Russian River First Flush 2007

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Russian River First Flush 2007 Summary Report

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Russian River First Flush 2007 was made possible with help from: North Coast Regional Water Quality Control Board, Sonoma County Water Agency, EPA Region 9, Cities of Santa Rosa, Rohnert Park, and Healdsburg, Cotati Creek Critters, and Community Clean Water Institute and countless community volunteers!

A big thank you to all of the brave souls who endured a long night in the pouring rain to collect water samples!

1 Executive Summary

The Russian River First Flush sampling event occurred on the evening of October 9-10, 2007. Donning rain gear and sampling equipment, 31 participants sampled 21 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, Pool, Foss Creeks and the Laguna-Cotati Channel and represented stormwater runoff from the Cities of Santa Rosa, Rohnert Park, Cotati, Sebastopol, Healdsburg and the towns of Windsor and Guerneville.

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, Cities of Santa Rosa, Rohnert Park, and Healdsburg, Cotati Creek Critters, and Community Clean Water Institute.

Table 1: Russian River First Flush 2007 Range of Results & Water Quality Objectives

Parameter	Range of results	Water Quality Objective
Temperature	12.5 to 16°C	<21°C
pH	5.5 to 7.0	6.5 to 8.5
Conductivity	40 to 420 us/cm	>375 us/cm
Ammonia	0.6 – 3.3 mg/L	0.5 mg/L
Nitrate	0.7 – 3.8 mg/L	1.0 mg/L
Orthophosphate as P	0.65 – 3.28 mg/L	0.1 mg/L
Escherichia coli (E. coli)	540 -- >24,000 MPN/100 ml	> 235 MPN
Total Copper	7.2 – 1300 ug/L	Metals standards vary with hardness - see section on metals results
Total Zinc	37 – 1100 ug/L	
Total Lead	ND – 63 ug/L	
Turbidity	1.06 – 194 NTU	No standard
Total Suspended Solids (TSS)	5 – 360 mg/L	> 100 mg/L

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 2002-2007 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 2007 event, coordinated by the Sotoyome Resource Conservation District and the Russian Riverkeeper and funded in part by the Sonoma County Water Agency and Russian Riverkeeper, featured a pared down, but improved sampling design that measured selected pollutants in both urban storm and receiving waters, while eliminating more rural stations that had continually failed to show a runoff response to the first flush.

This synoptic, county-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 creeks that run though the urban areas of Sonoma County. The paired storm drain outfall and creek surface water sampling design employed for the 2007 RRFF event 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. Also, due to an EPA sponsored World Wide Monitoring Day event that occurred hours before the First Flush sampling, baseline samples were collected from creeks that had surface flow prior to the rainfall. 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.

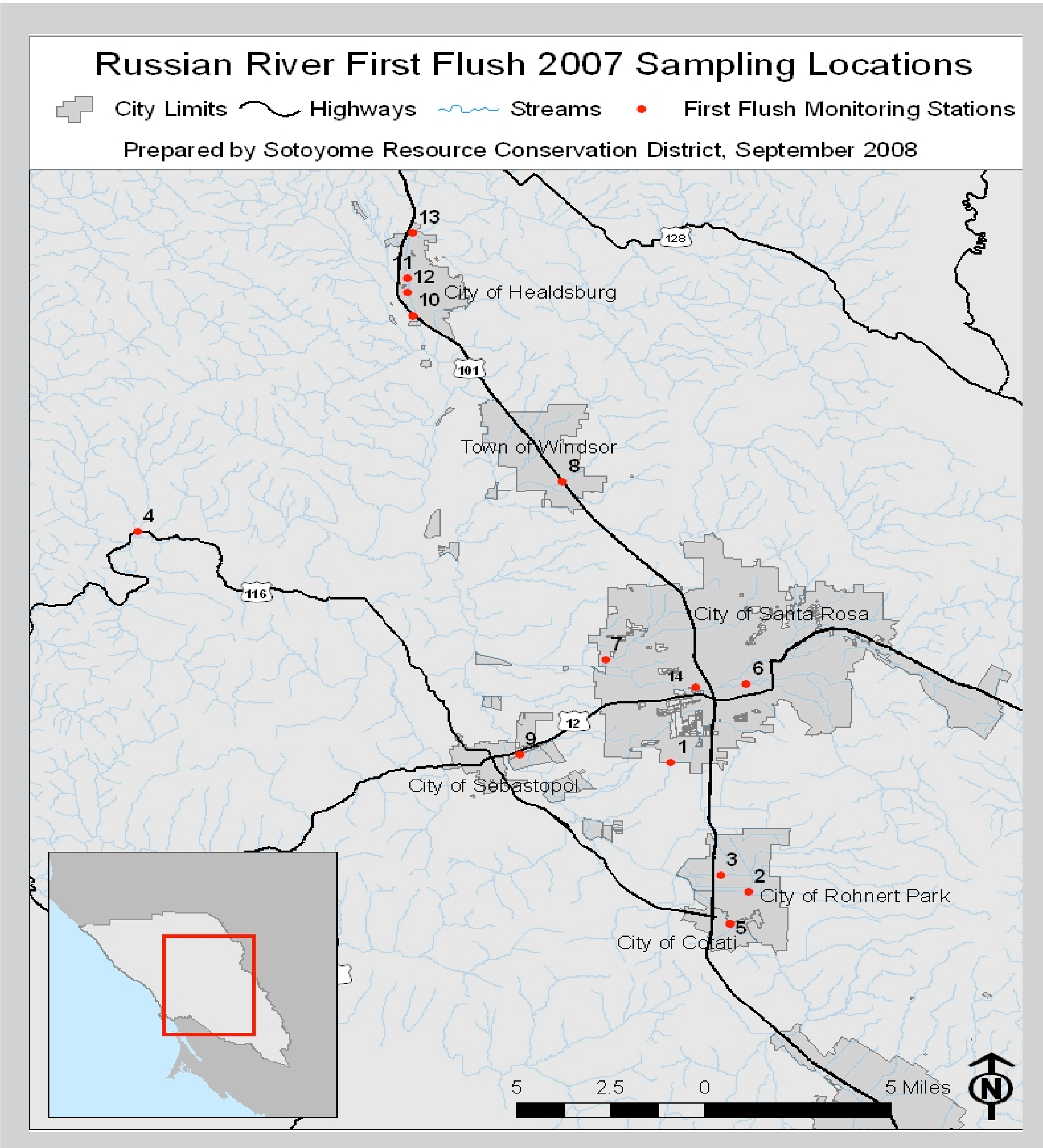
Gathering first flush water quality data throughout a watershed, and building a multi-year data record, gives municipal officials, regulatory agencies and citizens pertinent information on how the sum of all our activities impacts our waterways. It should also be pertinent to everyone who lives, works, 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 from Brelje and Race Laboratories, the City of Santa Rosa's Laguna Wastewater Treatment Plant lab, Russian Riverkeeper, the North Coast Regional Water Quality Control Board and the Environmental Protection Agency (EPA) Lab in Richmond, analysis was conducted on creek and outfall samples for nutrients, metals, bacteria and turbidity. 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.). By understanding the pollutants of concern, Best Management Practices (BMPs) can be proposed that can most effectively target the input of these pollutants. These BMPs can be adopted by the community to improve water quality and aquatic habitat.

2 Study Design

Figure 1: Map of RRFF07 Water Quality Monitoring Locations



2.1 Sampling Locations

Figure 1: RRFF07 Water Quality Stations

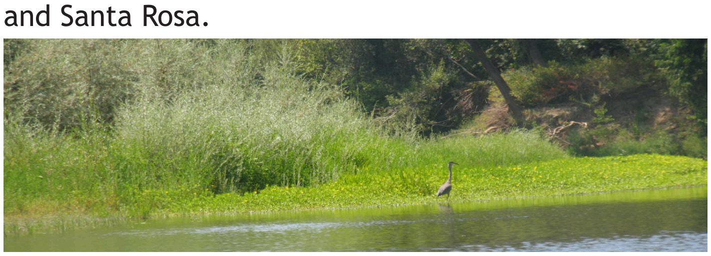
Map ID #	Station ID	Waterbody	Station Type	Station City	Latitude	Longitude
1	CG29	Colgan Creek	Creek	Santa Rosa	38.40204	-122.73568
2	COP40	Copeland Creek	Creek	Rohnert Park	38.34319	-122.69557
2	COP41	Copeland Creek	**Outfall**	Rohnert Park		
3	HIN40	Hinbaugh	Creek	Rohnert Park	38.35060	-122.70930
3	HIN42	Hinbaugh	**Outfall**	Rohnert Park		
4	FIF10	Fife Creek	**Outfall**	Guerneville	38.50210	-123.00190
5	LCC38	Laguna Cotati Channel	Creek	Cotati	38.32793	-122.70365
5	LCC39	Laguna Cotati Channel	**Outfall**	Cotati	38.32818	-122.70391
5	LCC40	Laguna Cotati Channel	**Outfall**	Cotati		
6	MAT14	Santa Rosa Creek	Creek	Santa Rosa	38.43890	-122.69980
6	MAT15	Santa Rosa Creek	**Outfall**			
7	PN08	Piner Creek	Creek	Santa Rosa	38.44853	-122.76941
7	PN09	Piner Creek	Creek	Santa Rosa		
8	POL35	Pool Creek	Creek	Windsor	38.53014	-122.79360
9	CAL10	Calder Creek	Creek	Sebastopol	38.40391	-122.81021
10	FOS05	Foss Creek	Creek	Healdsburg	38.60479	-122.87027
11	MB10	Foss Creek	Creek	Healdsburg	38.62198	-122.8738
12	FOS22	Foss Creek	**Outfall**	Healdsburg	38.61578	-122.87325
13	FOS30	Foss Creek	Creek	Healdsburg	38.64296	-122.87168
14	SR19	Santa Rosa Creek	**Outfall**	Santa Rosa	38.43693	-122.72500
14	SR18	Santa Rosa Creek	Creek	Santa Rosa		

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. Additionally, a number of non-urban creeks were sampled due to volunteer interest but rural creeks failed to produce run-off like urban areas. The lack of dense areas of impervious surfaces such as parking lots, roads and rooftops in rural areas did not yield significant run-off in the first storm of the season. 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. Other than Fife Creek, which has a small urban area in Guerneville, all 2007 stations are located in well-developed urban areas.

An event for World Wide Monitoring Day (WWMD) was held on the morning of October 9, 2007. The data was analyzed by the EPA, Region 9 laboratory. Due to the happy coincidence of this event occurring the morning prior to RRFF samples being collected, the WWMD samples are represented as baseline data against which the RRFF07 data can be compared.

WWMD samples were only collected in locations that had base flow prior to the rainfall event. These sampling locations were restricted to creek samples with at least two inches of continuous surface flow and include the following creeks: Calder, Colgan, Hinebaugh, Laguna Cotati Channel, Matanzas, Piner and Santa Rosa.



3 Results

3.0 Results

As with all previous RRFF sampling efforts, a series of three samples is collected at each station (at both creek and outfall locations), taken at half-hour intervals and labeled with a corresponding 1, 2 or 3. The purpose of taking multiple samples at each station is to ideally capture conditions during the rising limb of the hydrograph and to track each pollutant for 90 minutes during the course of the storm once the rainfall criteria has been met. Since RRFF 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 series of three samples for each pollutant. For example, if the highest concentration of nitrate measured on Fife 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 Copeland Creek occurred during the third sample of the series, so the concentration from the third 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 for the WQO table.

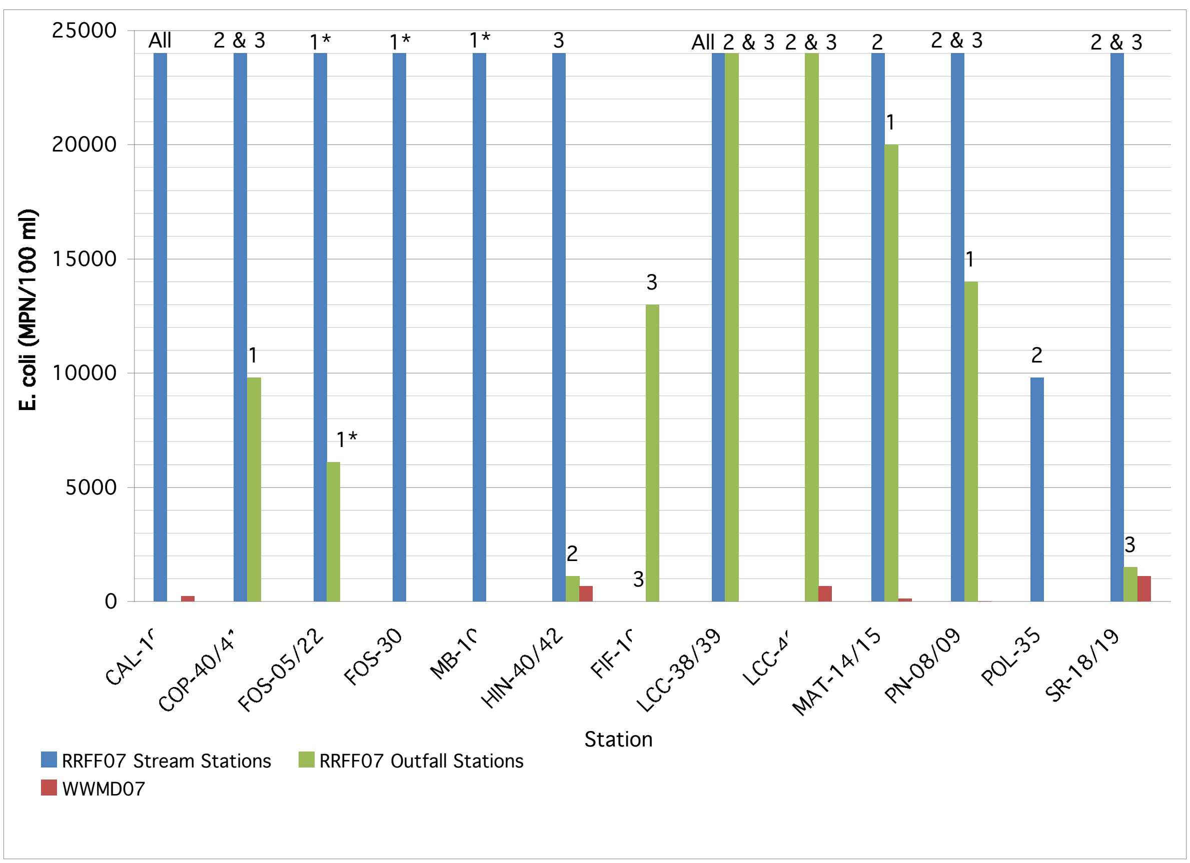
3.1 Event Result Graphs

Each graph shows the results for one parameter, representing the creek samples in blue, the paired outfall samples in green, and the WWMD samples (if taken) in red. The red horizontal line depicts the Water Quality Objective, when established, for each parameter. The field parameters, Temperature, Conductivity and pH all 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 A.

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 presence of waste and the pathogens associated with it and therefore indicates a potential threat to animal, including human, health.

With the exception of the WWMD/baseline samples taken on Calder, Matanzas and Piner Creeks, every sample taken at all creeks exceeded the E. coli WQO, with most of the results exceeding the analytical methods maximum result of 24,000 MPN/100ml.

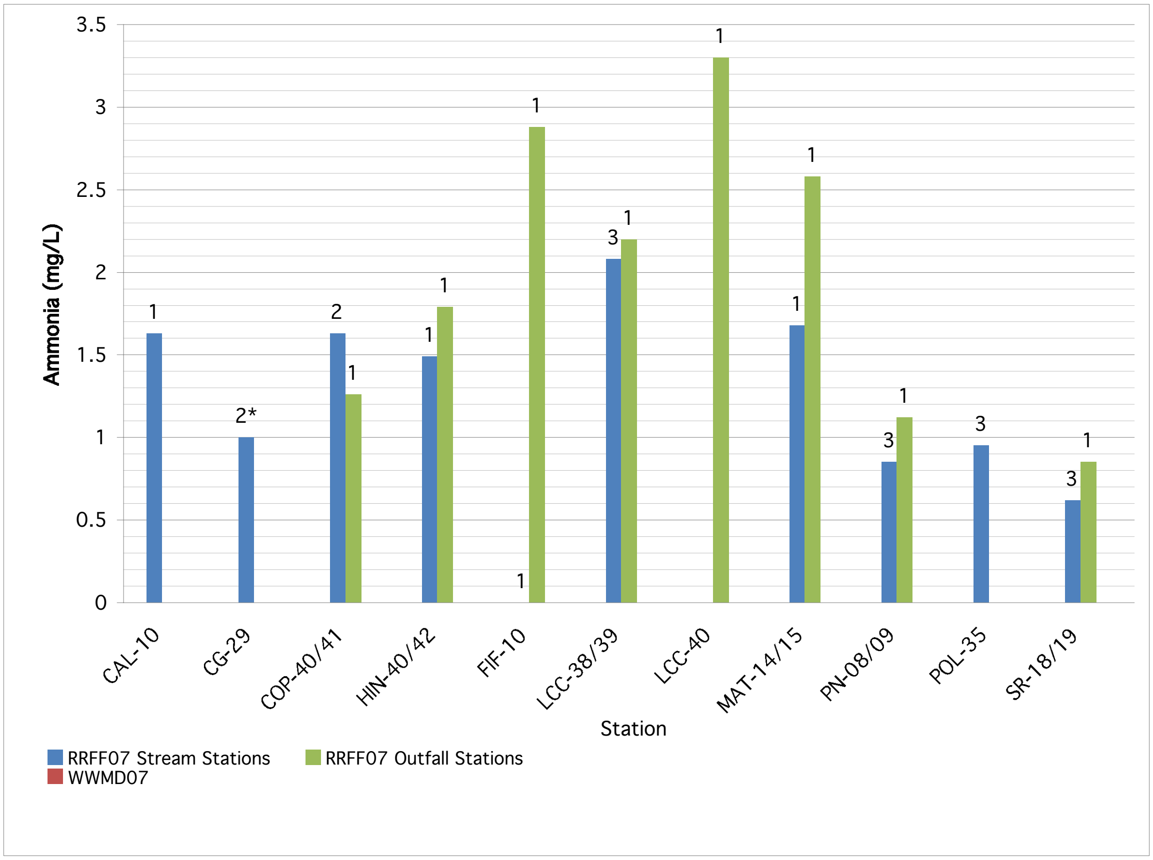


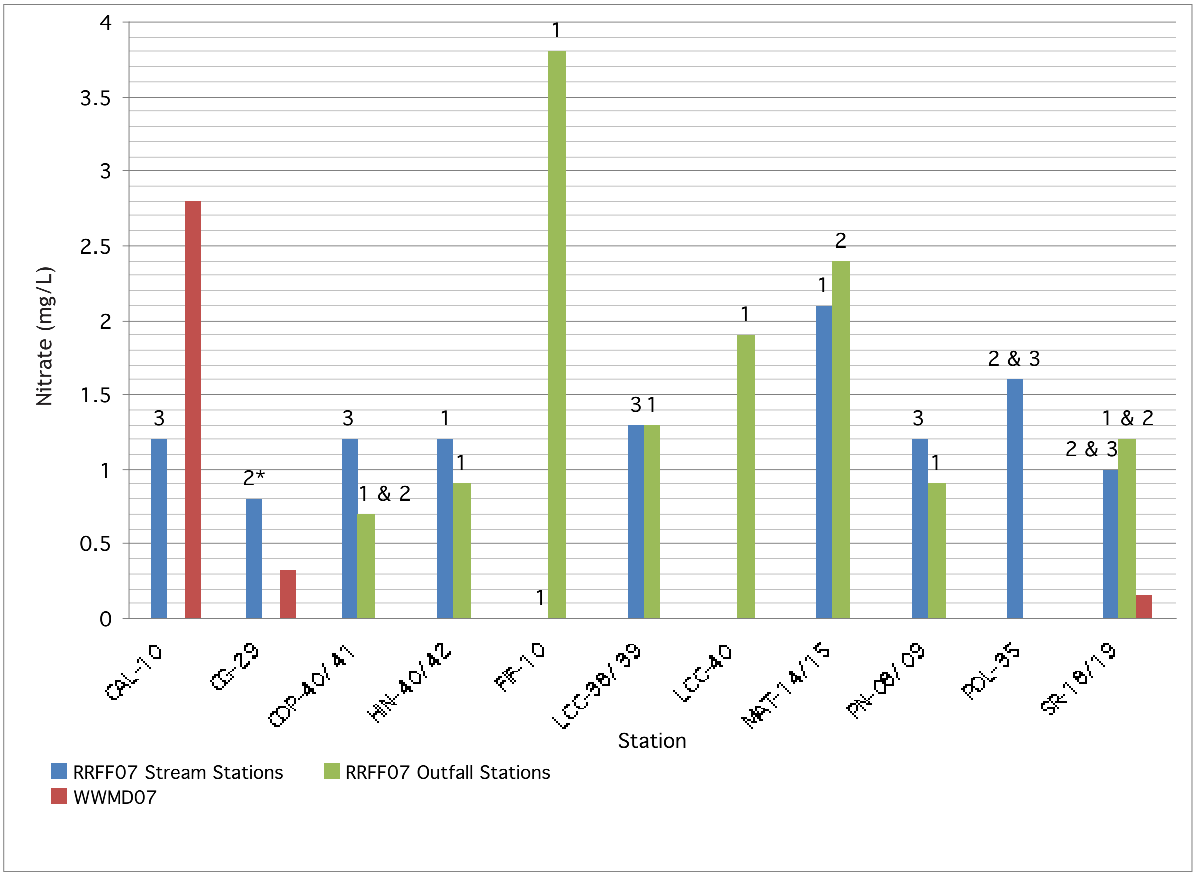
3.3 Nutrients

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 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

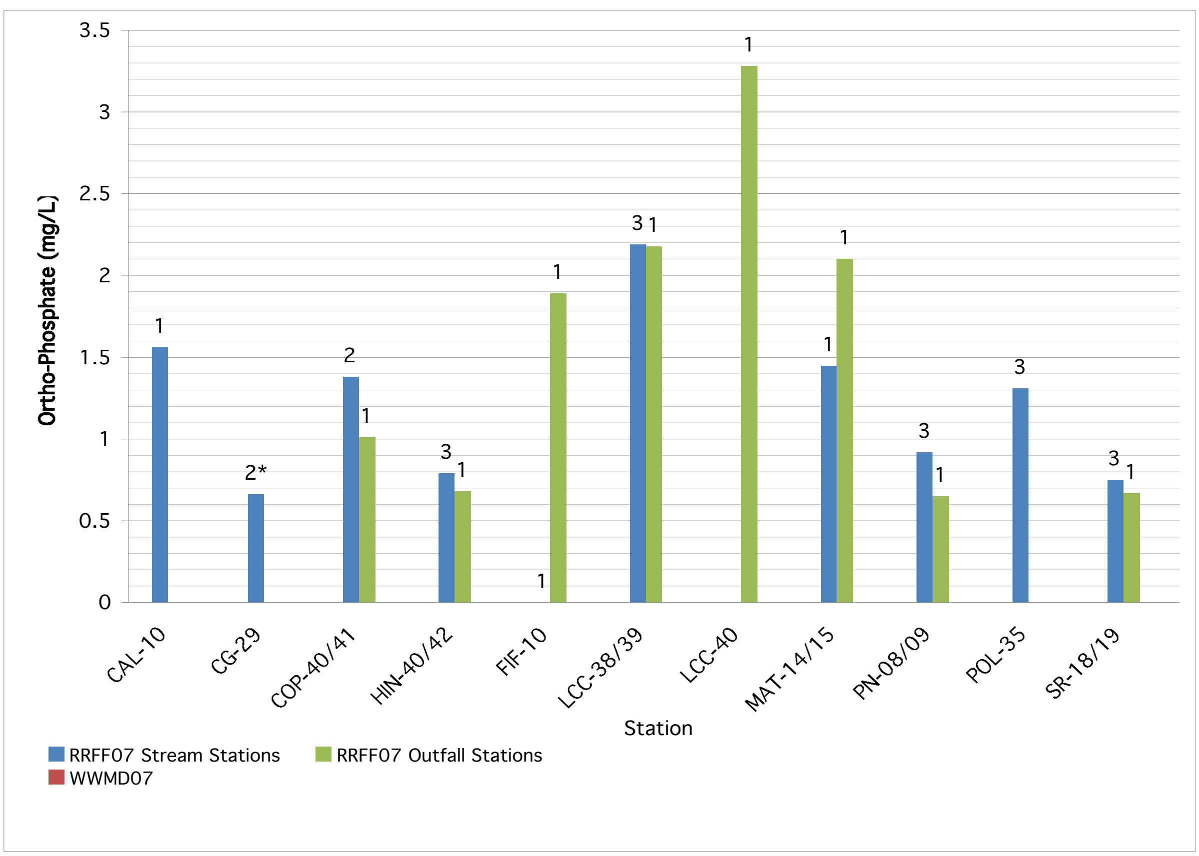
All sampled stations exceeded the WQO for Ammonia and Ortho-Phosphate. Where paired station data was available, the Nitrate results showed a general trend towards the receiving waters having higher concentration than the incoming storm water. One outlier to note is the Calder Creek result that shows the Nitrate concentration of the WWMD/baseline sample markedly higher than the first flush sample. In this case the storm water input actually diluted the Nitrate concentration.

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.





Nitrate (mg/L)
4
3.5
3
2.5
2
1.5
1
0.5
0
CAL-10
CG-29
COP-40/41
HIN-40/42
FIF-10
LCC-38/39
LCC-40
MAT-14/15
PN-08/09
POL-35
SR-18/19
Station
3
2*
1 & 2
1
3 1
2
2 & 3
1 & 2
RRFF07 Stream Stations
RRFF07 Outfall Stations
WWMD07



Ortho-Phosphate (mg/L)
3.5
3
2.5
2
1.5
1
0.5
0
CAL-10
CG-29
COP-40/41
HIN-40/42
FIF-10
LCC-38/39
LCC-40
MAT-14/15
PN-08/09
POL-35
SR-18/19
Station
2*
3 1
RRFF07 Stream Stations
RRFF07 Outfall Stations
WWMD07

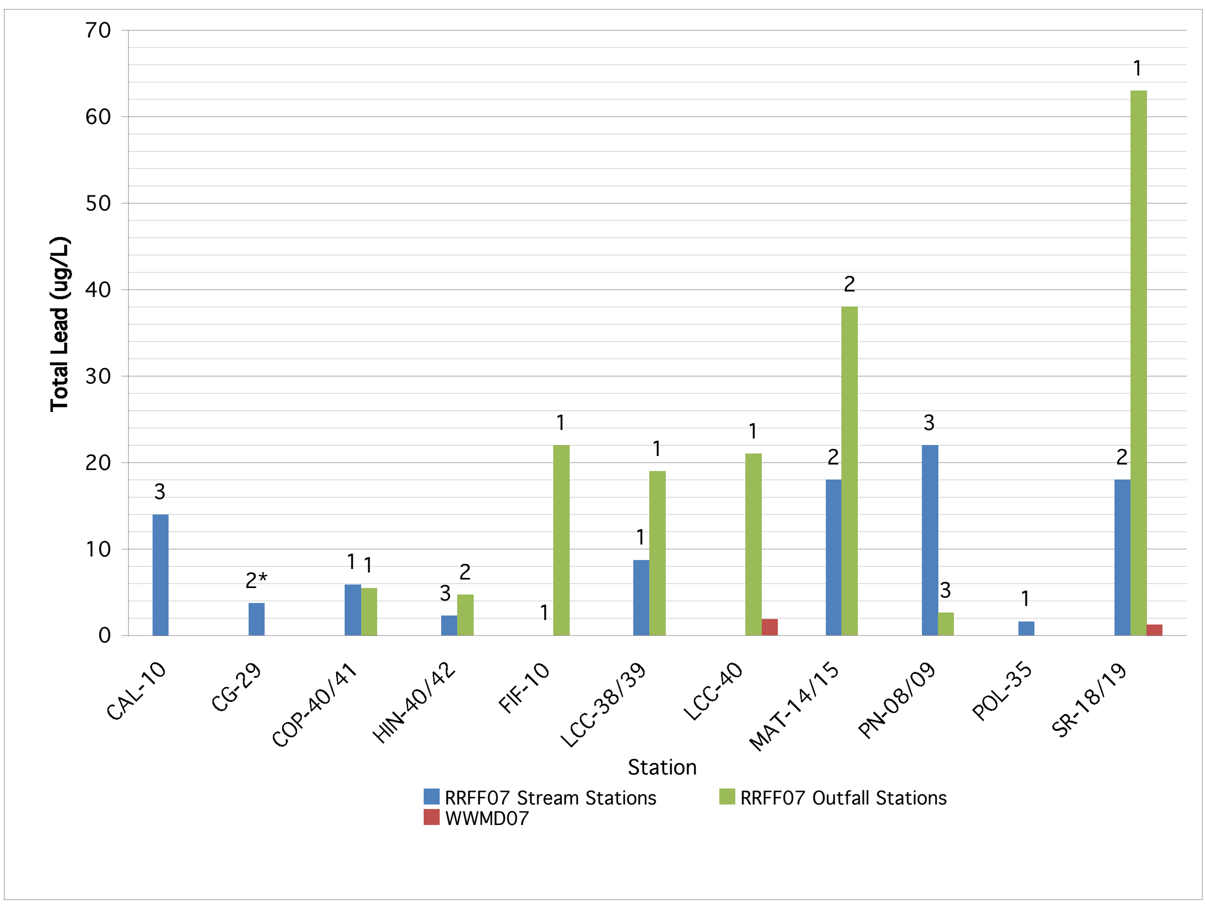
3.4 Metals

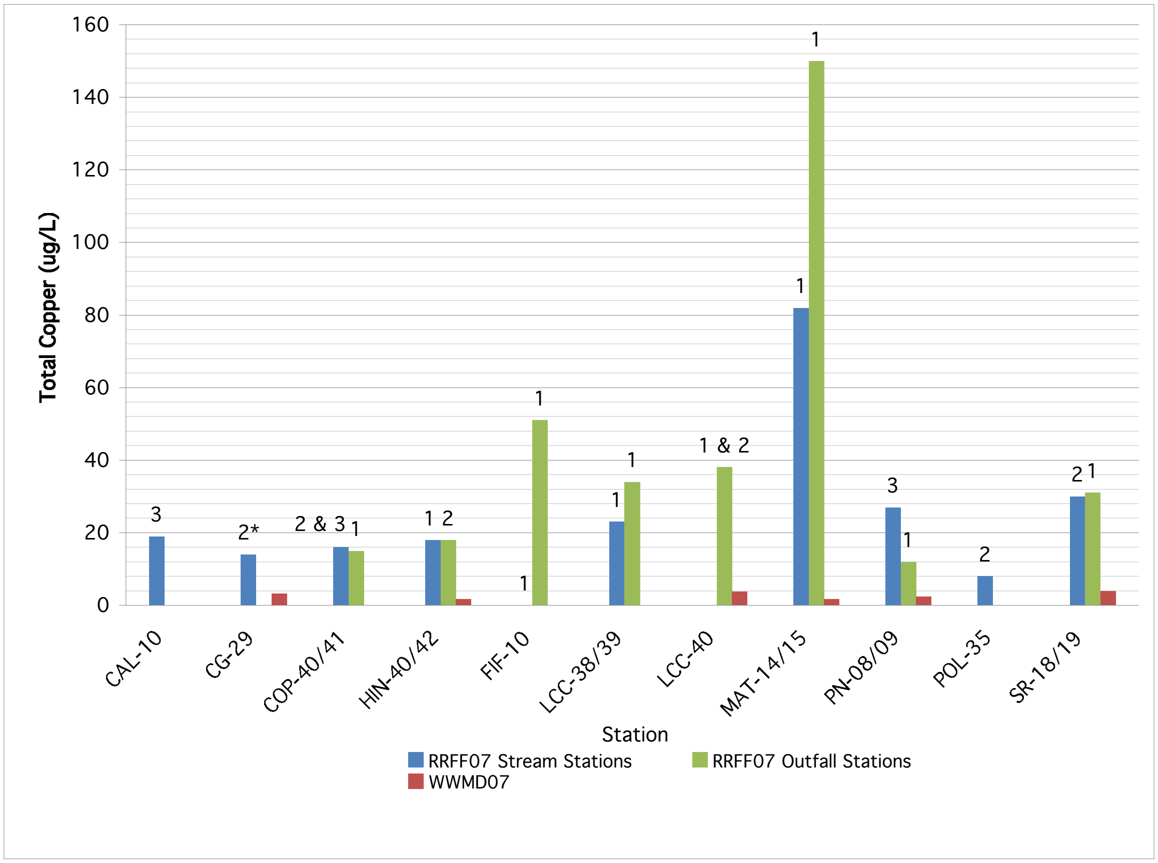
The presence of elevated concentrations of heavy metals in surface waters can produce significant toxicity to early life stages of aquatic organisms. Metals are known as a persistent pollutant since they accumulate in aquatic animals and can lead to effects including reduced reproduction, developmental deformities, and mortality. For RRFF07 sampling, samples were analyzed for lead, copper and zinc, the results are represented by total metal concentration numbers. Results for the associated analysis, including total hardness, dissolved/total zinc, lead and copper and total magnesium and calcium values are available by request and can be used to determine toxicity. 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.

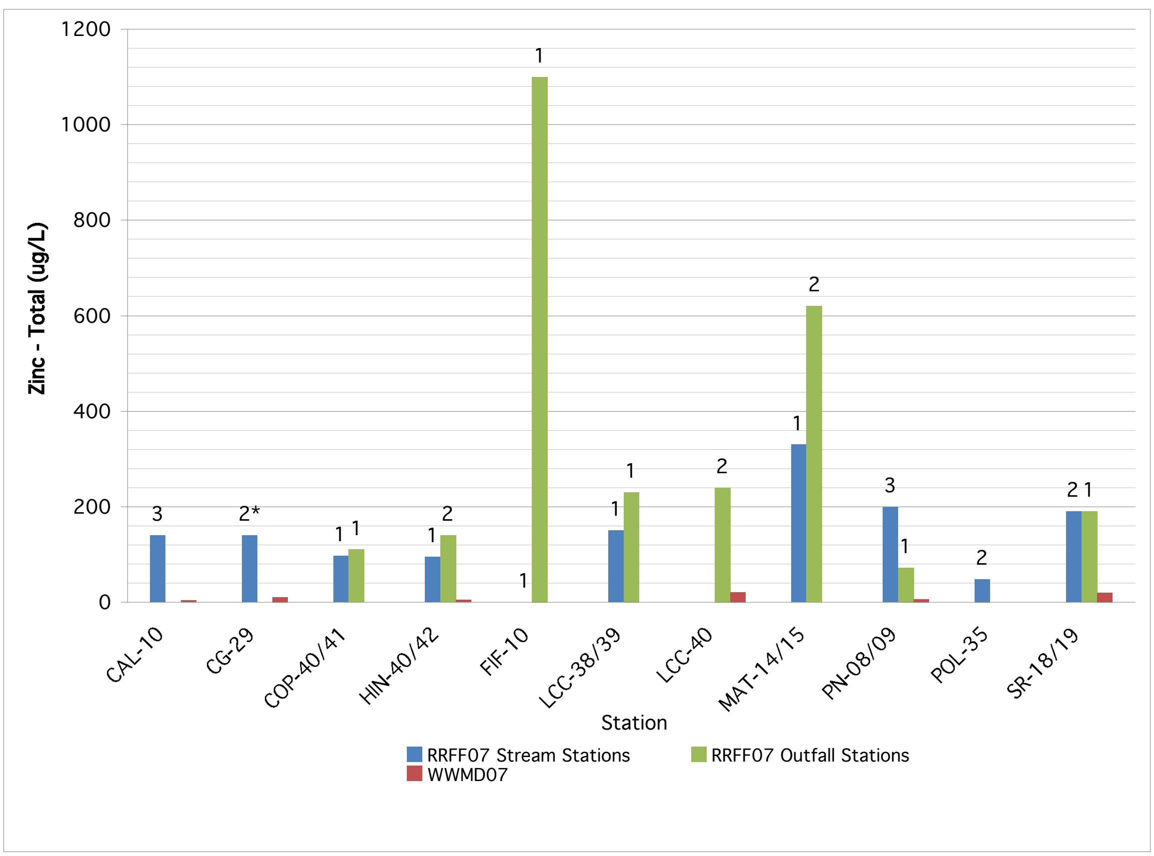
One can determine toxicity by comparing results against the metals graphs for the California Toxics Rule that can be found at http://www.swrcb.ca.gov/rwqcb5/water_issues/water_quality_standards_limits/water_quality_goals/limit_tables_2008.pdf on pages 104, 105 and 111. In general high concentrations of total or dissolved metals are problematic - dissolved since they are more easily absorbed and total since it normally contains a portion that is dissolved, which will eventually dissolve in most aquatic environments. Several of the dissolved copper and zinc concentrations were above toxicity thresholds but no lead concentrations exceeded for instantaneous measurements, which is a 1-hour average.

All of the results for copper and zinc at FIF10 exceeded the toxicity thresholds for instantaneous measurements and are a cause for concern and warrant follow-up. The particularly high concentration of lead at station SR-19 is of particular concern because it could cause human health effects.

Metals in stormwater mostly originate from vehicles, paints, zinc galvanized building materials, preservatives, motor oil, construction and other urban activities.




Total Copper (ug/L)
160
140
120
100
80
60
40
20
0
3
2*
2 & 3
1
1 2
1
1
1
1
1 & 2
1
1
3
1
2
2 1
CAL-10
CG-29
COP-40/41
HIN-40/42
FIF-10
LCC-38/39
LCC-40
MAT-14/15
PN-08/09
POL-35
SR-18/19
Station
RRFF07 Stream Stations
RRFF07 Outfall Stations
WWMD07

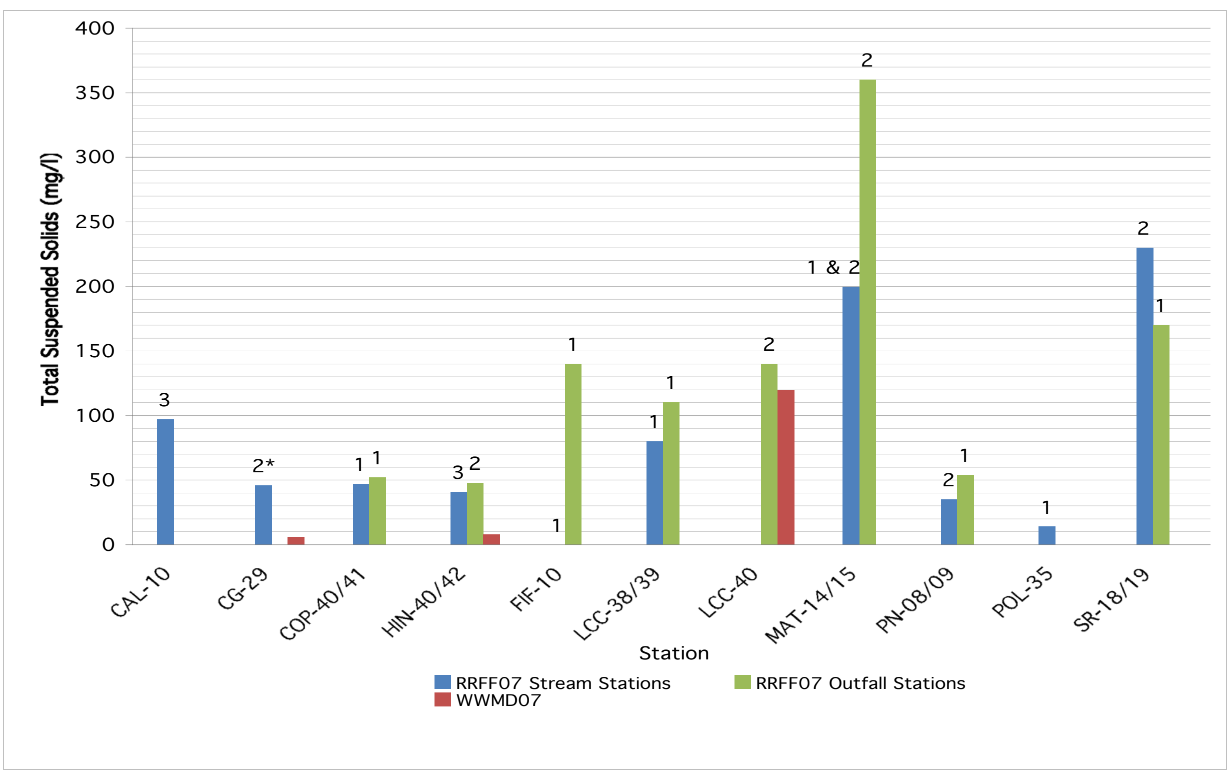

Zinc - Total (ug/L)
1200
1000
800
600
400
200
0
3
2*
1 1
1
2
1
1
1
1
2
1
2
3
1
2
2 1
CAL-10
CG-29
COP-40/41
HIN-40/42
FIF-10
LCC-38/39
LCC-40
MAT-14/15
PN-08/09
POL-35
SR-18/19
Station
RRFF07 Stream Stations
RRFF07 Outfall Stations
WWMD07

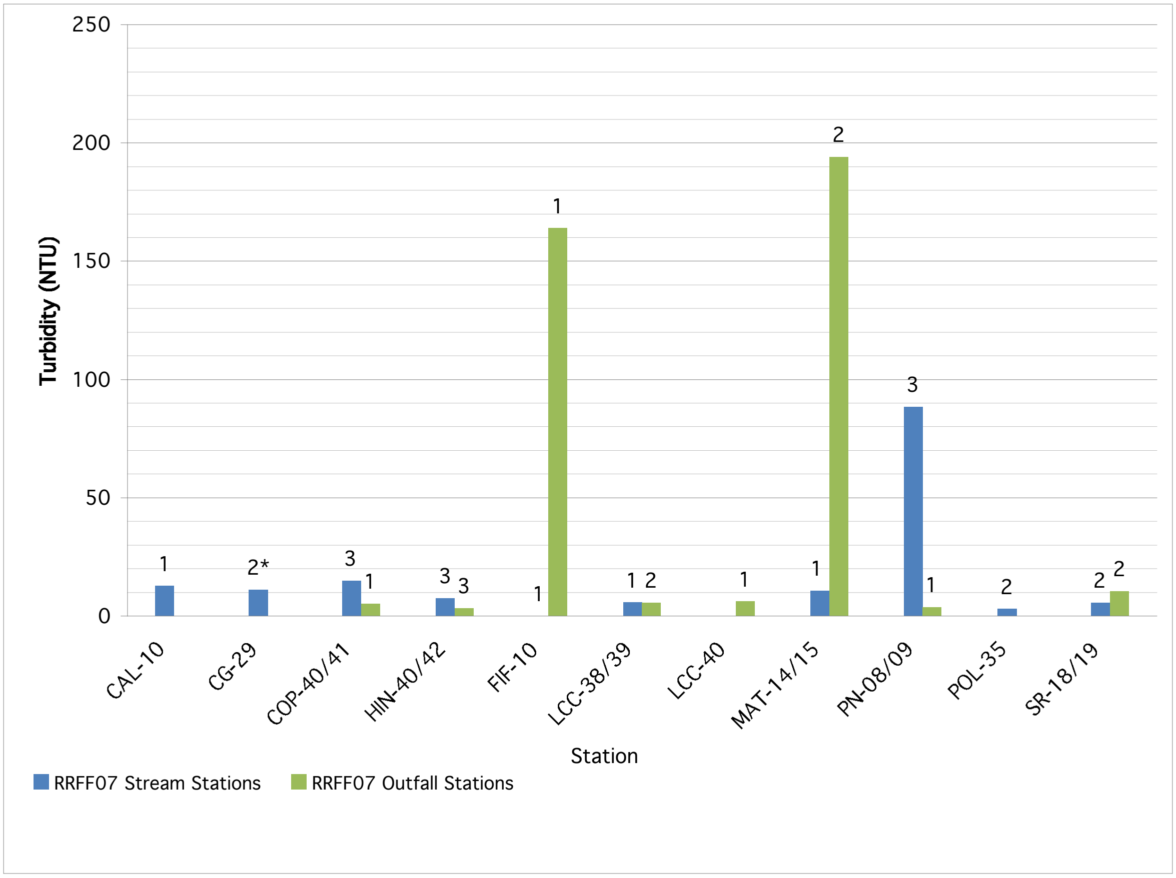
3.5 Total Suspended Solids and Turbidity

Any particles suspended in the water column, be they soil, algae or plant matter, fecal or other organic waste, can have several detrimental effects on aquatic organisms. The measurement for particles in water is Total Suspended Solids and results are 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 general trend of the Total Suspended Solids (TSS) results, where paired stations were sampled, showed that the storm water inputs had higher suspended solid concentrations than the receiving waters. Stormwater mobilizes particles on streets and other urban hardscape surfaces and delivers them to our creeks. 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 or suspended particles and informs us about water clarity and results are expressed in NTUs. The higher the result the lower the water's 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 MAT15 but not always as the second highest TSS yielded one of the lowest turbidity readings at the creek station SR18. Our turbidity results fell outside of our holding time so results should be viewed as estimates and are flagged in full result tables.





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. 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 most exceeded the objectives for ortho-phosphate, which is the limiting nutrient in freshwater. 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) continues to show extremely poor water quality and in particular very high metals, which are normally associated with vehicle use. This site drains the portion of Highway 116 through downtown Guerneville and indicates a need for street sweeping and other dry weather measures to prevent pollutants from entering our creeks. Even though Fife Creek is usually dry during First Flush the pollutants are "loaded" into the creek bed and will eventually wash into the Russian River.

The storm drain that empties into Matanzas Creek just downstream of the Doyle Park footbridge (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. The baseline results show that the degraded water quality is a product of storm water runoff. 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 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.

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 storm water 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 analyzers to assess the effects of storm water on the summer base flow.

• Determine the drainage areas of the storm drain outlets being sampled 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.

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 developments are being required to design features that slow down, retain, infiltrate and treat stormwater using landscaped areas known as Low Impact Development. New developments that can't use Low Impact Development will likely be required to install filtration systems in stormdrain inlets. Riverkeeper has been testing one filter system in Healdsburg and found enormous amounts of pollutants are removed indicating the 99% of 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 take greater care 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. Further testing to identify the source of the bacteria would point to proper reduction 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 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 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 and 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, which 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 its 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	Stage (cm)	Conductivity (uS)	pH	Temperature (^{0}C)	Total Ammonia Nitrogen (mg/L)	Ortho-Phosphate (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)
16	CAL-10-1	10/9/07	10:45 PM		90	7	15	1.63	1.56	1.1	12.7	77	>24000	18	10	130
16	CAL-10-2	10/9/07	11:12 PM		110	7	15	1.62	1.5	1.1	2.83	53	>24000	15	8.1	110
16	CAL-10-3	10/9/07	11:42 PM		90	7	14.5	1.12	1.29	1.2	4.78	97	>24000	19	14	140
16	CAL-10-DUP	10/9/07	11:42 PM					1.61	1.5	1.2	4.72	82	>24000	16	9.4	120
1	CG-29-2	10/10/07	12:30 AM	30	60	6	16	1	0.66	0.8	11.1	46		14	3.7	140
2	COP-40-1	10/10/07	1:00 AM		70	7	15.2	1.29	0.97	0.8	2.63	47	12000	16	5.9	97
2	COP-40-2	10/10/07	1:30 AM		100	6.5	15.5	1.63	1.09	1.1	3.42	28	>24000	16	3.6	75
2	COP-40-3	10/10/07	12:15 AM		250	6.5	15.2	1.1	1.38	1.2	14.9	45	>24000	12	2.6	55
2	COP-41-1	10/10/07	12:45 AM		50	6.3	15.1	1.26	1.01	0.7	5.09	52	9800	15	5.5	110
2	COP-41-2	10/10/07	1:15 AM		50	6.5	15.2	1.1	0.8	0.7	4.05	15	6100	9.4	2.3	74
2	COP-41-3	10/9/07	11:15 PM		40	6.3	15.1	1.05	0.78	0.6	4.1	15	6900	8.7	2.1	65
3	HIN-40-1	10/9/07	10:17 PM	5	290	6.5	15	1.49	0.098	1.2	2.78	26	13000	18	ND	95
3	HIN-40-2	10/9/07	10:00 PM	10	420	6.5	14.5	1.06	0.76	0.9	4.56	22	9800	12	ND	68
3	HIN-40-3	10/9/07	11:00 PM	15	320	6.5	14.8	1.16	0.79	0.9	7.56	41	>24000	13	2.3	89
3	HIN-42-1	10/9/07	11:35 PM	5	50	6.5	12.5	1.79	0.68	0.9	2.41	17	670	17	ND	120
3	HIN-42-2	10/10/07	12:05 AM	10	40	6.5	14.5	1.3	0.58	0.7	3.19	48	1100	18	4.7	140
3	HIN-42-3	10/9/07	11:00 PM	13	40	6.5	14.5	1.06	0.45	0.5	3.39	25	540	12	2.4	100
4	FIF-10-1	10/9/07	11:35 PM		180	5.5	16	2.88	1.89	3.8	164	140	12000	51	22	1100
4	FIF-10-2	10/10/07	12:10 AM		100	6	14.5	2.28	1.51	2.1	45	87	8700	34	14	700
4	FIF-10-3	10/9/07	8:10 PM		80	5.5		1.85	1.13	1.9	25.5	120	13000	30	13	820
	FOS-05-1	10/9/07	8:35 PM		239	7.3	15	0.86	0.91	1.1	160	233	24000	42.6	234	21.3
12	FOS-22-1	10/9/07	9:00 PM		49	7.2	15.2	1.2	1.02	1	75	103	6100	16.6	115	20.7
13	FOS-30-1	10/10/07	12:25 AM		421	7.5	16.2	0.83	1.18	1.6	260	297	>24000	27	104	6.8

Number on Map	Sample ID	Collection Date	Collection Time	Stage (cm)	Conductivity (uS)	pH	Temperature (^{0}C)	Total Ammonia Nitrogen (mg/L)	Ortho-Phosphate (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)
5	LCC-38-1	10/10/07	12:55 AM		70	7	15	1.66	1.85	1	5.83	80	>24000	23	8.7	150
5	LCC-38-2	10/10/07	1:25 AM		70	7	15	1.66	1.81	0.8	3.16	26	>24000	14	3.8	95
5	LCC-38-3	10/9/07	11:55 PM		170	7	15	2.08	2.19	1.3	5.06	20	>24000	17	3.2	110
5	LCC-39-1	10/10/07	12:30 AM	30	90	7	15	2.2	2.18	1.3	2.54	110	7700	34	19	230
5	LCC-39-2	10/10/07	1:03 AM	28	60	7	15	1.72	1.85	0.8	5.58	47	>24000	17	5.1	120
5	LCC-39-3	10/9/07	11:35 PM	30	60	7	15	1.45	1.63	0.7	3.4	21	>24000	11	2.4	73
5	LCC-40-1	10/10/07	12:05 AM	33	140	7	15	3.3	3.28	1.9	6.11	100	>24000	38	21	240
5	LCC-40-2	10/10/07	12:40 AM	40	80	7	15	1.9	1.76	1.3	5.44	140	>24000	38	16	220
5	LCC-40-3	10/9/07	12:55 PM	42	60	7	15	1.57	1.8	0.8	5.22	36	>24000	16	4.4	120
6	MAT-14-1	10/9/07	10:15 PM		250	6	16	1.68	1.45	2.1	10.8	200	16000	820	15	330
6	MAT-14-2	10/9/07	10:46 PM		140	6.3	16	1.12	1.26	1.4	10.5	200	24000	260	18	250
6	MAT-14-3	10/9/07	11:12 PM		200	6.3	16	1.06	1.07	1.2	2.64	64	5500	34	7.6	100
6	MAT-15-1	10/9/07	10:05 PM		300	6.5	16	2.58	2.1	2.3	13.7	200	20000	150	20	390
6	MAT-15-2	10/9/07	10:35 PM		110	6.2	16	2.03	1.71	2.4	194	360	6500	1300	38	620
6	MAT-15-3	10/9/07	10:58 PM		110	6.3	16	1.24	1.11	1.2	3.62	94	6100	63	10	140
11	MB-10	10/9/07	10:35 PM		78	7	16	1.09	0.99	1.2	200	257	>24000	39.3	190	19
7	PN-08-1	10/9/07	11:30 PM					0.68	0.59	0.7	1.06	17	14000	7.2	ND	52
7	PN-08-2	10/10/07	12:15 AM	up 10	360	6.5	14	0.71	0.72	0.9	6.46	35	>24000	7.9	2.7	58
7	PN-08-3	10/10/07	12:50 AM	up 25 more	330	6.5	14	0.85	0.92	1.2	88.5	16	>24000	27	22	200
7	PN-08-DUP	10/10/07	12:15 AM									36	>24000	8.2	3	63
7	PN-09-1	10/9/07	11:50 PM		60	7	15	1.12	0.65	0.9	3.69	54	14000	12	2.3	72
7	PN-09-2	10/10/07	12:35 AM	up 10	60	6.5	15	1.1	0.62	0.8	2.86	6	8200	10	2	65
7	PN-09-3	10/10/07	1:15 AM	up 15 more	40	6.5	15	0.88	0.53	0.8	3.37	11	13000	8.5	2.6	66

Number on Map	8	8	8	14	14	14	14	14	14
Sample ID	POL-35-1	POL-35-2	POL-35-3	SR-18-1	SR-18-2	SR-18-3	SR-19-1	SR-19-2	SR-19-3
Collection Date	10/10/07	10/10/07	10/10/07	10/9/07	10/9/07	10/9/07	10/9/07	10/9/07	10/9/07
Collection Time	11:30 PM	12:00 AM	12:30 AM	10:35 PM	11:10 PM	11:35 PM	10:35 PM	11:10 PM	11:35 PM
Stage (cm)									
Conductivity (uS)	80	110	130	250	210	170	80	90	90
pH	7	7	7	7	6.5	6.5	6.5	7	7
Temperature (^{0}C)	16	15	15	15	15	15	15	15	15
Total Ammonia Nitrogen (mg/L)	0.8	0.89	0.95	0.42	0.52	0.62	0.85	0.84	0.81
Ortho-Phosphate (mg/L)	1.04	1.27	1.31	0.5	0.55	0.75	0.67	0.61	0.57
Nitrate as N (mg/L)	1.3	1.6	1.6	0.9	1	1	1.2	1.2	0.9
Turbidity (NTU)	1.6	3.01	2.33	2.57	5.51	2.95	9.14	10.5	3.21
TSS (mg/L)	14	9.5	5	200	230	160	170	61	60
E. coli (MPN/100 mL)	8700	9800	9200	8700	>24000	>24000	960	1000	1500
Total Copper (ug/L)	7.4	8	7.5	22	30	20	31	19	20
Total Lead (ug/L)	1.6	1.4	ND	14	18	2.9	63	29	33
Total Zinc (ug/L)	46	49	37	140	190	120	190	110	140