Pollutants of Concern Monitoring - Data Report

Water Year 2016

Submitted in Compliance with
NPDES Permit No. CAS612008 (Order No. R2-2015-0049),
Provision C.8.h.iii

SAN MATEO COUNTYWIDE
Water Pollution
Prevention Program

A Program of the City/County Association of Governments

MARCH 31, 2017

CREDITS

This report is submitted by the participating agencies in the

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BASMAA	Bay Area Stormwater Management Agency Association
BMP	Best Management Practice
CEC	Chemicals of Emerging Concern
CEDEN	California Environmental Data Exchange Network
CSCI	California Stream Condition Index
CW4CB	Clean Watersheds for Clean Bay
DTSC	California Department of Toxic Substances Control
ECWG	Emerging Contaminants Work Group of the RMP
MRP	Municipal Regional Permit
NPDES	National Pollution Discharge Elimination System
PBDEs	Polybrominated Diphenyl Ethers
PCBs	Polychlorinated Biphenyls
PFAS	Perfluoroalkyl Sulfonates
PFOS	Perfluorooctane Sulfonates
POC	Pollutant of Concern
RMC	Regional Monitoring Coalition
RMP	San Francisco Estuary Regional Monitoring Program
RWSM	Regional Watershed Spreadsheet Model
SAP	Sampling and Analysis Plan
SMCWPPP	San Mateo Countywide Water Pollution Prevention Program
SFEI	San Francisco Estuary Institute
SPoT	Statewide Stream Pollutant Trend Monitoring
SSC	Suspended Sediment Concentration
STLS	Small Tributary Loading Strategy
TOC	Total Organic Carbon
UCMR	Urban Creeks Monitoring Report
USEPA	US Environmental Protection Agency
WY	Water Year

1.0 INTRODUCTION

This Pollutants of Concern (POC) Monitoring - Data Report (POC Data Report) was prepared by the San Mateo Countywide Water Pollution Prevention Program (SMCWPPP or Program) on behalf of its member agencies subject to the National Pollutant Discharge Elimination System (NPDES) stormwater permit for Bay Area municipalities, referred to as the Municipal Regional Permit (MRP). The MRP was reissued by the San Francisco Regional Water Quality Control Board (Regional Water Board) on November 19, 2015 as Order R2-2015-0049. This report fulfills the requirements of Provision C.8.h.iii of the MRP for reporting a summary of MRP Provision C.8.f POC Monitoring conducted during Water Year (WY) 2016[1].

This POC Data Report builds on the POC Monitoring Report that was submitted to the Regional Water Board on October 15, 2016. In accordance with Provision C.8.h.iv, the POC Monitoring Report included POC monitoring locations, number and types of samples collected, purpose of sampling (i.e., Management Questions addressed), and analytes measured (SMCWPPP 2016a). The October 15, 2016 POC Monitoring Report also described the allocation of sampling effort for POC monitoring planned for WY 2017.

This POC Data Report is included as an appendix to the WY 2016 Urban Creeks Monitoring Report (UCMR) which was submitted to the Regional Water Board on March 31, 2017. Consistent with MRP Provision C.8.h.ii, POC monitoring data generated from sampling of receiving waters (e.g., creeks) were submitted to the San Francisco Bay Area Regional Data Center for upload to the California Environmental Data Exchange Network (CEDEN)[2].

1.1. POC Monitoring Requirements

Provision C.8.f of the MRP requires monitoring of several POCs including polychlorinated biphenyls (PCBs), mercury, copper, emerging contaminants[3], and nutrients. POC monitoring is conducted on a Water Year (WY) basis. Provision C.8.f specifies yearly (i.e., WY) and total (i.e., permit term) minimum numbers of samples for each POC. In addition, POC monitoring must address the five priority management information needs (i.e., Management Questions) identified in C.8.f:

1. **Source Identification** – identifying which sources or watershed source areas provide the greatest opportunities for reductions of POCs in urban stormwater runoff;

[1] Most hydrologic monitoring occurs for a period defined as a water year, which begins on October 1 and ends on September 30 of the names year. For example, water year 2016 (WY 2016) began on October 1, 2015 and concluded on September 30, 2016.

[2] CEDEN has historically only accepted and shared data collected in streams, lakes, rivers, and the ocean (i.e., receiving waters). In late-2016, we were notified that there were changes to the types of data that CEDEN would accept and share. However, there is still some uncertainty and until the changes are clarified, SMCWPPP will continue to submit only receiving water data to CEDEN.

[3] Emerging contaminant monitoring requirements will be met through participation in the Regional Monitoring Program for Water Quality in the San Francisco Estuary (RMP) special studies. The special studies will account for relevant constituents of emerging concern (CECs) in stormwater and will address at least PFOS, PFAS, and alternative flame retardants being used to replace PBDEs.

2. **Contributions to Bay Impairment** – identifying which watershed source areas contribute most to the impairment of San Francisco Bay beneficial uses (due to source intensity and sensitivity of discharge location);

3. **Management Action Effectiveness** – providing support for planning future management actions or evaluating the effectiveness or impacts of existing management actions;

4. **Loads and Status** – providing information on POC loads, concentrations or presence in local tributaries or urban stormwater discharges; and

5. **Trends** – providing information on trends in POC loading to the Bay and POC concentrations in urban stormwater discharges or local tributaries over time.

The MRP specifies the minimum number of samples for each POC that must address each Management Question. For example, over the first five years of the permit, a minimum total of 80 PCBs samples must be collected and analyzed. At least eight PCB samples must be collected each year. By the end of year four[4] of the permit term, each of the five Management Questions must be addressed with at least eight PCB samples. It is possible that a single sample can address more than one information need. POC Monitoring requirements are summarized in Table 1.

Other MRP provisions require studies or have information needs that could be addressed through Provision C.8.f (POC Monitoring) and for which related samples will count towards POC monitoring requirements. These other Permit provisions and their associated timelines are listed below.

- Provisions C.11.a.iii and C.12.a.iii require that Permittees provide a list of management areas in which new mercury and PCB control measures will be implemented during the permit term. Progress toward developing the list was reported on April 1, 2016 (SMCWPPP 2016b). This preliminary list was greatly expanded upon in the September 2016 Annual Report by designating as Watershed Management Areas (WMAs) all catchments with high interest parcels and/or existing or planned pollutant controls (SMCWPPP 2016c). The updated list of WMAs will be further updated with each subsequent Annual Report per Provision C.11.a.iii(3). Provision C.8.f (POCs Monitoring) supports C.11.a/12.a requirements by requiring monitoring directed toward source identification (i.e., identifying which WMAs have source areas and provide the greatest opportunities for implementing controls to reduce loads of POCs in urban stormwater runoff).

- Provision C.12.e requires that Permittees collect at least 20 composite samples (region-wide) of the caulks and sealants used in storm drains or roadway infrastructure in public rights-of-way. Results of the investigation must be reported with the 2018 Annual Report, due by September 30, 2018. SMCWPPP is participating in a Bay Area Stormwater Management Agencies Association (BASMAA) regional project to address this requirement. Development of the monitoring plan is anticipated in 2017 with implementation in Fiscal Year 2017/18.

1.2. Third-Party Data

SMCWPPP strives to work collaboratively with our water quality monitoring partners to find mutually beneficial monitoring approaches. Provision C.8.a.iii of the MRP allows Permittees to use data collected by third-party organizations to fulfill monitoring requirements, provided the data are demonstrated to

[4] Note that the minimum sampling requirements addressing information needs must be completed by the end of year four of the permit (i.e., WY 2019); whereas, the minimum number of total samples does not need to be met until the end of year five of the permit (i.e., WY 2020).

meet the required data quality objectives. For example, samples collected in San Mateo County through the Regional Monitoring Program for Water Quality in the San Francisco Estuary (RMP), the Clean Watersheds for a Clean Bay (CW4CB) project, and the State's Stream Pollution Trends (SPoT) Monitoring Program may supplement the Program's efforts towards achieving Provision C.8.f monitoring requirements. Third party monitoring conducted by the RMP, SPoT, and CW4CB also provide context for reviewing and interpreting SMCWPPP monitoring results.

Table 1. MRP Provision C.8.f pollutants of concern monitoring requirements.

Pollutant of Concern	Media	Total Samples by the End of Year Five [d]	Yearly Minimum	Minimum Number of Samples That Must Be Collected for Each Information Need by the End of Year Four				
				Source Identification	Contributions to Bay Impairment	Management Action Effectiveness	Loads and Status	Trends
PCBs	Water or sediment	80	8	8	8	8	8	8
Total Mercury	Water or sediment	80	8	8	8	8	8	8
Total & Dissolved Copper	Water	20	2	--	--	--	4	4
Nutrients [a]	Water	20	2	--	--	--	20	--
Emerging Contaminants [b]	--	--	--	--	--	--	--	--
Ancillary Parameters [c]	--	--	--	--	--	--	--	--

[a.] Ammonium[5], nitrate, nitrite, total Kjeldahl nitrogen, orthophosphate, total phosphorus (analyzed concurrently in each nutrient sample).

[b.] Must include perfluorooctane sulfonates (PFOS, in sediment), perfluoroalkyl sulfonates (PFAS, in sediment), alternative flame retardants. The Permittee shall conduct or cause to be conducted a special study that addresses relevant management information needs for emerging contaminants. The special study must account for relevant Chemicals of Emerging Concern (CECs) in stormwater and would address at least PFOS, PFAS, and alternative flame retardants being used to replace PBDEs.

[c.] Total Organic Carbon (TOC) should be collected concurrently with PCBs data when normalization to TOC is deemed appropriate. Suspended sediment concentration (SSC) should be collected in water samples used to assess loads, loading trends, or BMP effectiveness. Hardness data are used in conjunction with copper concentrations collected in fresh water.

[d.] Total samples that must be collected over the five-year Permit term.

[5] There are several challenges to collecting samples for "ammonium" analysis. Therefore, samples will be analyzed for total ammonia which is the sum of un-ionized ammonia (NH_3) and ionized ammonia (ammonium, NH_{4+}). Ammonium concentrations will be calculated by subtracting the calculated concentration of un-ionized ammonia from the measured concentration of total ammonia. Un-ionized ammonia concentrations will be calculated using a formula provided by the American Fisheries Society that includes field pH, field temperature, and specific conductance. This approach was approved by Regional Water Board staff in an email dated June 21, 2016.

2.0 POC MONITORING RESULTS

In compliance with Provision C.8.f of the MRP, the Program conducted POC monitoring for PCBs, mercury, copper, and nutrients in WY 2016. Monitoring was conducted in accordance with the WY 2016 POC Monitoring Plan (SMCWPPP 2016d) which describes monitoring goals, methods, and quality assurance/quality control (QA/QC) procedures. The MRP-required yearly minimum number of samples was met or exceeded for all POCs. The total number of samples collected for each POC, the agency conducting the monitoring, and the Management Questions addressed are listed in Table 2. Specific monitoring stations are listed in Table 3 and mapped in Figure 1. The sections below describe the results of the monitoring accomplished in WY 2016. Compliance with applicable water quality standards is described in Section 3.0.

2.1. Statement of Data Quality

A comprehensive QA/QC program was implemented by SMCWPPP covering all aspects of POC monitoring. Monitoring for PCBs, mercury, copper, and nutrients was performed according to protocols specified or referenced in the WY 2016 POC Monitoring Plan (SMCWPPP 2016d). The Monitoring Plan references the CW4CB Quality Assurance Project Plan (QAPP; AMS 2012) and the BASMAA Regional Monitoring Coalition (RMC) QAPP (BASMAA 2016) as the basis for (QA/QC) procedures.

Overall, the results of the QA/QC review suggest that the POC monitoring data generated during WY 2016 were of sufficient quality. Although, some data were flagged in the project database, none were rejected. Details of the QA/QC review are provided in Attachment 1.

Table 2. SMCWPPP and third-party POC monitoring accomplishments, WY 2016.

Pollutant of Concern/ Organization	Number of Samples (WY 2016)	Management Question Addressed [a]					Sample Type and Comments
		1. Source Identification	2. Contributions to Bay Impairment	3. Management Action Effectiveness	4. Loads and Status	5. Trends	
PCBs & Mercury							
SMCWPPP	**8**	8	8	--	8	--	Stormwater runoff samples to characterize WMAs
RMP STLS	**7**	7	7	--	7	--	Stormwater runoff samples to characterize WMAs
CW4CB	**3**	--	--	3	--	--	BMP effectiveness samples at Bransten Road bioretention facilities
Copper							
SMCWPPP	**3**	NA	NA	NA	3	--	Copper analyzed on a subset of PCBs/Hg stormwater runoff samples
Nutrients							
SMCWPPP	**2**	NA	NA	NA	2	NA	Water samples collected from bottom-of-the-watershed stations

NA = The MRP does not require sampling to address the management question.

a. Individual samples can address more than one Management Question simultaneously.

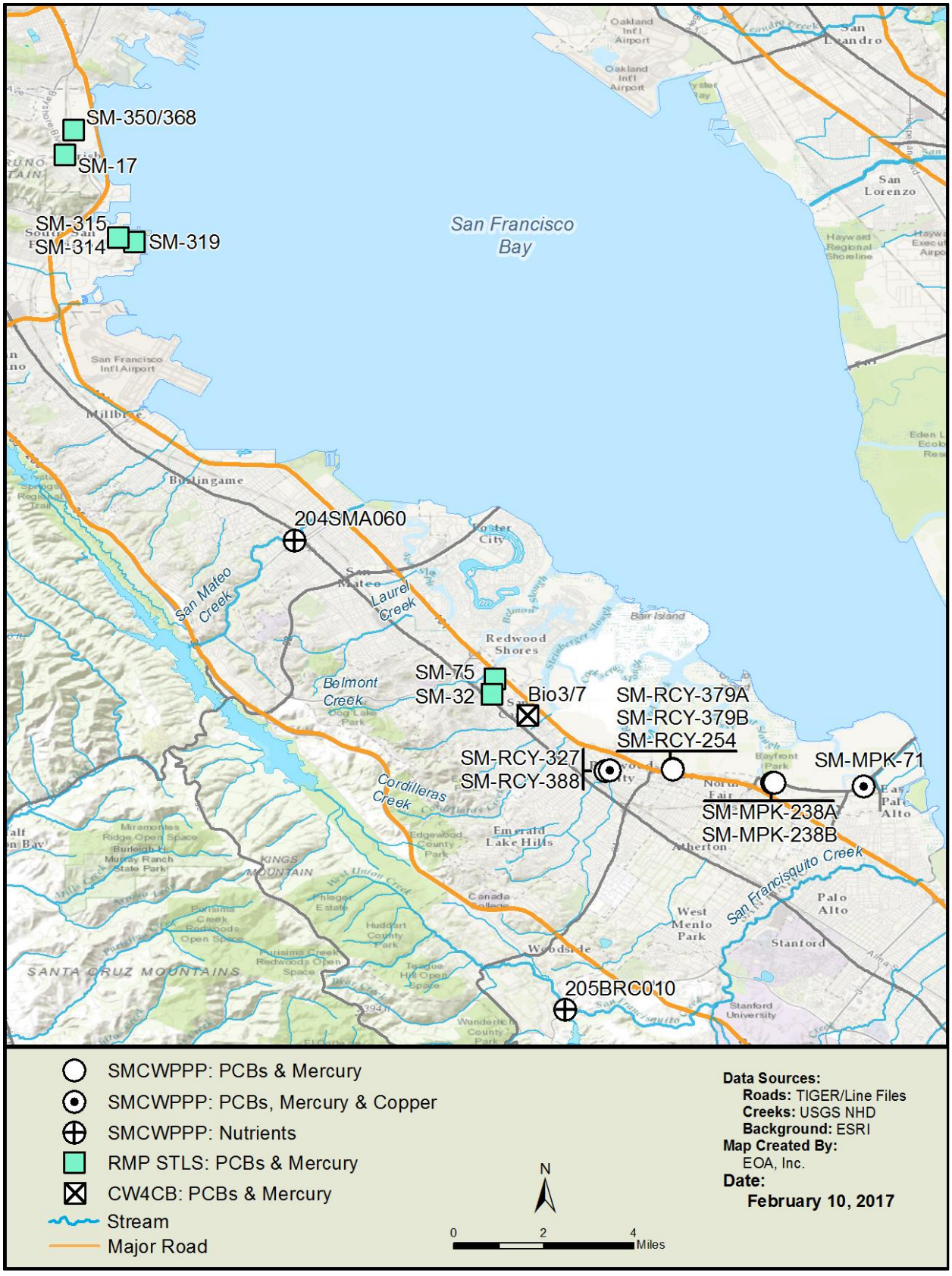

Figure 1. POC monitoring stations in San Mateo County, WY 2016.

Table 3. POC monitoring stations in San Mateo County, WY 2016.

Organization	Station Code	Sample Date	Latitude	Longitude	Matrix	PCBs	Mercury	Suspended Sediment	Total Copper	Dissolved Copper	Hardness as CaCO3	Nutrients [b]
SMCWPPP	SM-MPK-71A	2/17/2016	37.4836	-122.1451	water	x	x	x	x	x	x	
SMCWPPP	SM-RCY-327A	2/17/2016	37.4887	-122.2282	water	x	x	x	x	x	x	
SMCWPPP	SM-RCY-388A	2/17/2016	37.4888	-122.2266	water	x	x	x	x	x	x	
SMCWPPP	SM-MPK-238A	3/5/2016	37.4848	-122.1744	water	x	x	x				
SMCWPPP	SM-MPK-238B	3/5/2016	37.4849	-122.1738	water	x	x	x				
SMCWPPP	SM-RCY-254A	3/5/2016	37.4892	-122.2065	water	x	x	x				
SMCWPPP	SM-RCY-379A	3/5/2016	37.4891	-122.2065	water	x	x	x				
SMCWPPP	SM-RCY-379B	3/5/2016	37.4891	-122.2065	water	x	x	x				
RMP STLS	SM-319 (SM-SSF-319A)	(a)	37.6589	-122.3800	water	x	x	x				
RMP STLS	SM-315 (SM-SSF-315A)	(a)	37.6603	-122.3850	water	x	x	x				
RMP STLS	SM-314 (SM-SSF-314A)	(a)	37.6603	-122.3851	water	x	x	x				
RMP STLS	SM-75 (SM-SCS-75A)	(a)	37.5183	-122.2637	water	x	x	x				
RMP STLS	SM-32 (SM-SCS-32A)	(a)	37.5132	-122.2647	water	x	x	x				
RMP STLS	SM-350/368 (SM-BRI-1004A)	(a)	37.6949	-122.3995	water	x	x	x				
RMP STLS	SM-17 (SM-BRI-17A)	(a)	37.6869	-122.4022	water	x	x	x				
SMCWPPP	204MSA060	6/23/2016	37.5628	-122.3282	water							x
SMCWPPP	205BRC010	6/23/2016	37.4117	-122.2412	water							x
CW4CB	Bio3 - Influent	WY 2016 (c)	(c)	(c)	water	x	x	x				
CW4CB	Bio7 - Influent	WY 2016 (c)	(c)	(c)	water	x	x	x				
CW4CB	Bio7 - Effluent	WY 2016 (c)	(c)	(c)	water	x	x	x				

a. Specific sample dates have not yet been provided by the RMP STLS.
b. Ammonia (for ammonium), nitrate, nitrite, total Kjeldahl nitrogen, orthophosphate, and total phosphorus are analyzed concurrently in each nutrient sample.
c. Specific sample dates and locations will be provided in the CW4CB project report, which is anticipated to be available by April 2017.

2.2. PCBs and Mercury

During WY 2016 the Program collected eight stormwater runoff samples for PCBs and mercury analysis. An additional seven stormwater runoff samples were collected in San Mateo County through the RMP's Small Tributary Loading Strategy (STLS). These combined 15 samples address Management Questions #1

(Source Identification) and #2 (Contributions to Bay Impairment). Data will also be used by the RMP STLS to improve calibration of the Regional Watershed Spreadsheet Model (RWSM) which is a land use based planning tool for estimation of overall POC loads from small tributaries to San Francisco Bay at a regional scale (i.e., Management Question #4 – Loads and Status). Three additional PCB and mercury samples were collected by the CW4CB project to address Management Question #3 (Management Action Effectiveness).

PCBs and mercury monitoring by the Program in WY 2016 was conducted in accordance with the Water Year 2016 POC Monitoring Plan (SMCWPPP 2016d). The primary goal of the monitoring, as described in the Monitoring Plan, was to inform identification of WMAs where control measures could be implemented to comply with MRP requirements for load reductions of PCBs and mercury. WY 2016 PCBs and mercury monitoring was focused on collection of storm composite samples from WMAs (i.e., catchments containing high interest parcels with land uses associated with PCBs such as old industrial, electrical and recycling). WMAs (delineated from municipal storm drain data) were identified and prioritized for sampling by evaluating several types of data, including: PCBs and mercury concentrations from prior sediment and stormwater runoff sampling efforts, land use data, municipal storm drain data showing pipelines and access points (e.g., manholes, outfalls, pump stations), and logistical/safety considerations (SMCWPPP 2015). WMAs with elevated PCBs and/or mercury concentrations may be targeted for future source investigations.

Composite samples, consisting of six to eight aliquots collected during the rising limb and peak of the storm hydrograph (as determined through field observations), were analyzed for the "RMP 40" PCB congeners (method EPA 1668C), total mercury (method EPA 1631E), and suspended sediment concentration (SSC; method ASTM D3977-97). A subset of three samples were also analyzed for total and dissolved copper (method EPA 200.8) and hardness (method SM 2340C). See Section 2.3 for a discussion of copper results.

Table 4 lists PCBs, mercury, and SSC monitoring results collected by SMCWPPP in WY 2016[6]. "Total PCBs" were calculated as the sum of the RMP 40 congeners. The PCBs particle ratio is calculated by dividing Total PCBs by SSC; likewise, the Hg particle ratio is calculated by dividing mercury concentrations by SSC. The particle ratios, which are sometimes referred to as particle concentrations, estimate the concentration of pollutant on the suspended sediment within the water sample. Since PCBs and mercury are hypothesized to primarily be bound to sediment, particle ratios may be used to normalize pollutant concentrations in samples with varying levels of suspended sediment. Particle ratios may therefore be used to compare and rank monitoring station results.

For the eight samples that were collected by SMCWPPP in WY 2016, mercury concentrations ranged from 6.8 ng/L to 18 ng/L and Hg particle ratios ranged from 149 ng/g to 712 ng/g. Total PCB concentrations ranged from 0.592 ng/L to 13 ng/L and PCB particle ratios ranged from 39.8 ng/g to 182 ng/g. Section 2.2.2 describes PCB monitoring results within the context of other stormwater runoff samples analyzed for PCBs in San Mateo County and region-wide.

[6] RMP STLS results are reported separately by the San Francisco Estuary Institute (SFEI).

Table 4. PCB, mercury, and suspended sediment concentrations in stormwater runoff samples collected by SMCWPPP, WY 2016.

Station Code	Sample Date	SSC (mg/L)	Total PCBs (ng/L) [a]	PCB Particle Ratio (ng/g) [b]	Hg (ng/L)	Hg Particle Ratio (ng/g)
SM-MPK-238A	3/5/2016	80.1	3.19	39.8	13	159
SM-MPK-238B	3/5/2016	51.3	6.20	121	8.9	173
SM-MPK-71A	2/17/2016	13.7	0.592	43.2	6.8	496
SM-RCY-254A	3/5/2016	13.9	1.57	113	9.9	712
SM-RCY-327A	2/17/2016	43.7	5.70	130	15	341
SM-RCY-379A	3/5/2016	123	13.0	106	18	149
SM-RCY-379B	3/5/2016	43.3	7.87	182	11	252
SM-RCY-388A	2/17/2016	49.5	2.49	50.3	15	311

[a] Total PCBs calculated as sum of RMP 40 congeners.

[b] PCB and Hg particle ratios calculated by dividing Total PCBs and Hg by SSC.

2.2.1. Third Party POC Monitoring in WY 2016

The **RMP's STLS** Team typically conducts annual monitoring for POCs on a region-wide basis. SMCWPPP is an active participant in the STLS and works with other Bay Area municipal stormwater programs to identify opportunities to direct RMP funds and monitoring activities towards meeting both short- and long-term municipal stormwater permit requirements. During WY 2013 – WY 2014 POC monitoring activities by the STLS focused on pollutant loading monitoring at six region-wide stations, including one station in San Mateo County. In WY 2015, the loading stations were discontinued and STLS monitoring shifted to wet weather characterization in catchments of interest. In WY 2016, the STLS Team continued wet weather characterization sampling using a similar approach to the PCBs and mercury sampling that was implemented by SMCWPPP. Seven WMAs (i.e., seven storm composite samples) were sampled for PCBs and mercury by the RMP's STLS in San Mateo County in WY 2016 and six WMAs were sampled in WY 2015.

During WY 2016 the EPA grant-funded **CW4CB** project collected three best management practices (BMP) effectiveness samples at two bioretention facilities along Bransten Road in San Carlos, CA. During storm events, an urban runoff influent sample was collected at the facility designated "Bio3" and paired influent and effluent samples were collected at the facility designated "Bio7." Flow through the bioretention facilities and bypass flows were also measured. Analytes for all three samples included PCBs, mercury and SSC. Results will be reported in the CW4CB Project Report that is anticipated in April 2017.

2.2.2. Comparison with Region-wide Storm Sampling Results

Previous reports prepared by SMCWPPP and other BASMAA RMC partners describe PCB concentrations in *sediment* from samples collected throughout the region (SMCWPPP 2015). There are over 1,200 region-wide sediment samples that have been analyzed for PCBs. The large sediment dataset was evaluated by the BASMAA RMC to develop the sediment concentration thresholds that have been used to identify WMAs and/or PCB source areas where new PCBs and mercury control measures will be implemented. Although sediment sampling efforts have been and will continue to be very informative in this process, there are some limitations to sediment sampling that can be resolved by collecting storm composite stormwater runoff samples. For example, sediment is not always found at the identified

sampling stations. Furthermore, storm composite water samples can integrate POC sources over time and space within a catchment. In addition, composite stormwater runoff samples collected at the bottom of a catchment are hypothesized to have a lower potential to yield false negative results than sediment samples, especially when particle ratios are considered. For these reasons, WY 2016 monitoring focused on storm composite water samples.

Storm composite water sampling presents many source identification opportunities; however, the dataset for water samples is not as large or robust as the sediment sample dataset. Therefore, the BASMAA RMC has not established PCBs water concentration or particle ratio thresholds for evaluating and categorizing catchments. As a preliminary step towards developing thresholds for water samples, SMCWPPP worked with the Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP) to review the PCBs monitoring data collected by SMCWPPP and SCVURPPP in WY 2016 along with data from water samples collected throughout the region. The analysis includes preliminary data from RMP STLS monitoring (Gilbreath et al. 2017).

The storm sample dataset includes samples collected from 61 MS4 catchments and 15 natural waterways throughout the Bay Area. The MS4 catchment sites include storm drain manholes, outfalls, pump stations, and artificial channels.[7] The 15 sites in natural waterways have watersheds ranging in size from less than 3,000 acres (i.e., Lower Penitencia Creek) to the entire Sacramento–San Joaquin River Delta watershed (i.e., Mallard Island). Many of the sites have been sampled more than once and/or have multiple sample results reported for individual storm events. Eight of the 61 MS4 sites have multiple sample results (i.e., sample counts of 4 to 80). All the natural waterway sites have multiple sample results i.e., (sample counts of 3 to 125). For sites with more than one sample, the particle ratio is calculated by dividing the sum of PCB concentrations by the sum of suspended sediment concentrations. Performing the calculation in this way is effectively the equivalent of compositing all the individual samples that have been collected at a site. This is consistent with the RMP STLS approach to data evaluation (Gilbreath et al. 2017).

PCB concentrations in water samples for the Bay Area dataset (n=76) are plotted in Figure 2. PCB particle ratios are plotted in Figure 3. Figures 2 and 3 identify sites by location (i.e., County) and sample type (i.e., MS4 or natural waterway/creek). There are 25 sites in San Mateo County. Eight of the sites were sampled by SMCWPPP in WY 2016, thirteen sites were sampled by the RMP STLS in WY 2015 and WY 2016, and four sites were sampled multiple times by the RMP in prior water years.

Two of the top three highest PCB concentrations in the dataset were measured in San Mateo County, with Pulgas Creek Pump Station South having the highest (average 448 ng/L) and SM-SCS-75A (Industrial Rd Ditch) having the third highest (160 ng/L). There have been 33 samples collected at Pulgas Creek Pump Station South with concentrations consistently very elevated. The site has had by far the two highest PCB concentrations measured out of 647 total samples (6,669 ng/L and 4,084 ng/L), as well as the four highest PCB particle ratios (37,363 ng/g, 20,733 ng/g, 15,477 ng/g, and 14,744 ng/g).

[7] Stormwater runoff samples have also been collected from inlets and/or treatment systems (e.g., bioretention) during special studies. However, those are not included in this analysis.

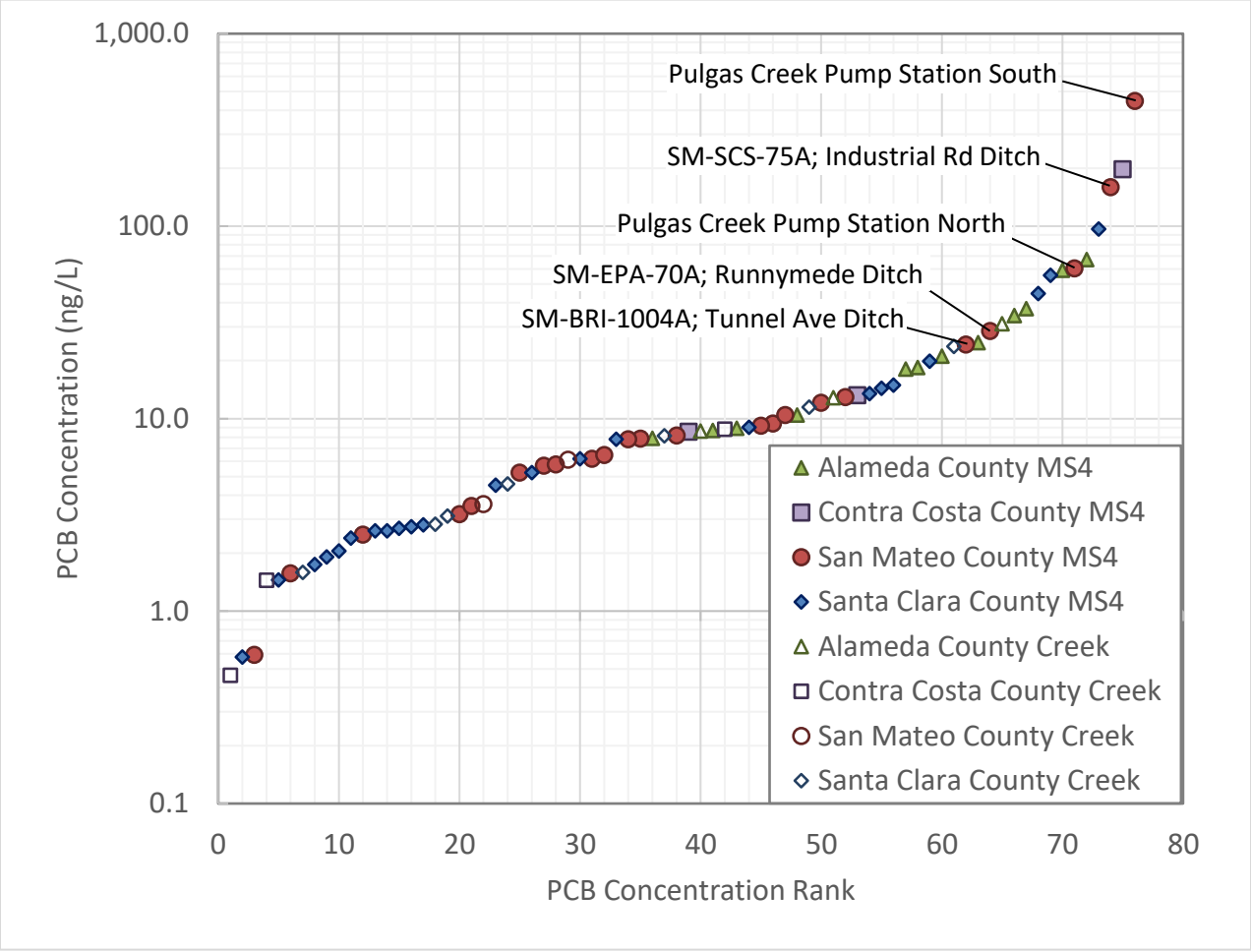

Figure 2. PCB concentrations for water samples collected in MS4s and creeks in the Bay Area.

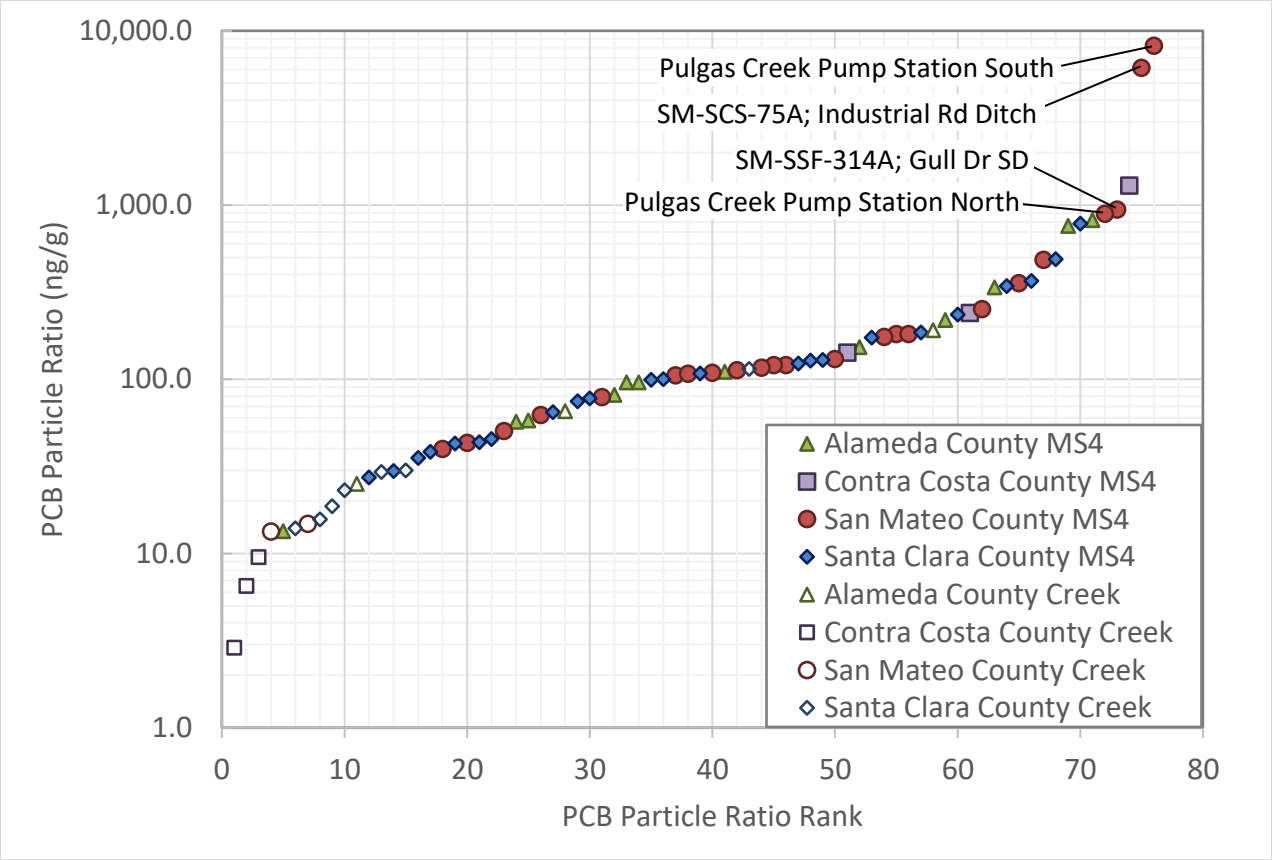

Figure 3. PCB particle ratios for water samples collected in large MS4s in the Bay Area

Table 5 lists descriptive statistics on PCB and mercury concentrations for the Bay Area stormwater dataset (n=76). The median PCB concentration in water samples is 8.37 ng/L, and the mean is 23.9 ng/L. The median PCB particle ratio is 108 ng/g, and the mean is 366 ng/g. As can be seen in Figures 2 and 3, which are plotted on a log scale, there are a few catchments with highly elevated in PCBs (such as the Pulgas Creek Pump Station) that greatly influence the mean concentration statistic but have less impact on the median (i.e., 50th percentile) statistic. Both SMCWPPP and the RMP are collecting more stormwater composite samples in WY 2017 which will expand this dataset. In future years, it may be informative to correlate measured concentrations to various factors such as storm size, rainfall intensity, antecedent dry weather, and land use characteristics.

Table 5. Descriptive statistics of stormwater runoff sample concentrations of PCBs and mercury

	PCBs (ng/L) [a]	Hg (ng/L)	SSC (mg/L)	PCB Particle Ratio (ng/g) [b]	Hg Particle Ratio (ng/mg) [b]
N	76	53	76	76	53
Min	0.464	3.9	10.0	2.88	127
10th Percentile	1.70	6.0	25.2	15.4	165
25th Percentile	3.14	11	43.4	42.9	247
50th Percentile	8.37	20	75.7	108	341
75th Percentile	18.4	41	153	190	555
90th Percentile	56.5	81	355	766	948
Max	448	440	1570	8220	5317
Mean	23.9	38	151	366	526

[a] Total PCBs calculated as sum of RMP 40 congeners.
[b] PCB and Hg particle ratios calculated by dividing Total PCBs and Hg concentrations by SSC.

2.2.3. Monitored WMAs

PCB and mercury sampling data are used to prioritize WMAs for further investigation and control measure implementation. There are currently no Bay Area wide thresholds established for classifying or prioritizing WMAs based on PCB or mercury concentrations in water. Therefore, this report provisionally applies the BASMAA RMC sediment concentration thresholds to PCB particle ratio data. Sediment data and particle ratio data are shown in similar units (e.g., ng/g or mg/kg). A PCB particle ratio greater than 0.5 mg/kg (or 500 ng/g) (about the 88th percentile of stormwater runoff samples) is used as a threshold for classifying a WMA as higher priority, 0.2 – 0.5 mg/kg (200 – 500 ng/g) is medium priority, and less than 0.2 mg/kg (200 ng/g)(about the 75th percentile) is lower priority. Of the 21 stormwater runoff samples collected in San Mateo County in WY 2015 and WY 2016 by SMCWPPP and the RMP, two samples had PCB particle ratios over 0.5 mg/kg, three were between 0.2 and 0.5 mg/kg, and the remainder were below 0.2 mg/kg. The WMAs where samples were collected with PCB particle ratios over 0.2 mg/kg are described in more detail below. [8]

[8] The WMA IDs in San Mateo County are numerical (1 – 1017). Sample IDs consist of a prefix for the county (SM), followed by a three-letter prefix for the Permittee where the sample was collected (e.g., SSF for South San Francisco, SCS for San Carlos), followed by the WMA ID, and followed by a letter (e.g., A, B, C) to distinguish the sampling site from the WMA in which that sample was collected. Samples collected previously may have a different sampling ID system.

Figure 4 is a map of current WMA status in San Mateo County based on sediment and stormwater runoff samples collected through WY 2016[9]. Only WMAs with parcels of interest are included in Figure 4.

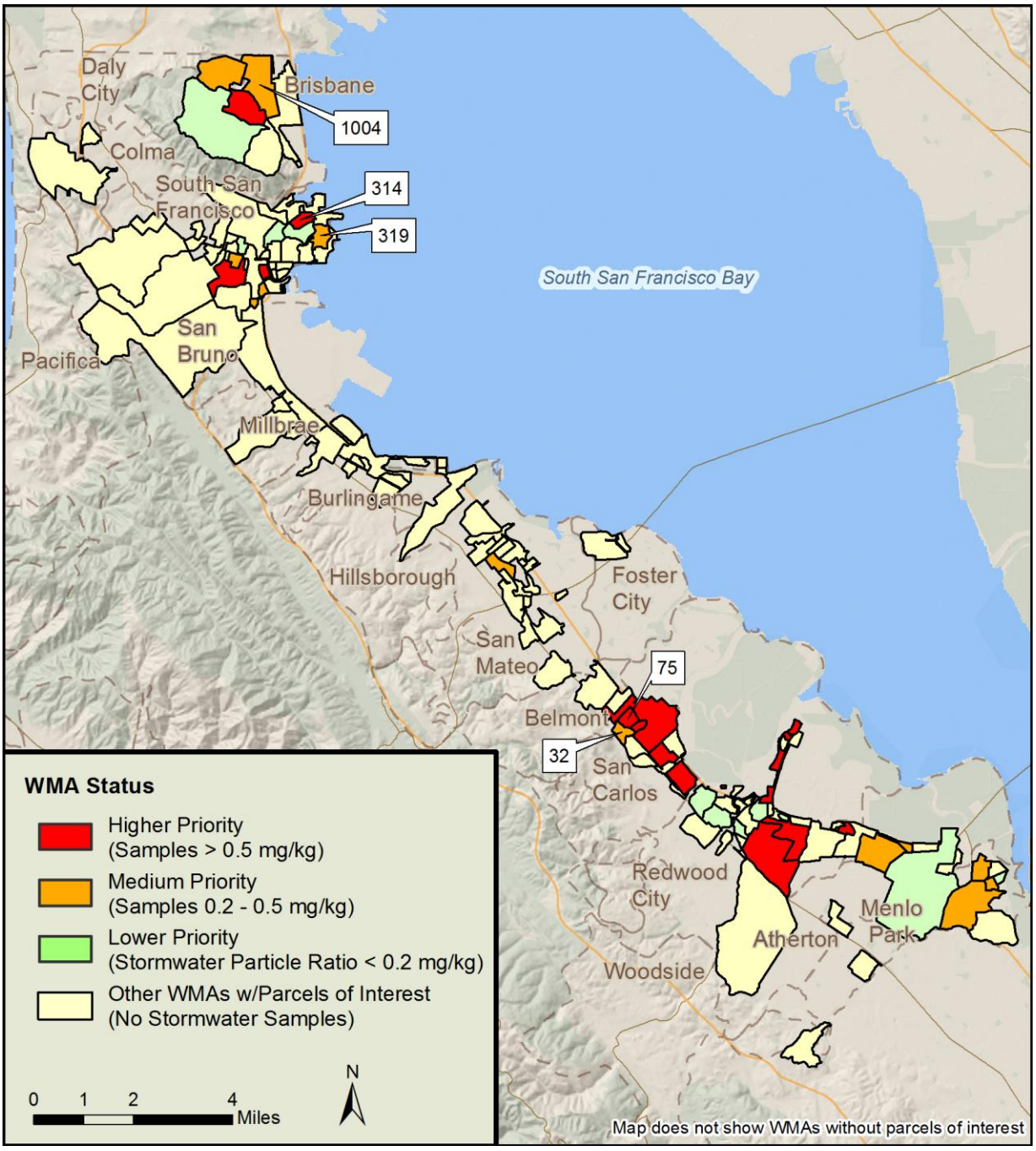

Figure 4. San Mateo County WMA status based on sediment and stormwater runoff data collected through WY 2016.

[9] Where sediment and stormwater runoff particle ratio analysis results conflict, the higher result was conservatively applied.

WMA 75

Sample SM-SCS-75A (Industrial Rd Ditch) was collected by the RMP in WY 2016. The sample station is located within the MS4 downstream of the Delta Star site in the City of San Carlos. Delta Star is a property on the Federal "Superfund" National Priorities List with a known history of PCB pollution in soil and groundwater. The Delta Star property was previously remediated for PCBs and is currently determined to be in compliance with public health, safety, and the environmental cleanup goals based on exposure at the site (DTSC 2015). However, based on the PCB concentration in the stormwater sample, the site appears to be a source of PCBs to the MS4 and San Francisco Bay at levels that are a concern from the standpoint of the Bay PCBs TMDL (i.e., contribute to bioaccumulation in Bay fish and other wildlife). The PCB particle ratio was 6,140 ng/g, which was the fifth highest of the 647 Bay Area samples. The PCB concentration (160 ng/L) was the nineteenth highest (the top eighteen are all from only three sites). This catchment may not need additional source investigation since the source appears to be the Delta Star facility. However, it is important to measure PCB water concentrations from catchments with known sources to better calculate loading to San Francisco Bay and to establish baselines that can help with evaluating the effectiveness of control measures to meet TMDL goals. Department of Toxic Substances Control (DTSC) clean up goals have historically been focused on human health guidelines for exposure at the site rather than TMDL goals.

WMA 314

WMA 314 is a relatively small catchment (66 acres) located in the City of South San Francisco near Oyster Point and is composed entirely of light industrial land uses along with an old railroad right-of-way. Site SM-SSF-314A (Gull Dr. SD) was sampled by the RMP in WY 2016 and had a relatively average PCB concentration (9.4 ng/L), but an elevated PCB particle ratio (943 ng/g). This sample had a relatively low suspended sediment concentration (SSC) of 10 mg/L.

WMA 32

WMA 32 is a relatively small catchment (67 acres) in the City of San Carlos. It is located adjacent to WMA 75 which contains the Delta Star Corporation property. Sample SM-SCS-32A (Taylor Way SD) was collected by the RMP in WY 2016 and had a PCB particle ratio of 484 ng/g, the third highest of the water samples collected in WY 2015 and WY 2016 in San Mateo County. The catchment contains a very small area of old industrial land use and some of the Caltrain right-of-way. It is possible that the source of the moderately elevated PCB particle ratio in Catchment 32 is from a "halo effect" of the nearby Delta Star property.

WMA 319

WMA 319 is located near WMA 314 in the City of South San Francisco near Oyster Point. Sample SM-SSF-319A (Forbes Blvd Outfall) was collected by the RMP in WY 2016 and had a PCB particle ratio of 356 ng/g. Although the catchment was historically industrial, it is now mostly redeveloped and composed of biotechnology corporations.

WMA 1004

WMA 1004 is located in the City of Brisbane along Tunnel Avenue in the Brisban Baylands area. Sample SM-BRI-1004A (Tunnel Ave Ditch) was collected by the RMP in WY 2016 and had a PCB particle ratio of 253 ng/g, just above the 200 ng/g threshold to be considered moderately elevated. The catchment contains all of the Brisbane Baylands old railyard, as well as a very large PG&E property on Geneva Avenue. The catchment is mostly pervious, and therefore if additional water samples are collected from this catchment, larger storms that result in sufficient runoff to sample should be targetted.

2.3. Copper

In WY 2016, SMCWPPP collected copper samples concurrently with a subset (three) of the PCBs and mercury storm composite samples[10]. This approach provides a relatively efficient means of collecting copper samples during wet weather when copper is most likely to be discharged from the urban landscape. The goal of this approach is to address Management Question #4 (Loads and Status) by characterizing copper concentrations in stormwater runoff from highly urban catchments. Samples were analyzed for total copper, dissolved copper, and hardness. Results are listed in Table 6. Comparisons to freshwater water quality objectives are described in Section 3.0.

Table 6. Total and dissolved copper concentrations in water samples collected by SMCWPPP, WY 2016.

Station Code	Sample Date	Total Copper (ug/L)	Dissolved Copper (ug/L)	Hardness as $CaCO_3$ (mg/L)
SM-MPK-71	2/17/2016	23.1	14.8	450
SM-RCY-327	2/17/2016	19.7	9.34	38.4
SM-RCY-388	2/17/2016	27.0	9.24	28.0

2.4. Nutrients

Nutrients were included in the POC monitoring requirements to support Regional Water Board efforts to develop nutrient numeric endpoints (NNE) for the San Francisco Bay Estuary. The "Nutrient Management Strategy for San Francisco Bay" is part of a statewide initiative to address nutrient over-enrichment in State waters (Regional Water Board 2012). The suite of nutrients required in the MRP (i.e., ammonium, nitrate, nitrite, total Kjeldahl nitrogen, orthophosphate, and total phosphorus) closely reflects the list of analytes measured by the RMP and BASMAA partners at the six regional loading stations (including a San Mateo County station at the Pulgas Creek Pump Station in the City of San Carlos) monitored in WY 2012 - WY 2014. The prior data were used by the Nutrient Strategy Technical Team to develop and calibrate nutrient loading models.

[10] In order to simplify the field effort and reduce the risk of sample contamination, SMCWPPP requested that the analytical laboratory conduct the sample filtration required for dissolved copper analysis. The hold time for sample filtration is 24 hours and the laboratory is not staffed for this work on weekends. Therefore, only samples collected Monday through Thursday could be submitted for copper analysis. This constraint limited copper monitoring efforts to three samples.

In WY 2016, POC monitoring for nutrients in San Mateo County was conducted during the dry season at two bottom-of-the-watershed stations with mixed land uses (Figure 1). Nutrient monitoring addresses Management Question #4 (Loads and Status). Results are listed in Table 7. Comparisons to applicable freshwater water quality objectives are described in Section 3.0.

Table 7. Nutrient concentrations in POC water samples collected by SMCWPPP, WY 2016.

Constituent	Units	204SMA060	205BRC010
Nitrate as N	(mg/L)	0.063	< 0.02
Nitrite as N	(mg/L)	0.002	0.001
Total Kjeldahl Nitrogen (TKN)	(mg/L)	0.48	0.26
Ammonia as N	(mg/L)	0.024	0.048
Un-ionized Ammonia as N [1]	(mg/L)	0.0004	0.001
Ammonium [2]	(mg/L)	0.024	0.047
Total Nitrogen [3]	(mg/L)	0.545	0.271
Dissolved Orthophosphate as P	(mg/L)	0.014	0.034
Phosphorus as P	(mg/L)	0.011	0.042

Notes:

[1] Un-ionized ammonia calculated using formula provided by the American Fisheries Society Online Resources.

[2] Ammonium = ammonia – un-ionized ammonia.

[3] Total nitrogen = TKN + nitrate + nitrite. Non-detects valued at ½ method detection limit in calculation.

2.5. Emerging Contaminants

Emerging contaminant monitoring is being addressed through Program participation in the RMP. The RMP has been investigating Chemicals of Emerging Concern (CECs) since 2001 and established the RMP Emerging Contaminants Work Group (ECWG) in 2006. The goal of the ECWG is to identify CECs that have the potential to impact beneficial uses in the Bay and to develop cost-effective strategies to identify and monitor, and minimize impacts. The RMP published a CEC Strategy "living" document in 2013 (Sutton et al. 2013; Sutton and Sedlak 2015) which is scheduled for a full revision in the near future. The CEC Strategy document guides RMP special studies on CECs using a tiered risk and management action framework.

3.0 COMPLIANCE WITH APPLICABLE WATER QUALITY STANDARDS

MRP provision C.8.h.i requires RMC participants to assess all data collected pursuant to Provision C.8 for compliance with applicable water quality standards. In compliance with this requirement POC data collected in WY2016 by SMCWPPP were compared to applicable numeric water quality objectives (WQOs). There were no exceedances of applicable water quality standards. Details of the analysis are provided below.

When conducting a comparison to applicable WQOs/criteria, certain considerations should be taken into account to avoid the mischaracterization of water quality data:

Discharge vs. Receiving Water – WQOs apply to receiving waters, not discharges. WQOs are designed to represent the maximum amount of pollutants that can remain in the water column without causing any adverse effect on organisms using the aquatic system as habitat, on people consuming those organisms or water, and on other current or potential beneficial uses. Only nutrient data were collected in receiving waters. PCB, mercury, and copper data were collected within the engineered storm drain network. Dilution is likely to occur when the MS4 discharges urban stormwater (and non-stormwater) runoff into the local receiving water. Therefore, it is unknown whether discharges that exceed WQOs result in exceedances in the receiving water itself, the location where there is the potential for exposure by aquatic life.

Freshwater vs. Saltwater - POC monitoring data were collected in freshwater, above tidal influence and therefore comparisons were made to freshwater WQOs/criteria.

Aquatic Life vs. Human Health - Comparisons were primarily made to objectives/criteria for the protection of aquatic life, not objectives/criteria for the protection of human health to support the consumption of water or organisms. This decision was based on the assumption that water and organisms are not likely being consumed from the stations monitored.

Acute vs. Chronic Objectives/Criteria - Monitoring for PCBs, mercury, and copper was conducted during episodic storm events and results do not likely represent long-term (chronic) concentrations of monitored constituents. POC monitoring data were therefore compared to “acute” WQOs/criteria for aquatic life that represent the highest concentrations of an analyte to which an aquatic community can be exposed briefly (e.g., 1-hour) without resulting in an unacceptable effect.

Of the analytes monitored at POC stations in WY 2016, WQOs or criteria for the protection of aquatic life have only been promulgated for total mercury, dissolved copper, and unionized ammonia.

- **Total Mercury**. All of the mercury concentrations measured in SMCWPPP samples were well below the freshwater acute objective for mercury of 2.4 ug/L (see Table 4).

- **Dissolved Copper.** Acute (1-hour average) WQOs for copper are expressed in terms of the dissolved fraction of the metal in the water column and are hardness dependent. The acute copper WQO was calculated using the measured hardness values. For stations located within the MS4, hardness was not measured in the receiving water and it is unknown whether the same calculated WQO would apply to the receiving water. Dissolved copper concentrations measured at those stations are compared to the calculated WQO. Two of the three stations had

dissolved copper concentrations that exceeded the calculated WQO (Table 8). However, as stated above, the samples were collected in the MS4, not the receiving water. Dilution of the MS4 discharge would occur in the receiving water and it is unknown whether the discharge would result in an exceedance of the copper WQO in the receiving water. Furthermore, it is unknown whether the receiving water has the same hardness as the discharge. If the hardness in the receiving water was higher, a higher WQO would be applicable.

Table 8. Comparison of WY 2016 Copper Monitoring Data to WQO that Applies to Receiving Water.

Station Code	Sample Date	Hardness as $CaCO_3$ (mg/L)	Acute WQO for Dissolved Copper at Measured Hardness (ug/L)	Dissolved Copper (ug/L)
SM-MPK-71	2/17/2016	450	57.8	14.8
SM-RCY-327	2/17/2016	38.4	5.68	**9.34**
SM-RCY-388	2/17/2016	28.0	4.22	**9.24**

- **Nutrients**. The un-ionized ammonia concentrations measured in SMCWPPP samples were well below the annual median objective for un-ionized ammonia of 0.025 mg/L (see Table 7).

4.0 CONCLUSIONS AND RECOMMENDATIONS

In WY 2016, SMCWPPP collected and analyzed POC samples in compliance with Provision C.8.f of the MRP. Yearly minimum requirements were met for all monitoring parameters. In addition, SMCWPPP worked with the RMP's STLS to supplement WY 2016 monitoring accomplishments.

Conclusions from WY 2016 POC monitoring include the following:

- SMCWPPP collected eight wet weather samples from high interest catchments for PCBs and mercury analysis. Results from SMCWPPP monitoring were compiled with results from RMP STLS monitoring to identify new WMAs in which new PCB and mercury control measures could be implemented during the permit term. Based on the monitoring results, five catchments were prioritized as Potential WMAs and may be targeted for source investigations in WY 2017.
- A subset (three of eight) of the wet weather samples were analyzed for total and dissolved copper.
- Two bottom-of-the-watershed samples were collected during the dry season for nutrient analysis.
- None of the samples exceeded applicable water quality standards which generally apply to receiving waters rather than pipelines within the MS4.

Recommendations for WY 2017 POC monitoring include the following:

- SMCWPPP and the RMP's STLS will continue to conduct PCB and mercury monitoring with the goal of identifying specific source properties and prioritizing WMAs for PCB and mercury control measures implementation.
- At least eight samples that address Management Question #3 (Management Action Effectiveness) must be collected by the end of year four of the permit. SMCWPPP is currently working with BASMAA to develop a regional project to design a Monitoring Plan for POC Management Action Effectiveness. The goal is to finalize the Monitoring Plan/study design in WY 2017 and implement the plan in WY 2018. A major consideration for the regional Management Action Effectiveness Monitoring Plan and other future monitoring efforts will be collection of data in support of conducting the Reasonable Assurance Analysis (RAA) that is required by Provision C.12.c.iii.(3) of the MRP and which must be submitted with the 2020 Annual Report (September 30, 2020). Results of the CW4CB Project Report should be considered as part of this process.
- At least eight samples that address Management Question #5 (Trends) must be collected by the end of year four of the permit. SMCWPPP will continue to participate in the STLS Trends Strategy Team to meet this requirement. The STLS Trends Strategy Team, initiated in WY 2015, is currently developing a regional monitoring program to assess trends in POC loading to San Francisco Bay from small tributaries. The STLS Trends Strategy will initially focus on PCBs and mercury, but will not be limited to those POCs. The preliminary design concept includes additional monitoring at one or two of the region-wide loadings stations to gain a better understanding of the variability in PCBs concentrations/loadings in the existing dataset. The variability of PCB concentrations in stormwater runoff will predict the number and frequency of

samples needed to depict given load reductions over given periods of time. STLS Trends Strategy monitoring could begin as early as WY 2017 and will likely continue through the Permit term; however, the monitoring design is still being developed.

- SMCWPPP will continue to work with work with the SPoT Program to address Management Question #5 (Trends). The **SPoT Monitoring Program** conducts annual dry season monitoring (subject to funding constraints) of sediments collected from a statewide network of large rivers. The goal of the SPoT Program is to investigate long-term trends in water quality (Management Question #5 – Trends). Sites are targeted in bottom-of-the-watershed locations with slow water flow and appropriate micromorphology to allow deposition and accumulation of sediments, including a station near the mouth of San Mateo Creek. In most years, sediments are analyzed for PCBs, mercury, toxicity, pesticides, and organic pollutants (Phillips et al. 2014). In WY 2016, SPoT monitoring in San Mateo Creek did not include PCBs or mercury; however, those constituents are anticipated for WY 2017.

- A subset of the wet weather PCB and mercury samples collected from catchments with old industrial land uses will continue to be analyzed for total and dissolved copper. Copper monitoring efforts should be increased above the minimum number of yearly samples in order to make more progress towards the total number of samples required by the end of year five of the MRP.

- Nutrient samples will continue to be collected from mixed land use watersheds. Nutrient monitoring efforts should be increased above the minimum number of yearly samples in order to make more progress towards the total number of samples required by the end of year five of the MRP. If feasible, samples for nutrient analysis should be collected during or shortly after storm events when nutrient discharges are most likely.

- SMCWPPP will continue to participate in the RMP and the RMP's CEC Strategy.

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Pollutants of Concern Monitoring - Quality Assurance/Quality Control Report, WY 2016

1.0 INTRODUCTION

San Mateo Countywide Water Pollution Prevention Program (SMCWPPP) conducted Pollutants of Concern (POC) Monitoring in Water Year (WY) 2016 to comply with Provision C.8.f (Pollutants of Concern Monitoring) of the reissued National Pollutant Discharge Elimination Program (NPDES) Municipal Regional Permit for the San Francisco Bay Area (MRP). Monitoring included analysis for polychlorinated biphenyls (PCBs), total mercury, total and dissolved copper, suspended sediment concentration (SSC), and nutrients (i.e., ammonia, nitrate, nitrite, total Kjeldahl nitrogen, orthophosphate, and total phosphorus). Monitoring was performed according to the project Monitoring Plan (SMCWPPP 2016).

This project utilized the Clean Watersheds for Clean Bay Project (CW4CB) Quality Assurance Project Plan (QAPP; AMS 2012) as a basis for Quality Assurance and Quality Control (QA/QC) procedures. Missing components were supplemented by the Bay Area Stormwater Management Agencies Association (BASMAA) Regional Monitoring Coalition (RMC) QAPP (BASMAA 2016), specifically for nutrient samples. Data were assessed for seven data quality attributes, which include (1) Representativeness, (2) Comparability, (3) Completeness, (4) Sensitivity, (5) Contamination, (6) Accuracy, and (7) Precision. These seven attributes are compared to Data Quality Objectives (DQOs), which were established to ensure that data collected are of adequate quality and sufficient for the intended uses. DQOs address both quantitative and qualitative assessment of the acceptability of data – representativeness and comparability are qualitative; completeness, sensitivity, precision, accuracy, and contamination are quantitative assessments. Specific DQOs are based on Measurement Quality Objectives (MQOs) for each analyte.

The MQOs for each of the POC data types are summarized in Table 1. As there was no reporting limit listed in the QAPP for copper, results were compared the SWAMP-recommended reporting limits for inorganic analytes in freshwater. Overall, the results of the QA/QC review suggest that the data generated during this study were of sufficient quality for the purposes of the project. While some data were flagged in the project database, none of the data were rejected. Further details regarding the QA/QC review are provided in the sections below.

Table 1. Measurement quality objectives from the Clean Watersheds for a Clean Bay (CW4CB) Quality Assurance Project Plan (AMS 2012) and BASMAA RMC Quality Assurance Project Plan (BASMAA 2016)

Sample	PCBs[1]	Mercury[2]	Copper and Hardness[2]	SSC[3]	Nutrients[4]
Laboratory Blank	< Reporting Limit	< Reporting Limit	< Reporting Limit	< Reporting Limit	< Reporting Limit
Reference Material (Laboratory Control Sample)	50-150% recovery	75-125% recovery	75-125% recovery	80-120% recovery	80-120% recovery
Matrix Spike	50-150% recovery	75-125% recovery	75-125% recovery	NA	80-120% recovery
Matrix Spike, Field, and Laboratory Duplicate[4]	Relative Percent Difference < 25%	Relative Percent Difference < 25%	Relative Percent Difference < 25%	Lab Dup Relative Percent Difference < 25%	Relative Percent Difference < 25%
Reporting Limit	0.002 µg/L (2000 pg/L)	0.0002 µg/L (0.2 ng/L)	0.10 µg/L[5]	0.5 mg/L	None Listed

[1] Synthetic Analytes in Water (CW4CB)

[2] Inorganic Analytes in Water (CW4CB)

[3] Conventional Analytes – Solids (CW4CB)

Conventional Analytes in Water (BASMAA)

[4] NA if native concentration for either sample is less than the reporting limit

[5] No copper reporting limit listed in CW4CB QAPP. From SWAMP-recommended reporting limits for inorganic analytes in freshwater. (http://www.waterboards.ca.gov/water_issues/programs/swamp/docs/tools/19_tables_fr_water/4_inorg_fr_water.pdf)

2.0 REPRESENTATIVENESS

Data representativeness assesses whether the data were collected so as to represent actual conditions at each monitoring location. For this project, all samples are assumed to be representative if they are performed according to protocols specified in the Project Monitoring Plan, CW4CB QAPP, and RMC QAPP. All field and laboratory personnel received and reviewed the Monitoring Plan and QAPPs, and followed prescribed protocols including laboratory methods prescribed by the project Monitoring Plan (SMCWPPP 2016).

3.0 COMPARABILITY

Electronic data deliverables (EDDs) are submitted to the San Francisco Regional Water Quality Control Board (SFRWQCB) in Microsoft Excel templates developed by California Surface Water Ambient Monitoring Program (SWAMP), to ensure data comparability with the SWAMP program. In addition, data entry follows SWAMP documentation specific to each data type, including the

exclusion of qualitative values that do not appear on SWAMP's look up lists[1]. Completed templates are reviewed using SWAMP's online data checker[2], further ensuring SWAMP-comparability.

4.0 COMPLETENESS

The project Monitoring Plan specifies a goal of eight (8) PCB and mercury samples and four (4) copper and nutrients be collected during WY 2016. However, the Monitoring Plan notes that these numerical targets are goals and allows for unforeseen field conditions which may hinder efforts. During WY 2016, SMCWPPP collected the planned number of PCB and mercury samples, but only collected three of the four planned copper samples and two of four planned nutrient samples. Though SMCWPPP did not collect 100% of planned samples, the Program did collect and analyze the annual minimum number of samples specified by the MRP. Additionally, the Program collected one field duplicate, as specified by the SAP.

5.0 SENSITIVITY

The project QAPP identified a reporting limit of 0.0002 ug/L or 0.2 ng/L for mercury, but the actual reporting limit was much higher at 5 ng/L. This elevated reporting limit was due to a high dilution factor (10), which was necessary to conduct the analysis. Copper samples met the SWAMP-recommended reporting limit of 0.1 µg/L for freshwater samples and PCB samples exceeded the reporting limit of 0.002 µg/L (2000 pg/L).

Nutrient analysis met the reporting limits listed in the RMC QAPP, except for nitrate whose target reporting limit 0.01 mg/L is slightly lower than the laboratory's reporting limit (0.05mg/L).

6.0 CONTAMINATION

The project Monitoring Plan (SMCWPPP 2016) requires that one field blank be analyzed for PCB and mercury, but due to staff oversight, no field blank was collected in WY 2016. However, the laboratory did analyze several laboratory blanks. All blank samples were analyzed for contamination, and results were compared to MQOs in Table 1 and the CW4CB QAPP, which require blanks to be less than the reporting limit.

Laboratory method blanks were less than reporting limits for most analytes with the exception of the following, which were flagged as "VIPRL" by the QA officer[3]:

- PCB 8
- PCB 18/30
- PCB 20/28
- PCB 31
- PCB 44/47/65
- PCB 52

[1] Look up lists available online at http://swamp.waterboards.ca.gov/swamp_checker/LookUpLists.php.

[2] Checker available online at http://swamp.waterboards.ca.gov/swamp_checker/SWAMPUpload.php

[3] None of the analytes detected in the laboratory method blanks above the reporting limit were flagged by the laboratory.

Laboratory blanks were run during nutrient analysis and all results were non-detect. While no field blank for nutrients was required or collected, an orthophosphate field blank was collected during SMCWPPP creek status monitoring that was performed concurrently with POC sampling. Since the field crew collecting nutrients during creek status monitoring and POC monitoring was the same, this field blank is considered to be representative of POC sampling as well. Orthophosphate concentrations were non-detect for this field blank. Refer to the SMCWPPP Creek Status Monitoring QA/QC Report for more information.

7.0 ACCURACY

Accuracy is assessed as the percent recovery of samples spiked with a known amount of a specific chemical constituent. The analytical laboratory evaluated and reported the percent recovery (PR) of laboratory control samples (LCS; in lieu of reference materials) and matrix spikes (MS), which were recalculated and compared to the target range in the CW4CB QAPP. If a QA sample did not meet the MQOs, all samples in that batch for that particular analyte were flagged.

For PCBs, the CW4CB QAPP specifies a MQO of 50-150% recovery for both LCS and MS/MSD. For mercury and copper, the MQO for recovery is 75-125% for both accuracy measurements. For nutrients, the BASMAA RMC QAPP (BASMAA 2016) specifies a MQO of 80-120% recovery for LCS and MS/MSD.

None of the LCS or MS/MSD samples for mercury, copper, or PCBs exceeded their respective MQO ranges specified by the CW4CB QAPP. All nutrient laboratory LCS and MS/MSD samples were within the MQO specified by the BASMAA QAPP. Though the laboratory MQO ranges for certain analytes were slightly different than those specified by the CQ4CB and BASMAA QAPPs, all of the LCS and MS/MSD results were within both MQO ranges and no data were qualified by either the laboratory or the QA officer for accuracy issues. See Table 2 for a comparison of QAPP and laboratory MQOs with the actual LCS range and Table 3 for the actual MS/MSD ranges.

Table 2. Laboratory control sample results compared to quality assurance project protocol and laboratory measurement quality objectives.

LCS Ranges	**QAPP MQO**	**Laboratory MQO**	**Results Range**
Copper	75-125%	85-115	92-105%
Mercury	75-125%	77-123%	98-114%
PCBs	50-150%	60-135%	73-131%
Nutrients	80-120%	80-120% 90-110%[a]	93-106%

[a] Total Kjeldahl nitrogen, orthophosphate, phosphorus, nitrate

Table 3. Matrix spike and matrix spike duplicate results compared to quality assurance project protocol and laboratory measurement quality objectives.

MS/MSD Ranges	**QAPP MQO**	**Laboratory MQO**	**Results Range**
Copper	75-125%	70-130	97-99%
Mercury	75-125%	71-125	85-97%
PCBs	50-150%	50-150	91-119%
Nutrients	80-120%	80-120% 90-110%[b]	95-104%

[b] Phosphorus, orthophosphate

8.0 PRECISION

Precision is the repeatability of a measurement and is quantified by the relative percent different (RPD) of two duplicates samples. Three measures of precision were used for this project – matrix spikes duplicates (MSD), laboratory duplicates, and field duplicates. The MQO for RPD specified by both the CW4CB QAPP and the BASMAA QAPP is <25%.

8.1. Matrix Spike Duplicates

Matrix spike duplicates were analyzed for mercury, PCBs, and nutrients. The RPDs for all duplicate samples were less than 5% (mercury 3-5%; PCBs 0-3.8%; nutrients 0.4-4.2%), which is well below the targeted range of less than 25%.

8.2. Field Duplicates

One field duplicate was collected during this project at site SM-MPK-71 (labelled as SM-RCY-397C). The duplicate sample was run as a blind duplicate by the laboratory. The RPD for most analytes met the CW4CB MQO (< 25%), except for PCB 201, whose RPD was 32%. The high RPD was attributed to very low concentrations, as PCB 201 was the PCB congener measured at the lowest concentration. The original sample was 1.2 pg/L and the duplicate was 1.65 pg/L.

A nutrient field duplicate was collected during creek status monitoring that is considered representative of nutrient sampling for POC monitoring and met the measurement quality objective for all analytes, except for ammonia. Refer to the SMCWPPP Creek Status Monitoring QA/QC Report for more information.

8.3. Lab duplicates

Laboratory duplicates were analyzed for copper and PCBs. All the copper duplicates (RPDs 1-5%) were well below the CW4CB MQO and the laboratory's internal RPD limit of 20%. Most of the PCB duplicates were less than 25% except for the following:

- PCB 30/18 (27%)
- PCB 20/28 (25%)
- PCB 49/69 (33%)
- PCB 83/99 (26%)
- PCB 90/101/113 (32%)
- PCB 195 (33%)

The laboratory RPD for PCBs was 50% and several samples were not flagged by the laboratory that exceeded the CW4CB MQO (< 25%). The PCB samples associated with these QA samples were flagged by the QA officer with "VIL".

9.0 REFERENCES

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