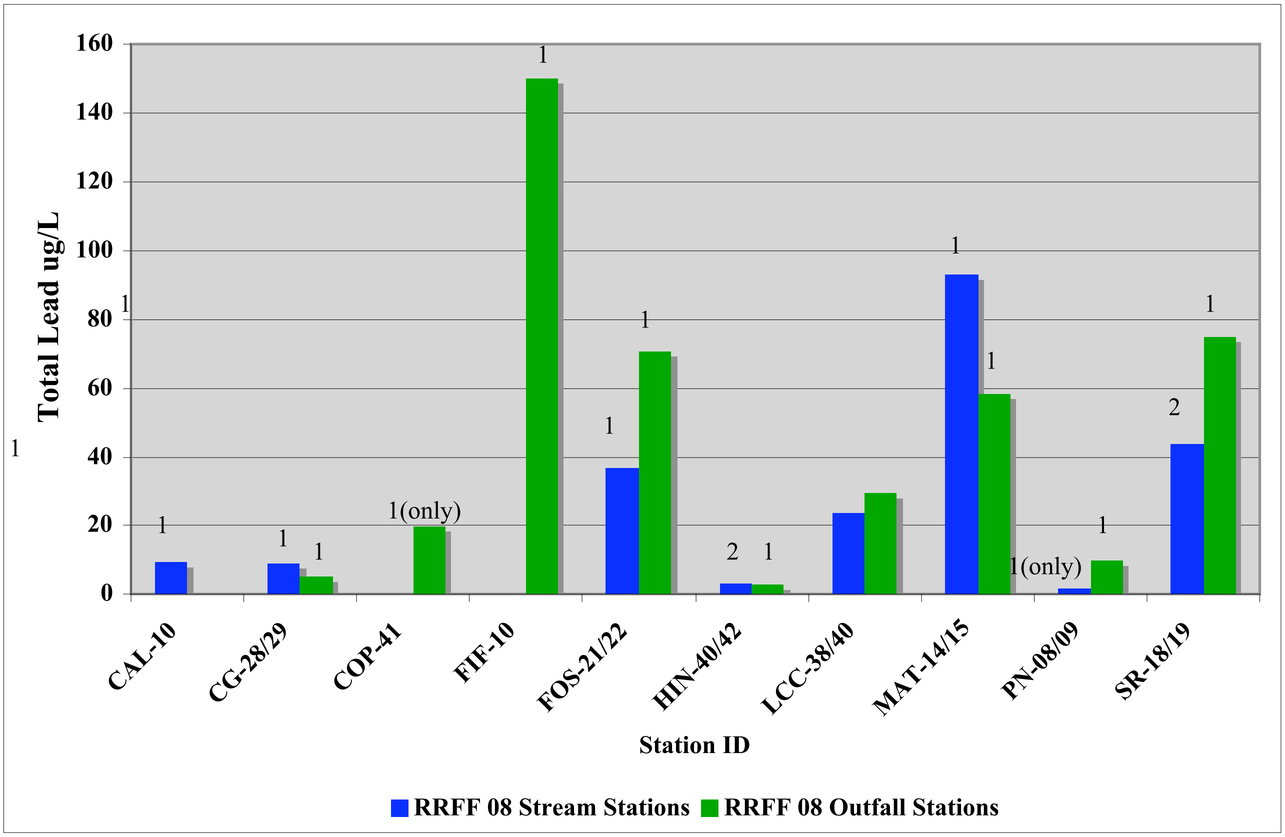


Figure 3.6: Total Lead concentrations by station

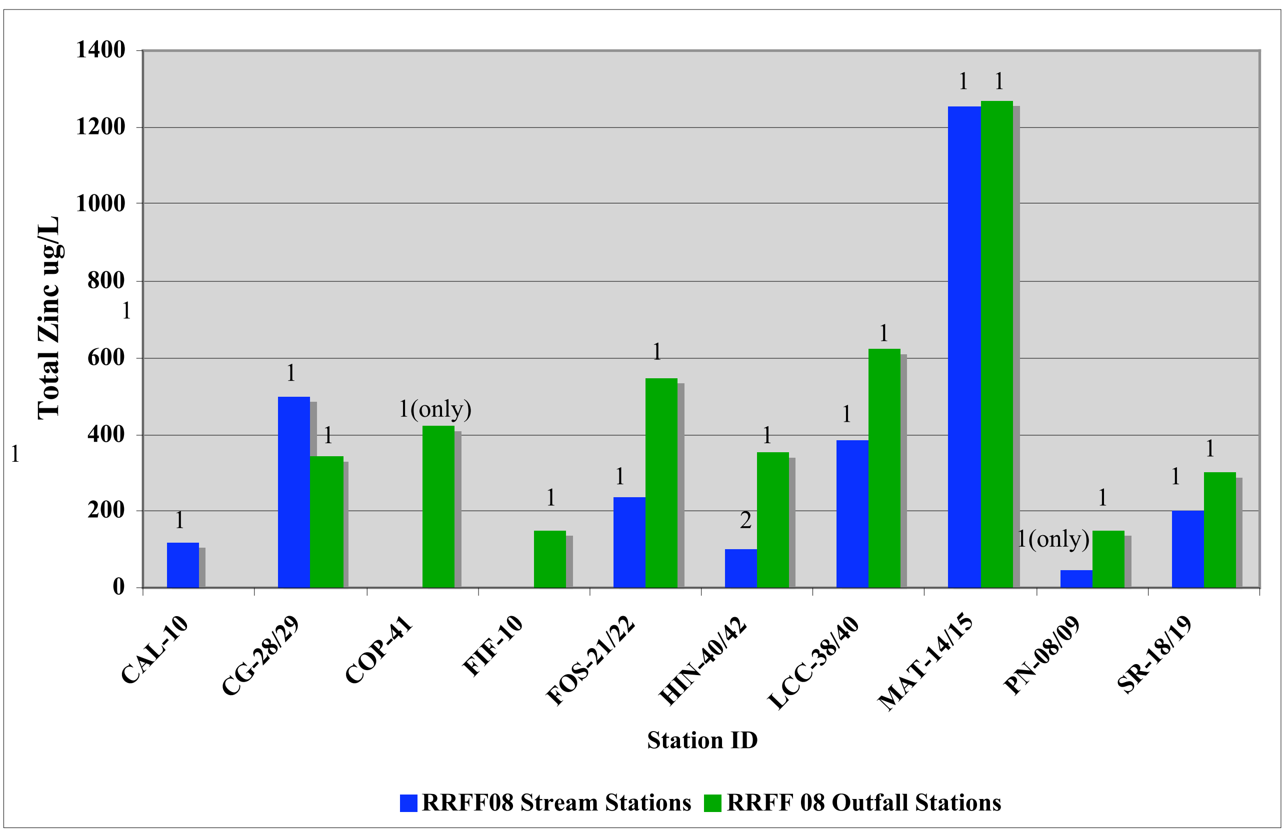


Figure 3.7: Total Zinc concentrations by station

3.5 Total Suspended Solids and Turbidity

Stormwater mobilizes particles on streets and other urban hardscape surfaces and delivers them to our creeks. Any particles suspended in the water column, be they soil, algae or plant matter, metals or organic waste, can have several detrimental effects on aquatic organisms. The measurement for particles in water is Total Suspended Solids and concentration results are measured by the weight of particles filtered from the sample. High concentrations of suspended solids can harm fish and aquatic organisms by degrading habitat, clogging gills, suffocating eggs, limiting food supply and impairing visibility for feeding, etc. No water quality standards have been established although industrial dischargers have a USEPA benchmark of 100mg/L to give some perspective to results.

The trend of the Total Suspended Solids (TSS) results, where paired stations were sampled, showed that the stormdrain outfalls had higher Total Suspended Solid concentrations than the stream stations in four of seven station pairs. This indicates that urban sources of sediment and solid/dissolvable waste should be investigated and reduced, i.e. utilizing particle reduction BMPs, such as street sweeping or using straw waddles and silt fences around disturbed, unvegetated soil at construction sites.

Turbidity is a measurement of the light-scattering ability of suspended particles and informs us about water clarity and results are expressed in NTUs. Higher turbidity concentration expressed by higher NTU results indicate increased light scattering ability and therefore lower water clarity. Turbidity is important to salmon and steelhead since excess turbidity makes it hard for them to avoid predators or find their food. Turbidity is often correlated with TSS as seen by the highest TSS yielding the highest turbidity in the stormwater sample at MAT14/15 with the stormwater inputs and stream results proportional for both TSS and turbidity. Outfalls stations showed markedly higher turbidity results than stream stations in station pairs with five of seven stations showing higher results in outfalls than streams.

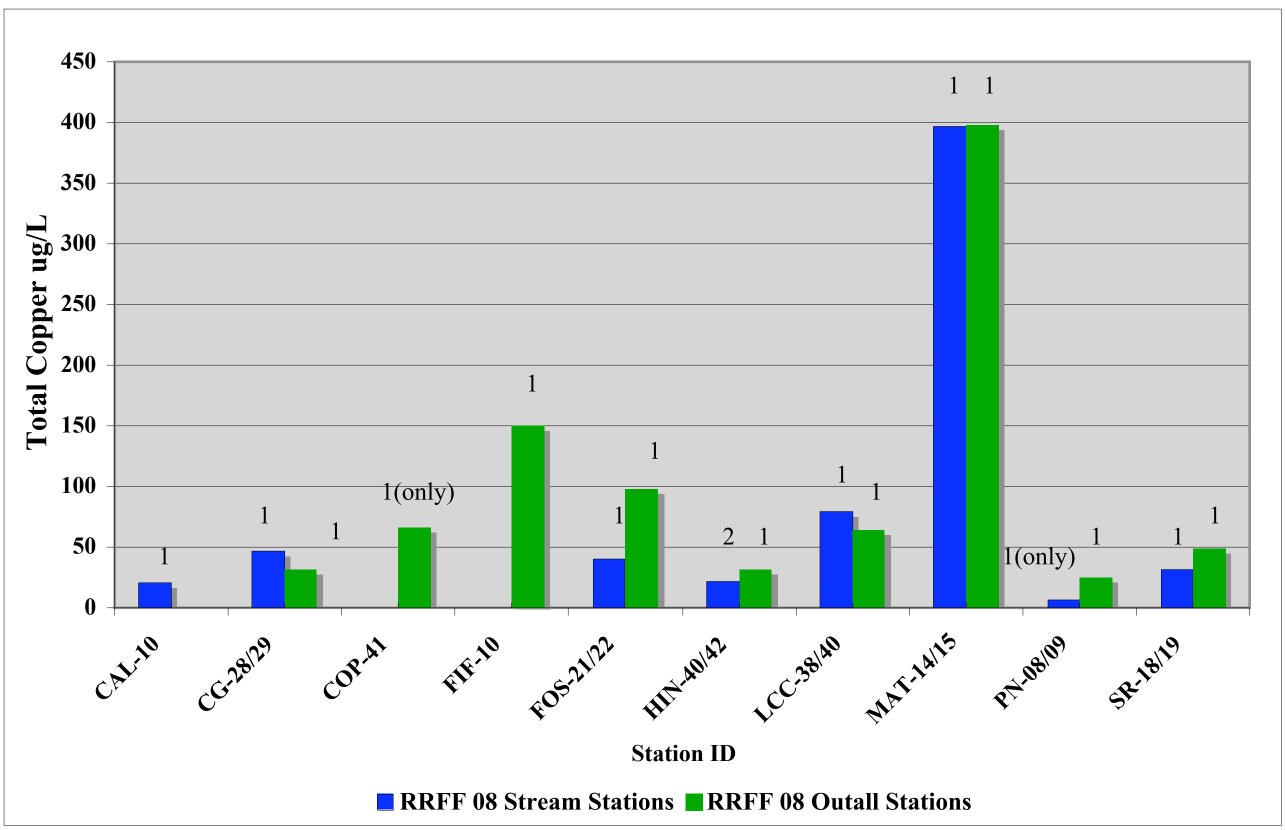


Figure 3.8: Total Copper concentrations by station

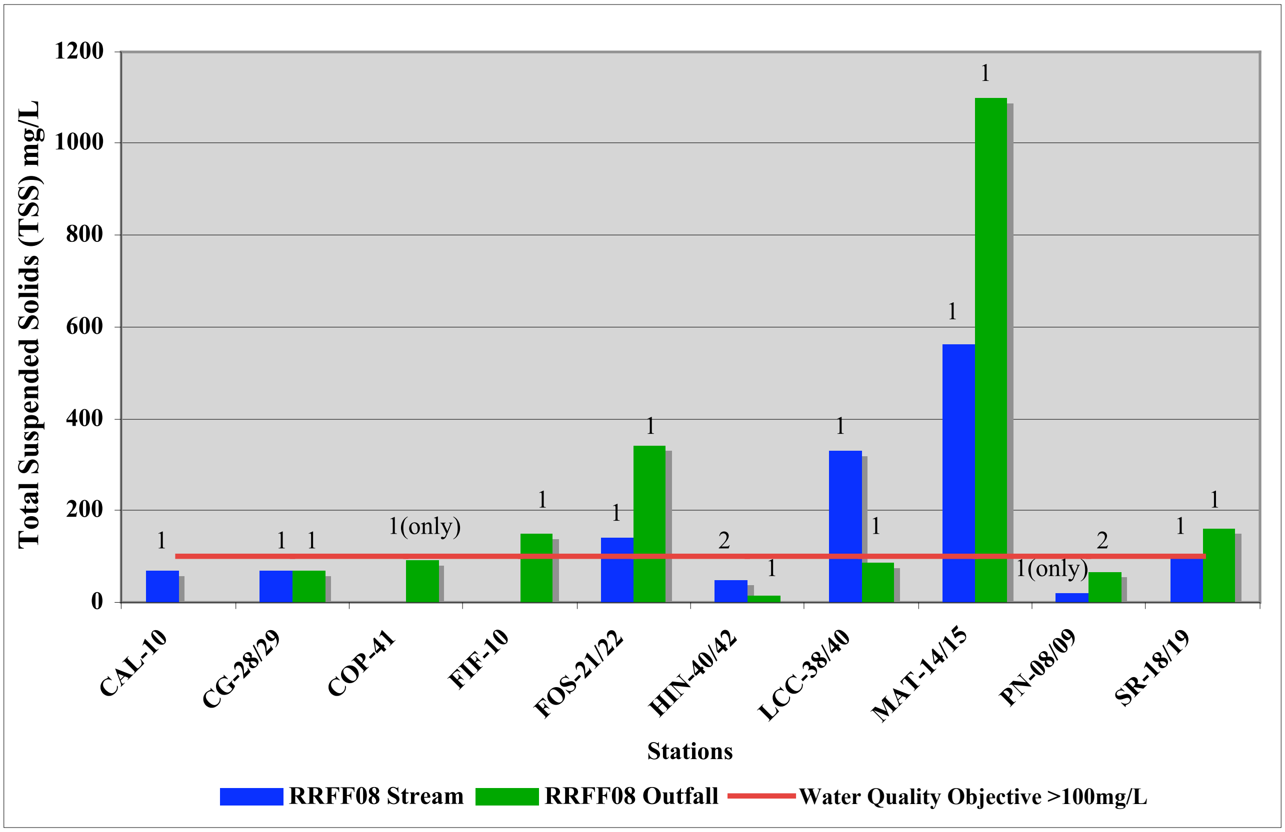


Figure 3.9: Total Suspended Solids (TSS) concentrations by station

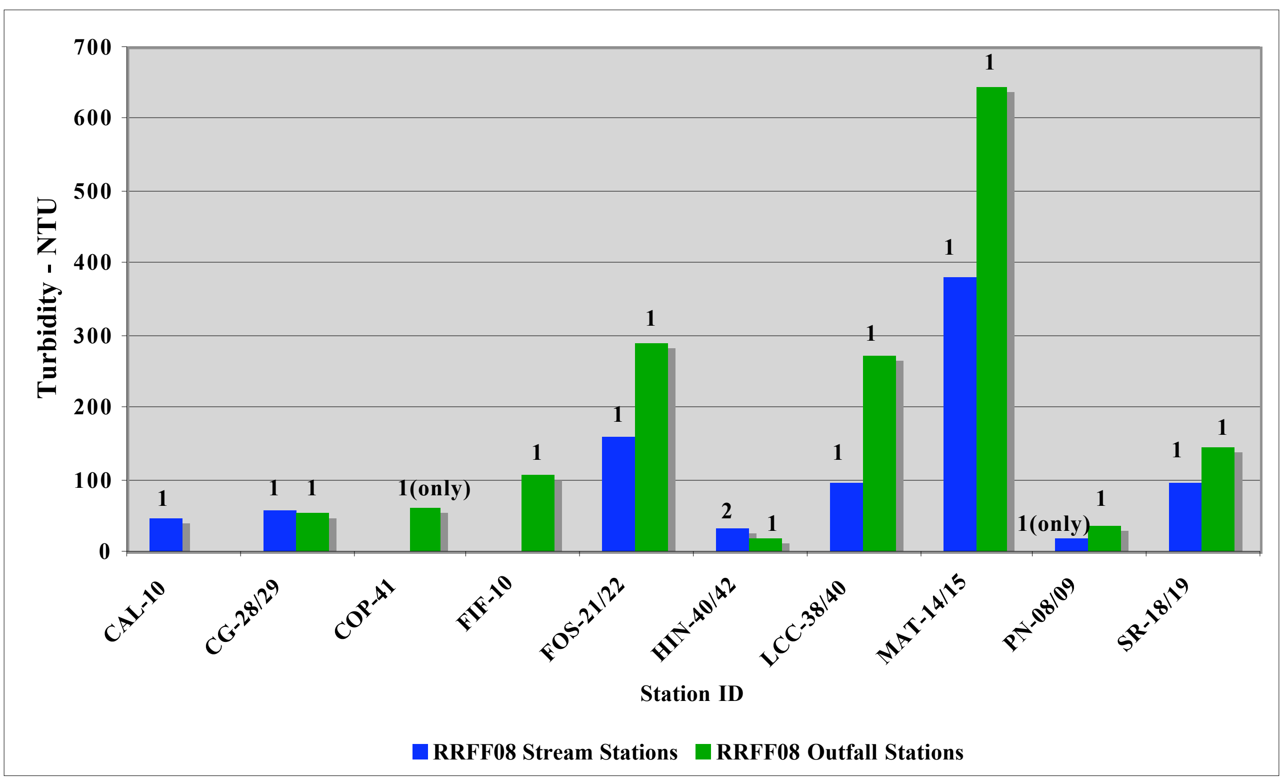


Figure 3.10: Turbidity concentrations by station

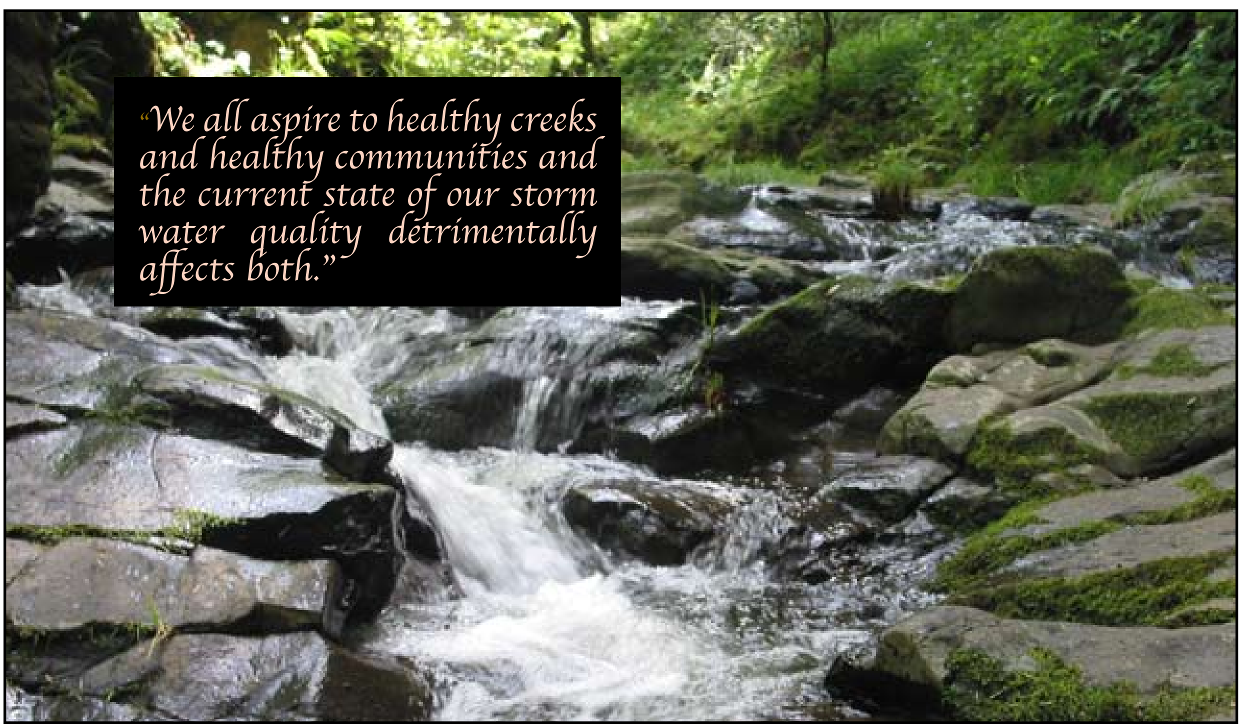
4 Conclusions

The high E. coli concentrations indicate a need to address untreated fecal matter entering the creeks from urban areas. While wildlife can be a source of E. coli, the large inputs during the first flush indicate that this is likely due to urban sources and points towards pet waste being of particular concern. Funding allowing, future sampling efforts may want to consider employing additional parameters to type the source of the bacteria to determine what animal it originated from so reduction strategies can be employed.

Many of the results indicated acutely toxic levels of ammonia-nitrogen and although only 3 of 32 nitrate samples for exceeded water quality objectives all but three samples yielded measurable nitrate concentrations. Phosphate results were harder to interpret in 2008 than in previous years due to the detection limit being above water quality standards a scenario that could hide problems. Excessive nutrient concentrations are problematic for our waterways as high nutrient levels make conditions more favorable for plants and more lethal for animals in our creeks and the river. In light of the money and effort going to restoring our salmon and steelhead fishery, we are putting that effort at risk by allowing nutrient pollution. More effort needs to go to controlling sources of nutrient pollution if we are to restore our native fishery and keep our creeks from turning to algae soup.

The storm drain outlet to Fife Creek (formerly site JB-21) had produced far higher results for metals than any other station in the past but this year Matanzas Creek – MAT14/15 – greatly exceeded Fife Creek for Zinc and Copper and had similar high results for Lead.

The storm drain that empties into Matanzas Creek just downstream of the Doyle Park footbridge in Santa Rosa (station MAT-15) is a large diameter (72″) culvert that assumedly drains a correspondingly large area. This station, MAT-15, and the corresponding creek station, MAT-14, showed some of the worst water quality results of all of the sampled stations in 2008 as well as 2007. MAT 14/15 displayed higher results in 2008 for five of the eight pollutants graphed. The outfall station MAT-15 produced higher results in five of seven pollutants and equal results of bacteria with both stations exceeding the analytical maximum. This is of great concern as this section of the creek runs through a public park and is adjacent to an elementary school, and thus has a high probability of kids and pets playing in the creek. Because



this creek generally flows year round, the aquatic organisms present in the creek would be significantly affected by the influx of pollutants from urban run-off.

Colgan Creek in Santa Rosa, (CG-28/29), Foss Creek in Healdsburg (FOS-21/22), Fife Creek in Guerneville (FIF-10) and Laguna Cotati Channel in Cotati (LCC38/40) all displayed elevated results for several pollutants measured showing that stormwater pollution is widespread and affects the entire Russian River watershed.

The results in general show that First Flush stormwater run-off is very high in pollutants and is a significant cause of water quality degradation into the creeks to which it drains. This pollution affects a wide spectrum of beneficial uses from recreation to wildlife and endangered salmon and steelhead. Since most stormwater flows untreated to our local creeks, our community needs to work harder to keep our urban landscape clean in order to protect our creeks and the Russian River. This report highlights several of the common urban pollutants and their sources so we can work as a community to reduce impacts to our creeks. We all aspire to healthy creeks and healthy communities and the current state of our storm water quality detrimentally affects both.

5.0 Recommendations

The following is a list of recommendations for future RRFF sampling events as well as recommendations for landowners and residents to improve stream and stormwater quality.

5.1 Future RRFF Event Recommendations:

• A dry run or pre-first flush rainfall sampling event should be integrated into the sampling design. This baseline information enables the data analyzers to assess the effects of storm water on the summer base flow.

• Determine the drainage areas of the storm drain outlets being sampled to better interpret results and analyze the land use of the drainage area to assess potential pollution sources.

• A data summary report comparing results from 2002 to 2008 RRFF sampling events should be completed to document trends, i.e. improvements or degradations in water quality, and correlate data to specific pollutant reduction efforts/strategies to assess associated improvements.

• For streams with stations that have exceeded WQOs for the same parameter for two or more years, additional stations should be added to assess the cumulative effects downstream of the station.

•The community should be more engaged through workshops, information/results distribution and the production of videos/youtube postings highlighting the event and water quality improvement recommendations.

5.2 Water Quality Recommendations:

Almost all stormdrain systems in the Russian River are designed to rapidly convey water from streets, rooftops and parking lots directly to our local creeks with no treatment for pollutants. This rapid conveyance system for stormwater efficiently delivers pollutants to creeks and deprives our local areas of groundwater recharge. Future development construction projects are being required to design features that slow down, retain, infiltrate and treat stormwater using landscaped areas known as Low Impact Development that actually reduces costs over traditional development while protecting water quality. New developments that can't use Low Impact Development (LID) methods will likely be required to install filtration systems in stormdrain inlets or retrofit LID elements which are both more costly than addressing stormwater when development occurs. Riverkeeper has been testing one filter system in Healdsburg and found enormous amounts of pollutants are removed indicating the unprotected stormdrains are, as First Flush results indicate, contributing greatly to stormwater pollution. Until we change our stormdrain systems it is up to us as a community to employ source control measures to ensure that our streets, rooftops and parking lots are clean so they aren't sending pollutants to our creeks each time it rains.

• High bacteria levels can originate from a variety of sources, wildlife, domestic pets, homeless camps, soils and leaky sewage pipes and septic systems. Further testing to identify the source of the bacteria would point to proper education strategies but is expensive and might not be feasible. In the meantime it is always a good idea to properly dispose of pet waste as our samplers see evidence of pet waste on creek banks. Posting signs and pet waste bags and trash receptacles at popular locations can help encourage proper stewardship practices.

• Fertilizers and pesticides should be carefully and judicially applied and never done so in conjunction with rainfall in order to minimize toxic runoff from lawns and gardens. The City of Santa Rosa Storm Water Management Program states, "Homeowners are certainly the most likely culprit for pesticide release to our waters due to inexperience, lack of understanding about how pesticides get into our waterways and how they can use products safely. Teaching homeowners not to use pesticides within a week of rainfall, not to spray hard surfaces, to control irrigation so as not to allow run-off carrying pesticides… is a start. Utilizing utility bills, public service announcements, newspaper stories and other media is important in addition to educational materials at point of purchase for pesticides at retail locations where pesticides are sold. It is clear that past pesticide use patterns have to change in order to avert widespread degradation to our urban creeks." This effort should be continued and expanded.

• All exposed dirt should be covered or contained with berms or straw to reduce sediment pollution, which is a big problem for salmon and steelhead. Yard waste should not be blown into streets where it can accumulate and be flushed into stormdrains, but instead picked up and put in yard waste bins to keep excess nutrients out of our creeks.

• Vehicles should be well maintained to avoid oil leaks and if oil or other chemical residues are observed, kitty litter should be applied to absorb the pollutants, then disposed of in a garbage can. Poorly maintained brakes and excess brake pad wear are primary contributors or metals so good brakes will save your life and keep our creeks cleaner.

•Whether you get your water from a well or municipal water source, your water use affects the amount and quality of stream flow. Water conservation is vital for many reasons. Wasteful over-irrigation helps deliver pollutants from lawns, streets and driveways to local creeks in dry months when flows and dilution are low. Water conservation will help preserve higher natural baseflows by pumping less water out of wells and the Russian River, which allows more groundwater that is cleaner than gutter water, to seep from the ground to area streams. There are a number of water conservation education and incentive programs available from the City of Santa Rosa and the Sonoma County Water Agency.

In addition to water conservation, all cities have stormwater pollution prevention programs. So if you see large amounts of trash, dirt, oil or other debris in gutters or streets call your city and let them know where you saw it and when so they can ensure it gets cleaned up before the next rain. Remember that your actions at your home or business directly affect the health of the watershed. What is on our driveways, streets, rooftops and parking lots will soon be in our creeks. If it's not rain it shouldn't go down the storm drain!

Appendix 1: Russian River First Flush 2008 Results Table

Number on Map	Sample ID	Collection Date	Collection Time	Conductivity (uS)	pH	Temperature (ºC)	Total Ammonia Nitrogen (mg/L)	Ortho-phosphate as P (mg/L)	Nitrate as N (mg/L)	Turbidity (NTU)	TSS (mg/L)	E. coli (MPN/100 mL)	Total Copper (ug/L)	Total Lead (ug/L)	Total Zinc (ug/L)
1	LCC-38-	10/03/08	23:30	490	6.5	17.5	2.2	1	1.7	94.2	330	24,192	79.9	23.7	385.6
1	LCC-38-	10/04/08	0:10	130	6.5	18	1.3	0.5	0.9	74.2	76	24,192	29.6	8.4	152.3
1	LCC-40-	10/03/08	22:55	110	6.5	18	1	ND	0.5	271	86	24,192	64.7	29.4	624.3
1	LCC-40-	10/03/08	0:00	130	6.5	18	1.3	0.5	0.9	87.0	42	24,192	34.0	11.0	253.9
2	COP41-	10/03/08	23:45	80	6	17.5	1.5	ND	0.7	61.4	91	24,192	66.1	19.7	421.6
3	HIN40-1	10/03/08	22:21	nm	nm	nm	0.68	ND	0.3	23.6	34	14,136	22.2	2.9	94.8
3	HIN40-2	10/03/08	23:21	nm	nm	nm	0.82	ND	0.3	32.1	48	17,329	20.7	3.3	101.3
3	HIN42-1	10/03/08	22:35	nm	nm	nm	1.7	ND	0.4	19.0	15	4,160	31.3	2.8	354.4
3	HIN42-2	10/03/08	23:34	nm	nm	nm	1.1	ND	0.3	8.83	6.5	2,014	16.4	1.5	127.7
4	CG-28	10/03/08	22:25	380	6.5	18.5	1.6	ND	1.9	57.9	68	24,192	47.1	8.9	499.7
4	CG-28	10/03/08	23:25	120	6.5	17.8	1.1	ND	0.7	38.4	55	24,192	29.0	7.5	420.2
4	CG-29	10/03/08	22:10	380	6.5	18.5	1.1	ND	2	54.0	67	24,192	31.4	5.2	344.7
4	CG-29	10/03/08	23:10	110	6.5	17.5	1.1	ND	0.7	25.5	43	24,192	19.1	3.5	271.4
5	CAL 10-	10/03/08	23:20	96	7.3	17.5	0.66	ND	0.6	44.9	68	24,192	21.1	9.2	117.1
5	CAL 10-	10/04/08	0:20	88	7.1	17.4	0.58	ND	0.5	20.1	31	24,192	15.8	6.2	94.5

Number on Map	Sample ID	Collection Date	Collection Time	Conductivity (uS)	pH	Temperature (°C)	Total Ammonia Nitrogen (mg/L)	Ortho-phosphate as P (mg/L)	Nitrate as N (mg/L)	Turbidity (NTU)	TSS (mg/L)	E. coli (MPN/100 mL)	Total Copper (ug/L)	Total Lead (ug/L)	Total Zinc (ug/L)
6	MAT-14-1	10/03/08	21:45	290	6.5	17	2.6	ND	ND	379	560	>24,192	397.4	93.0	1255.1
6	MAT-14-2	10/03/08	22:45	210	6.5	17	1.5	ND	0.9	62.9	90	>24,192	53.4	9.8	265.1
6	MAT-15-1	10/03/08	21:35	350	6.5	17.5	3.6	ND	ND	642	1100	19,863	398.4	58.5	1268.7
6	MAT-15-2	10/03/08	22:35	150	6	16.5	1.6	ND	0.8	69.0	170	24,192	66.1	14.5	326.6
7	PN08-1	10/03/08	23:01	376	7.6	17.5	0.38	ND	0.4	16.0	19	>24,192	6.8	1.7	47.3
7	PN09-1	10/03/08	21:58	49	7.67	17.6	0.82	ND	0.4	35.6	65	>24,192	25.0	9.7	147.9
7	PN09-3	10/03/08	22:38	80	7.12	18.2	0.98	ND	0.7	12.2	14	>24,192	16.6	3.2	83.2
8	SR-18-1	10/03/08	22:30	420	7.68	17.4	0.69	ND	0.7	94.1	99	>24,192	32.2	35.7	201.6
8	SR-18-2	10/03/08	23:25	160	7.88	17.4	0.55	ND	0.4	45.2	94	15,531	28.4	43.6	201.3
8	SR-19-1	10/03/08	22:25	16	8.43	17.8	0.81	ND	0.8	144	160	15,531	49.3	75.0	300.4
8	SR-19-2	10/03/08	23:20	61	8.15	17.4	0.71	ND	0.5	63.5	88	8,664	29.9	46.1	196.4
9	FIF-10-1	10/03/08	18:50	260	nm	19	2.2	ND	ND	104	150	15,531	92.4	16.5	1013.5
9	FIF-10-2	10/03/08	19:50	270	6.5	18.5	1	0.6	ND	83.1	53	5,794	77.1	10.0	1427.5
10	FOS-21	10/03/08	19:55	110	6	13.5	1.4	0.62	0.5	160	140	>24,192	40.8	36.7	236.4
10	FOS-21	10/03/08	21:02	230	6.5	13.3	0.84	ND	0.6	65.3	81	>24,192	25.7	13.3	128.1
10	FOS-22	10/03/08	19:42	120	6	12	1.6	0.52	0.7	289	340	>24,192	97.8	70.9	546.2
10	FOS-22	10/03/08	20:53	60	6.5	13.5	0.91	ND	0.5	38.6	49	>24,192	20.9	20.2	137.8