# Total Maximum Daily Loads for PCBs in the Houston Ship Channel

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**Quarterly Report 2**

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# 1. INTRODUCTION

Polychlorinated biphenyls (PCBs) are widespread organic contaminants that are environmentally persistent and can be harmful to human health even at low concentrations. A major route of exposure for PCBs worldwide is through food consumption, and this route is especially significant in seafood. The discovery of PCBs in seafood tissue has led the Texas Department of State Health Services (TDSHS) to issue seafood consumption advisories, and some of these advisories have been issued for the Houston Ship Channel (HSC). Three specific advisories have been issued recently for all finfish species based on concentrations of PCBs, organochlorine pesticides, and dioxins. ADV-20 was issued in October 2001 and includes the HSC upstream of the Lynchburg Ferry crossing and all contiguous waters, including the San Jacinto River Tidal below the U.S. Highway 90 Bridge. ADV-28 was issued in January 2005 for Upper Galveston Bay (UGB) and the HSC and all contiguous waters north of a line drawn from Red Bluff Point to Five Mile Cut Marker to Morgan's Point. In addition to these two finfish advisories, the TDSHS issued ADV-35 (for PCBs and dioxins) that advises against consumption of gafftopsail Catfish and speckled trout in upper Galveston Bay, lower Galveston Bay, and Trinity Bay. These advisories represent a large surface water system for which a PCB TMDL needs to be developed and implemented. The overall purpose of this project is to develop a total maximum daily load (TMDL) allocation for PCBs in the Houston Ship Channel System, including upper Galveston Bay. Though ADV-35 covers surface water beyond upper Galveston Bay, the TMDL boundary is currently set for upper Galveston Bay. Tasks performed under this work order include monitoring and data collection, as well as data evaluation and analysis in the Houston Ship Channel. Chapter 2 presents the status of the quality assurance activities, while Chapter 3 presents data analysis for the sampling activities undertaken in FY09.

# 2. QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

## 2.1 QA/QC of Sampling Results

The quality assurance/quality control (QA/QC) tasks that were conducted included monitoring/coordinating sample deliveries to the laboratories, verifying laboratory compliance with the QAPP, and verification of data packages. There were no major noncompliant issues encountered in the shipping and receiving of the samples collected. All samples were received from the sample site to the UH laboratory and from the UH laboratory to analytical laboratories without incident and were within the temperature range specified in the QAPP.

Once the sample results were obtained from the labs, UH/Parsons personnel using QA/QC criteria specified in the QAPP reviewed the results. The QA/QC requirements outlined in the QAPP included: holding times, method blanks, initial calibration curves, ambient water reporting limits (AWRL) verification, laboratory control sample (LCS), field duplicates, matrix spikes/matrix spike duplicates, laboratory duplicates, continuing calibration samples, surrogates, and internal standards. Table 2.1 lists the types and numbers of samples collected, data received and data reviewed from the Spring-Summer 2009 sampling. Table 2.2 shows the data flags that were used to designate the data as needed based on the QA/QC review. Appendix A of this report contains the data verification reports for all the data gathered in FY09 (ambient, effluent and runoff sampling).

**Table 2.1 Percentage of sample results obtained and reviewed for QA/QC**

| Laboratory | Media | Analysis | Number of samples collected | Number of sample results obtained from laboratory | Number of sample results reviewed for QA/QC | % Results reviewed for QA/QC |
|---|---|---|---|---|---|---|
| Xenco/NWDL | Water | TSS, DOC, TOC | 81 | 81 | 81 | 100% |
| Xenco/PTS | Sediment | Grain size and Solids content | 42 | 42 | * | * |
| Maxxam | Water | PCB (209 Congeners) | 174 | 174 | 174 | 100% |
| Pace | Sediment | PCB (209 Congeners) | 42 | 42 | 42 | 100% |
| Maxxam | Sediment | TOC | 42 | 42 | 42 | 100% |
| Pace | Fish | PCB (209 Congeners), Lipid and Moisture content* | 58 | 58 | 58 | 100% |

* no specific QA/QC criterion.

**Table 2.2 Standardized flags assigned to sample results**

| Flag | Description |
|---|---|
| B | Blank contamination (result is less than twenty times the amount found in the associated blank) |
| D | Surrogate/Internal Standard exceedance |
| E | Estimated |
| F | Field duplicate exceedance (%RPD of parent/duplicate sample > 50%) |
| H | Holding time exceedance |
| I | Ion ratio failure |
| J | Result is between the method detection limit (MDL) and the reporting level (RL) or the value is to be considered an estimate due to quality control issues involved in the analysis |
| L | Lab duplicate exceedance (%RPD of lab/lab duplicate sample > 50%) |
| M | Matrix spike exceedance |
| Q | Limit of Quantitation (LOQ) exceedance |
| R | Sample result is to be rejected and is considered unusable |
| S | Blank spike or lab control spike exceedance |
| U | Target analyte is not detected above the method detection level (MDL) in the sample |
| | |

Table 2.3 below lists the percent of samples that have been flagged as a result of QA/QC analysis. As can be seen from Table 2.3, the majority of the flags were associated with the PCB results in water (46.4%) and fish (31.3%) for non-detects ("U" flag).

**Table 2.3 Percentage sample results reviewed and flagged for QA/QC criteria**

| Analysis | Samples QA/QC reviewed/Samples collected* | Percentage results flagged for | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | U | B | J | E | H | F | M | Q | D | S | I |
| DOC-Water | 81/81 | | | | 6.17% | | | 2.47% | | | | |
| TOC-Water | 81/81 | | | | 6.17% | | | | | | | |
| TSS-Water | 81/81 | 9.88% | | | | 6.17% | 4.94% | | | | | |
| TOC-Sediment | 42/42 | | | | | | | | 1.23% | | | |
| PCB (209 Congeners) ¶ -Water | 174 | 46.36% | 0.34% | 15.39% | | | 0.47% | | 0.71% | 0.31% | 0.19% | 0.01% |
| PCB (209 Congeners) ¶ -Sediment | 42/42 | 0.44% | 0.05% | | | | 2.94% | 0.14% | 1.08% | | | 0.22% |
| PCB (209 Congeners) ¶-Fish | 58/58 | 31.27% | 0.14% | | | | | | 1.93% | | | 0.17% |

¶ Flagging Percentage based on individual congeners in the case of PCB.

4.41%

# 3. WATER, AND SEDIMENT RESULTS

This section examines exploratory analyses performed on the 2009 data in this quarter. The analysis has been completed for water concentrations but is in progress for sediment sediment. Thus, the results presented here are preliminary, and further analysis is necessary for decision-making using these analyses.

## 3.1 PCBs in Water

Table 3.1 presents summary statistics for PCBs in various forms of water column-based sampling (ambient, effluent and runoff). PCB concentrations in water are most naturally expressed as mass per volume, but hydrophobic contaminants are known to preferentially sorb to various manifestations of organic carbon in the aquatic environment. This is the reason for dissolved PCB concentration (PCB that passes through a 1 um glass fiber filter (GFF)) and suspended PCB concentration to be expressed as ng PCB/g DOC (dissolved organic carbon) and ng PCB/g POC (particulate organic carbon), respectively. Concentrations of particulate organic carbon (POC) were estimated by subtracting DOC from TOC. This proved ineffective, as the two values were often so close that at times DOC was analytically determined to be greater than TOC. The likely reason for this is that DOC is far more dominant and larger than POC in actuality, a condition that is known to exist in marine environments.

The lack of reliable POC data is significant because its absence means that dissolved PCB concentrations can be expressed in terms of OC, but the suspended counterpart cannot. It was, however, possible to express the suspended phase associated PCBs as dry weight of >1 um

particles[1] as well as volumetrically. The use of a dry weight basis suspended PCB concentration is warranted because the conditions in the HSC are unstable and turbulent meaning that concentrations of suspended solids can change rapidly. If there were a situation where a large amount of low to medium PCB concentration by dry weight suspended sediment was sampled, it might appear that the concentration of suspended sediment associated PCB at a location was particularly high. The result may, however simply be an illusion related to higher suspended solids at the time of sampling. The dry weight basis suspended sediment PCB concentration attempts to adjust for the varying amounts of suspended solids that may exist at different locations and at different times. The amount of organic carbon on those suspended sediments is still of course a source of variability for concentration that remains uncharacterized.

The summary statistics in Table 3.1 are presented so as to compare differences in PCB concentrations in different media according to sample type: ambient dry weather sampling, effluent sampling, and runoff sampling. This is the first time in the project where this comparison can be made since these three kinds of samples were all gathered within the same sampling season. The first thing to note with this sample subset is that the ambient samples are in far greater number than the effluent and runoff samples, which is important because this means that summary statistics (especially median and mean) are known most precisely with the ambient sample subset.

[1] The use of >1 um particles stems from the fact that 1 um nominal pore size glass fiber filters are used during PCB sampling. The result of the high volume sampling then gives values as ng PCB/L. That concentration is converted to a dry weight basis by using the TSS (mg/L) sample result, which was taken during PCB sampling. Laboratories were specifically asked to analyze TSS at 1 um filtration so that comparisons between PCB concentrations per volume and per mass of solid could be made. TSS is not necessarily analyzed at this specific filter size during standard analysis, and so a special request was made to ensure that this happened.

**Table 3.1 Total PCB (209 congener) summary statistics for water samples by sample type**

| Media | Sample Type | Count | Min | Max | Median | Mean | Standard Deviation |
|---|---|---|---|---|---|---|---|
| Diss+Susp (ng/L) | Ambient | 48 | 0.55 | 187.1 | 2.2 | 9.8 | 34.7 |
| | Effluent | 16 | 0.37 | 7.9 | 1.3 | 1.8 | 1.8 |
| | Runoff | 9 | 0.81 | 9.4 | 4.6 | 5.0 | 2.9 |
| Susp (ng/L) | Ambient | 48 | 0.05 | 99.3 | 0.4 | 3.8 | 16.1 |
| | Effluent | 16 | 0.03 | 1.6 | 0.5 | 0.6 | 0.5 |
| | Runoff | 9 | 0.19 | 6.8 | 3.4 | 3.4 | 2.2 |
| Susp (ng/g dry) | Ambient | 48 | 2.2 | 2919 | 16 | 117 | 435 |
| | Effluent | 16 | 1.3 | 87 | 39 | 36 | 27 |
| | Runoff | 9 | 2.6 | 104 | 32 | 34 | 30 |
| Diss (ng/L) | Ambient | 48 | 0.40 | 132.5 | 1.78 | 5.9 | 20.6 |
| | Effluent | 16 | 0.25 | 7.2 | 0.73 | 1.3 | 1.7 |
| | Runoff | 9 | 0.62 | 2.8 | 1.31 | 1.6 | 0.8 |
| Diss (ng/g DOC) | Ambient | 48 | 65 | 9003 | 303 | 694 | 1714 |
| | Effluent | 16 | 14 | 1025 | 53 | 155 | 250 |
| | Runoff | 9 | 96 | 383 | 174 | 207 | 101 |

The sum of dissolved and suspended (total water) concentration means and medians show that ambient PCB is generally higher than both the effluent and runoff, but this is not so for the median. A comparison of median concentrations shows that the runoff sample subset is actually higher. The reason for this somewhat inconclusive comparison between runoff and ambient samples is that the runoff samples have fairly high values for the suspended phase. The volumetric (ng/L) concentrations of suspended phase PCB are nearly the same for the runoff and ambient samples, but the mean for the suspended sediment mass adjusted concentrations (ng/g dry) are decidedly larger in the ambient sample set. The suspended phase runoff samples make

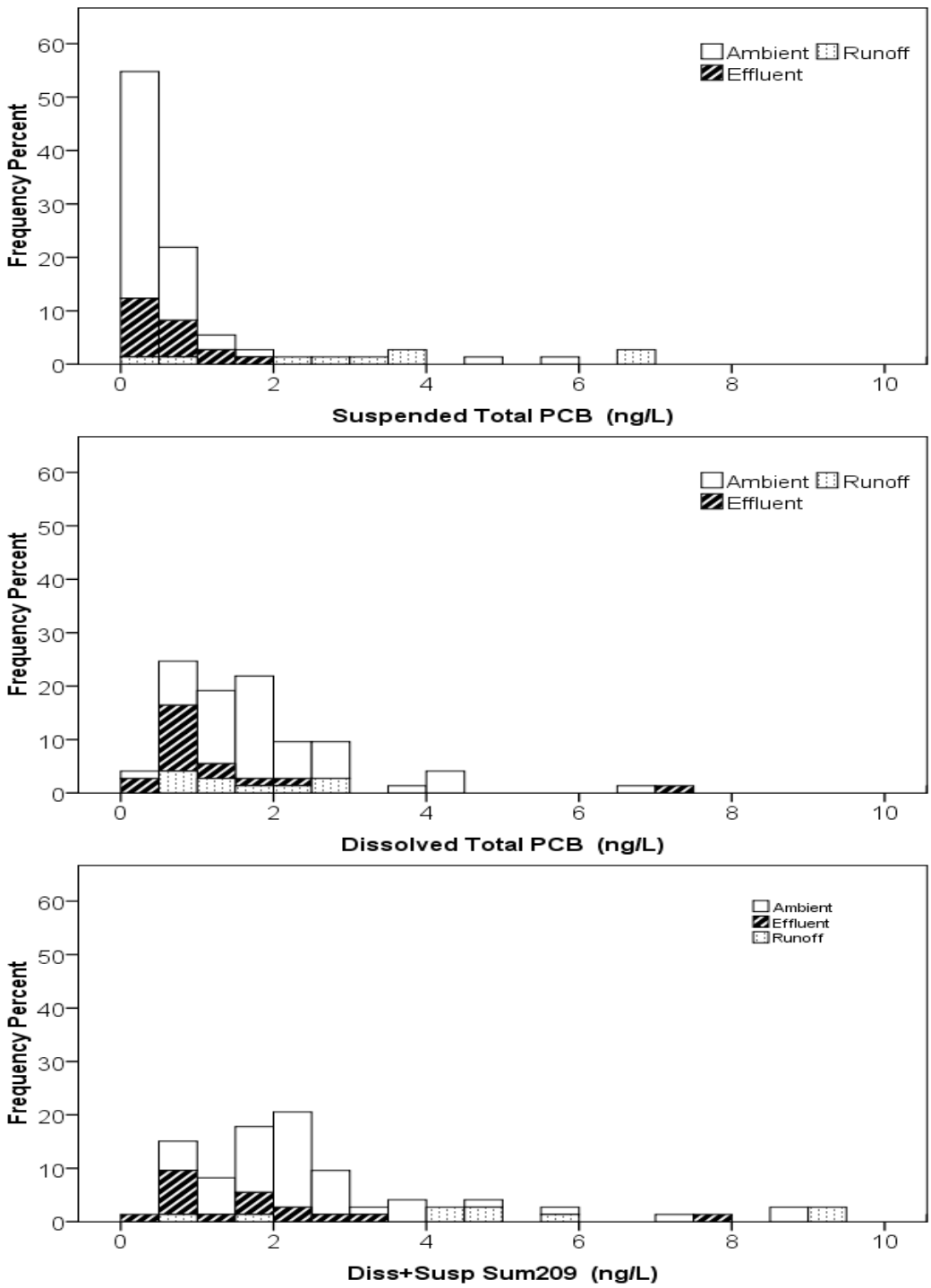
up six of the top ten by total PCB concentrations (ng/L), but only one of the top ten in suspended ng/g dry weight basis. This change in going from one kind of concentration base to another illustrates the importance of understanding what unit basis is being used. The statistics on TSS (given in Table 3.2 along with DOC statistics) show that runoff exhibits by far the highest load of suspended solids undoubtedly impacting what concentrations are seen for PCB in suspended and in total water.

**Table 3.2 Summary statistics for DOC and TSS by sample collection type.**

| | Count | Mean | Median | Minimum | Maximum | Standard Deviation |
|---|---|---|---|---|---|---|
| | | | | | | |
| DOC (mg/L) | 48 | 6.3 | 6.3 | 2.3 | 15.5 | 2.3 |
| TSS (mg/L) | | 31.8 | 30 | 2 | 93 | 20.6 |
| | | | | | | |
| DOC (mg/L) | 16 | 15.2 | 10.4 | 2.5 | 48.5 | 12.0 |
| TSS (mg/L) | | 27.9 | 17 | 2 | 137 | 34.6 |
| | | | | | | |
| DOC (mg/L) | 9 | 7.6 | 7.3 | 5.6 | 11.5 | 1.7 |
| TSS (mg/L) | | 115 | 99 | 63 | 221 | 57 |

In the dissolved phase, ambient concentrations are higher by volumetric and DOC basis followed by runoff, and effluent. Effluent concentrations were surprisingly low in nearly all instances. The highest overall concentration was at Intercontinental Terminals Co. (ITC), which had a total water concentration of 7.9 ng/L with 91% of that concentration in the dissolved phase. That total concentration puts it in the 93$^{rd}$ percentile of all of the ambient total water concentrations. Flow was not measured at the outfalls for any of the effluent sampling events, and so it is possible that the load may be also be low.

Figure 3.1 shows the statistical spread of the suspended, dissolved, and total water column concentrations on a volumetric basis. All samples showed right skewed distribution which is common in environmental datasets, and it is even more right-skewed than what is shown because two outlier locations have been removed, both in Patrick Bayou. It is to be noted that the suspended phase has a higher frequency of very low sample concentrations (< 1 ng/L) compared with the dissolved and the total water histograms. These two histograms (suspended and total water) still show a noticeable greater frequency on the left though not as much as the dissolved.




*In each histogram, two outlier samples are not shown. The outliers are the same for suspended, dissolved, and combined. They are 17149, Patrick Bayou at OxyVinyls, and 16877, Patrick Bayou at immediately downstream of the railroad bridge at Shell. Valued pairs (17149, 16877) in ng/L for suspended, dissolved, and combined are (99,54), (61, 132), and (160, 187). These two extremes have very different distribution coefficients (Kd=Susp/Diss) of 1.6 and 0.4 despite being in the same bayou.

**Figure 3.1 PCB histograms for ambient, effluent and runoff water samples**

## 3.2 Water Column Relationships

Before delving any further into the PCB data itself, it is valuable to consider the water column parameters of DOC, TOC, and TSS. The relationships between these parameters are shown in Figure 3.2. TOC and DOC are well correlated as shown by the plot and in Table 3.3. The linear relationship between TOC and DOC ($p < 0.05$) is so strong that one would nearly be able to reasonably predict one from the other without the need for two measurements.

DOC (and by extension TOC) is fairly uncorrelated with TSS. It is certainly possible that the two could be linked by way of at least two potential mechanisms. One is that when there is a higher solids concentration, there will inevitably be small parts of the solids that break off during turbulent action, degradation, and deflocculating processes that cross the threshold for the operationally defined "dissolved" (< 1um). The other possibility is that the same sources of TSS >1 um (e.g. land surface erosion, sediment bed resuspension, outfalls) carry with them a certain amount of dissolved organic matter (DOM). Since there is no practical correlation between TSS and DOC, it would seem that neither mechanism is very active in the HSC as it has been sampled thus far. This result further highlights the low OC volumetric content of suspended particles compared with DOM.[2] The plot shows that TSS concentrations rise and DOC (and TOC) remain mostly unchanging. Thus, whatever the particular source of TSS to the water column, it likely has low OC yield. This OC yield is critical to understanding and quantifying PCB sorption in the HSC, and since it has not really been well characterized on suspended particles, it is difficult to

[2] Note that DOM is the transport analog of TSS in consideration of how OC is in general moved throughout the water column. DOM is the small-size (< 1 um) carrier of OC while TSS is the large size (> 1 um) carrier of OC. Since DOC is so often such a large portion of TOC, it is inferred that the DOM provides a larger in-stream load of OC over TSS.

ascertain how vital of a role it plays in explaining the variations observed in the suspended and total water phases.

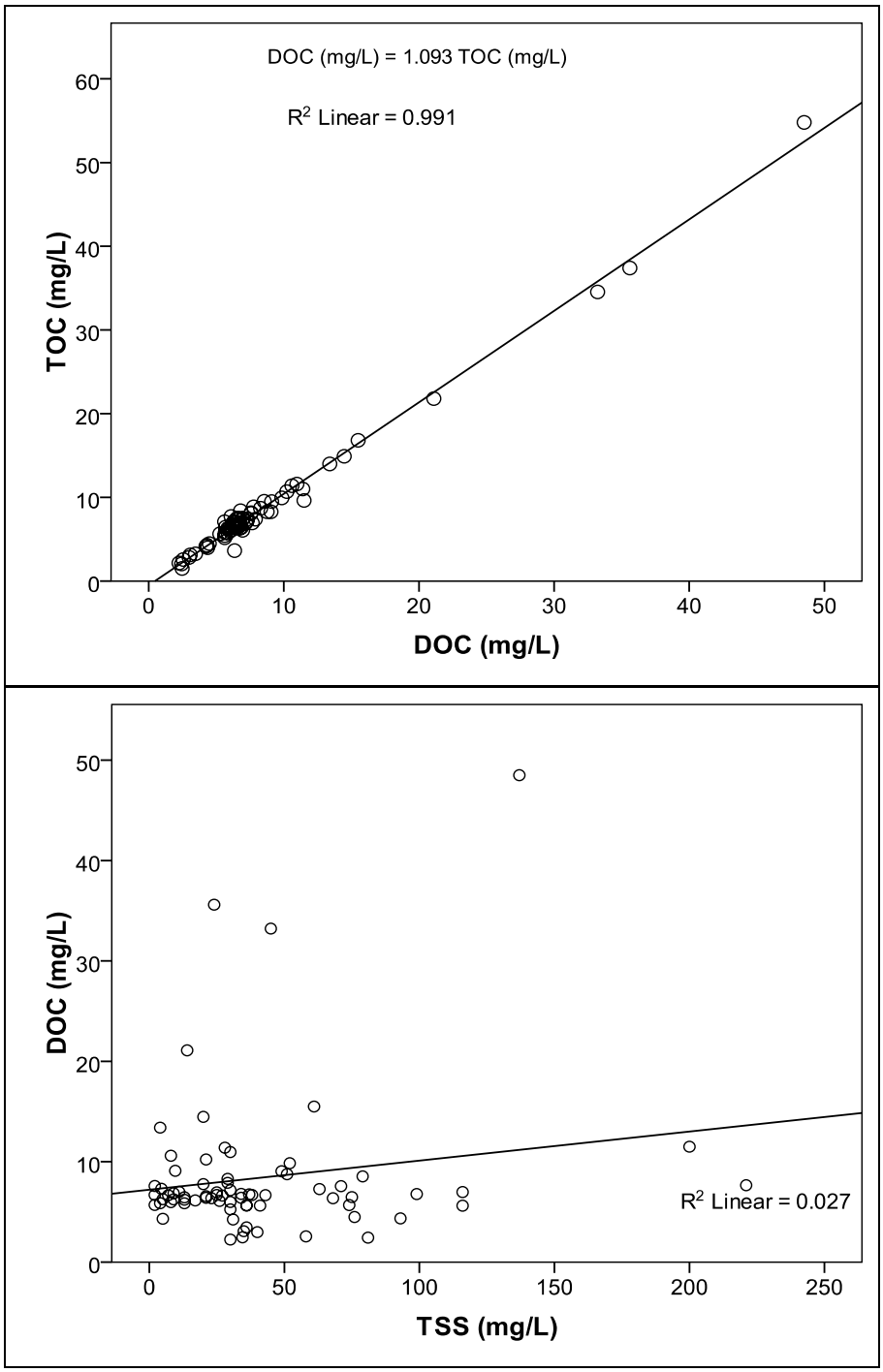



**Figure 3.2 Bivariate correlative comparisons between DOC, TOC, and TSS from summer 2009 water samples.**

Table 3.3 shows the correlation between water column OC and TSS to PCB concentrations. Figures 3.3 and 3.4 show the correlations between Dissolved/Suspended PCB concentrations vs. TSS and Dissolved/Suspended PCB concentrations vs. DOC.

Table 3.3a compares PCB in different phases to TOC, DOC, and TSS for all water samples regardless of sample type (ambient, effluent, runoff). The strong TOC-DOC correlation is confirmed again, and there is the standard correlation between suspended and dissolved phase PCB concentrations. The correlation is not perfect because (1) it cannot be assumed the suspended-dissolved partitioning, a thermodynamic process, always achieves and maintains equilibrium and (2) all PCB congeners have even theoretically different equilibrium partition coefficients. If equilibrium existed, a 1:1 correlation should only exist if the congener fingerprints match between dissolved and suspended phase, which never occurs.

Table 3.3b shows the linear correlations between suspended and dissolved phases with OC are significant (only the ambient water sample results are included). The presence of the effluent and runoff seems to mask the subtle correlation between OC and PCB in the water column.

**Table 3.3a Pearson correlations between PCB and water column ancillary parameters for all unique combinations of station, sample type, and date (n=73)**

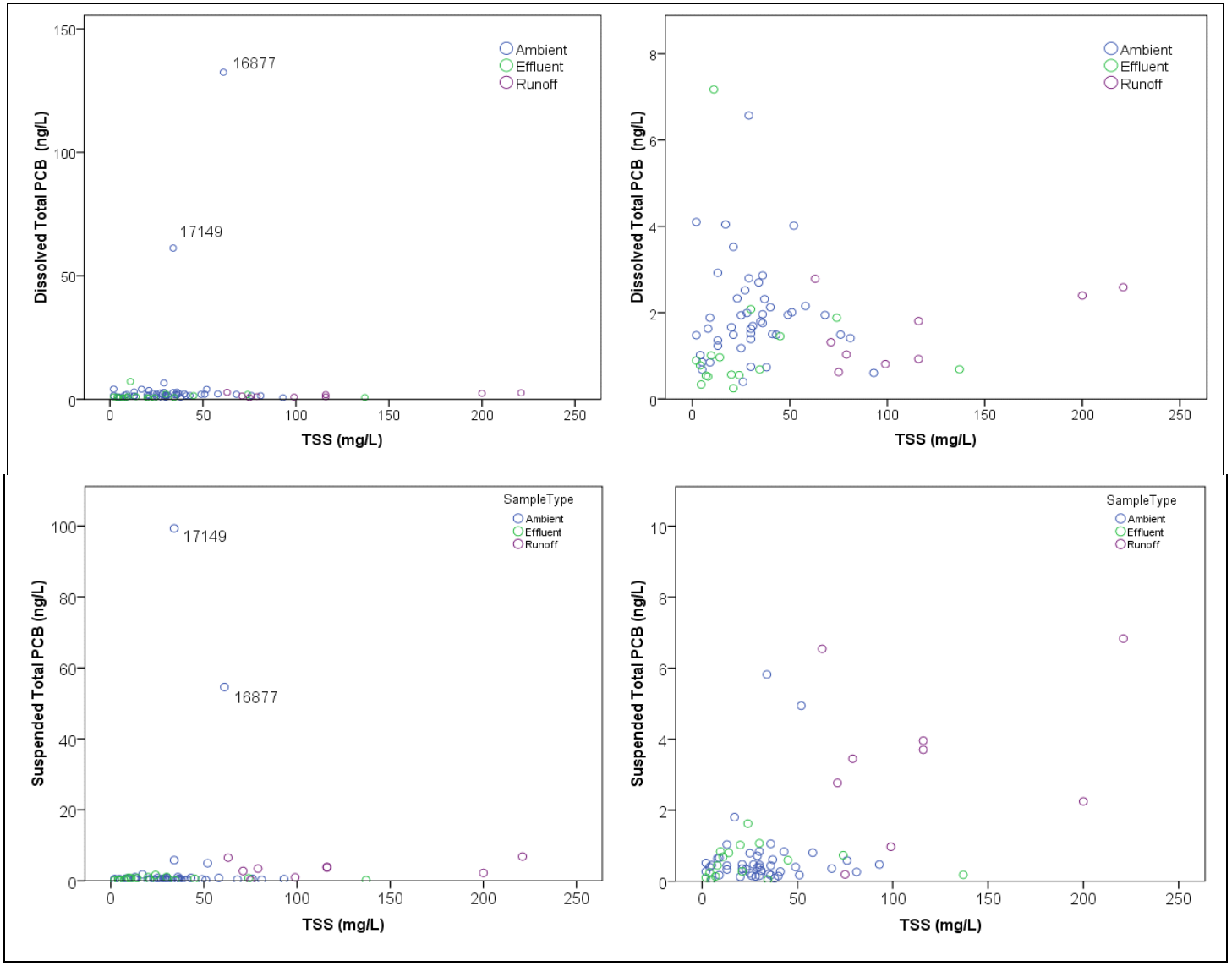
| | DOC (mg/L) | TOC (mg/L) | TSS (mg/L) | Suspended PCB (ng/L) | Dissolved PCB (ng/L) |
|---|---|---|---|---|---|
| DOC (mg/L) | 1 | | | | |
| TOC (mg/L) | **.995**** | 1 | | | |
| TSS (mg/L) | .165 | .152 | 1 | | |
| Suspended Total PCB (ng/L) | .034 | .056 | .067 | 1 | |
| Dissolved Total PCB (ng/L) | .085 | .098 | .044 | **.789**** | 1 |

* Bolded and double asterisked correlations are significant (two tailed) at the p=0.01 level and the p=0.05 level for a single asterisk

**Table 3.3b Pearson correlations between PCB and water column ancillary parameters collected for ambient samples only (n=48).**

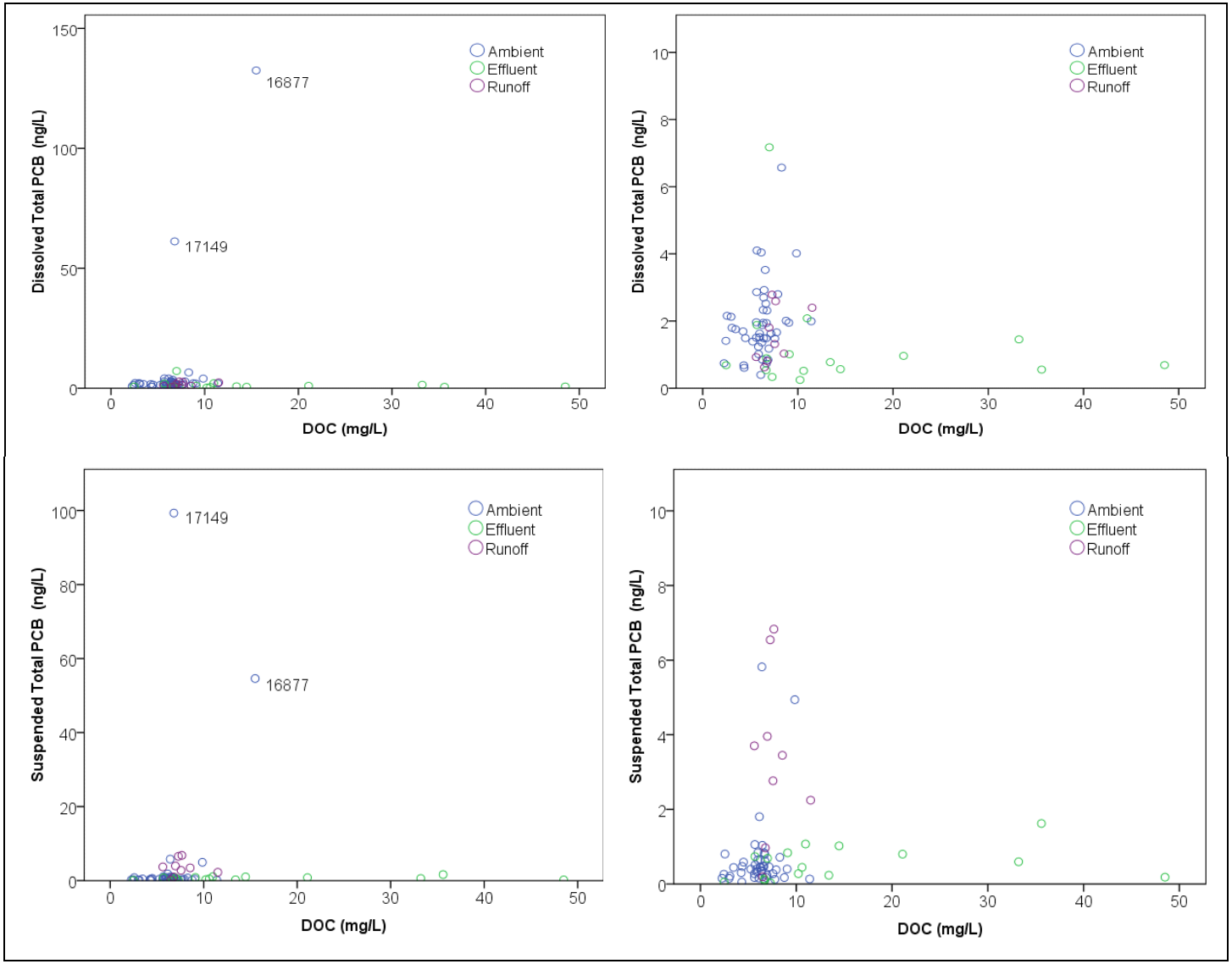
| | DOC (mg/L) | TOC (mg/L) | TSS (mg/L) | Suspended Total PCB (ng/L) | Dissolved Total PCB (ng/L) |
|---|---|---|---|---|---|
| DOC (mg/L) | 1 | | | | |
| TOC (mg/L) | **.961**** | 1 | | | |
| TSS (mg/L) | -.045 | -.126 | 1 | | |
| Suspended Total PCB (ng/L) | **.327*** | **.415**** | .122 | 1 | |
| Dissolved Total PCB (ng/L) | **.573**** | **.628**** | .196 | **.790**** | 1 |

* Bolded and double asterisked correlations are significant (two tailed) at the p=0.01 level and the p=0.05 level for a single asterisk




*Panels on right and left are the same data with different extent vertical axes

**Figure 3.3 Correlation of TSS to PCB water concentrations**




*Panels on right and left are the same data with different extent vertical axes. Note that no graphical correlation was plotted with TOC because TOC and DOC have near perfect correlation (Pearson R=0.995, Spearman ρ=0.915, both at p<0.01)

**Figure 4.4 Correlation of DOC to PCB water concentrations**

### 3.3 Homolog Profiling

The water column can be represented through total PCB concentrations in various media and in different bases, but the homolog profiles and ultimately the congener fingerprints are useful in understanding the difference in the total levels of the chlorination groups and their relative fractions according to the different sample types (ambient, runoff, and effluent).

Figure 3.5 presents the homolog levels as suspended, dissolved, and total PCB concentrations in the form of box plots. This format allows comparisons of the general shape of the profiles to some degree and their magnitudes. In the dissolved phase, it is fairly clear that the general shape of the profiles as a whole for each sample type is consistent. As expected, the profile was distributed around the lower chlorinated congeners with the peak in homolog 2 followed by homolog 3. There are differences in the relative abundance of these homologs amongst the sample types because it looks as if homologs 3 and 4 are nearly equal in ambient samples, but homolog 3 is definitely more abundant than homolog 4 for runoff. The box plots also show a greater overall concentration in ambient samples and a greater spread. The suspended phase shows a much greater concentration of PCB in runoff over effluent and ambient samples though changing to mass basis would diminish some of this apparent increase. The homolog profile for the suspended phase showed a distribution around hexa-chlorinated congeners for both runoff and effluent samples. In the case of runoff, the combined profile (suspended+dissolved) resembles more of the general shape of the suspended profile while the ambient profile represents more of the dissolved, which is understandable considering their significant contribution to the total PCB concentrations.

The calculation of partition coefficient ($K_d$) for ambient and runoff (mean ± 95% confidence) showed higher $K_d$ for runoff samples (2.1 ± 0.90) than with ambient samples (0.35 ±

0.11). However, when calculations were made on suspended PCB per mass basis, $K_d$ was higher for ambient samples (160 ± 43 L/Kg) than with runoff samples (88 ± 60 L/Kg). In a real sense, there will be relatively more PCB on particles in runoff over ambient, but the difference in which sample type is higher by changing units indicates that the ambient suspended phase is more efficient at sorbing PCB than runoff is. Here, OC differences may explain this, but the data do not exist to prove it as both DOC and TOC are per volume measurements as they are currently performed.

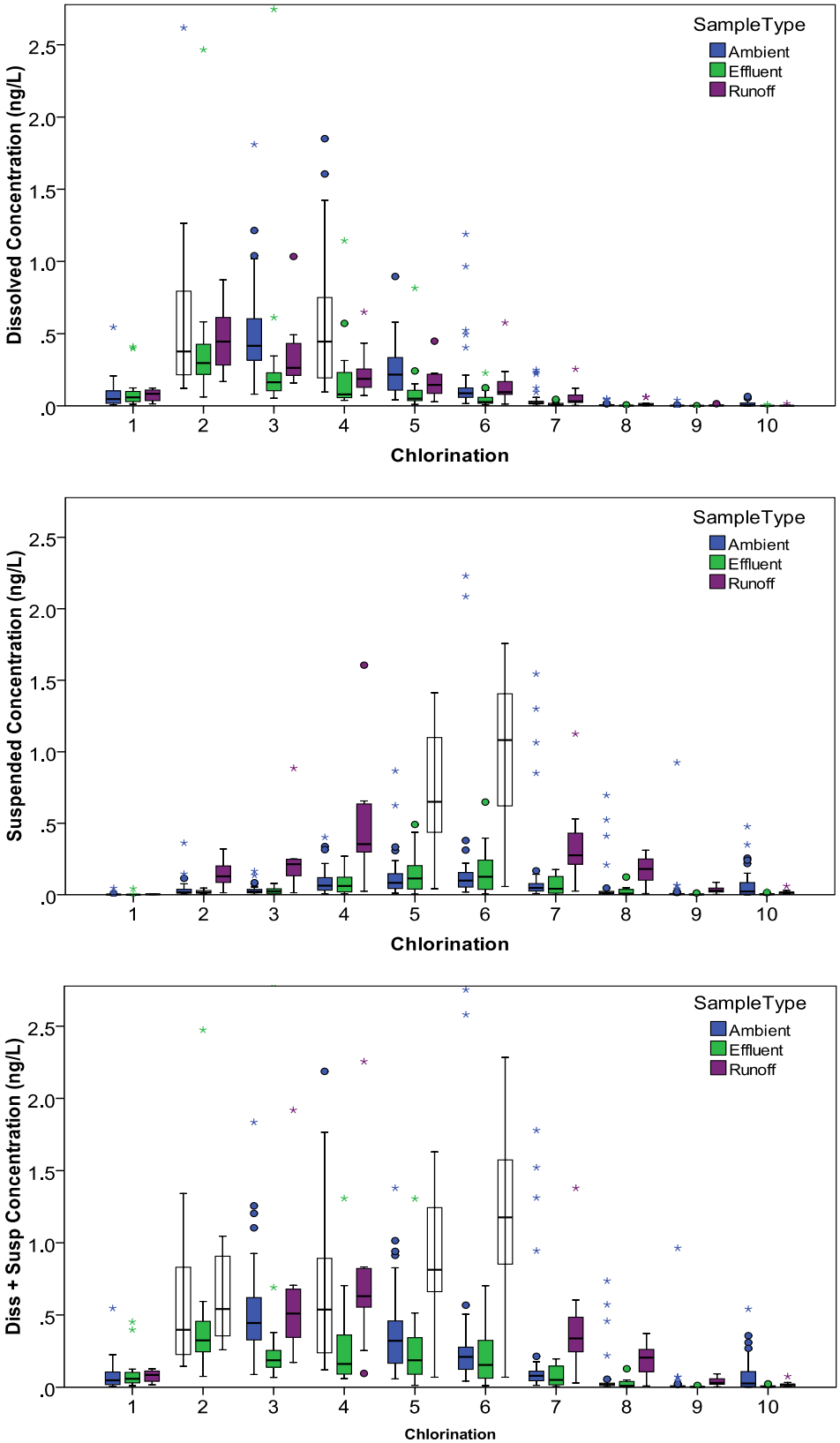



**Figure 3.5 PCB homolog profiles for ambient, effluent, and runoff samples**

Figure 3.6 shows the PCB relative chlorination fraction for ambient, effluent, and runoff samples in the dissolved and suspended phases. The difference in signatures between runoff, effluent, and ambient sampled PCBs indicate that the sources of PCB are different for each of them. This would almost certainly seem to be a good explanation in the case of effluent because it is known from exactly what industry and facility the water comes. The other explanation for the distinct profiles could be related to transport. Numerous fate and transport processes can occur during time of transit for any mass of PCB. Different types of suspended sediments may partition differently, or their travel times and paths may be different due to size differences of the particles. In the dissolved phase, it is possible that one sample type might be more comprised of what is called "truly dissolved" PCB, which is part of water solution or "apparently dissolved" PCB, that which is sorbed to DOM of one kind or another (Butcher et al., 1998).

It may not be that simple to discern from a few homolog profile plots exactly what is occurring in the dissolved and suspended phases, but some distinctions could be made[3]. For the most part, all of the profiles are similar. The dissolved phase is similar in most sample types. The ambient profile has high relative fraction in homolog 4 that is not seen in effluent and runoff while effluent and runoff have a higher peak in homolog 2 that is not present in the ambient. This is interesting because it indicates that the dissolved phase PCB in runoff and effluent is more similar in character than in the ambient phase. This also could indicate that whatever loads come from runoff and effluent as dissolved have only a relatively small effect on the HSC. Another explanation for these differences in the dissolved could be that the signature in the ambient is a mixture of multiple signatures of which runoff and effluent have a less significant contribution.

[3] Though much has been made about the choice of units for suspended and dissolved phases, it should be mentioned that for relative fraction homolog or congener profiles that the unit change does not make a difference in these cases.

If the right proportion of the effluent and runoff signals could be subtracted, the underlying "no rainfall-effluent" signal might become apparent in ambient samples.

The suspended phase shows an even greater difference than was observed with the dissolved phase for all three sample types: ambient, effluent, and runoff. Runoff is distinct because it has significant "heavy" chlorine contribution from homologs 8-10 while the other two have only modest contributions except for homolog 10 in ambient. Effluent has the "lightest" chlorine profile as it is shifted more left than the other two with maximum relative fractions in homologs 4-6. The ambient profile is centered more in the middle with a strong fractional showing in homolog 10 but with a gap from there to homolog 7 at which point it more generally resembles the effluent profile. It has been previously noted specifically that homolog 10 made solely of PCB 209 is an odd congener to find in high abundance in surface waters (Howell et al., 2008; Rowe et al., 2007). It would appear that there is at least one source of this congener outside of the legacy sediments since the runoff profile has the highest relative fraction of that congener.

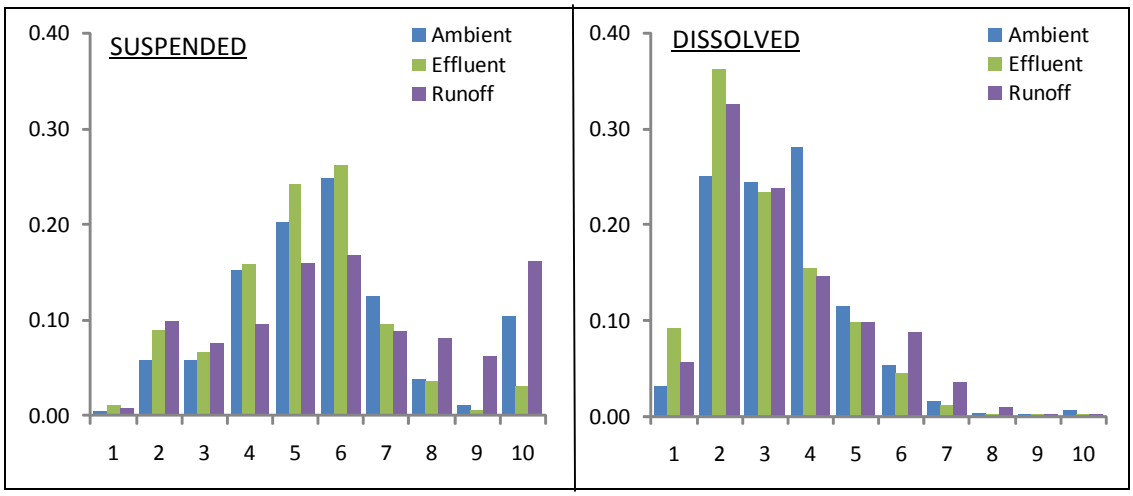



**Figure 3.6 Average PCB relative fraction (vertical) chlorination (horizontal) homolog profiles for ambient, effluent and runoff samples in the dissolved and suspended phases**

There are two main conclusions to be made from the homolog based analyses of ambient, effluent, and runoff water samples. The first is the greater explanation of why runoff is more contaminated in suspended over the dissolved while effluent and ambient samples show the reverse trend. Runoff is dominated by the suspended phase primarily due to high levels of the mid to high range chlorinated species (4-8 Cl). This result is different from ambient and effluent samples, which exhibit primarily dissolved-based contamination that resides most prominently in the lighter chlorinated species of 2-4 Cl. The ambient-effluent dissolved contamination and runoff suspended contamination intersect at the 4-Cl species. It is interesting that at a volume-based concentration level the ambient 4-Cl dissolved and runoff 4-Cl suspended are statistically similar (see Figure 3.5). The other major conclusion is that in a relative congener level (more of a contaminant signature type metric), the effluent and ambient exhibit similar signatures while runoff is again distinct. Runoff contamination is more suspended based, and the homolog shows that it has significant levels of very highly chlorinated species. These species have been seen in previous samplings in sediments and water and were thought to be more of a legacy type source concentrated mostly in the sediment. Areas such as the HSC often exhibit legacy sources in the sediments but not in the watershed. This runoff data reveals that the watershed itself may be sourcing these higher chlorinated species. Some of the HSC watersheds may also have legacy PCB sources, or else the higher chlorinated species represent a more unique contemporary source.

## 3.4 PCB Partitioning

Figure 3.7 examines the distribution coefficient ($K_d$), (unitless and in L/Kg) in aggregate, while Figure 3.8 analyzes the effect of chlorination on $K_d$ for the different sample types. The

aggregate figure confirms what was mentioned earlier that in a unitless fashion, the greatest instance of suspended phase dominated PCB contamination is in runoff samples, but when the amount of sediment per volume is taken into account, ambient and runoff $K_d$'s show no statistical difference ($p > 0.05$, Mann-Whitney U). Figure 3.7 also shows on an L/Kg basis that as a whole population the greatest values of mass basis partitioning actually occur in the effluent rather than either ambient or runoff. The ambient samples have extreme cases of high partitioning that extend beyond the ultimate upper boundary of the effluent values, but the second, third, and fourth quartiles are all higher in effluent over ambient.

Figure 3.8 is interesting because it seems to show three separate trends for unitless partitioning in the three sample types. All three sample types increase in their partitioning levels with increasing chlorination, but the amount of increase is not the same. Ambient seems to be the most predictable and consistent (perhaps due to its larger sample size) and could be fit with an exponential trend. Effluent also seems to follow a similar exponential trend (though with a higher slope) except for what could be called an aberration in the trend where the 9-chlorination $K_d$ median value is higher than the value for deca-chlorination $K_d$. The only reason that this might seem odd is that it is known that PCB-209 has a higher log $K_{ow}$ value than do PCB-206,-207, and-208, and yet it is certain that log $K_{ow}$ alone does not determine partitioning tendencies because it has been observed before in this HSC dataset that partitioning, as governed and predicted by thermodynamics, does not always occur in field-observed measurements. A similar trend is seen in the runoff partitioning $K_d$. With the runoff data, there is an early maximum at homolog 6 and at both homologs 8 and 9 before decreasing at homolog 10. These trends may be understood in consideration of the fact that there is likely more perturbation, mixing, and even chemical reaction (effluent) than in ambient waters. These influences might prevent any stable

equilibrium from being observed. So a simple linear partitioning models normally used to describe this behavior may not always be adequate for effluent and runoff conditions.

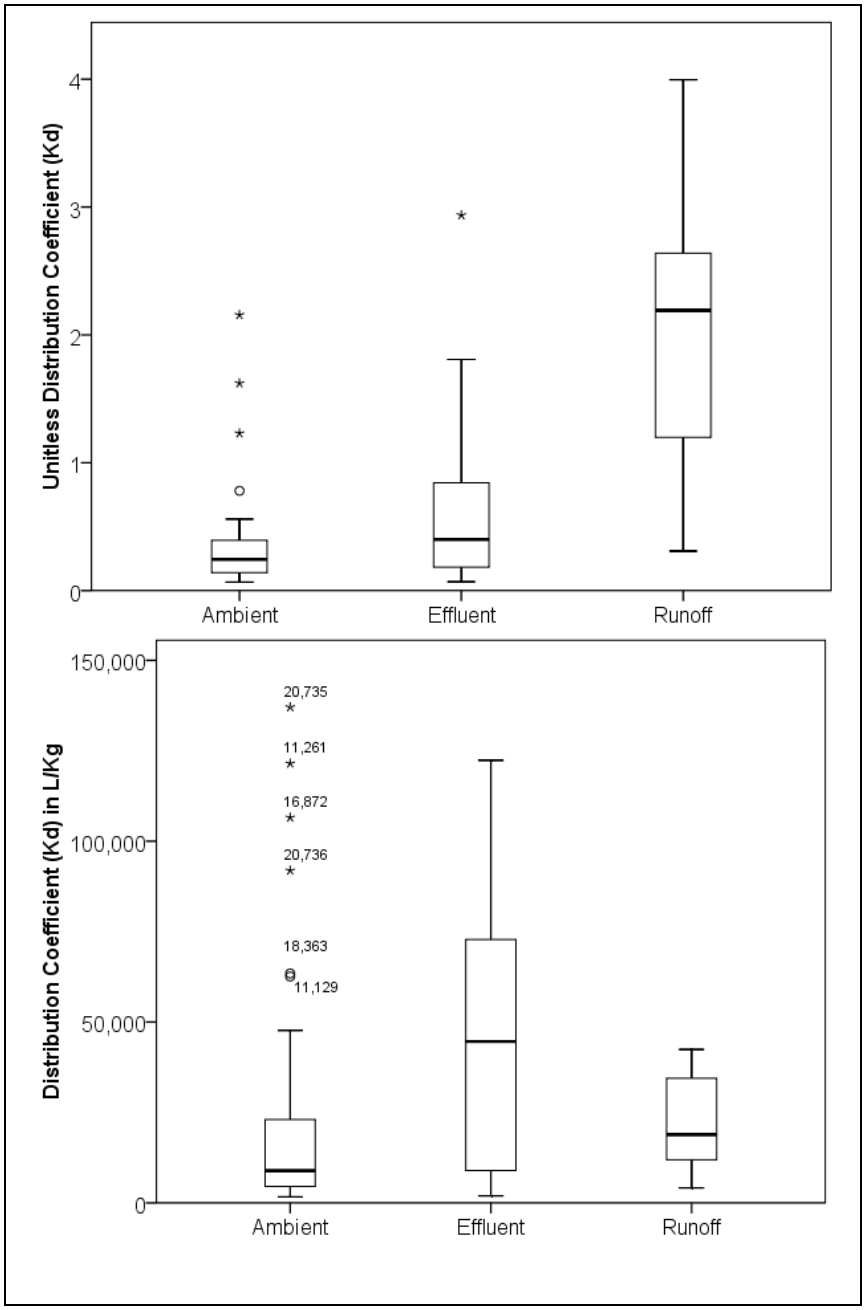
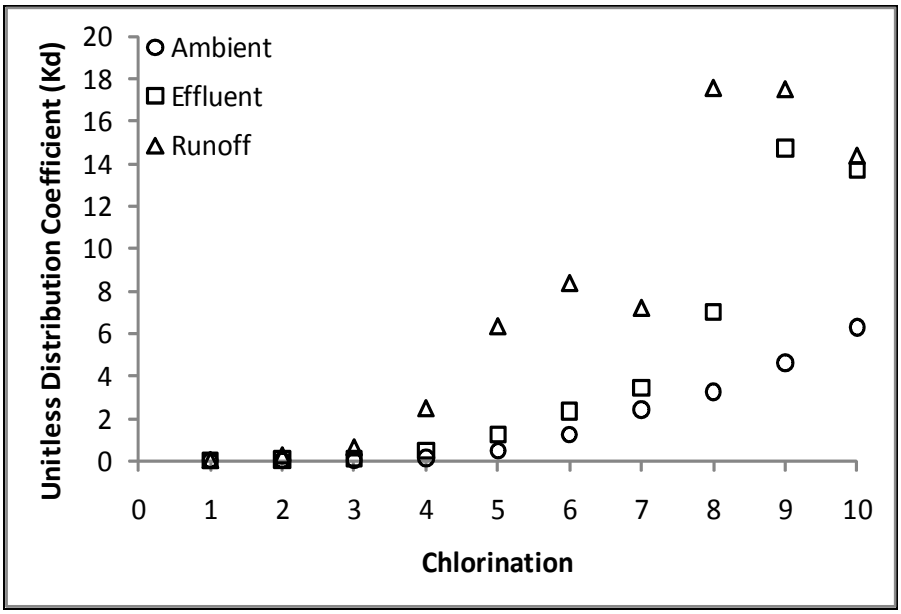



**Figure 3.7 Statistical spread of distribution coefficient ($K_d$) for ambient, effluent and runoff water samples**




*Each data point represents the median value of the sample subset

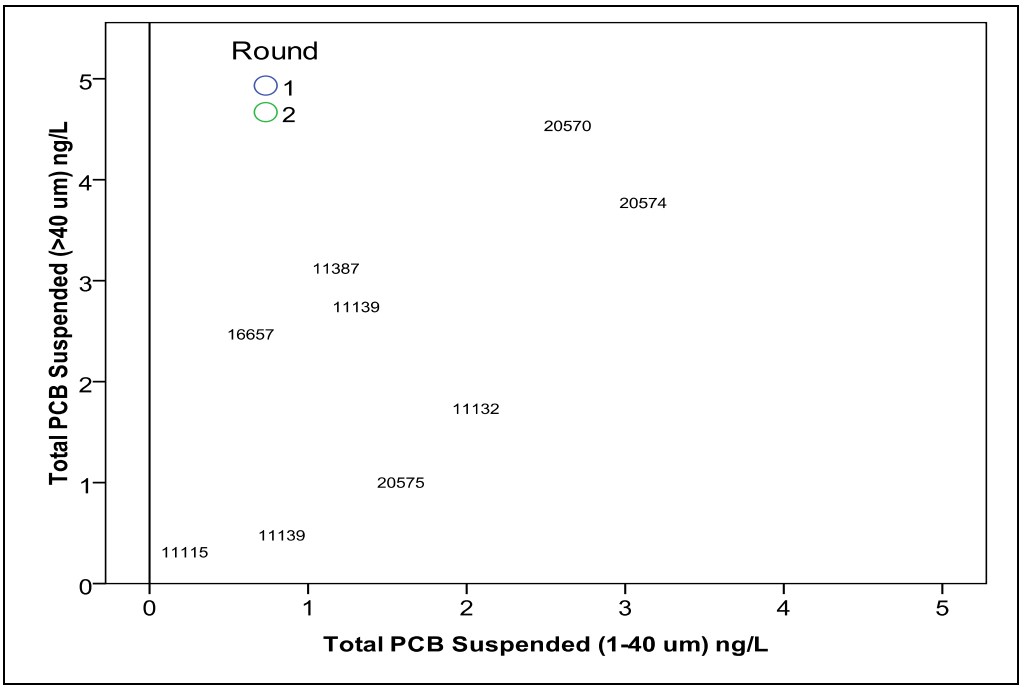
**Figure 3.8 Partition coefficients for different chlorination trends for ambient, effluent and runoff water samples**

### 3.5 Differences in Runoff Suspended PCB Concentration Based on Size

High volume runoff sampling requires the use of two filters in series of different sizes due to the problem of suspended solid clogging. While this creates more samples for analysis, it also provides more data about differences in PCB levels and character according to particle size class. Two particle size classes of PCBs in runoff are examined in Figure 3.9. The 45˚ line provides a reference point for judging the relative contamination levels between the >40 μm size class and the 1-40 μm size class. If the two were equal, the points would plot along the 45˚, but they do not. Instead what is observed is that for most of the runoff samples, the >40 μm particles contained a higher volumetric concentration of PCB in total than the smaller size class (1-40 μm). The only sampling event that exhibited approximately equal concentration amount was 11115 at Cedar Bayou. This rain event was slow and had a low intensity, which may or may not

have had an effect. The >40 μm dominated stations are all located on bayous (White Oak, Buffalo west of downtown, Brays, and Hunting) while the bayou locations of 1-40 μm dominated sampling were Brays (second event), Sims, and Carpenters. The only limitation to be noted is that the responses for the rainfall events are probably not completely comparable because they likely did not catch the same part of the hydrograph nor have they been adjusted in any way for the intensity of the storm or the total rainfall. Furthermore, the problem of sediment load still remains because there were no TSS measurements taken for each of the filters sizes used. The comparison between the two filter sizes is then not entirely based on a common basis. This plot does show, however (1) that different conditions can determine what sizes of sediments are present at higher concentration and load of PCBs and (2) that larger size particles can at least be significant carriers for PCBs during rain events[4].

[4] Previous particle size measurements conducted at University of Houston of ambient HSC waters revealed that few particles over a size of 10 um even existed in the water column during a normal dry weather 2-3 hour high volume water sampling event. The 40 um filter size is not considered to be representative of a relatively large particle size by any means, but it does present the potential that some particles beyond the smallest still can carry PCBs at appreciable levels.

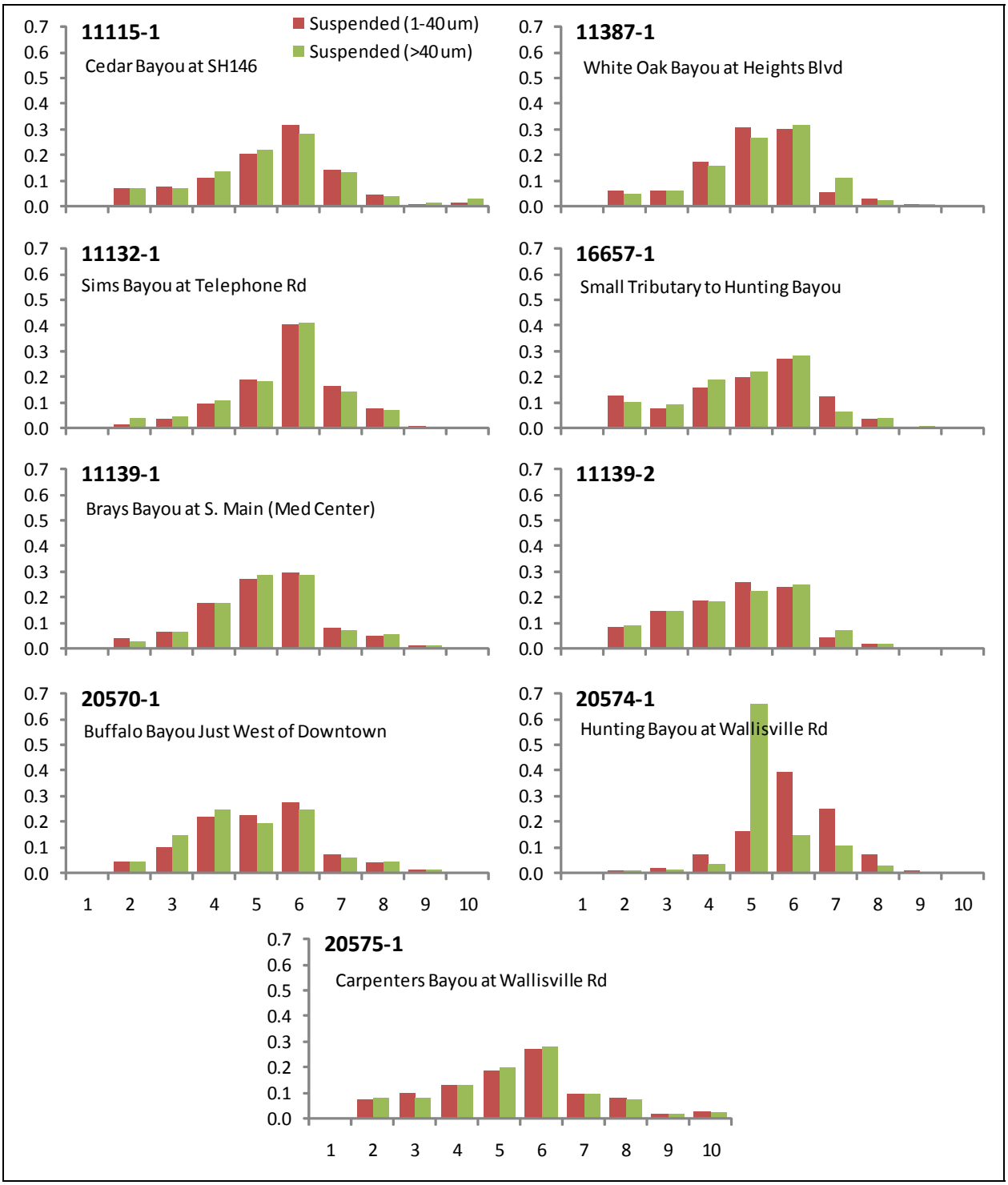



*Nominally the two filters should have collected suspended sediments in the range of 1-40 um and >40 um. Each was collected on a separate glass fiber filter (GFF) and analyzed separately for PCB.

**Figure 3.9 Comparison of suspended runoff PCB concentrations based on filter size**

Figure 3.10 presents individual homolog profiles for every rain event sampled during 2009 for both size classes of suspended sediments. Though Figure 3.9 reveals that the overall PCB concentration may be different amongst the differing size classes, such divisions by size class are not much seen in the homolog profiles except at one site, Hunting Bayou. Assuming that the result is not erroneous, it is an odd profile found in the >40 um size range. The profile is characterized by an extremely high relative fraction of penta-chlorinated congeners. Closer examination reveals that the spike is caused by a single coelution group concentration of 2.1 ng/L, which seems unlikely for one penta-chlorinated group though it is not impossible. As far as between sites, the profiles do not seem to change that much from site to site. Most of these sites are at least highly urbanized at the small sub-watershed level though areas of Carpenters, Sims, and Cedar Bayou are less developed. Finally, it is seen that the one site where two rain events

were collected, Brays Bayou at S. Main, has fairly consistent profiles between events. If these two samplings do differ in event condition and still produce similar profiles, then this lends credibility to the idea of consistent results (at least in PCB signature) regardless of runoff event conditions.




*All profiles are given as relative fraction to the total for same chlorination level species.

**Figure 3.10 Comparison of homolog profile in runoff samples**

### 3.6 PCBs in Sediment

A limited amount of analysis was performed on sediment data from 2009. It is not known to what extent Hurricane Ike, which occurred between the 2008 and 2009 samplings, had on the state of contaminated sediment, but the analysis provided here, used only on 2009 data, could be used with 2008 data and earlier to aid in that understanding.

Figure 3.11 is an attempt to locate "characteristic fingerprint" PCB sediment profiles mainly by using rankings of total PCB concentrations. Concentrations of sediment PCB (in ng/g dry and ng/g OC) were combined to select the top five highest concentration samples from 2009. There are large distinctions between each profile. Those distinctions combined with the large concentration at these sites (next largest concentration is half of the lowest value) suggest that these locations represent current or historically sourced PCBs that are perhaps more pure (single source impacted) than other locations. They are not all particularly spaced apart geographically, but they all have homolog profiles that are fairly unique from each other. Furthermore, the presence of these profiles at these locations does not necessarily indicate that these profiles are native to the locations specifically. Environmental flows may have moved them far from their original entry point into the water, and these locations may even be a collection point for lesser contaminated sediments rather than a launching point.

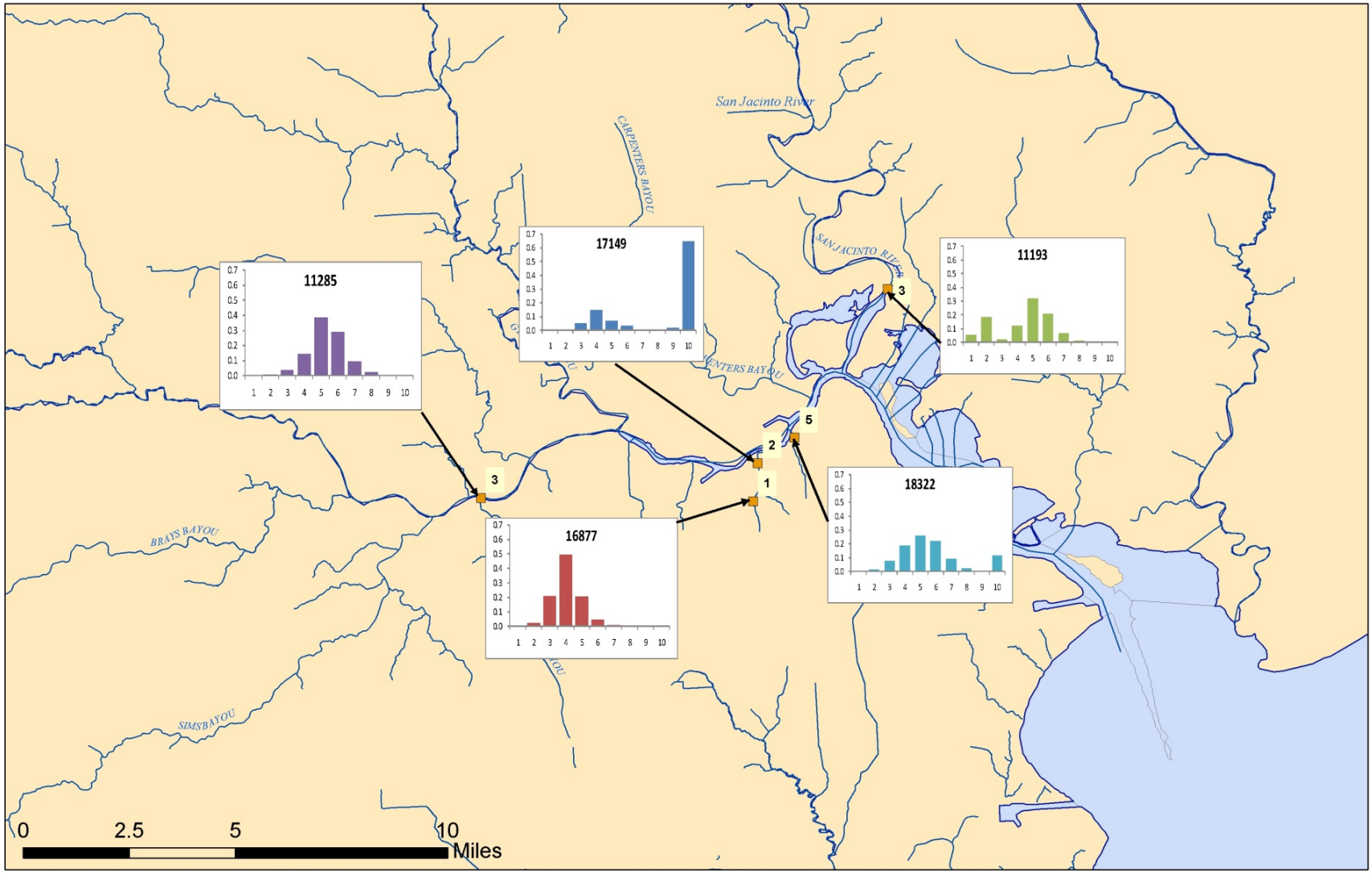
Site 11285 is at the mouth of Vince Bayou, which was not necessarily always considered to be a high sediment PCB location as indicated by data prior to 2009. It has a one-peak profile centered at homolog 5, and 16877 (Patrick Bayou at Shell) has a similar profile in some respects except that it is centered on the lighter homolog 4 and has a higher peak. Curiously, site 17149 (PB at Oxy), only about a mile downstream from 16877, has a sediment profile that is almost completely dominated only by PCB-209. This station was not sampled for sediment in summer

2008, but one nearby was sampled twice in 2002-2003. The result in 2002-2003 was 15 times lower by ng/g dry than what was sampled in summer 2009. An environmental sample that is 65% pure PCB-209 seems an odd find. Station 18322 is just inside the wide mouthed area for Tucker Bayou, and it appears as almost a mixture of 11285 and 17149. Station 11193 is right at the San Jacinto River Waste Pits Superfund PCDD/F site, and it is odd because it has two local peaks, one at chlorination 2 and one at chlorination 5.

An attempt to try and link on a by congener basis all 2009 sediment results and the five "characteristic fingerprint" sediment locations is summarized in Figure 3.12. The overall root mean squared error (RMSE) was calculated for all congeners and compared between the sample and five characteristic fingerprint locations. A reasonable threshold was used to determine matches that were mostly likely, those that were probable and those with no realistic match at all. Many of the matches in the figure have secondary or tertiary characteristic fingerprint locations, which did not match as strongly neither could they be ruled out completely. Using the primary match, one can begin to gauge the influence of a characteristic fingerprint location on the sediment throughout the HSC. The sites related to the Vince Bayou confluence make intuitive sense as they are nearby. There are some cases on Hunting and Sims Bayou where likely matches are separated by inconclusive results, and the far upstream sediment sample (near White Oak-Buffalo confluence) seems to match with no characteristic fingerprint sample used. This is a reasonable conclusion since this area is far from more industrial type PCB uses and would likely exhibit PCB concentration primarily from upstream sources and long-range transport. The upstream Patrick Bayou characteristic fingerprint location had two matches in Greens Bayou. As it is not likely that sediment would travel in that fashion, there may be another characteristic fingerprint of lower intensity (concentration) in Greens Bayou. Possibly because the PCB-209

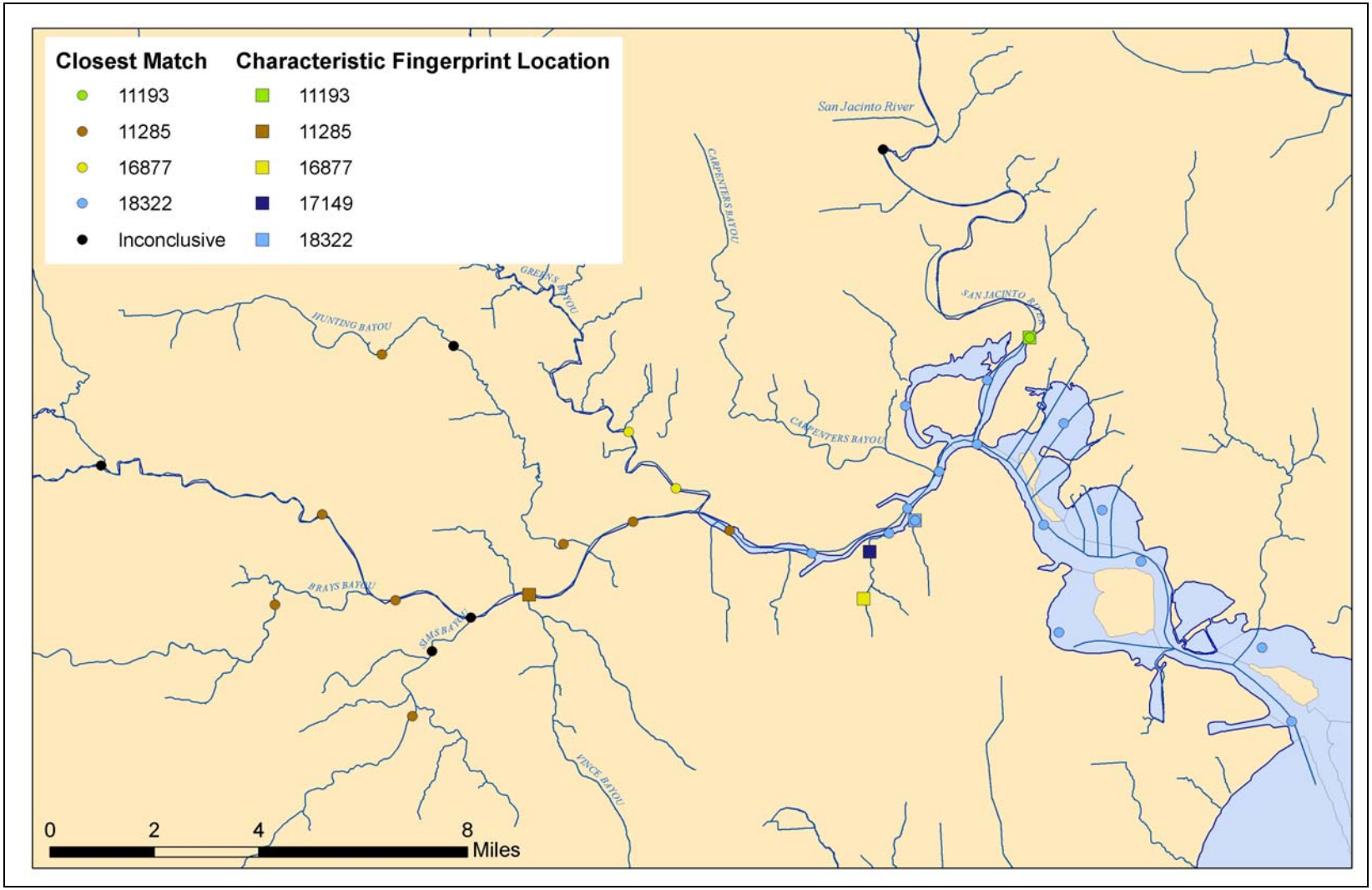
attenuates rapidly[5], no match was found for the Lower Patrick Bayou site, and the Tuckers Bayou site seems to match in signature with nearly every site downstream. Such matching would further support the hypothesis that the sediment in Tucker Bayou is of mixed fingerprint type since it is unlikely that sediment from such a low flow tributary could affect the entire ship channel downstream. Finally, the SJR characteristic location appears localized to that one spot as the only sediment sample that was determined to be a primary match was the field duplicate sediment sample collected at that location. This location could be a place of collection for SJR sediments, a sink rather than source. The widening of the river as it joins with the HSC may lower velocity allowing deposition of contaminated sediments here. No sediment model, however, has as yet been generated to prove or disprove this trend in sediment transport.

[5] It is not clear what would be the cause of such attenuation. It is only here noted that attenuation of PCB-209 seems to exist in the data that has been collected. One possible theory for large attenuation of PCB-209 relates to its high $K_{ow}$, the highest of all PCBs. If $K_{ow}$ is high, less will be able to volatilize and less will be able to desorb from the bed sediments compared with other congeners. Other PCB congeners may be able to use these mechanisms to transport differently from PCB-209 when they exist together in bed sediments. This would result in PCB-209 being less mobile in this aquatic environment compared with lower $K_{ow}$ species. It could only move be sediment transport while other PCBs can move back and forth between media allowing greater geographic spreading to occur.




*Numbers next to each point represent the ranking of the total PCB concentration for entire summer 2009 sediment dataset.

**Figure 3.11 Homolog fingerprints for the top 5 total PCB sediment site locations of summer 2009**




*Matches were made using summed root mean squared error (closely related to Euclidean distance) for 136 PCB constituents found detected most often in the sediment sample set. Note that squares represent the high concentration "characteristic fingerprint" locations used for sample matching, and the circles with corresponding colors represent lower concentration samples that are colored according to highest probability of a match with one of the five characteristic fingerprint locations. Secondary and tertiary matches were also possible, but they are not shown for ease of viewing in the figure.

**Figure 3.12 Matching of probabilistic sediment characteristic fingerprint location to the entire 2009 sediment PCB dataset.**

# 4. REFERENCES

Butcher, J. B.; Garvey, E. A.; Bierman, V. J., Jr. Equilibrium partitioning of PCB congeners in the water column: field measurements from the Hudson River. *Chemosphere* **1998,** *36*, (15), 3149-3166.

Howell, N. L.; Suarez, M. P.; Rifai, H. S.; Koenig, L. Concentrations of polychlorinated biphenyls (PCBs) in water, sediment, and aquatic biota in the Houston Ship Channel, Texas. *Chemosphere* **2008,** *70*, (4), 593-606.

Rowe, A. A.; Totten, L. A.; Xie, M.; Fikslin, T. J.; Eisenreich, S. J. Air-Water Exchange of Polychlorinated Biphenyls in the Delaware River. *Environ. Sci. Technol.* **2007,** *41*, (4), 1152-1158.

# APPENDICES

# APPENDIX A

# DATA VERIFICATION REPORTS

**DATA VERIFICATION SUMMARY REPORT**

**for**

**TOC, TSS and DOC in**

**WATER AND SEDIMENT SAMPLES COLLECTED IN THE**

**HOUSTON SHIP CHANNEL SYSTEM**

**(Segments 0901, 1001, 1005, 1006, 1007, 2420, 2429, 2428, 2427, 2426, 2436, 2438, and 2421)**

**HOUSTON, TEXAS**

Data Verifier: Sandra de las Fuentes (Parsons - Austin, TX)

## INTRODUCTION

The following data verification summary report covers analysis of environmental water samples collected from the Houston Ship Channel System in Houston Texas over the five month period between April 17, 2009 and September 22, 2009. The samples were analyzed for Total Suspended Solids (TSS), Dissolved Organic Carbon (DOC) and Total Organic Carbon (TOC) in the following laboratory Sample Delivery Groups (SDGs):

SDGs for TSS, TOC and DOC in water:

**330792, 331356, 331909, 332240, 332695, 332948, 333612, 333662, 334298, 334729, 160845, 161913, 164313, 165205, 100109001, 167736, and 169562.**

SDGs for TSS in water only:

**334118, 335108, 335390, 335583, 336707, 336922, 338185, 338987, 340093, 340434, 341064, 341563, 343366, 344344, and 345908.**

In addition to the water samples, there were sediment samples collected from the Houston Ship Channel System in Houston Texas over the four month period between May 6, 2009 and August 31, 2009. The samples were analyzed for Total Organic Carbon (TOC) in the following laboratory Sample Delivery Groups (SDGs):

**A954388, A964463, A968218, A971779, A978361, A981800, A982220, A992281, and A948900.**

All samples were collected by the University of Houston and Parsons following the procedures described in the QAPP. All analyses were performed by Xenco Laboratories in Houston, Texas, NWDLS, Inc. in The Woodlands, Texas and Maxxam Analytics Inc. in Burlington, Canada following procedures outlined in the QAPP and EPA Method 160.2

(SM2450D) for TSS, SM5310 for DOC, and SM5310C for TOC in waters and CAM SOP-00468 for TOC in sediments.

**Note:** In addition to the water samples analyzed for TSS, DOC and TOC, sediment samples were sent to Xenco, whom then forwarded the samples to PTS Laboratories in Houston, Texas for Particle Size Analysis (also known as Grain Size) and % Solids analysis. The Particle Size method used by PTS Laboratories is ASTM D422/D4464M and % Solids method is ASTM D2216. Since there isn't QC data analyzed in association with the sediment analyses, this data verification report will focus on water sample analysis and the TOC sediment analysis only.

## EVALUATION CRITERIA

The data submitted by the laboratory has been reviewed and verified following the guidelines outlined in the QAPP and National Functional Guidelines for Organic and Inorganic Data (EPA 1994). Information reviewed in the data packages includes sample results; blanks; case narrative and chain-of-custody forms. The analyses and findings presented in this report are based on the reviewed information, and meeting guidelines in the QAPP (with the exceptions noted below).

## NOTES ON TOC AND DOC:

Approximately mid-June 2009, UH and Parsons decided to send TOC and DOC samples to NWDLS in The Woodlands Texas instead of Xenco in Houston, Texas. This decision was made in response to an unusually high amount of samples being reported with DOC greater than TOC. In addition, several field blanks were being reported with TOC and DOC above the reporting limits. After extensive testing via split sample comparisons and DI water evaluations, the decision was made to send the remaining samples to NWDLS. This report discusses the combined results of both labs.

Samples results with DOC greater than TOC by 10% or more were flagged "E" as estimated.

## TOTAL SUSPENDED SOLIDS

### General

The SDGs included in this report contained the samples listed in Table 1 and analyzed for TSS. The TSS analyses were performed using EPA Method 160.2. All samples for this SDG were collected and analyzed following the procedures and protocols outlined in the QAPP. All samples collected were prepared and analyzed within the holding times required by the method, except as indicated below:

**Table 1: Data Packages, Sample IDs and Collection Dates and Times**

| | | | | | | **Meet DQO for Holding Time *** |
|---|---|---|---|---|---|---|
| 330792 | 20570-W-1-RO | 221 | 4/17/2009 20:20 | 4/23/2009 14:30 | 5.8 | Y |
| 331356 | 16657-W-1-RO | 71.0 | 4/27/2009 0:00 | 5/1/2009 15:06 | 4.6 | Y |
| | 11387-W-1-RO | 116 | 4/27/2009 19:36 | 4/30/2009 15:26 | 2.8 | Y |
| 331909 | 16213-W-2 | 35.0 | 5/5/2009 14:45 | 5/7/2009 14:30 | 2.0 | Y |
| | 11252-W-2 | 76.0 | 5/5/2009 12:00 | 5/7/2009 14:32 | 2.1 | Y |
| 332240 | 14560-W-2 | 81.0 | 5/7/2009 12:00 | 5/13/2009 11:50 | 6.0 | Y |
| | 13338-W-2 | 93.0 | 5/6/2009 12:00 | 5/13/2009 11:52 | 7.0 | Y |
| | 13340-W-2 | 68.0 | 5/6/2009 12:00 | 5/13/2009 11:54 | 7.0 | Y |
| | 16499-W-2 | 37.0 | 5/7/2009 12:00 | 5/13/2009 11:56 | 6.0 | Y |
| | TRIP01-W-2 | BRL | 5/7/2009 12:00 | 5/13/2009 11:58 | 6.0 | Y |
| 332695 | **11132-W-2** | **29.0** | **5/12/2009 12:00** | **5/20/2009 15:22** | **8.1** | **N** |
| | **TBD Vince-W-2** | **51.0** | **5/12/2009 12:00** | **5/20/2009 15:24** | **8.1** | **N** |
| | **20575-W-2** | **49.0** | **5/11/2009 12:00** | **5/20/2009 15:26** | **9.1** | **N** |
| | **20575-W-RO-1** | **200** | **5/11/2009 12:00** | **5/20/2009 15:28** | **9.1** | **N** |
| 332948 | 11279-W-2 | 38.0 | 5/14/2009 12:00 | 5/20/2009 16:22 | 6.2 | Y |
| | 11387-W-2 | 9.00 | 5/14/2009 12:00 | 5/20/2009 16:24 | 6.2 | Y |
| | 11139-W-2 | 30.0 | 5/13/2009 12:00 | 5/20/2009 16:26 | 7.2 | Y |
| 333612 | 13342-W-2 | 31.0 | 5/19/2009 12:00 | 5/26/2009 9:08 | 6.9 | Y |
| | 16618-W-2 | 40.0 | 5/19/2009 12:00 | 5/26/2009 9:10 | 6.9 | Y |
| | 13344-W-2 | 36.0 | 5/21/2009 12:00 | 5/26/2009 9:12 | 4.9 | Y |
| | 11258-W-2 | 58.0 | 5/21/2009 12:00 | 5/26/2009 9:22 | 4.9 | Y |
| 333662 | 11193-W-2 | 41.0 | 5/22/2009 12:00 | 5/26/2009 9:16 | 3.9 | Y |
| | 16622-W-2 | 28.0 | 5/22/2009 12:00 | 5/26/2009 9:18 | 3.9 | Y |
| 334118 | 15979-W-2 | 23.0 | 5/28/2009 12:00 | 6/2/2009 12:16 | 5.0 | Y |
| | 15301-W-2 | 43.0 | 5/26/2009 12:00 | 6/2/2009 12:20 | 7.0 | Y |
| | 15936-W-2 | 25.0 | 5/26/2009 12:00 | 6/2/2009 12:22 | 7.0 | Y |
| | 11264-W-2 | 27.0 | 5/27/2009 12:00 | 6/2/2009 12:24 | 6.0 | Y |
| | 11280-W-2 | 21.0 | 5/28/2009 12:00 | 6/2/2009 12:26 | 5.0 | Y |
| | 11270-W-2 | 21.0 | 5/27/2009 12:00 | 6/2/2009 12:28 | 6.0 | Y |
| 334298 | 13355-W-2 | 30.0 | 5/29/2009 12:00 | 6/4/2009 8:14 | 5.8 | Y |

| | | | | | | Meet DQO for Holding Time * |
|---|---|---|---|---|---|---|
| | 13355-W-2-DUP | 16.0 | 5/29/2009 12:00 | 6/4/2009 8:12 | 5.8 | Y |
| | 13363-W-2 | 26.0 | 5/29/2009 12:00 | 6/4/2009 8:10 | 5.8 | Y |
| 334729 | 11292-W-2 | 25.0 | 6/3/2009 12:00 | 6/9/2009 13:38 | 6.1 | Y |
| | 11274-W-2 | 30.0 | 6/4/2009 12:00 | 6/9/2009 13:40 | 5.1 | Y |
| | 11287-W-2 | 29.0 | 6/4/2009 12:00 | 6/9/2009 13:42 | 5.1 | Y |
| 335108 | 11262-W-2 | 13.0 | 6/5/2009 12:00 | 6/12/2009 15:20 | 7.1 | Y |
| | 11261-W-2 | 8.00 | 6/5/2009 12:00 | 6/12/2009 15:22 | 7.1 | Y |
| | 11261-W-2-DUP | BRL | 6/5/2009 12:00 | 6/12/2009 15:24 | 7.1 | Y |
| | 18363-W-2 | BRL | 6/9/2009 12:00 | 6/12/2009 15:26 | 3.1 | Y |
| | 18322-W-2 | 17.0 | 6/9/2009 12:00 | 6/12/2009 15:28 | 3.1 | Y |
| 335390 | T002-W-2 | 4.00 | 6/11/2009 12:00 | 6/17/2009 12:10 | 6.0 | Y |
| | TBD11-W-2 | BRL | 6/10/2009 12:00 | 6/17/2009 12:12 | 7.0 | Y |
| | 11288-W-2 | 13.0 | 6/11/2009 12:00 | 6/17/2009 12:14 | 6.0 | Y |
| | T002-W-2-DUP | BRL | 6/11/2009 12:00 | 6/17/2009 12:16 | 6.0 | Y |
| | TBD10-W-2 | 13.0 | 6/10/2009 12:00 | 6/17/2009 12:18 | 7.0 | Y |
| 335583 | TRIP2-W-2 | BRL | 6/12/2009 10:10 | 6/17/2009 12:38 | 5.1 | Y |
| | 11265-W-2 | 36.0 | 6/12/2009 12:00 | 6/17/2009 12:40 | 5.0 | Y |
| | 11285-W-2 | 9.00 | 6/12/2009 12:00 | 6/17/2009 12:42 | 5.0 | Y |
| 336707 | 11115-W-2 | 20.0 | 6/25/2009 12:00 | 7/2/2009 16:22 | 7.2 | Y |
| | 16657-W-2 | 5.00 | 6/25/2009 12:00 | 7/2/2009 16:24 | 7.2 | Y |
| | 20574-W-2 | 52.0 | 6/26/2009 12:00 | 7/2/2009 16:26 | 6.2 | Y |
| | 11129-W-2 | 34.0 | 6/26/2009 12:00 | 7/2/2009 16:30 | 6.2 | Y |
| 336922 | TRIP3-W-2 | BRL | 6/29/2009 12:00 | 7/2/2009 16:42 | 3.2 | Y |
| | 11347-W-2 | 30.0 | 6/29/2009 12:00 | 7/2/2009 16:44 | 3.2 | Y |
| | 11347-W-2-DUP | 22.0 | 6/29/2009 12:00 | 7/2/2009 16:46 | 3.2 | Y |
| | 20570-W-2 | 36.0 | 6/29/2009 12:00 | 7/2/2009 16:48 | 3.2 | Y |
| 338185 | 17149-W-2 | 34.0 | 7/14/2009 12:00 | 7/17/2009 17:22 | 3.2 | Y |
| 338987 | 11132-W-RO-1 | 79.0 | 7/23/2009 12:00 | 7/28/2009 14:46 | 5.1 | Y |
| | 11139-W-RO-1 | 116 | 7/23/2009 12:00 | 7/28/2009 14:48 | 5.1 | Y |
| 340093 | 10495-003-Dup | 4.00 | 8/5/2009 12:00 | 8/7/2009 16:58 | 2.2 | Y |
| | 10495-003 | 10.0 | 8/5/2009 12:00 | 8/7/2009 17:00 | 2.2 | Y |
| | 10206-000 | 137 | 8/4/2009 12:00 | 8/7/2009 17:02 | 3.2 | Y |
| | HarrisCo-FWSD51 | 4.5 | 8/3/2009 12:00 | 8/7/2009 17:04 | 4.2 | Y |
| | 10206-001 | 8.00 | 8/4/2009 0:00 | 8/7/2009 17:06 | 3.7 | Y |
| 340434 | 01740-000 | 24.0 | 8/7/2009 12:00 | 8/11/2009 12:05 | 4.0 | Y |
| | 10495-090 | 9.60 | 8/7/2009 12:00 | 8/11/2009 12:05 | 4.0 | Y |
| | 00458-000 | 14.0 | 8/6/2009 12:00 | 8/11/2009 12:05 | 5.0 | Y |
| | 10395-008 | BRL | 8/6/2009 12:00 | 8/11/2009 12:05 | 5.0 | Y |
| 341064 | 00492-000-W-2 | 30.0 | 8/12/2009 12:00 | 8/17/2009 12:12 | 5.0 | Y |
| | 00402-000-W-2 | 45.0 | 8/12/2009 12:00 | 8/17/2009 12:14 | 5.0 | Y |
| | WQ0001429-W-2 | 74.0 | 8/13/2009 12:00 | 8/17/2009 12:16 | 4.0 | Y |

| | | | | | | Meet DQO for Holding Time * |
|---|---|---|---|---|---|---|
| | TBD15-W-2 | 61.0 | 8/11/2009 12:00 | 8/17/2009 12:18 | 6.0 | Y |
| | 20574-W-2 | 63.0 | 8/13/2009 12:00 | 8/17/2009 12:20 | 4.0 | Y |
| | 00587-000 | 20.0 | 8/11/2009 12:00 | 8/17/2009 12:22 | 6.0 | Y |
| 341563 | 0000544-000-W-2 | 21.0 | 8/17/2009 12:00 | 8/20/2009 17:24 | 3.2 | Y |
| | WQ0000749-W-2 | 34.5 | 8/14/2009 12:00 | 8/20/2009 17:26 | 6.2 | Y |
| | 0001984-000-W-2 | 11.0 | 8/18/2009 12:00 | 8/20/2009 17:28 | 2.2 | Y |
| | 0010495-009-W-2 | 7.00 | 8/18/2009 12:00 | 8/24/2009 10:06 | 5.9 | Y |
| **343366** | **16872-W-2** | **5.00** | **8/31/2009 12:00** | **9/8/2009 14:36** | **8.1** | **N** |
| 344344 | 11139-W-RO-2 | 99.0 | 9/9/2009 12:00 | 9/14/2009 16:36 | 5.2 | Y |
| 345908 | 11115-W-RO-1 | 75.0 | 9/22/2009 12:00 | 9/26/2009 0:00 | 3.5 | Y |

* Holding time acceptance criteria for TSS is less than 8 days.

BRL = Below Reporting Limit

The minor Holding time exceedances were flagged "H" for TSS.

## Accuracy

Accuracy was evaluated using the %R results for the blank spike samples (BS) and Blank Spike Duplicate (BSD) samples. The BS/BSD %Rs were within method acceptance criteria for all SDGs.

The BS/BSD results are as follows:

| Blank Spike Recovery Results for TSS Samples | | | | | | |
|---|---|---|---|---|---|---|
| | | | | TSS % Recovery | | Accept |
| 330792 | 756945 | Blank Spike | 4/23/2009 | 98 | 99 | Y |
| 331356 | 757521 | Blank Spike | 4/30/2009 | 98 | 99 | Y |
| 331356 | 757713 | Blank Spike | 5/1/2009 | 94 | 95 | Y |
| 331909 | 758338 | Blank Spike | 5/7/2009 | 94 | 97 | Y |
| 332240 | 758783 | Blank Spike | 5/13/2009 | 98 | 102 | Y |
| 332695 | 759620 | Blank Spike | 5/20/2009 | 98 | 102 | Y |
| 332948 | 759621 | Blank Spike | 5/20/2009 | 98 | 102 | Y |
| 333612<br>333662 | 760081 | Blank Spike | 5/26/2009 | 99 | 98 | Y |
| 334118 | 760914 | Blank Spike | 6/2/2009 | 98 | 98 | Y |
| 334298 | 761191 | Blank Spike | 6/4/2009 | 96 | 98 | Y |
| 334729 | 761745 | Blank Spike | 6/9/2009 | 98 | 99 | Y |
| | 762233 | Blank Spike | | | | Y |
| 335390 | 762569 | Blank Spike | 6/17/2009 | 100 | 99 | Y |

| Blank Spike Recovery Results for TSS Samples | | | | | | |
|---|---|---|---|---|---|---|
| | | | | TSS % Recovery | | Accept |
| 335583 | | | | | | |
| 336707<br>336922 | 764427 | Blank Spike | 7/2/2009 | 97 | 95 | Y |
| 338185 | 765787 | Blank Spike | 7/17/2009 | 101 | 100 | Y |
| 338987 | 766822 | Blank Spike | 7/28/2009 | 98 | 98 | Y |
| 340093 | 768140 | Blank Spike | 8/7/2009 | 85 | 88 | Y |
| 340434 | 768212 | Blank Spike | 8/11/2009 | 98 | 98 | Y |
| 341064 | 768776 | Blank Spike | 8/17/2009 | 98 | 97 | Y |
| 341563 | 769342 | Blank Spike | 8/20/2009 | 105 | 94 | Y |
| | 769714 | Blank Spike | 8/24/2009 | 97 | 96 | Y |
| 343366 | 771335 | Blank Spike | 9/8/2009 | 97 | 100 | Y |
| 344344 | 772449 | Blank Spike | 9/14/2009 | 103 | 98 | Y |
| 345908 | 774369 | Blank Spike | 9/26/2009 | 101 | 102 | Y |

**Precision**

Precision was evaluated using the Relative Percent Difference (%RPD) obtained from the parent sample/field duplicate sample results, lab duplicate results and BS/BSD duplicate results. The following samples were collected and analyzed in duplicate for field duplicate QC purposes: 13355-W-2 (collected 5/29/08), 11261-W-2 (collected 6/5/08), T002-W-2 (collected 6/4/09), 11347-W-2 (collection 6/29/09), and 10495-003 (collection 8/5/09). All field duplicate results were within QAPP tolerance, except for the following:

| Field Duplicate Results for TSS Samples | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | TSS (mg/L) | | | Accept |
| 334298 | 761191 | 13355-W-2 | 5/29/2009 | 16.0 | 30.0 | 60.9 | N |
| 335108 | 762233 | 11261-W-2 | 6/5/2009 | 8.00 | BRL | NC | Y |
| 335390 | 762569 | T002-W-2 | 6/11/2009 | 4.00 | BRL | NC | Y |
| 336922 | 764427 | 11347-W-2 | 6/29/2009 | 30.0 | 22.0 | 30.8 | Y |
| 340093 | 768140 | 10495-003 | 8/5/2009 | 10.0 | 4.00 | 85.7 | N |

BRL = Below Reporting Levels; NC = Not Calculated

The parent and duplicate sample for 13355-W-2 and 10495-003 were flagged “F” for the % RPD exceedance.

The following table lists the samples that were analyzed in duplicate for lab duplicate QC purposes:

| Laboratory Duplicate Results for TSS Samples | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | TSS (mg/L) | | | Accept |
| 330792 | 756945 | Unk: 330662-001D | 4/23/2009 | 22.0 | 23.0 | 4.4 | Y |
| 330792 | 756945 | Unk: 330783-002D | 4/23/2009 | <4.00 | <4.00 | NC | Y |
| 331356 | 757521 | Unk: 331303-001D | 4/30/2009 | 16.0 | 16.0 | 0.0 | Y |
| 331356 | 757521 | 11387-W-1-RO | 4/30/2009 | 116 | 115 | 0.9 | Y |
| 331356 | 757713 | Unk: 331390-001D | 5/1/2009 | <4.00 | <4.00 | NC | Y |
| 331356 | 757713 | Unk: 331459-005D | 5/1/2009 | 8.00 | 8.00 | 0.0 | Y |
| 331909 | 758338 | Unk: 331640-001D | 5/7/2009 | <4.00 | <4.00 | NC | Y |
| 331909 | 758338 | Unk: 331812-001D | 5/7/2009 | 8.00 | 8.00 | 0.0 | Y |
| 332240 | 758783 | Unk: 331975-001D | 5/13/2009 | <4.00 | <4.00 | NC | Y |
| 332240 | 758783 | Unk: 332281-001D | 5/13/2009 | <4.00 | <4.00 | NC | Y |
| 332695 | 759620 | Unk: 332697-001D | 5/20/2009 | <4.00 | <4.00 | NC | Y |
| 332948 | 759621 | Unk: 332889-001D | 5/20/2009 | 8.00 | 9.00 | 11.8 | Y |
| 332948 | 759621 | Unk: 332994-001D | 5/20/2009 | <4.00 | <4.00 | NC | Y |
| 333612 | 760081 | 13344-W-2 | 5/26/2009 | 36.0 | 35.0 | 2.8 | Y |
| 333612 | 760081 | 11258-W-2 | 5/26/2009 | 58.0 | 59.0 | 1.7 | Y |
| 334118 | 760914 | 15979-W-2 | 6/2/2009 | 23.0 | 22.0 | 4.4 | Y |
| 334118 | 760914 | Unk: 334143-001D | 6/2/2009 | <4.00 | <4.00 | NC | Y |
| 334298 | 761191 | Unk: 334243-005D | 6/4/2009 | <4.00 | <4.00 | NC | Y |
| 334298 | 761191 | Unk: 334413-001D | 6/4/2009 | <4.00 | <4.00 | NC | Y |
| 334729 | 761745 | Unk: 334487-001D | 6/9/2009 | 42.0 | 43.0 | 2.4 | Y |
| 334729 | 761745 | Unk: 334494-001D | 6/9/2009 | <4.00 | <4.00 | NC | Y |
| 335108 | 762233 | Unk: 334997-001D | 6/12/2009 | 10.0 | 10.0 | 0.0 | Y |
| 335390 | 762569 | TBD10-W-2 | 6/17/2009 | 13.0 | 13.0 | 0.0 | Y |
| 335583 | 762569 | Unk: 335583-003D | 6/17/2009 | 9.00 | 9.00 | 0.0 | Y |
| 336707 | 764427 | 20574-W-2 | 7/2/2009 | 52.0 | 48.0 | 8.0 | Y |
| 336922 | | | | | | | |
| 338185 | 765787 | Unknown: 338086-001 D | 7/17/2009 | <4.00 | <4.00 | NC | Y |
| 338987 | 766822 | Unknown: 338772-001 D | 7/28/2009 | 10.0 | 10.0 | 0.0 | Y |
| 338987 | 766822 | Unknown: 338904-003 D | 7/28/2009 | 91000 | 86000 | 5.6 | Y |
| 340093 | 768140 | Unknown: 339693-001 D | 8/7/2009 | 7.00 | 8.00 | 13.3 | Y |
| 340434 | 768212 | Unknown: 340377-001 D | 8/11/2009 | <4.00 | <4.00 | NC | Y |
| | 768212 | Unknown: 340476-001 D | 8/11/2009 | 6.40 | 5.60 | 13.3 | Y |
| 341064 | 768776 | Unknown: 340936-001 D | 8/17/2009 | 4420 | 4360 | 1.4 | Y |
| 341563 | 769342 | Unknown: 341291-001 D | 8/20/2009 | 5.00 | 4.50 | 10.5 | Y |
| | | Unknown: 341627-001 D | 8/20/2009 | <4.00 | <4.00 | NC | Y |
| | 769714 | 0010495-009-W-2 | 8/24/2009 | 7.00 | 7.00 | 0.0 | Y |
| 343366 | 771335 | Unknown: 343239-001 D | 9/8/2009 | 4.50 | 4.50 | 0.0 | Y |
| 344344 | 772449 | Unknown: 344302-002 D | 9/14/2009 | <4.00 | <4.00 | NC | Y |
| 345908 | 774369 | 11115-W-RO-1 | 9/26/2009 | 75.0 | 83.0 | 10.1 | Y |

NC = Not Calculated

All lab duplicate samples met criteria. The QAPP does not require a sample collected under this project be used for batch QC purposes. All lab duplicate results were within QAPP tolerance.

Each TSS batch QC includes both BS and BSD samples. All BS/BSD % RPDs were within QAPP required tolerance.

| Blank Spike Recovery Results for TSS Samples | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | TSS % Recovery | | | Accept |
| | | | | | | | |
| 330792 | 756945 | Blank Spike | 4/23/2009 | 98 | 99 | 1.0 | Y |
| 331356 | 757521 | Blank Spike | 4/30/2009 | 98 | 99 | 1.0 | Y |
| 331356 | 757713 | Blank Spike | 5/1/2009 | 94 | 95 | 1.1 | Y |
| 331909 | 758338 | Blank Spike | 5/7/2009 | 94 | 97 | 3.1 | Y |
| 332240 | 758783 | Blank Spike | 5/13/2009 | 98 | 102 | 4.0 | Y |
| 332695 | 759620 | Blank Spike | 5/20/2009 | 98 | 102 | 4.0 | Y |
| 332948 | 759621 | Blank Spike | 5/20/2009 | 98 | 102 | 4.0 | Y |
| 333612<br>333662 | 760081 | Blank Spike | 5/26/2009 | 99 | 98 | 1.0 | Y |
| 334118 | 760914 | Blank Spike | 6/2/2009 | 98 | 98 | 0.0 | Y |
| 334298 | 761191 | Blank Spike | 6/4/2009 | 96 | 98 | 2.1 | Y |
| 334729 | 761745 | Blank Spike | 6/9/2009 | 98 | 99 | 1.0 | Y |
| | 762233 | Blank Spike | | | 96 | 0.0 | Y |
| 335390<br>335583 | 762569 | Blank Spike | 6/17/2009 | 100 | 99 | 1.0 | Y |
| 336707<br>336922 | 764427 | Blank Spike | 7/2/2009 | 97 | 95 | 2.1 | Y |
| 338185 | 765787 | Blank Spike | 7/17/2009 | 101 | 100 | 1.0 | Y |
| 338987 | 766822 | Blank Spike | 7/28/2009 | 98 | 98 | 0.0 | Y |
| 340093 | 768140 | Blank Spike | 8/7/2009 | 85 | 88 | 3.5 | Y |
| 340434 | 768212 | Blank Spike | 8/11/2009 | 98 | 98 | 0.0 | Y |
| 341064 | 768776 | Blank Spike | 8/17/2009 | 98 | 97 | 1.0 | Y |
| 341563 | 769342 | Blank Spike | 8/20/2009 | 105 | 94 | 11.1 | Y |
| | 769714 | Blank Spike | 8/24/2009 | 97 | 96 | 1.0 | Y |
| 343366 | 771335 | Blank Spike | 9/8/2009 | 97 | 100 | 3.0 | Y |
| 344344 | 772449 | Blank Spike | 9/14/2009 | 103 | 98 | 5.0 | Y |
| 345908 | 774369 | Blank Spike | 9/26/2009 | 101 | 102 | 1.0 | Y |

The overall frequency of LD and FD is as follows:

| QC Frequency for TSS Samples | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | **Frequency of LD** |
| 330792 | 1 | 4/23/09 | 0 | 0 | 2 | 4/23/09 | 1 | 0% | 200% |
| 331356 | 1 | 4/30/09 | 0 | 0 | 2 | 4/30/09 | 1 | 0% | 200% |
| 331356 | 1 | 5/1/09 | 0 | 0 | 2 | 5/1/09 | 1 | 0% | 200% |
| 331909 | 2 | 5/7/09 | 0 | 0 | 2 | 5/7/09 | 2 | 0% | 100% |
| 332240 | 5 | 5/13/09 | 0 | 0 | 2 | 5/13/09 | 5 | 0% | 40% |
| 332695 | 4 | 5/20/09 | 0 | 0 | 1 | 5/20/09 | 4 | 0% | 25% |
| 332948 | 3 | 5/20/09 | 0 | 0 | 2 | 5/20/09 | 3 | 0% | 67% |
| 333612<br>333662 | 6 | 5/26/09 | 0 | 0 | 2 | 5/26/09 | 6 | 0% | 33% |
| 334118 | 6 | 6/2/09 | 0 | 0 | 2 | 6/2/09 | 6 | 0% | 33% |
| 334298 | 2 | 6/4/09 | 1 | 6/4/09 | 2 | 6/4/09 | 3 | 50% | 67% |
| 334729 | 3 | 6/9/09 | 0 | 0 | 2 | 6/9/09 | 3 | 0% | 67% |
| 335108 | 4 | 6/12/09 | 1 | 6/12/09 | 1 | 6/12/09 | 5 | 25% | 20% |
| 335390<br>335583 | 7 | 6/17/09 | 1 | 6/17/09 | 2 | 6/17/09 | 8 | 14% | 25% |
| 336707<br>336922 | 7 | 7/2/09 | 1 | 7/2/09 | 1 | 7/2/09 | 8 | 14% | 13% |
| 338185 | 1 | 7/17/09 | 0 | 0 | 1 | 7/17/09 | 1 | 0% | 100% |
| 338987 | 2 | 7/28/09 | 0 | 0 | 2 | 7/28/09 | 2 | 0% | 100% |
| | | | | | | | | | 50% |
| 340434 | 4 | 8/11/09 | 0 | 0 | 2 | 8/11/09 | 4 | 0% | 50% |
| 341064 | 6 | 8/17/09 | 0 | 0 | 1 | 8/17/09 | 6 | 0% | 17% |
| 341563 | 3 | 8/20/09 | 0 | 0 | 2 | 8/20/09 | 3 | 0% | 67% |
| | 1 | 8/24/09 | 0 | 0 | 1 | 8/24/09 | 1 | 0% | 100% |
| 343366 | 1 | 9/8/09 | 0 | 0 | 1 | 9/8/09 | 1 | 0% | 100% |
| 344344 | 1 | 9/14/09 | 0 | 0 | 1 | 9/14/09 | 1 | 0% | 100% |
| 345908 | 1 | 9/26/09 | 0 | 0 | 1 | 9/26/09 | 1 | 0% | 100% |
| | | | | | | **Overall Frequency** | | **6.5%** | **48.7%** |

The minimum overall frequency of FD's is 5%.

**Representativeness**

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing the chain-of-custody procedures to those described in the QAPP;
- Evaluating holding times; and

- Examining method blanks for contamination of samples during analysis.

The samples in this SDG were collected and analyzed following the QAPP, COC and analytical procedures. All samples were prepared and analyzed with the holding times required for the analysis.

There was at least one method blank analyzed with each batch associated with the TSS analyses in each SDG. The method blanks were below the RLs.

**Completeness**

Completeness has been evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

No reported results for samples in this SDG have been rejected or invalidated (qualified "R"). The completeness for this SDG is 100% compared to the minimum acceptance limit of 90%.

## DISSOLVED ORGANIC CARBON

### General

The SDGs included in this report contained the samples listed in Table 1 and analyzed for DOC. The DOC analyses were performed using EPA Method SM5310. All samples for this SDG were collected and analyzed following the procedures and protocols outlined in the QAPP. All samples collected were prepared and analyzed within the holding times required by the method.

**Table 1: Data Packages, Sample IDs and Collection Dates and Times**

| | | | | | | Meet DQO for Holding Time * |
|---|---|---|---|---|---|---|
| 330792 | 20570-W-1-RO | 7.66 | 4/17/2009 | 4/23/2009 | 6 | Y |
| 331356 | 16657-W-1-RO | 7.57 | 4/27/2009 | 5/4/2009 | 7 | Y |
| | 11387-W-1-RO | 6.98 | 4/27/2009 | 5/4/2009 | 7 | Y |
| 331909 | 16213-W-2 | 3.08 | 5/5/2009 | 5/13/2009 | 8 | Y |
| | 11252-W-2 | 4.49 | 5/5/2009 | 5/13/2009 | 8 | Y |
| 332240 | 14560-W-2 | 2.44 | 5/7/2009 | 5/13/2009 | 6 | Y |
| | 13338-W-2 | 4.36 | 5/6/2009 | 5/13/2009 | 7 | Y |
| | 13340-W-2 | 6.36 | 5/6/2009 | 5/13/2009 | 7 | Y |
| | 16499-W-2 | 6.75 | 5/7/2009 | 5/13/2009 | 6 | Y |
| | TRIP01-W-2 | 1.40 | 5/7/2009 | 5/13/2009 | 6 | Y |
| 332695 | 11132-W-2 | 7.90 | 5/13/2009 | 5/21/2009 | 8 | Y |
| | TBD Vince-W-2 | 8.76 | 5/13/2009 | 5/21/2009 | 8 | Y |
| | 20575-W-2 | 9.05 | 5/13/2009 | 5/21/2009 | 8 | Y |
| | 20575-W-RO-1 | 11.5 | 5/13/2009 | 5/21/2009 | 8 | Y |
| 332948 | 11279-W-2 | 6.69 | 5/14/2009 | 5/21/2009 | 7 | Y |
| | 11387-W-2 | 6.86 | 5/14/2009 | 5/21/2009 | 7 | Y |
| | 11139-W-2 | 7.17 | 5/13/2009 | 5/21/2009 | 8 | Y |
| 333612 | 13342-W-2 | 4.25 | 5/19/2009 | 5/27/2009 | 8 | Y |
| | 16618-W-2 | 2.99 | 5/19/2009 | 5/27/2009 | 8 | Y |
| | 13344-W-2 | 3.46 | 5/21/2009 | 5/27/2009 | 6 | Y |
| | 11258-W-2 | 2.56 | 5/21/2009 | 5/27/2009 | 6 | Y |
| 333662 | 11193-W-2 | 5.63 | 5/22/2009 | 5/27/2009 | 5 | Y |
| | 16622-W-2 | 11.4 | 5/22/2009 | 5/27/2009 | 5 | Y |
| 334298 | 13355-W-2-DUP | 2.09 | 5/29/2009 | 6/8/2009 | 10 | Y |
| | 13355-W-2 | 2.25 | 5/29/2009 | 6/8/2009 | 10 | Y |
| 334729 | 11292-W-2 | 6.95 | 6/3/2009 | 6/12/2009 | 9 | Y |
| 160845 | 11261-W-2 | 5.98 | 6/5/2009 | 6/19/2009 | 14 | Y |
| | 11261-W-2-DUP | 5.86 | 6/5/2009 | 6/19/2009 | 14 | Y |
| | 11262-W-2 | 5.86 | 6/5/2009 | 6/19/2009 | 14 | Y |
| | 11264-W-2 | 6.63 | 5/27/2009 | 6/19/2009 | 23 | Y |

| | | | | | | Meet DQO for Holding Time * |
|---|---|---|---|---|---|---|
| | 11265-W-2 | 5.67 | 6/12/2009 | 6/19/2009 | 7 | Y |
| | 11270-W-2 | 6.57 | 5/27/2009 | 6/19/2009 | 23 | Y |
| | 11274-W-2 | 5.99 | 6/4/2009 | 6/19/2009 | 15 | Y |
| | 11280-W-2 | 6.41 | 5/28/2009 | 6/19/2009 | 22 | Y |
| | 11285-W-2 | 6.25 | 6/12/2009 | 6/19/2009 | 7 | Y |
| | 11287-W-2 | 8.29 | 6/4/2009 | 6/19/2009 | 15 | Y |
| | 11288-W-2 | 6.46 | 6/11/2009 | 6/19/2009 | 8 | Y |
| | 13363-W-2 | 6.10 | 5/29/2009 | 6/19/2009 | 21 | Y |
| | 15301-W-2 | 6.67 | 5/26/2009 | 6/19/2009 | 24 | Y |
| | 15936-W-2 | 6.70 | 5/26/2009 | 6/19/2009 | 24 | Y |
| | 15979-W-2 | 6.36 | 5/28/2009 | 6/19/2009 | 22 | Y |
| | 18322-W-2 | 6.15 | 6/9/2009 | 6/19/2009 | 10 | Y |
| | 18363-W-2 | 5.70 | 6/9/2009 | 6/19/2009 | 10 | Y |
| | T002-W-2 | 5.87 | 6/11/2009 | 6/19/2009 | 8 | Y |
| | T002-W-2-DUP | 5.87 | 6/11/2009 | 6/19/2009 | 8 | Y |
| | TBD10-W-2 | 6.22 | 6/10/2009 | 6/19/2009 | 9 | Y |
| | TBD11-W-2 | 7.58 | 6/10/2009 | 6/19/2009 | 9 | Y |
| | TRIP2-W-2 | <1.00 | 6/12/2009 | 6/19/2009 | 7 | Y |
| 161913 | 11115-W-2 | 7.77 | 6/25/2009 | 7/18/2009 | 23 | Y |
| | 11129-W-2 | 6.41 | 6/26/2009 | 7/18/2009 | 22 | Y |
| | 11347-W-2 | 5.26 | 6/29/2009 | 7/18/2009 | 19 | Y |
| | 11347-W-2-DUP | 5.48 | 6/29/2009 | 7/18/2009 | 19 | Y |
| | 16657-W-2 | 4.32 | 6/25/2009 | 7/18/2009 | 23 | Y |
| | 20570-W-2 | 5.63 | 6/29/2009 | 7/18/2009 | 19 | Y |
| | 20574-W-2 | 9.85 | 6/26/2009 | 7/18/2009 | 22 | Y |
| | TRIP3-W-2 | <1.00 | 6/29/2009 | 7/18/2009 | 19 | Y |
| 164313 | 11132-W-RO-1 | 8.55 | 7/23/2009 | 8/5/2009 | 14 | Y |
| | 11139-W-RO-1 | 5.62 | 7/23/2009 | 8/5/2009 | 14 | Y |
| 165205 | 0001984-000-W-2 | 7.00 | 8/18/2009 | 8/21/2009 | 4 | Y |
| | 0010495-009-W-2 | 6.66 | 8/18/2009 | 8/21/2009 | 4 | Y |
| | WQ0001429-W-2 | 5.69 | 8/13/2009 | 8/21/2009 | 9 | Y |
| | 00492-000-W-2 | 11.0 | 8/12/2009 | 8/21/2009 | 10 | Y |
| | 00402-000-W-2 | 33.2 | 8/12/2009 | 8/21/2009 | 10 | Y |
| | 00587-000 | 14.5 | 8/11/2009 | 8/21/2009 | 11 | Y |
| | TBD15-W-2 | 15.5 | 8/11/2009 | 8/21/2009 | 11 | Y |
| | WQ0000749-W-2 | 2.47 | 8/14/2009 | 8/21/2009 | 8 | Y |
| | 20574-W-1-RO | 7.28 | 8/13/2009 | 8/21/2009 | 9 | Y |
| | 0000544-000-W-2 | 10.2 | 8/17/2009 | 8/21/2009 | 5 | Y |
| 100109001 | 10206-001 | 10.6 | 8/4/2009 | 8/11/2009 | 7 | Y |
| | 17149-W-2 | 6.80 | 7/14/2009 | 8/12/2009 | 29 | Y |
| | Harris Co-FWSD51 | 7.30 | 8/3/2009 | 8/12/2009 | 9 | Y |

| | | | | | | Meet DQO for Holding Time * |
|---|---|---|---|---|---|---|
| | 01740-000 | 35.6 | 8/7/2009 | 8/12/2009 | 5 | Y |
| | 10206-000 | 48.5 | 8/4/2009 | 8/12/2009 | 8 | Y |
| | 00458-000 | 21.1 | 8/6/2009 | 8/12/2009 | 6 | Y |
| | 10495-090 | 9.10 | 8/7/2009 | 8/12/2009 | 5 | Y |
| | 10395-008 | 6.70 | 8/6/2009 | 8/12/2009 | 6 | Y |
| | 10495-003-Dup | 13.4 | 8/5/2009 | 8/12/2009 | 7 | Y |
| | 10495-003 | 13.4 | 8/5/2009 | 8/12/2009 | 7 | Y |
| 167736 | 16872-W-2 | 6.27 | 8/31/2009 | 9/11/2009 | 12 | Y |
| | 11139-W-RO-2 | 6.78 | 9/9/2009 | 9/11/2009 | 3 | Y |
| 169562 | 11115-W-RO-1 | 6.48 | 9/22/2009 | 10/12/2009 | 20 | Y |

* Holding time acceptance criteria for DOC is less than 29 days.

**Accuracy**

Accuracy was evaluated using the %R results for the blank spike samples (BS) and the matrix spike (MS) and matrix spike duplicate (MSD) samples. The BS %Rs were within method acceptance criteria for all SDGs.

Blank spike results are as follows:

| Blank Spike Recovery Results for DOC Samples | | | | | |
|---|---|---|---|---|---|
| | | DOC (mg/L) | | | Accept |
| 330792 | 4/23/2009 | 10.0 | 10.5 | 105 | Y |
| 331356 | 5/4/2009 | 10.0 | 10.5 | 105 | Y |
| 331909<br>332240 | 5/13/2009 | 10.0 | 10.7 | 107 | Y |
| 332695<br>332948 | 5/21/2009 | 10.0 | 10.3 | 103 | Y |
| 333612<br>333662 | 5/27/2009 | 10.0 | 10.8 | 108 | Y |
| 334298 | 6/8/2009 | 10.0 | 10.5 | 105 | Y |
| 334729 | 6/12/2009 | 10.0 | 10.0 | 100 | Y |
| 160845 | 6/19/2009 | 50.0 | 52.4 | 105 | Y |
| | 6/19/2009 | 50.0 | 52.4 | 105 | Y |
| | 6/19/2009 | 50.0 | 52.6 | 105 | Y |

| Blank Spike Recovery Results for DOC Samples | | | | | |
|---|---|---|---|---|---|
| | | DOC (mg/L) | | | Accept |
| | | | | | |
| 161913 | 7/18/2009 | 50.0 | 52.5 | 105 | Y |
| 164312 | 8/5/2009 | 1.00 | 1.08 | 108 | Y |
| 165205 | 8/21/2009 | 1.00 | 1.07 | 107 | Y |
| 100109001 | 8/11/2009 | 50.0 | 52.9 | 106 | Y |
| | 8/12/2009 | 50.0 | 52.0 | 104 | Y |
| 167736 | 9/24/2009 | 50.0 | 51.4 | 103 | Y |
| 169562 | 10/12/2009 | 50.0 | 52.3 | 105 | Y |

The MS and MSD spike recovery results are as follows:

| Matrix Spike Duplicate Results for DOC Samples | | | | | | |
|---|---|---|---|---|---|---|
| | | | | Recovery | | Accept |
| | | | | | | |
| 330792 | 756869 | 20570-W-1-RO | 4/23/2009 | 113 | NA | Y |
| 331909 | **758833** | **11252-W-2** | **5/13/2009** | **79** | **74** | **N** |
| 332240 | | | | | | |
| 332695 | 759756 | 20575-W-RO-1 | 5/21/2009 | 98 | 98 | Y |
| 332948 | | | | | | |
| 333612 | 60259 | 11258-W-2 | 5/27/2009 | 101 | 99 | Y |
| 333662 | | | | | | |
| 334298 | **761667** | **13355-W-2-DUP** | **6/8/2009** | **43** | **NA** | **N** |
| 160845 | NA | Unk: 160845-1 | 6/19/2009 | 98 | NA | Y |
| | NA | Unk: 160845-2 | 6/19/2009 | 101 | NA | Y |
| | NA | Unk: 160845-3 | 6/19/2009 | 102 | NA | Y |
| 161913 | NA | Unk: 161913-1 | 7/18/2009 | 106 | NA | Y |
| 164313 | NA | Unk: 164312-1 | 8/5/2009 | 108 | NA | Y |
| 165205 | NA | Unk: 165205-1 | 8/21/2009 | 105 | NA | Y |
| 100109001 | NA | Unk | 8/11/2009 | 105 | NA | Y |
| | NA | Unk | 8/12/2009 | 102 | NA | Y |
| 167736 | NA | Unk: 167736-1 | 9/24/2009 | 107 | NA | Y |
| 169562 | NA | Unk: 169562-1 | 10/12/2009 | 105 | NA | Y |

The MS and MSD %Rs were within method acceptance criteria for all SDGs, except for samples 11252-W-2 and 13355-W-2-DUP failed accuracy results. The parent samples were flagged “M” for matrix spike exceedance.

**Precision**

Precision was evaluated using the Relative Percent Difference (%RPD) obtained from the parent sample/field duplicate sample results, lab duplicate results, BS/BSD and MS/MSD duplicate results. The following samples were collected and analyzed in duplicate for field duplicate QC purposes: 13355-W-2 (collected 5/29/08), 11261-W-2 (collected 6/5/08), T002-W-2 (collected 6/4/09), 11347-W-2 (collection 6/29/09), and 10495-003 (collected 8/5/09).

All field duplicate results were within QAPP tolerance.

| Field Duplicate Results for DOC Samples | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | DOC (mg/L) | | | Accept |
| 334298 | 761667 | 13355-W-2 | 5/29/2009 | 2.09 | 2.25 | 7.4 | Y |
| 160845 | NA | 11261-W-2 | | | 5.86 | 2.0 | Y |
| | NA | T002-W-2 | | | 5.87 | 0.0 | Y |
| 161913 | NA | 11347-W-2 | | | 5.48 | 4.1 | Y |
| 167736 | NA | 10495-003 | | | 13.4 | 0.0 | Y |

The following table lists samples that were analyzed in duplicate for lab duplicate QC purposes:

| Laboratory Duplicate Results for DOC Samples | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | DOC (mg/L) | | | Accept |
| 330792 | 756869 | 20570-W-1-RO | 4/23/2009 | 7.66 | 7.95 | 3.7 | Y |
| 331356 | 757879 | 16657-W-1-RO | 5/4/2009 | 7.57 | 7.48 | 1.2 | Y |
| 331909 | 758833 | 11252-W-2 | 5/13/2009 | 4.49 | 4.58 | 2.0 | Y |
| 332240 | | | | | | | |
| 332695 | 759756 | 20575-W-RO-1 | 5/21/2009 | 11.5 | 11.3 | 1.8 | Y |
| 332948 | | | | | | | |
| 333612 | 760259 | 11258-W-2 | 5/27/2009 | 2.56 | 2.55 | 0.4 | Y |
| 333662 | | | | | | | |
| 334298 | 761667 | Unk:334332-002D | 6/8/2009 | 10.8 | 11.0 | 1.8 | Y |
| 334729 | 762254 | Unk:334998-001D | 6/12/2009 | 5.23 | 5.00 | 4.5 | Y |
| 160845 | NA | 11285-W-2 | 6/19/2009 | 6.17 | 6.25 | 1.3 | Y |
| | NA | 11264-W-2 | 6/19/2009 | 6.47 | 6.63 | 2.4 | Y |
| | NA | 13363-W-2 | 6/19/2009 | 5.82 | 6.09 | 4.5 | Y |
| 161913 | NA | 11115-W-2 | 7/18/2009 | 7.56 | 7.77 | 2.7 | Y |
| 164313 | NA | 11132-W-RO-1 | 8/5/2009 | 8.55 | 8.43 | 1.4 | Y |
| 165205 | NA | 0001984-000-W-2 | 8/21/2009 | 7.00 | 6.98 | 0.3 | Y |
| 100109001 | NA | 10206-001 | 8/11/2009 | 10.8 | 10.6 | 1.9 | Y |
| | NA | Harris Co-FWSD51 | 8/12/2009 | 36.0 | 35.6 | 1.1 | Y |
| 167736 | NA | 16872-W-2 | 9/24/2009 | 6.32 | 6.27 | 0.8 | Y |
| 169562 | NA | 11115-W-RO-1 | 10/12/2009 | 6.52 | 6.48 | 0.6 | Y |

All lab samples used for batch QC lab duplicate purposes. The QAPP does not require a sample collected under this project be used for batch QC purposes. All lab duplicate results were within QAPP tolerance.

Each DOC batch QC includes a MS and MSD and all % RPDs were within QAPP required tolerance, unless previously noted.

| Matrix Spike Duplicate Results for DOC Samples | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | DOC (mg/L) | | | Accept |
| 331356 | 757879 | 16657-W-1-RO | 5/4/2009 | 11.4 | 12.2 | 6.8 | Y |
| 331909<br>332240 | 758833 | 11252-W-2 | 5/13/2009 | 8.43 | 8.2 | 2.8 | Y |
| 332695<br>332948 | 759756 | 20575-W-RO-1 | 5/21/2009 | 16.4 | 16.4 | 0.0 | Y |
| 333612<br>333662 | 760259 | 11258-W-2 | 5/27/2009 | 7.62 | 7.49 | 1.7 | Y |
| 334298 | 761667 | Unk:334332-002S | 6/8/2009 | 15.9 | 15.7 | 1.3 | Y |
| 334729 | 762254 | Unk:334998-001S | 6/12/2009 | 10.4 | 10.5 | 1.0 | Y |

The overall frequency of LD and FD is as follows:

| QC Frequency for DOC Samples | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Frequency of LD |
| 330792 | 1 | 4/23/09 | 0 | 0 | 1 | 4/23/09 | 1 | 0% | 100% |
| 331356 | 2 | 5/4/09 | 0 | 0 | 1 | 5/4/09 | 2 | 0% | 50% |
| 331909 | 7 | 5/13/09 | 0 | 0 | 1 | 5/13/09 | 7 | 0% | 14% |
| 332240 | | | 0 | 0 | | | | | |
| 332695 | 7 | 5/21/09 | 0 | 0 | 1 | 5/21/09 | 7 | 0% | 14% |
| 332948 | | | 0 | 0 | | | | | |
| 333612 | 6 | 5/27/09 | 0 | 0 | 1 | 5/27/09 | 6 | 0% | 17% |
| 333662 | | | 0 | 0 | | | | | |
| 334298 | 1 | 6/8/09 | 1 | 6/8/09 | 1 | 6/8/09 | 2 | 100% | 50% |
| 334729 | 1 | 6/12/09 | 0 | 0 | 1 | 6/12/09 | 1 | 0% | 100% |
| 160845 | 18 | 6/19/09 | 2 | 6/19/09 | 4 | 6/19/09 | 20 | 11% | 20% |
| 161913 | 7 | 7/18/09 | 1 | 7/18/09 | 1 | 7/18/09 | 8 | 14% | 13% |
| 164313 | 2 | 8/5/09 | 0 | 0 | 1 | 8/5/09 | 2 | 0% | 50% |
| 165205 | 10 | 8/21/09 | 0 | 0 | 1 | 8/21/09 | 10 | 0% | 10% |
| 100109001 | 1 | 8/11/09 | 0 | 0 | 1 | 8/11/09 | 1 | 0% | 100% |
| | 8 | 8/12/09 | 1 | 8/12/09 | 1 | 8/12/09 | 9 | 13% | 11% |
| 167736 | 2 | 9/24/09 | 0 | 0 | 1 | 9/24/09 | 2 | 0% | 50% |
| 169562 | 1 | 10/12/09 | 0 | 0 | 1 | 10/12/09 | 2 | 0% | 50% |
| | | | | | | | **Overall Frequency** | **6.8%** | **22.5%** |

The minimum overall frequency of FD's is 5%.

**Representativeness**

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing the chain-of-custody procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining method blanks for contamination of samples during analysis.

The samples in this SDG were collected and analyzed following the QAPP, COC and analytical procedures. All samples were prepared and analyzed with the holding times required for the analysis.

There was at least one method blank analyzed with each batch associated with the DOC analyses in each SDG. The method blanks were below the RLs.

**Completeness**

Completeness has been evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

No reported results for samples in this SDG have been rejected or invalidated (qualified "R"). The completeness for this SDG is 100% compared to the minimum acceptance limit of 90%.

## TOTAL ORGANIC CARBON (WATERS)

### General

The SDGs included in this report contained the samples listed in Table 1 and analyzed for TOC. The TOC analyses were performed using SM5310C. All samples for this SDG were collected and analyzed following the procedures and protocols outlined in the QAPP. All samples collected were prepared and analyzed within the holding times required by the method.

**Table 1: Data Packages, Sample IDs and Collection Dates and Times**

| | | | | | | Meet DQO for Holding Time * |
|---|---|---|---|---|---|---|
| 330792 | 20570-W-1-RO | 6.95 | 4/17/2009 | 4/23/2009 | 6 | Y |
| 331356 | 16657-W-1-RO | 8.09 | 4/27/2009 | 5/4/2009 | 7 | Y |
| | 11387-W-1-RO | 7.50 | 4/27/2009 | 5/4/2009 | 7 | Y |
| 331909 | 16213-W-2 | 3.13 | 5/5/2009 | 5/13/2009 | 8 | Y |
| | 11252-W-2 | 4.49 | 5/5/2009 | 5/13/2009 | 8 | Y |
| 332240 | 14560-W-2 | 2.05 | 5/7/2009 | 5/14/2009 | 7 | Y |
| | 13338-W-2 | 3.99 | 5/6/2009 | 5/14/2009 | 8 | Y |
| | 13340-W-2 | 3.64 | 5/6/2009 | 5/14/2009 | 8 | Y |
| | 16499-W-2 | 6.31 | 5/7/2009 | 5/14/2009 | 7 | Y |
| | TRIP01-W-2 | BRL | 5/7/2009 | 5/14/2009 | 7 | Y |
| 332695 | 11132-W-2 | 7.40 | 5/13/2009 | 5/19/2009 | 6 | Y |
| | TBD Vince-W-2 | 8.28 | 5/13/2009 | 5/19/2009 | 6 | Y |
| | 20575-W-2 | 8.28 | 5/13/2009 | 5/19/2009 | 6 | Y |
| | 20575-W-RO-1 | 9.63 | 5/13/2009 | 5/19/2009 | 6 | Y |
| 332948 | 11279-W-2 | 6.53 | 5/14/2009 | 5/20/2009 | 6 | Y |
| | 11387-W-2 | 6.41 | 5/14/2009 | 5/20/2009 | 6 | Y |
| | 11139-W-2 | 6.95 | 5/13/2009 | 5/20/2009 | 7 | Y |
| 333612 | 13342-W-2 | 4.15 | 5/19/2009 | 5/27/2009 | 8 | Y |
| | 16618-W-2 | 2.83 | 5/19/2009 | 5/27/2009 | 8 | Y |
| | 13344-W-2 | 3.26 | 5/21/2009 | 5/27/2009 | 6 | Y |
| | 11258-W-2 | 2.58 | 5/21/2009 | 5/27/2009 | 6 | Y |
| 333662 | 11193-W-2 | 5.18 | 5/22/2009 | 5/27/2009 | 5 | Y |
| | 16622-W-2 | 11.0 | 5/22/2009 | 5/28/2009 | 6 | Y |
| 334298 | 13355-W-2 | 2.16 | 5/29/2009 | 6/3/2009 | 5 | Y |
| | 13355-W-2-DUP | 2.03 | 5/29/2009 | 6/3/2009 | 5 | Y |
| 334729 | 11292-W-2 | 6.07 | 6/3/2009 | 6/8/2009 | 5 | Y |
| 160845 | 11261-W-2 | 6.05 | 6/5/2009 | 6/19/2009 | 14 | Y |
| | 11261-W-2-DUP | 6.01 | 6/5/2009 | 6/19/2009 | 14 | Y |
| | 11262-W-2 | 6.30 | 6/5/2009 | 6/19/2009 | 14 | Y |
| | 11264-W-2 | 7.54 | 5/27/2009 | 6/19/2009 | 23 | Y |
| | 11265-W-2 | 5.77 | 6/12/2009 | 6/19/2009 | 7 | Y |
| | 11270-W-2 | 6.57 | 5/27/2009 | 6/19/2009 | 23 | Y |

| | | | | | | Meet DQO for Holding Time * |
|---|---|---|---|---|---|---|
| | 11274-W-2 | 6.32 | 6/4/2009 | 6/19/2009 | 15 | Y |
| | 11280-W-2 | 7.06 | 5/28/2009 | 6/19/2009 | 22 | Y |
| | 11285-W-2 | 7.01 | 6/12/2009 | 6/19/2009 | 7 | Y |
| | 11287-W-2 | 8.70 | 6/4/2009 | 6/19/2009 | 15 | Y |
| | 11288-W-2 | 6.47 | 6/11/2009 | 6/19/2009 | 8 | Y |
| | 13363-W-2 | 7.73 | 5/29/2009 | 6/19/2009 | 21 | Y |
| | 15301-W-2 | 7.41 | 5/26/2009 | 6/19/2009 | 24 | Y |
| | 15936-W-2 | 7.00 | 5/26/2009 | 6/19/2009 | 24 | Y |
| | 15979-W-2 | 6.62 | 5/28/2009 | 6/19/2009 | 22 | Y |
| | 18322-W-2 | 6.11 | 6/9/2009 | 6/19/2009 | 10 | Y |
| | 18363-W-2 | 5.82 | 6/9/2009 | 6/19/2009 | 10 | Y |
| | T002-W-2 | 5.77 | 6/11/2009 | 6/19/2009 | 8 | Y |
| | T002-W-2-DUP | 5.75 | 6/11/2009 | 6/19/2009 | 8 | Y |
| | TBD10-W-2 | 6.66 | 6/10/2009 | 6/19/2009 | 9 | Y |
| | TBD11-W-2 | 8.17 | 6/10/2009 | 6/19/2009 | 9 | Y |
| | TRIP2-W-2 | <1.00 | 6/12/2009 | 6/19/2009 | 7 | Y |
| 161913 | 11115-W-2 | 8.87 | 6/25/2009 | 7/18/2009 | 23 | Y |
| | 11129-W-2 | 7.03 | 6/26/2009 | 7/18/2009 | 22 | Y |
| | 11347-W-2 | 5.64 | 6/29/2009 | 7/18/2009 | 19 | Y |
| | 11347-W-2-DUP | 5.67 | 6/29/2009 | 7/18/2009 | 19 | Y |
| | 16657-W-2 | 4.29 | 6/25/2009 | 7/18/2009 | 23 | Y |
| | 20570-W-2 | 5.44 | 6/29/2009 | 7/18/2009 | 19 | Y |
| | 20574-W-2 | 9.94 | 6/26/2009 | 7/18/2009 | 22 | Y |
| | TRIP3-W-2 | <1.00 | 6/29/2009 | 7/18/2009 | 19 | Y |
| 164312 | 11132-W-RO-1 | 9.53 | 7/23/2009 | 8/5/2009 | 14 | Y |
| | 11139-W-RO-1 | 7.09 | 7/23/2009 | 8/5/2009 | 14 | Y |
| 165205 | 0001984-000-W-2 | 7.47 | 8/18/2009 | 8/21/2009 | 4 | Y |
| | 0010495-009-W-2 | 6.81 | 8/18/2009 | 8/21/2009 | 4 | Y |
| | WQ0001429-W-2 | 6.44 | 8/13/2009 | 8/21/2009 | 9 | Y |
| | 00492-000-W-2 | 11.6 | 8/12/2009 | 8/21/2009 | 10 | Y |
| | 00402-000-W-2 | 34.5 | 8/12/2009 | 8/21/2009 | 10 | Y |
| | 00587-000 | 14.9 | 8/11/2009 | 8/21/2009 | 11 | Y |
| | TBD15-W-2 | 16.8 | 8/11/2009 | 8/21/2009 | 11 | Y |
| | WQ0000749-W-2 | 1.51 | 8/14/2009 | 8/21/2009 | 8 | Y |
| | 20574-W-1-RO | 7.15 | 8/13/2009 | 8/21/2009 | 9 | Y |
| | 0000544-000-W-2 | 10.7 | 8/17/2009 | 8/21/2009 | 5 | Y |
| 100109001 | 10206-001 | 11.4 | 8/4/2009 | 8/11/2009 | 7 | Y |
| | 17149-W-2 | | | | | Y |
| | Harris Co-FWSD51 | 7.40 | 8/3/2009 | 8/12/2009 | 9 | Y |
| | 01740-000 | 37.4 | 8/7/2009 | 8/12/2009 | 5 | Y |
| | 10206-000 | 54.8 | 8/4/2009 | 8/12/2009 | 8 | Y |
| | 00458-000 | 21.8 | 8/6/2009 | 8/12/2009 | 6 | Y |

| | | | | | | Meet DQO for Holding Time * |
|---|---|---|---|---|---|---|
| | 10495-090 | 9.50 | 8/7/2009 | 8/12/2009 | 5 | Y |
| | 10395-008 | 6.80 | 8/6/2009 | 8/12/2009 | 6 | Y |
| | 10495-003-Dup | 13.8 | 8/5/2009 | 8/12/2009 | 7 | Y |
| | 10495-003 | 14.0 | 8/5/2009 | 8/12/2009 | 7 | Y |
| 167736 | 16872-W-2 | 6.78 | 8/31/2009 | 9/24/2009 | 25 | Y |
| | 11139-W-RO-2 | 6.84 | 9/9/2009 | 9/24/2009 | 16 | Y |
| 169562 | 11115-W-RO-1 | 7.41 | 9/22/2009 | 10/12/2009 | 20 | Y |

* Holding time acceptance criteria for DOC is less than 29 days.

## Accuracy

Accuracy was evaluated using the %R results for the blank spike samples (BS) and matrix spike and matrix spike duplicate recovery results. The BS %Rs were within method acceptance criteria for all SDGs.

| Blank Spike Recovery Results for TOC Samples | | | | | |
|---|---|---|---|---|---|
| | | TOC (mg/L) | | | Accept |
| 330792 | 4/23/2009 | 10.0 | 10.5 | 105 | Y |
| 331356 | 5/4/2009 | 10.0 | 10.2 | 102 | Y |
| 331909<br>332240 | 5/13/2009 | 10.0 | 10.9 | 109 | Y |
| 332695 | 5/19/2009 | 10.0 | 10.0 | 100 | Y |
| 332948 | 5/19/2009 | 10.0 | 10.2 | 102 | Y |
| 333612<br>333662 | 5/26/2009 | 10.0 | 10.2 | 102 | Y |
| 333662 | 5/28/2009 | 10.0 | 10.7 | 107 | Y |
| 334298 | 6/3/2009 | 10.0 | 10.8 | 108 | Y |
| 334729 | 6/12/2009 | 10.0 | 10.9 | 109 | Y |
| 160845 | 6/19/2009 | 50.0 | 52.5 | 105 | Y |
| | 6/19/2009 | 50.0 | 52.9 | 106 | Y |
| | 6/19/2009 | 50.0 | 52.6 | 105 | Y |
| 161913 | 7/18/2009 | 50.0 | 52.7 | 105 | Y |
| 164312 | 8/5/2009 | 50.0 | 53.8 | 108 | Y |
| 165205 | 8/21/2009 | 1.0 | 1.1 | 106 | Y |
| 100109001 | 8/11/2009 | 50.0 | 52.5 | 105 | Y |
| | 8/12/2009 | 50.0 | 51.2 | 102 | Y |
| 167736 | 9/24/2009 | 50.0 | 52.7 | 105 | Y |
| 169562 | 10/12/2009 | 50.0 | 51.9 | 104 | Y |

The MS/MSD recovery results were within limits as follows:

| Matrix Spike Duplicate Results for TOC Samples | | | | | | |
|---|---|---|---|---|---|---|
| | | | | TOC % Recovery | | Accept |
| 330792 | 756873 | Unk:330169-003S | 4/23/2009 | 118 | 120 | Y |
| 331356 | 757859 | Unk:331414-002S | 5/4/2009 | 102 | 108 | Y |
| 331909<br>332240 | 758839 | Unk:331869-005S | 5/13/2009 | 102 | 104 | Y |
| 332695 | 759448 | 11132-W-2S | 5/19/2009 | 106 | 102 | Y |
| 332948 | 759452 | Unk:333010-002S | 5/20/2009 | 98 | 108 | Y |
| 333612<br>333662 | 760086 | 11258-W-2S | 5/27/2009 | 99 | 100 | Y |
| 333662 | 760261 | Unk:332834-013S | 5/28/2009 | 111 | 112 | Y |
| 334298 | 761120 | Unk:334149-002S | 6/3/2009 | 107 | 95 | Y |
| 334729 | 761595 | Unk:334404-001S | 6/8/2009 | 84 | 100 | Y |
| 160845 | NA | Unk: 160845-1 | 6/19/2009 | 107 | NA | Y |
| | NA | Unk: 160845-2 | 6/19/2009 | 108 | NA | Y |
| | NA | Unk: 160845-3 | 6/19/2009 | 104 | NA | Y |
| 161913 | NA | Unk: 161913-1 | 7/18/2009 | 110 | NA | Y |
| 164312 | NA | Unk: 164312-1 | 8/5/2009 | 107 | NA | Y |
| 165205 | NA | Unk: 165205-1 | 8/21/2009 | 105 | NA | Y |
| 100109001 | NA | Unk | 8/11/2009 | 106 | NA | Y |
| | NA | Unk | 8/12/2009 | 107 | NA | Y |
| 167736 | NA | Unk | 9/24/2009 | 106 | NA | Y |
| 169562 | NA | Unk | 10/12/2009 | 105 | NA | Y |

**Precision**

Precision was evaluated using the Relative Percent Difference (%RPD) obtained from the parent sample/field duplicate sample results, the lab duplicate results and the MS/MSD sample results. The following samples were collected and analyzed in duplicate for field duplicate QC purposes: 13355-W-2 (collected 5/29/08), 11261-W-2 (collected 6/5/08), T002-W-2 (collected 6/4/09), 11347-W-2 (collection 6/29/09), and 10495-003 (collected 8/5/09). All field duplicate results were within QAPP tolerance.

| Field Duplicate Results for TOC Samples | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | TOC (mg/L) | | | Accept |
| 334298 | 761120 | 13355-W-2 | 05/29/09 | 2.2 | 2.0 | 6.2 | Y |
| 160845 | NA | 11261-W-2 | | | 6.0 | 0.7 | Y |
| | NA | T002-W-2 | | | 5.8 | 0.3 | Y |
| 161913 | NA | 11347-W-2 | | | 5.7 | 0.5 | Y |
| 167736 | NA | 10495-003 | | | 13.8 | 1.4 | Y |

The following samples were analyzed in duplicate for lab duplicate QC purposes:

All lab duplicate results were within QAPP tolerance.

| Laboratory Duplicate Results for TOC Samples | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | TOC (mg/L) | | | Accept |
| 330792 | 756873 | Unk:330169-003D | 04/23/09 | 11.2 | 10.0 | 11.3 | Y |
| 331356 | 757859 | Unk:331414-002D | 05/04/09 | 4.37 | 4.18 | 4.4 | Y |
| 331909 | 758839 | Unk:331869-005D | 05/13/09 | 1.46 | 1.46 | 0.0 | Y |
| 332240 | | | | | | | |
| 332695 | 759448 | 11132-W-2 | 05/19/09 | 7.40 | 7.62 | 2.9 | Y |
| 332948 | 759452 | Unk:333010-002D | 05/20/09 | 12.6 | 11.1 | 12.7 | Y |
| 333612 | 760086 | 11258-W-2 | 05/27/09 | 2.58 | 2.59 | 0.4 | Y |
| 333662 | | | | | | | |
| 333662 | 760261 | Unk:332834-013D | 05/28/09 | 1.03 | 0.96 | 6.6 | Y |
| 334298 | 761120 | Unk:334149-002D | 06/03/09 | 5.76 | 5.73 | 0.5 | Y |
| 334729 | 761595 | Unk:334404-001D | 06/08/09 | 10.7 | 10.7 | 0.0 | Y |
| 160845 | NA | 11285-W-2 | 06/19/09 | 6.70 | 7.01 | 4.5 | Y |
| | NA | 11264-W-2 | 06/19/09 | 7.32 | 7.54 | 3.0 | Y |
| | NA | 13363-W-2 | 06/19/09 | 7.70 | 7.73 | 0.4 | Y |
| 161913 | NA | 11115-W-2 | 07/18/09 | 8.68 | 8.87 | 2.2 | Y |
| 164312 | NA | 11132-W-RO-1 | | 9.53 | 9.21 | 3.4 | Y |
| 165205 | NA | 0001984-000-W-2 | | 7.47 | 7.43 | 0.5 | Y |
| 100109001 | NA | Harris Co-FWSD51 | 08/12/09 | 37.5 | 37.4 | 0.3 | Y |
| 167736 | NA | 16872-W-2 | 09/24/09 | 6.42 | 6.78 | 5.5 | Y |
| 169562 | NA | 11115-W-RO-1 | 10/12/09 | 7.16 | 7.41 | 3.4 | Y |

All MS/MSD % RPD were within QAPP tolerance as follows:

| Matrix Spike Duplicate Results for TOC Samples | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | TOC (mg/L) | | | Accept |
| 330792 | 756873 | Unk:330169-003S | 04/23/09 | 17.1 | 17.2 | 0.6 | Y |
| 331356 | 757859 | Unk:331414-002S | 05/04/09 | 9.45 | 9.77 | 3.3 | Y |
| 331909 | 758839 | Unk:331869-005S | 05/13/09 | 6.57 | 6.64 | 1.1 | Y |
| 332240 | | | | | | | |
| 332695 | 759448 | 11132-W-2 | 05/19/09 | 12.7 | 12.5 | 1.6 | Y |
| 332948 | 759452 | Unk:333010-002S | 05/20/09 | 17.5 | 18.0 | 2.8 | Y |
| 333612 | 760086 | 11258-W-2 | 05/27/09 | 7.55 | 7.60 | 0.7 | Y |
| 333662 | | | | | | | |
| 333662 | 760261 | Unk:332834-013S | 05/28/09 | 6.57 | 6.64 | 1.1 | Y |
| 334298 | 761120 | Unk:334149-002S | 06/03/09 | 11.1 | 10.5 | 5.6 | Y |
| 334729 | 761595 | Unk:334404-001S | 06/08/09 | 14.9 | 15.7 | 5.2 | Y |

The overall frequency of LD and FD is as follows:

| QC Frequency for TOC Samples | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | **Freq. of LD** |
| 330792 | 1 | 4/23/09 | 0 | 0 | 1 | 4/23/09 | 1 | 0% | 100% |
| 331356 | 2 | 5/4/09 | 0 | 0 | 1 | 5/4/09 | 2 | 0% | 50% |
| 331909 | 7 | 5/13/09 | 0 | 0 | 1 | 5/13/09 | 7 | 0% | 14% |
| 332240 | | 5/14/09 | | | | | | | |
| 332695 | 4 | 5/19/09 | 0 | 0 | 1 | 5/19/09 | 4 | 0% | 25% |
| 332948 | 3 | 5/20/09 | 0 | 0 | 1 | 5/20/09 | 3 | 0% | 33% |
| 333612 | 6 | 5/27/09 | 0 | 0 | 1 | 5/27/09 | 6 | 0% | 17% |
| 333662 | | | | | | | | | |
| 334298 | 1 | 6/8/09 | 1 | 6/8/09 | 1 | 6/8/09 | 2 | 100% | 50% |
| 334729 | 1 | 6/8/09 | 0 | 0 | 1 | 6/8/09 | 1 | 0% | 100% |
| 160845 | 18 | 6/19/09 | 2 | 6/19/09 | 3 | 6/19/09 | 20 | 11% | 15% |
| 161913 | 7 | 7/18/09 | 1 | 7/18/09 | 1 | 7/18/09 | 8 | 14% | 13% |
| 164312 | 2 | 8/5/2009 | 0 | 0 | 1 | 8/5/09 | 2 | 0% | 50% |
| 165205 | 10 | 8/21/2009 | 0 | 0 | 1 | 8/21/09 | 10 | 0% | 10% |
| 100109001 | 1 | 8/11/2009 | 0 | 0 | | 8/11/09 | 1 | 0% | 0% |
| | 8 | 8/12/09 | 1 | 8/12/09 | 1 | 8/12/09 | 9 | 13% | 11% |
| 167736 | 2 | 9/24/09 | 0 | 0 | 1 | 9/24/09 | 2 | 0% | 50% |
| 169562 | 1 | 10/12/09 | 0 | 0 | 1 | 10/12/09 | 2 | 0% | 50% |
| | | | | | | | **Overall Frequency** | **6.8%** | **20.5%** |

The minimum overall frequency of FD's is 5%.

**Representativeness**

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

* Comparing the chain-of-custody procedures to those described in the QAPP;

* Evaluating holding times; and

* Examining method blanks for contamination of samples during analysis.

The samples in this SDG were collected and analyzed following the QAPP, COC and analytical procedures. All samples were prepared and analyzed with the holding times required for the analysis.

There was at least one method blank analyzed with each batch associated with the TOC analyses in each SDG. The method blanks were below the RLs.

**Completeness**

Completeness has been evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

No reported results for samples in this SDG have been rejected or invalidated. The completeness for this SDG is 100% compared to the minimum acceptance limit of 90%.

## TOTAL ORGANIC CARBON (SEDIMENTS)

### General

The SDGs included in this report contained the samples listed in Table 1 and analyzed for TOC. The TOC analyses were performed using LECO Combustion Method (lab method: CAM SOP-00468). All samples for this SDG were collected and analyzed following the procedures and protocols outlined in the QAPP. All samples collected were prepared and analyzed within the holding times required by the method.

**Table 1: Data Packages, Sample IDs and Collection Dates and Times**

| | | | | | | Meet DQO for Holding Time * |
|---|---|---|---|---|---|---|
| A954388 | 13338-SE-2-DUP | 6400 | 5/6/2009 10:55 | 5/15/2009 | 9 | Y |
| | 13338-SE-2 | 5300 | 5/6/2009 10:33 | 5/15/2009 | 9 | Y |
| | 16499-SE-2 | 9500 | 5/6/2009 14:00 | 5/15/2009 | 8 | Y |
| | 11252-SE-2 | 4200 | 5/6/2009 9:30 | 5/15/2009 | 9 | Y |
| A964463 | 13342-SE-2 | 4000 | 5/20/2009 14:36 | 6/15/2009 | 25 | Y |
| | 13344-SE-2 | 4400 | 5/20/2009 14:00 | 6/15/2009 | 25 | Y |
| | 15936-SE-2 | 6300 | 5/26/2009 10:05 | 6/15/2009 | 20 | Y |
| | 11270-SE-2 | 5200 | 5/26/2009 12:55 | 6/15/2009 | 19 | Y |
| | 16618-SE-2 | 4000 | 5/21/2009 17:10 | 6/15/2009 | 24 | Y |
| | 15979-SE-2 | 6000 | 5/26/2009 10:46 | 6/15/2009 | 20 | Y |
| | 15301-SE-2 | 6200 | 5/26/2009 15:10 | 6/15/2009 | 19 | Y |
| | 11261-SE-2 | 8500 | 5/20/2009 15:05 | 6/15/2009 | 25 | Y |
| | 11270-SE-2-DUP | 5800 | 5/26/2009 13:34 | 6/15/2009 | 19 | Y |
| | 11193-SE-2 | 9300 | 5/20/2009 15:35 | 6/15/2009 | 25 | Y |
| | 11258-SE-2 | 4300 | 5/22/2009 14:10 | 6/15/2009 | 23 | Y |
| | 16622-SE-2 | 1700 | 5/21/2009 13:07 | 6/15/2009 | 24 | Y |
| A968218 | 11280-SE-2 | 5500 | 5/29/2009 10:04 | 6/23/2009 | 25 | Y |
| | 11264-SE-2 | 4700 | 5/29/2009 9:29 | 6/23/2009 | 25 | Y |
| | 11262-SE-2 | 1900 | 6/4/2009 17:20 | 6/23/2009 | 18 | Y |
| | 11274-SE-2 | 4100 | 6/4/2009 17:02 | 6/23/2009 | 18 | Y |
| | 11292-SE-2 | 6800 | 6/4/2009 10:30 | 6/23/2009 | 19 | Y |
| | 11287-SE-2 | 6100 | 6/4/2009 11:40 | 6/23/2009 | 19 | Y |
| | 11287-SE-2- DUP | 7300 | 6/4/2009 11:40 | 6/23/2009 | 19 | Y |
| A971779 | 18363-SE-2 | 4500 | 6/10/2009 17:51 | 6/29/2009 | 18 | Y |
| | TBD11-SE-2 | 5200 | 6/10/2009 14:10 | 6/29/2009 | 18 | Y |
| | TRIP1-SED-2 | <500 | 6/10/2009 7:20 | 6/29/2009 | 19 | Y |
| A978361 | 11302-SE-2 | 5900 | 6/17/2009 10:13 | 7/7/2009 | 20 | Y |
| | 11285-SE-2 | 8000 | 6/12/2009 12:38 | 7/7/2009 | 24 | Y |
| | 11265-SE-2 | 4300 | 6/12/2009 14:18 | 7/7/2009 | 24 | Y |
| | 11288-SE-2 | 10000 | 6/12/2009 12:12 | 7/7/2009 | 24 | Y |

| | | | | | | Meet DQO for Holding Time * |
|---|---|---|---|---|---|---|
| | TRIP2-SE-2 | <500 | 6/18/2009 12:16 | 7/7/2009 | 18 | Y |
| | TBD10-SE-2 | 6800 | 6/12/2009 13:52 | 7/7/2009 | 24 | Y |
| | 11132-SE-2 | 19000 | 6/17/2009 9:16 | 7/7/2009 | 20 | Y |
| | ERB1-SE-2 | <500 | 6/18/2009 12:16 | 7/7/2009 | 18 | Y |
| | 18322-SE-2 | 8600 | 6/18/2009 12:36 | 7/7/2009 | 18 | Y |
| | 18322-SE-2-DUP | 12000 | 6/18/2009 12:55 | 7/7/2009 | 18 | Y |
| A981800 | 11347-SE-2 | 810 | 6/29/2009 0:00 | 7/7/2009 | 8.0 | Y |
| | 11129-SE-2 | 6700 | 6/26/2009 0:00 | 7/7/2009 | 11 | Y |
| | 20574-SE-2 | 3000 | 6/26/2009 0:00 | 7/7/2009 | 11 | Y |
| A982220 | T002-SE-2 | 3800 | 6/11/2009 9:26 | 7/7/2009 | 26 | Y |
| A992281 | 17149-SE-2 | 18000 | 7/15/2009 0:00 | 7/31/2009 | 16 | Y |
| A9A8900 | TBD15-SE-2 | 10000 | 8/12/2009 0:00 | 8/31/2009 | 19 | Y |

* Holding time acceptance criteria for TOC is less than 29 days.

**Accuracy**

Accuracy was evaluated using the %R results for the blank spike samples (BS) and the Lower Limit of Quantitation (LOQ) sample recovery results.

The BS %Rs were within method acceptance criteria for all SDGs.

| Blank Spike Recovery Results for TOC Samples | | | | | | |
|---|---|---|---|---|---|---|
| | | | | Recovery | | Accept |
| A954388 | 1817826 | QC Standard | 5/15/2009 | | | Y |
| A964463 | 1842502 | QC Standard | 6/15/2009 | | | Y |
| A968218 | 1844794 | QC Standard | 6/23/2009 | | | Y |
| A971779 | 1856763 | QC Standard | 6/29/2009 | | | Y |
| A978361 | 1868414 | QC Standard | 7/7/2009 | | | Y |
| A981800 | | | | | | |
| A982220 | | | | | | |
| A992281 | 1885518 | QC Standard | 7/31/2009 | | | Y |
| A9A8900 | 1921200 | QC Standard | 8/31/2009 | | | Y |

The LOQ %Rs were within method acceptance criteria for all SDGs.

| LOQ Spike Results | | | | | |
|---|---|---|---|---|---|
| | | | | | Accept |
| A964463 | 1842502 | LOQ Spike | 6/15/2009 | 129 | Y |
| A968218 | 1844794 | LOQ Spike | 6/8/2009 | 114 | Y |
| A971779 | 1856863 | LOQ Spike | 6/29/2009 | 112 | Y |
| A978361 | 1868414 | LOQ Spike | 7/7/2009 | 99 | Y |
| A981800 | 1868414 | LOQ Spike | 7/7/2009 | 93 | Y |
| A982220 | 1868414 | LOQ Spike | 7/7/2009 | 98 | Y |
| A992281 | 1885518 | LOQ Spike | 7/31/2009 | 137 | N |
| A9A8900 | 1921200 | LOQ Spike | 8/31/2009 | 119 | Y |

The LOQ for A992281 failed high. The associated sample, 17149-S-2 was flagged "Q" for LOQ exceedance.

**Precision**

Precision was evaluated using the Relative Percent Difference (%RPD) obtained from the parent sample/field duplicate sample results and the lab duplicate results. The following samples were collected and analyzed in duplicate for field duplicate QC purposes: 13338-SE-2 (collected 5/6/09), 11270-SE-2 (collected 5/26/09), 11287-SE-2 (collected 6/4/09), and 18322-SE-2 (collected 6/18/09).

All field duplicate results were within QAPP tolerance as follows:

| Field Duplicate Results for TOC Samples | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | TOC (mg/Kg) | | | Accept |
| A954388 | 1817826 | 13338-SE-2 | 5/6/2009 | 5300 | 6400 | 18.8 | Y |
| A964463 | 1842502 | 11270-SE-2 | 5/26/2009 | 5200 | 5800 | 10.9 | Y |
| A968218 | 1844794 | 11287-SE-2 | 6/4/2009 | 6100 | 7300 | 17.9 | Y |
| A978361 | 1868414 | 18322-SE-2 | 6/18/2009 | 8600 | 12000 | 33.0 | Y |

All lab duplicate results were within QAPP tolerance as follows:

| Laboratory Duplicate Results for TOC Samples | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | TOC (mg/Kg) | | | Accept |
| A964463 | 1842502 | 13342-SE-2 | 6/15/2009 | 4000 | 3800 | 5.1 | Y |
| A968218 | 1844794 | 11280-SE-2 | 6/23/2009 | 5500 | 5700 | 3.6 | Y |
| A978361 | 1868414 | 11132-SE-2 | 7/7/2009 | 19000 | 18000 | 5.4 | Y |
| A992281 | 1885518 | 17149-SE-2 | 7/31/2009 | 18000 | 19000 | 5.4 | Y |
| A9A8900 | 1921200 | TBD15-SE-2 | 8/31/2009 | 10000 | 9500 | 5.1 | Y |

All BS/BSD % RPDs were within QAPP required tolerance.

| Blank Spike Recovery Results for TOC Samples | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | TOC (mg/kg) | | | Accept |
| A954388 | 1817826 | QC Standard | 5/15/2009 | | NA | NC | Y |
| A964463 | 1842502 | QC Standard | 6/15/2009 | | 87 | 20.6 | Y |
| A968218 | 1844794 | QC Standard | 6/23/2009 | | 87 | 15.9 | Y |
| A971779 | 1856763 | QC Standard | 6/29/2009 | | 95 | 2.1 | Y |
| 978361<br>A981800<br>A982220 | 1868414 | QC Standard | 7/7/2009 | | 99 | 2.0 | Y |
| A992281 | 18885518 | QC Standard | 7/31/2009 | | 92 | 1.1 | Y |
| A9A8900 | 1921200 | QC Standard | 8/31/2009 | | 95 | 3.2 | Y |

The overall frequency of LD and FD is as follows:

| QC Frequency for TOC Samples | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | | Frequency of LD |
| A954388 | 3 | 1 | 4 | 0 | 33% | 0% |
| A964463 | 11 | 1 | 12 | 1 | 9.1% | 8.3% |
| A968218 | 6 | 1 | 7 | 1 | 17% | 14% |
| A971779 | 3 | 0 | 3 | 0 | 0% | 0% |
| A978361 | 9 | 1 | 10 | 1 | 11% | 10% |
| A981800 | 3 | 0 | 3 | 0 | 0% | 0% |
| A982220 | 1 | 0 | 1 | 0 | 0% | 0% |
| A992281 | 1 | 0 | 1 | 1 | 0% | 100% |
| A9A8900 | 1 | 0 | 1 | 1 | 0% | 100% |
| | | | **Overall Frequency** | | **10.5%** | **11.9%** |

The minimum overall frequency of FD's is 5%.

**Representativeness**

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

* Comparing the chain-of-custody procedures to those described in the QAPP;

* Evaluating holding times; and

* Examining method blanks for contamination of samples during analysis.

The samples in this SDG were collected and analyzed following the QAPP, COC and analytical procedures. All samples were prepared and analyzed with the holding times required for the analysis.

There was at least one method blank analyzed with each batch associated with the TOC analyses in each SDG. The method blanks were below the RLs.

**Completeness**

Completeness has been evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

No reported results for samples in this SDG have been rejected or invalidated. The completeness for this SDG is 100% compared to the minimum acceptance limit of 90%.

## COMPARABILITY

All data was generated using contract-specific standard methods and reported with known data quality, type of analysis, units, etc.

## DATA USABILITY

All calculations were spot checked and verified. All data in this SDG are considered usable for the purposes of this project.

**Flag Key:**
H = Holding time exceedance
I = Ion ration failure
F = Field dup exceedance
L = Lab dup exceedance
S = Blank spike or lab control spike exceedance
Q = Limit of Quantitation (LOQ) exceedance
D = Surrogate/Internal Standard exceedance
J = Estimated by lab
U = Non-detected above MDL
B = Blank Contamination
M = Matrix spike exceedance
E = Estimated due to DOC > TOC by over 10%

# DATA VERIFICATION SUMMARY REPORT
# FOR PCBS IN WATER SAMPLES COLLECTED IN THE
# HOUSTON SHIP CHANNEL SYSTEM

**(Segments 0901, 1001, 1005, 1006, 1007, 2420, 2429, 2428, 2427, 2426, 2436, 2438, and 2421)**

**HOUSTON, TEXAS**

Data Verifier: Sandra de las Fuentes (Parsons - Austin, TX)

## INTRODUCTION

The following data verification summary report covers analysis of environmental water samples, including ninety-one (91) glass fiber filters and eighty-three (83) XAD-2 resin columns, collected from the Houston Ship Channel System in Houston Texas over the five month period between April 17, 2009 and September 26, 2009. The samples were analyzed for Polychlorinated Biphenyls (PCBs) as congeners following laboratory Sample Delivery Groups (SDGs):

**A952954, A953086, A954410, A954413, A957760, A957781, A961408, A963546, A964499, A963036, A965944, A964571, A965978. A968435, A968613, A957821, A971722, A971975, A976792. A976818, A977356, A990536, A990551, A991224, A991228, A998728, A999148, A9A3171, A9A3175, A9A4264, A9A4243, A9A5411, A9A7802, A9A7925, A9A8903, A9A8904, A9C8705, and A9C8708.**

All samples were collected by the University of Houston and Parsons following the procedures described in the QAPP. All analyses were performed by Maxxam Analytical Inc. in Burlington, Canada following procedures outlined in the QAPP and Method 1668A for PCB congeners.

## EVALUATION CRITERIA

The data submitted by the laboratory has been reviewed and verified following the guidelines outlined in the QAPP and National Functional Guidelines for Organic and Inorganic Data (EPA 1994). Information reviewed in the data packages include sample results; the laboratory quality control results; instrument calibrations; blanks; case narrative and chain-of-custody forms. The verification protocol addressed the following parameters: method blanks, laboratory control spike recoveries, recoveries of labeled compounds (internal standards), continuing calibration verifications, laboratory and field duplicate sample percent reproducibility (%RPD), percent recovery (%R), and Level of Quantification (LOQ) standard results. The analyses and findings presented in this report are based on the reviewed information, and meeting guidelines in the QAPP (with the exceptions noted below).

## POLYCHLORINATED BIPHENYLS

### General

The SDGs included in this report contained the samples listed in Table 1 and analyzed for PCBs. The PCBs analyses were performed using USEPA Method 1668A. All samples for this SDG were collected and analyzed following the procedures and protocols outlined in the QAPP. All samples collected were prepared and analyzed within the holding times required by the method. Several water samples required dilution due to high PCBs and/or matrix interference.

**Table 1: Data Packages, Sample IDs and Collection Dates and Times**

| | | | | | Meet DQO for Holding Time * |
|---|---|---|---|---|---|
| A952954 | 20570-D-1-RO | | 05/27/09 | 40 | Y |
| | - | | 05/27/09 | 30 | Y |
| | - | | 05/27/09 | 30 | Y |
| | | | 05/27/09 | 22 | Y |
| | | | 06/11/09 | 37 | Y |
| | | | 05/27/09 | 23 | Y |
| | | | 06/11/09 | 38 | Y |
| A953086 | 20570-SU1-1-RO | | 06/16/09 | 60 | Y |
| | - | | 06/16/09 | 50 | Y |
| | - | | 06/16/09 | 50 | Y |
| | 20570-SU40-1-RO | | 06/16/09 | 60 | Y |
| | | | 06/16/09 | 50 | Y |
| | | | 06/16/09 | 50 | Y |
| A954410 | | | 06/11/09 | 35 | Y |
| | | | 06/11/09 | 36 | Y |
| | | | 06/11/09 | 36 | Y |
| | | | 06/11/09 | 35 | Y |
| | | | 06/11/09 | 35 | Y |
| A954413 | | | 05/28/09 | 21 | Y |
| | | | 05/28/09 | 22 | Y |
| | | | 05/28/09 | 22 | Y |
| | | | 05/28/09 | 21 | Y |
| | - | | 05/28/09 | 21 | Y |
| A957760 | 20575-SU1-1-RO | | 06/16/09 | 36 | Y |
| | 11387-SU-2 | | 06/11/09 | 28 | Y |
| | 11387-D-2 | | 07/24/09 | 71 | Y |
| A957781 | 11132-SU-2 | | 06/16/09 | 35 | Y |
| | 20575-SU-2 | | 06/17/09 | 37 | Y |
| | 11139-SU-2 | | 06/16/09 | 34 | Y |
| | 11132-D-2 | | 07/24/09 | 73 | Y |
| | 20575-D-2 | | 07/24/09 | 74 | Y |

| | | | | | Meet DQO for Holding Time * |
|---|---|---|---|---|---|
| | 11139-D-2 | | 07/24/09 | 72 | Y |
| A961408 | 11193-D-2 | | 07/27/09 | 66 | Y |
| | 16622-D-2 | | 07/27/09 | 66 | Y |
| | 13344-D-2 | | 07/27/09 | 67 | Y |
| | 13342-D-2 | | 07/28/09 | 70 | Y |
| | 16618-D-2 | | 07/28/09 | 70 | Y |
| | 11258-D-2 | | 07/28/09 | 68 | Y |
| A963546 | 15301-D-2 | | 07/28/09 | 63 | Y |
| | 15936-D-2 | | 07/28/09 | 63 | Y |
| A964499 | 15979-D-2 | | 07/29/09 | 62 | Y |
| | 11280-D-2 | | 07/29/09 | 62 | Y |
| | 11264-D-2 | | 07/29/09 | 63 | Y |
| | 11270-D-2 | | 07/29/09 | 63 | Y |
| A963036 | 13342-SU-2 | | 08/05/09 | 78 | Y |
| | 11258-SU-2 | | 08/06/09 | 77 | Y |
| | 15936-SU-2 | | 08/06/09 | 72 | Y |
| | 16618-SU-2 | | 08/06/09 | 79 | Y |
| | 16622-SU-2 | | 08/06/09 | 76 | Y |
| | 13344-SU-2 | | 08/06/09 | 77 | Y |
| | 11193-SU-2 | | 08/06/09 | 76 | Y |
| | 15301-SU-2 | | 08/06/09 | 72 | Y |
| A965944 | 13363-SU-2 | | 08/07/09 | 70 | Y |
| | 13355-SU-2 | | 08/07/09 | 70 | Y |
| | 13355-SU-2-DUP | | 08/07/09 | 70 | Y |
| A964571 | 11264-SU-2 | | 08/06/09 | 71 | Y |
| | 11270-SU-2 | | 08/06/09 | 71 | Y |
| | 15979-SU-2 | | 08/06/09 | 70 | Y |
| | 11280-SU-2 | | 08/09/09 | 73 | Y |
| A965978 | 13363-D-2 | | 08/19/09 | 82 | Y |
| | 13355-D-2 | | 07/29/09 | 61 | Y |
| | 13355-D-2-DUP | | 07/29/09 | 61 | Y |
| A968435 | 11262-SU-2 | | 08/14/09 | 70 | Y |
| | 11292-SU-2 | | 08/14/09 | 72 | Y |
| | 11287-SU-2 | | 08/14/09 | 71 | Y |
| | 11274-SU-2 | | 08/14/09 | 71 | Y |
| A968613 | 11262-D-2 | | 08/11/09 | 67 | Y |
| | 11274-D-2 | | 08/11/09 | 68 | Y |
| | 11287-D-2 | | 08/11/09 | 68 | Y |
| | 11292-D-2 | | 08/11/09 | 69 | Y |
| A957821 | TBDVINCE-SU-2 | | 08/05/09 | 85 | Y |
| | 11279-SU-2 | | 08/05/09 | 83 | Y |
| | TBDVINCE-D-2 | | 07/24/09 | 73 | Y |
| | 20575-D-1-RO | | 07/28/09 | 78 | Y |
| | 11279-D-2 | | 07/26/09 | 73 | Y |

| | | | | | Meet DQO for Holding Time * |
|---|---|---|---|---|---|
| | 20575-SU40-1-RO | | 06/17/09 | 35 | Y |
| A971722 | 18363-D-2 | | 08/19/09 | 71 | Y |
| | 18322-D-2 | | 08/19/09 | 71 | Y |
| | 11288-D-2 | | 08/19/09 | 69 | Y |
| | TBD10-D-2 | | 08/12/09 | 63 | Y |
| A971975 | T002-D-2 | | 08/12/09 | 62 | Y |
| | T002-D-2-DUP | | 08/19/09 | 69 | Y |
| | TBD11-D-2 | | 08/19/09 | 70 | Y |
| A976792 | 11288-SU-2 | | 08/14/09 | 64 | Y |
| | 18363-SU-2 | | 08/16/09 | 68 | Y |
| | TBD10-SU-2 | | 08/16/09 | 67 | Y |
| | T002-SU-2-DUP | | 08/16/09 | 66 | Y |
| | 11285-SU-2 | | 08/17/09 | 66 | Y |
| A976818 | 11265-D-2 | 06/12/09 | 8/29/2009 | 78 | Y |
| | 11265-D-2-REC | 06/12/09 | 8/19/2009 | 68 | Y |
| | TRIP2-D-2 | 06/12/09 | 8/14/2009 | 63 | Y |
| | 11285-D-2 | 06/12/09 | 8/29/2009 | 78 | Y |
| A977356 | T002-SU-2 | 06/11/09 | 8/17/2009 | 67 | Y |
| | TBD11-SU-2 | 06/10/09 | 8/17/2009 | 68 | Y |
| | 18322-SU-2 | 06/09/09 | 8/17/2009 | 69 | Y |
| | TRIP2-SU-2 | 06/12/09 | 8/17/2009 | 66 | Y |
| | 11265-SU-2 | 06/12/09 | 8/17/2009 | 66 | Y |
| A990536 | TRIP3-D-2 | 06/29/09 | 8/22/2009 | 54 | Y |
| | 16657-D-2 | 06/25/09 | 8/22/2009 | 58 | Y |
| | 17149-D-2 | 07/14/09 | 8/22/2009 | 39 | Y |
| | 11347-D-2 | 06/29/09 | 8/29/2009 | 61 | Y |
| | 20574-D-2 | 06/26/09 | 8/23/2009 | 58 | Y |
| A990551 | 11129-SU-2 | 06/26/09 | 8/17/2009 | 52 | Y |
| | 11115-SU-2 | 06/25/09 | 8/17/2009 | 53 | Y |
| | 16657-SU-2 | 06/25/09 | 8/17/2009 | 53 | Y |
| | 11347-SU-2-DUP | 06/29/09 | 8/19/2009 | 51 | Y |
| | 11347-SU-2 | 06/29/09 | 8/19/2009 | 51 | Y |
| A991224 | 11129-D-2 | 06/26/09 | 8/23/2009 | 58 | Y |
| | 11115-D-2 | 06/25/09 | 8/23/2009 | 59 | Y |
| | 11347-D-2-Dup | 06/29/09 | 8/23/2009 | 55 | Y |
| | 20570-D-2 | 06/29/09 | 8/23/2009 | 55 | Y |
| A991228 | 20574-SU-2 | 06/26/09 | 9/8/2009 | 74 | Y |
| | 17149-SU-2 | 07/14/09 | 9/8/2009 | 56 | Y |
| | TRIP3-SU-2 | 06/29/09 | 8/30/2009 | 62 | Y |
| | 20570-SU-2 | 06/29/09 | 9/30/2009 | 93 | Y |
| A998728 | 11132-D-RO-1 | 07/23/09 | 8/23/2009 | 31 | Y |
| | 11139-D-RO-1 | 07/23/09 | 8/23/2009 | 31 | Y |
| | FWSD 51-D | 08/03/09 | 8/23/2009 | 20 | Y |
| A999148 | FWSD 51-SU | 08/03/09 | 9/30/2009 | 58 | Y |

| | | | | | Meet DQO for Holding Time * |
|---|---|---|---|---|---|
| | 11132-SU1-RO-1 | 07/23/09 | 9/8/2009 | 47 | Y |
| | 11139-SU1-RO-1 | 07/23/09 | 9/8/2009 | 47 | Y |
| | 11132-SU40-RO-1 | 07/23/09 | 9/8/2009 | 47 | Y |
| | 11139-SU40-RO-1 | 07/23/09 | 9/8/2009 | 47 | Y |
| A9A3171 | 10395-008-D | 08/06/09 | 9/10/2009 | 35 | Y |
| | 01740-000-D | 08/07/09 | 9/11/2009 | 35 | Y |
| | 10495-090-D | 08/07/09 | 9/11/2009 | 35 | Y |
| | 10495-003-D-DUP | 08/05/09 | 9/11/2009 | 37 | Y |
| A9A3175 | 10395-008-SU | 08/06/09 | 9/8/2009 | 33 | Y |
| | 01740-000-SU | 08/07/09 | 9/8/2009 | 32 | Y |
| | 10495-090-SU | 08/07/09 | 9/8/2009 | 32 | Y |
| | 10495-003-SU-DUP | 08/05/09 | 9/9/2009 | 35 | Y |
| A9A4264 | 00458-000-D | 08/06/09 | 9/10/2009 | 35 | Y |
| | 10495-003-D | 08/05/09 | 9/10/2009 | 36 | Y |
| | 10206-001-D | 08/04/09 | 9/11/2009 | 38 | Y |
| | 10206-000-D | 08/04/09 | 9/11/2009 | 38 | Y |
| A9A4243 | 00458-000-SU | 08/06/09 | 9/9/2009 | 34 | Y |
| | 10495-003-SU | 08/05/09 | 9/9/2009 | 35 | Y |
| | 10206-001-SU | 08/04/09 | 9/9/2009 | 36 | Y |
| | 10206-000-SU | 08/04/09 | 9/9/2009 | 36 | Y |
| A9A5411 | 11261-D-2-DUP | 06/05/09 | 9/11/2009 | 98 | Y |
| | 11261-D-2 | 06/05/09 | 9/11/2009 | 98 | Y |
| | 11261-SU-2 | 06/05/09 | 9/9/2009 | 96 | Y |
| | 11261-SU-2-DUP | 06/05/09 | 9/9/2009 | 96 | Y |
| A9A7802 | | 08/18/09 | 9/11/2009 | 24 | Y |
| | - | 08/11/09 | 9/11/2009 | 31 | Y |
| | | 08/18/09 | 10/21/2009 | 64 | Y |
| | | 08/17/09 | 10/21/2009 | 65 | Y |
| | - - | 08/12/09 | 10/21/2009 | 70 | Y |
| A9A7925 | - | 08/18/09 | 9/17/2009 | 30 | Y |
| | - | 08/17/09 | 9/17/2009 | 31 | Y |
| | - | 08/18/09 | 9/17/2009 | 30 | Y |
| | - | 08/12/09 | 9/17/2009 | 36 | Y |
| | - | 08/12/09 | 9/17/2009 | 36 | Y |
| A9A8903 | - | 08/14/09 | 10/21/2009 | 68 | Y |
| | - | 08/13/09 | 10/21/2009 | 69 | Y |
| | - - | 08/12/09 | 9/11/2009 | 30 | Y |
| | - | 08/13/09 | 9/11/2009 | 29 | Y |
| | | 08/11/09 | 9/11/2009 | 31 | Y |
| A9A8904 | | 08/14/09 | 9/17/2009 | 34 | Y |
| | TBD15-SU-2 | 08/11/09 | 9/17/2009 | 37 | Y |
| | 20574-SU40-1-RO | 08/13/09 | 9/17/2009 | 35 | Y |
| | WQ0001429-SU-2 | 08/13/09 | 9/21/2009 | 39 | Y |
| | 20574-SU1-1-RO | 08/13/09 | 9/21/2009 | 39 | Y |

| | | | | | Meet DQO for Holding Time * |
|---|---|---|---|---|---|
| | 00587-000-SU | 08/11/09 | 9/22/2009 | 42 | Y |
| A9C8705 | ERB1-SU-2 | 09/26/09 | 10/13/2009 | 17 | Y |
| | 16872-SU-2 | 08/31/09 | 10/14/2009 | 44 | Y |
| | 11139-SU1-RO-2 | 09/09/09 | 10/14/2009 | 35 | Y |
| | 11139-SU40-RO-2 | 09/09/09 | 10/14/2009 | 35 | Y |
| | 11115-SU1-RO-1 | 09/22/09 | 10/13/2009 | 21 | Y |
| | 11115-SU40-RO-1 | 09/22/09 | 10/13/2009 | 21 | Y |
| A9C8708 | 11139-D-RO-2 | 09/09/09 | 10/21/2009 | 42 | Y |
| | ERB1-D-2 | 09/26/09 | 10/21/2009 | 25 | Y |
| | 11115-D-RO-1 | 09/22/09 | 10/22/2009 | 30 | Y |
| | 16872-D-2 | 08/31/09 | 10/22/2009 | 52 | Y |

**Accuracy**

Accuracy was evaluated using the %R results for the blank spike samples (BS), Limit of Quantification (LOQ) samples, and labeled compound spikes.

The BS, LOQ and labeled compound spike recoveries %Rs were within method acceptance criteria, except for the congeners listed in "PCB_QC_Water_Maxxam_UH_2009" worksheet "PCB Water Flags (vol correct)" and "PCB_QC_Water_Maxxam_UH_2009" worksheet "PCB Water Flags (vol correc (2)". All LOQ failures are flagged "Q", blank spike failures are flagged "S" and labeled compound spike recovery failures are flagged "D". All associated congeners are flagged according to the QC failure type.

**Precision**

Precision was evaluated using the Relative Percent Difference (%RPD) obtained from the parent sample/field duplicate sample results. There were ten (10) field duplicates (FD) collected and no lab duplicates (LD) analyzed.

The overall frequency of LD and FD is as follows:

| QC Frequency for PCB Water Samples | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | | Frequency of LD |
| A952954 | 7 | 0 | 7 | 0 | 0% | 0% |
| A953086 | 6 | 0 | 6 | 0 | 0% | 0% |
| A954410 | 5 | 0 | 5 | 0 | 0% | 0% |
| A954413 | 5 | 0 | 5 | 0 | 0% | 0% |
| A957760 | 3 | 0 | 3 | 0 | 0% | 0% |
| A957781 | 6 | 0 | 6 | 0 | 0% | 0% |

| QC Frequency for PCB Water Samples | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | | **Frequency of LD** |
| A961408 | 6 | 0 | 6 | 0 | 0% | 0% |
| A963546 | 2 | 0 | 2 | 0 | 0% | 0% |
| A964499 | 4 | 0 | 4 | 0 | 0% | 0% |
| A963036 | 8 | 0 | 8 | 0 | 0% | 0% |
| A965944 | 2 | 1 | 3 | 0 | 50% | 0% |
| A964571 | 4 | 0 | 4 | 0 | 0% | 0% |
| A965978 | 2 | 1 | 3 | 0 | 50% | 0% |
| A968435 | 4 | 0 | 4 | 0 | 0% | 0% |
| A968613 | 4 | 0 | 4 | 0 | 0% | 0% |
| A957821 | 6 | 0 | 6 | 0 | 0% | 0% |
| A971722 | 4 | 0 | 4 | 0 | 0% | 0% |
| A971975 | 2 | 1 | 3 | 0 | 50% | 0% |
| A976792 | 4 | 1 | 5 | 0 | 25% | 0% |
| A976818 | 4 | 0 | 4 | 0 | 0% | 0% |
| A977356 | 5 | 0 | 5 | 0 | 0% | 0% |
| A990536 | 5 | 0 | 5 | 0 | 0% | 0% |
| A990551 | 4 | 1 | 5 | 0 | 25% | 0% |
| A991224 | 3 | 1 | 4 | 0 | 33% | 0% |
| A991228 | 4 | 0 | 4 | 0 | 0% | 0% |
| A998728 | 3 | 0 | 3 | 0 | 0% | 0% |
| A999148 | 5 | 0 | 5 | 0 | 0% | 0% |
| A9A3171 | 3 | 1 | 4 | 0 | 33% | 0% |
| A9A3175 | 3 | 1 | 4 | 0 | 33% | 0% |
| A9A4264 | 4 | 0 | 4 | 0 | 0% | 0% |
| A9A4243 | 4 | 0 | 4 | 0 | 0% | 0% |
| A9A5411 | 2 | 2 | 4 | 0 | 100% | 0% |
| A9A7802 | 5 | 0 | 5 | 0 | 0% | 0% |
| A9A7925 | 5 | 0 | 5 | 0 | 0% | 0% |
| A9A8903 | 5 | 0 | 5 | 0 | 0% | 0% |
| A9A8904 | 6 | 0 | 6 | 0 | 0% | 0% |
| A9C8705 | 6 | 0 | 6 | 0 | 0% | 0% |
| A9C8708 | 4 | 0 | 4 | 0 | 0% | 0% |
| | | | **Overall Frequency** | | **6.1%** | **0.0%** |

The overall frequency met the required criteria for FD of 5%. Laboratory duplicates were not possible for these matrices due to insufficient media. An “F” flag was applied to the parent and duplicate congeners that was greater than 50% RPD.

## Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

* Comparing the chain-of-custody procedures to those described in the QAPP;
* Evaluating holding times; and
* Examining method blanks for contamination of samples during analysis.

The samples in this SDG were collected and analyzed following the QAPP, COC and analytical procedures. All samples were prepared and analyzed with the holding times required for the analysis.

All initial calibration criteria were met.

All continuing calibration criteria (BS) were met.

All LOQ standard criteria were met, with the exception of those listed in the accuracy table.

There was at least one method blank analyzed with each batch associated with the PCBs analyses in each SDG. The method blanks had some PCBs of concern above the RLs. The sample results that were less than five (5) times the amount found in the method blanks or trip blanks were "B" flagged for having blank contamination.

**Completeness**

Completeness has been evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

No reported results for samples in this SDG have been rejected or invalidated. The completeness for this SDG is 100% compared to the minimum acceptance limit of 90%.

## COMPARABILITY

All data was generated using contract-specific standard methods and reported with known data quality, type of analysis, units, etc.

## DATA USABILITY

All calculations were spot checked and verified. All data in this SDG are considered usable for the purposes of this project.

# DATA VERIFICATION SUMMARY REPORT

# FOR PCBS IN SEDIMENT SAMPLES COLLECTED IN THE

# HOUSTON SHIP CHANNEL SYSTEM

# (Segments 0901, 1001, 1005, 1006, 1007, 2420, 2429,

# 2428, 2427, 2426, 2436, 2438, and 2421)

## HOUSTON, TEXAS

Data Verifier: Sandra de las Fuentes (Parsons - Austin, TX)

## INTRODUCTION

The following data verification summary report covers analysis of environmental sediment samples, including forty-two (42) sediment samples and four (4) field duplicate samples, collected from the Houston Ship Channel System in Houston Texas over the three month period between May 6, 2009 and August 12, 2009. The samples were analyzed for Polychlorinated Biphenyls (PCBs) as congeners following laboratory Sample Delivery Groups (SDGs)

**1094733, 1096016, 1096018, 1097888, 1097891, 1097894, 1097895, 1098517, 1099535, and 10110354.**

All samples were collected by the University of Houston and Parsons following the procedures described in the QAPP. All analyses were performed by Pace Analytical Services, Inc. in Minneapolis, Minnesota, following procedures outlined in the QAPP and Method 1668A for PCB congeners.

## EVALUATION CRITERIA

The data submitted by the laboratory has been reviewed and verified following the guidelines outlined in the QAPP and National Functional Guidelines for Organic and Inorganic Data (EPA 1994). Information reviewed in the data packages include sample results; the laboratory quality control results; instrument calibrations; blanks; case narrative and chain-of-custody forms. The verification protocol addressed the following parameters: method blanks, laboratory control spike recoveries, recoveries of labeled compounds (internal standards), continuing calibration verifications, laboratory and field duplicate sample percent reproducibility (%RPD), percent recovery (%R), and Level of Quantification (LOQ) standard results. The analyses and findings presented in this report are based on the reviewed information, and meeting guidelines in the QAPP (with the exceptions noted below).

## POLYCHLORINATED BIPHENYLS

### General

The SDGs included in this report contained the samples listed in Table 1 and analyzed for PCBs. The PCBs analyses were performed using USEPA Method 1668A. All samples for this SDG were collected and analyzed following the procedures and protocols outlined in the QAPP. All samples collected were prepared and analyzed within the holding times required by the method. Some sediment samples required dilution due to high PCBs and/or matrix interference.

**Table 1: Data Packages, Sample IDs and Collection Dates and Times**

| | | | | | Meet DQO for Holding Time * |
|---|---|---|---|---|---|
| 1094733 | 13338-SE-2 | 5/6/2009 | 6/19/2009 | 44 | Y |
| | 13338-SE-2-DUP | 5/6/2009 | 6/19/2009 | 44 | Y |
| | 16499-SE-2 | 5/6/2009 | 6/19/2009 | 44 | Y |
| | 11252-SE-2 | 5/6/2009 | 6/19/2009 | 44 | Y |
| 1096016 | 11258-SE-2 | 5/22/2009 | 6/18/2009 | 27 | Y |
| | 15301-SE-2 | 5/26/2009 | 6/18/2009 | 23 | Y |
| | 11270-SE-2-DUP | 5/26/2009 | 6/18/2009 | 23 | Y |
| | 11193-SE-2 | 5/20/2009 | 6/22/2009 | 33 | Y |
| | 13344-SE-2 | 5/20/2009 | 6/21/2009 | 32 | Y |
| | 11261-SE-2 | 5/20/2009 | 6/18/2009 | 29 | Y |
| | 16618-SE-2 | 5/21/2009 | 6/19/2009 | 29 | Y |
| | 15936-SE-2 | 5/26/2009 | 6/18/2009 | 23 | Y |
| 1096018 | 16622-SE-2 | 5/21/2009 | 6/17/2009 | 27 | Y |
| | 11270-SE-2 | 5/26/2009 | 6/18/2009 | 23 | Y |
| | 15979-SE-2 | 5/26/2009 | 6/18/2009 | 23 | Y |
| 1097888 | 11264-SE-2 | 5/29/2009 | 7/1/2009 | 33 | Y |
| | 11280-SE-2 | 5/29/2009 | 07/10/2009 | 42 | Y |
| | 11274-SE-2 | 6/4/2009 | 07/01/2009 | 27 | Y |
| | 11292-SE-2 | 6/4/2009 | 07/01/2009 | 27 | Y |
| | 11287-SE-2 | 6/4/2009 | 07/10/2009 | 36 | Y |
| | 11287-SE-2-DUP | 6/4/2009 | 07/10/2009 | 36 | Y |
| | 11262-SE-2 | 6/4/2009 | 07/01/2009 | 27 | Y |
| 1097891 | TBD11-SE-2 | 6/10/2009 | 07/07/2009 | 27 | Y |
| | TRIP1-SED-2 | 6/10/2009 | 07/07/2009 | 27 | Y |
| 1097894 | 11132-SE-2 | 6/17/2009 | 07/13/2009 | 26 | Y |
| | 18322-SE-2 | 6/18/2009 | 07/13/2009 | 25 | Y |
| | 11265-SE-2 | 6/12/2009 | 07/13/2009 | 31 | Y |
| | 11285-SE-2 | 6/12/2009 | 07/13/2009 | 31 | Y |
| | ERB1-SE-2 | 6/18/2009 | 07/13/2009 | 25 | Y |
| | 11288-SE-2 | 6/12/2009 | 07/13/2009 | 31 | Y |
| | 11302-SE-2 | 6/10/2009 | 07/14/2009 | 34 | Y |

| | | | | | Meet DQO for Holding Time * |
|---|---|---|---|---|---|
| 1097895 | TBD10-SE-2 | 6/12/2009 | 07/07/2009 | 25 | Y |
| | 18322-SE-2-DUP | 6/18/2009 | 07/07/2009 | 19 | Y |
| | TRIP2-SE-2 | 6/18/2009 | 7/8/2009 | 20 | Y |
| 1098517 | 11347-SE-2 | 6/29/2009 | 7/14/2009 | 15 | Y |
| | 11129-SE-2 | 6/26/2009 | 7/21/2009 | 25 | Y |
| | 20574-SE-2 | 6/26/2009 | 7/15/2009 | 19 | Y |
| 1099535 | 13342-Se-2 | 5/20/2009 | 09/04/2009 | 107 | Y |
| | T002-Se-2 | 6/11/2009 | 09/04/2009 | 85 | Y |
| | 17149-Se-2 | 7/15/2009 | 09/04/2009 | 51 | Y |
| 10110354 | 18363-SE-2 | 8/10/2009 | 09/02/2009 | 23 | Y |
| | TBD15-SE-2 | 8/12/2009 | 09/02/2009 | 21 | Y |

* Holding time acceptance criteria for PCBs is less than 1 yr.

**Accuracy**

Accuracy was evaluated using the %R results for the blank spike samples (BS), Limit of Quantification (LOQ) samples, and labeled compound spikes.

The BS, LOQ and labeled compound spike recoveries %Rs were within method acceptance criteria, except for the congeners listed in "PCB_QC_Sed_Pace_UH_2009(P2)" worksheet "PCB Sed Flags". All LOQ failures are flagged "Q", blank spike failures are flagged "S" and labeled compound spike recovery failures are flagged "R". All associated congeners are flagged according to the QC failure type.

**Precision**

Precision was evaluated using the Relative Percent Difference (%RPD) obtained from the parent sample/field duplicate sample results. The following samples were collected and analyzed in duplicate for field duplicate QC purposes: 13338-SE-2 (collected 5/6/09), 11270-SE-2 (collected 5/26/09), 11287-SE-2 (collected 6/4/09), and 18322-SE-2 (collected 6/18/09).

All field duplicate results were within QAPP tolerance except for the congeners listed in "PCB_QC_Sed_Pace_UH_2009(P2)" worksheet "PCB Sed Flags". Both the parent and field duplicate samples were flagged "F" as estimated due to the out of tolerance % RPD. All associated congeners, that weren't previously flagged "J", "B" or "U" by the lab, were flagged as estimated ("F") by the data verifier.

The following sample was analyzed in duplicate for lab duplicate QC purposes: 15301-SE-2 (analyzed 6/18/09 in SDG 1096016). All lab duplicate results were within QAPP tolerance.

The overall frequency of LD and FD is as follows:

| QC Frequency for PCB Sediment Samples | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | | **Frequency of LD** |
| 1094733 | 3 | 1 | 4 | 0 | 33.3% | 0.0% |
| 1096018 | 3 | 0 | 3 | 0 | 0.0% | 0.0% |
| 1096016 | 7 | 1 | 8 | 1 | 14.3% | 12.5% |
| 1097888 | 6 | 1 | 7 | 0 | 16.7% | 0.0% |
| 1097895 | 2 | 1 | 3 | 0 | 50.0% | 0.0% |
| 1097891 | 2 | 0 | 2 | 0 | 0.0% | 0.0% |
| 1097894 | 7 | 0 | 7 | 0 | 0.0% | 0.0% |
| 1098517 | 3 | 0 | 3 | 0 | 0.0% | 0.0% |
| 1099535 | 3 | 0 | 3 | 0 | 0.0% | 0.0% |
| 10110354 | 2 | 0 | 2 | 0 | 0.0% | 0.0% |
| | | | **Overall Frequency** | | **10.5%** | **2.4%** |

The overall frequency met the required criteria for FDs and LDs of 5%. Laboratory duplicates were rarely possible for these matrices due to insufficient media. An "F" flag was applied to the parent and FD congeners that were greater than 50% RPD. All lab duplicate RPDs with results above the RL were within the 40% criteria. No flags were required.

**Representativeness**

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

* Comparing the chain-of-custody procedures to those described in the QAPP;
* Evaluating holding times; and
* Examining method blanks for contamination of samples during analysis.

The samples in this SDG were collected and analyzed following the QAPP, COC and analytical procedures. All samples were prepared and analyzed with the holding times required for the analysis.

All initial calibration criteria were met.

All continuing calibration criteria (BS) were met, with the exception of those listed in the accuracy table.

All LOQ standard criteria were met, with the exception of those listed in "PCB_QC_Sed_Pace_UH_2009(P2)" worksheet "PCB Sed Flags".

There was at least one method blank analyzed with each batch associated with the PCBs analyses in each SDG. The method blanks had many PCBs of concern above the RLs. The sample results that were less than five (5) times the amount found in the blank were "B" flagged for having blank contamination.

**Completeness**

Completeness has been evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

No reported results for samples in this SDG have been rejected or invalidated. The completeness for this SDG is 100% compared to the minimum acceptance limit of 90%.

## COMPARABILITY

All data was generated using contract-specific standard methods and reported with known data quality, type of analysis, units, etc.

## DATA USABILITY

All calculations were spot checked and verified. All data in this SDG are considered usable for the purposes of this project.

# DATA VERIFICATION SUMMARY REPORT

# FOR PCBS IN FISH SAMPLES COLLECTED IN THE

# HOUSTON SHIP CHANNEL SYSTEM

# (Segments 0901, 1001, 1005, 1006, 1007, 2420, 2429,

# 2428, 2427, 2426, 2436, 2438, and 2421)

## HOUSTON, TEXAS

Data Verifier: Sandra de las Fuentes (Parsons - Austin, TX)

## INTRODUCTION

The following data verification summary report covers analysis of environmental samples, including Fifty-eight (58) fish samples and six (6) field duplicate samples collected from the Houston Ship Channel System in Houston Texas over a two month between May 5, 2009 and June 25, 2009. The samples were analyzed for Polychlorinated Biphenyls (PCBs) as congeners and percent lipid content following laboratory Sample Delivery Group (SDG)

**1096010, 1096012, 1096013, 1097359, 1097103, 1098566, 1098568, 1099532, 1099533, and 1099534.**

All samples were collected by the University of Houston and Parsons following the procedures described in the QAPP. All analyses were performed by Pace Analytical Services, Inc. in Minneapolis, Minnesota, following procedures outlined in the QAPP and Method 1668A for PCB congeners and an "In-House" Method for % Lipid Content.

## EVALUATION CRITERIA

The data submitted by the laboratory has been reviewed and verified following the guidelines outlined in the QAPP and National Functional Guidelines for Organic and Inorganic Data (EPA 1994). Information reviewed in the data packages include sample results; the laboratory quality control results; instrument calibrations; blanks; case narrative and chain-of-custody forms. The verification protocol addressed the following parameters: method blanks, laboratory control spike recoveries, recoveries of labeled compounds (internal standards), continuing calibration verifications, laboratory and field duplicate sample percent reproducibility (%RPD), percent recovery (%R), and Level of Quantification (LOQ) standard results. The analyses and findings presented in this report are based on the reviewed information, and meeting guidelines in the QAPP (with the exceptions noted below).

Note: Lipid content has been reviewed and meets QAPP guidelines.

## POLYCHLORINATED BIPHENYLS

### General

The SDGs included in this report contained the samples listed in Table 1 and analyzed for PCBs. The PCBs analyses were performed using USEPA Method 1668A. All samples for this SDG were collected and analyzed following the procedures and protocols outlined in the QAPP. All samples collected were prepared and analyzed within the holding times required by the method.

**Table 1: Data Packages, Sample IDs and Collection Dates and Times**

| | | | | | Meet DQO for Holding Time |
|---|---|---|---|---|---|
| 1096010 | 16618-F1-2 | 05/18/09 | 06/19/2009 | 32 | Y |
| | 11193-F3-2-DUP | 05/21/09 | 06/20/2009 | 30 | Y |
| | 16499-F1-2 | 05/7/09 | 06/20/2009 | 44 | Y |
| | 11193-F2-2 | 05/21/09 | 06/20/2009 | 30 | Y |
| | 11193-F1-2 | 05/21/09 | 06/19/2009 | 29 | Y |
| | 13344-F2-2B | 05/19/09 | 06/20/2009 | 32 | Y |
| | 11258-F2-2 | 05/18/09 | 06/20/2009 | 33 | Y |
| 1096012 | 11193-F3-2 | 05/21/09 | 06/20/2009 | 30 | Y |
| | 16499-F2-2 | 05/18/09 | 06/21/2009 | 34 | Y |
| | 13338-F1-2 | 05/7/09 | 06/20/2009 | 44 | Y |
| | 13344-F1-2 | 05/19/09 | 06/20/2009 | 32 | Y |
| | 13338-F2-2 | 05/18/09 | 06/20/2009 | 33 | Y |
| | 11252-F1-2 | 05/5/09 | 06/20/2009 | 46 | Y |
| | 11258-F1-2 | 05/18/09 | 06/20/2009 | 33 | Y |
| 1096013 | 16618-F2-2 | 05/18/09 | 06/21/2009 | 34 | Y |
| | 14560-F1-2 | 05/7/09 | 06/21/2009 | 45 | Y |
| | 13342-F2-2 | 05/18/09 | 06/21/2009 | 34 | Y |
| | 11252-F1-2-DUP | 05/5/09 | 06/21/2009 | 47 | Y |
| | 11252-F2-2 | 05/5/09 | 06/21/2009 | 47 | Y |
| | 13342-F1-2 | 05/18/09 | 06/21/2009 | 34 | Y |
| 1097359 | 11264-F2-2-UHDUP | 05/29/09 | 06/29/2009 | 31 | Y |
| | 11270-F1-2-UHDUP | 05/27/09 | 06/29/2009 | 33 | Y |
| | 15301-F1-2-UHDUP | 05/27/09 | 06/29/2009 | 33 | Y |
| | 15936-F1-2-UHDUP | 05/27/09 | 06/28/2009 | 32 | Y |
| 1097103 | 11264-F1-2-UHDUP | 05/29/09 | 06/27/2009 | 29 | Y |
| | 13355-F1-2-UHDUP | 05/28/09 | 06/28/2009 | 31 | Y |
| | 13355-F2-2-UHDUP | 05/28/09 | 06/27/2009 | 30 | Y |
| | 13355-F3-2-UHDUP | 05/28/09 | 07/02/2009 | 35 | Y |
| | 13363-F1-2-UHDUP | 05/28/09 | 06/27/2009 | 30 | Y |
| | 15936-F2-2-UHDUP | 05/27/09 | 06/27/2009 | 31 | Y |
| | 15979-F1-2-UHDUP | 05/27/09 | 06/28/2009 | 32 | Y |
| 1098566 | 13363-F2-2-ST | 05/29/09 | 07/20/2009 | 52 | Y |

| | | | | | Meet DQO for Holding Time |
|---|---|---|---|---|---|
| | 11262-F1-2-DUP | 06/9/09 | 07/20/2009 | 41 | Y |
| | 11261-F2-2 | 06/9/09 | 07/20/2009 | 41 | Y |
| | 11280-F2-2 | 05/29/09 | 07/20/2009 | 52 | Y |
| | 13363-F2-2-ST-DUP | 05/29/09 | 07/27/2009 | 59 | Y |
| 1098568 | 11262-F2-2 | 06/9/09 | 07/27/2009 | 48 | Y |
| | 11292-F1-2 | 06/10/09 | 07/27/2009 | 47 | Y |
| | 13363-F2-2-AC | 05/28/09 | 07/26/2009 | 59 | Y |
| | 11261-F1-2 | 06/9/09 | 07/26/2009 | 47 | Y |
| | 11262-F1-2 | 06/9/09 | 07/26/2009 | 47 | Y |
| 1099532 | 11274-F1-2 | 06/19/09 | 07/29/2009 | 40 | Y |
| | 11287-F1-2 | 06/12/09 | 07/29/2009 | 47 | Y |
| | 11347-F1-2 | 06/12/09 | 07/29/2009 | 47 | Y |
| | 17149-F1-2 | 07/15/09 | 07/29/2009 | 14 | Y |
| | 11280-F1-2 | 06/10/09 | 07/29/2009 | 49 | Y |
| | 11288-F1-2 | 06/24/09 | 07/29/2009 | 35 | Y |
| 1099533 | 11265-F1-2-DUP | 06/19/2009 | 07/30/2009 | 41 | Y |
| | 18322-F1-2 | 06/19/2009 | 07/30/2009 | 41 | Y |
| | 11265-F1-2 | 06/18/2009 | 07/30/2009 | 42 | Y |
| | BLANKA-F2-2 | 06/18/2009 | 07/30/2009 | 42 | Y |
| | 16622-F1-2 | 06/18/2009 | 07/30/2009 | 42 | Y |
| | 11292-F1-2-DUP | 06/10/2009 | 07/30/2009 | 50 | Y |
| 1099534 | 11132-F1-2 | 05/20/2009 | 07/30/2009 | 71 | Y |
| | 11271-F1-2 | 06/25/2009 | 07/30/2009 | 35 | Y |
| | 15979-F2-2 | 06/17/2009 | 07/30/2009 | 43 | Y |
| | BLANKB-F2-2 | 06/18/2009 | 07/30/2009 | 42 | Y |
| | BLANKC-F2-2 | 06/18/2009 | 07/30/2009 | 42 | Y |

**Accuracy**

Accuracy was evaluated using the %R results for the blank spike samples (BS), Limit of Quantification (LOQ) samples, and labeled compound spikes.

The BS, LOQ and labeled compound spike recoveries %Rs were within method acceptance criteria, except for the congeners listed in "PCB_QC_Fish_Pace_UH_0910(P2)" worksheet "PCB Fish Flags". All LOQ failures are flagged "Q", blank spike failures are flagged "S", and labeled compound spike recovery failures are flagged "R". All associated congeners are flagged according to the QC failure type.

**Precision**

Precision was evaluated using the Relative Percent Difference (%RPD) obtained from the parent sample/field duplicate sample results. The following samples were collected and

analyzed in duplicate for field duplicate QC purposes: 11193-F3-2 (collected 5/21/09), 11252-F1-2 (collected 5/5/09), 13363-F2-2 (collected 5/29/09), 11262-F1-2 (collected 6/9/09), 11292-F1-2 (collected 6/10/09), and 11265-F1-2 (collected 6/19/09). All field duplicate results were within QAPP tolerance except for the congeners listed in "PCB_QC_Fish_Pace_UH_2009(P2)" worksheet "PCB Fish Flags". Both the parent and field duplicate samples were flagged "F" as estimated due to the out of tolerance % RPD. All associated congeners, that weren't previously flagged "J", "B" or "U" by the lab, were flagged as estimated ("F") by the data verifier.

The overall frequency of LD and FD is as follows:

| QC Frequency for PCB Fish Samples | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | | **Frequency of LD** |
| 1096010 | 6 | 1 | 6 | 0 | 17% | 0% |
| 1096012 | 7 | 0 | 7 | 0 | 0% | 0% |
| 1096013 | 5 | 1 | 5 | 0 | 20% | 0% |
| 1097359 | 4 | 0 | 4 | 0 | 0% | 0% |
| 1097103 | 7 | 0 | 7 | 0 | 0% | 0% |
| 1098566 | 8 | 2 | 8 | 0 | 25% | 0% |
| 1098568 | | | | | | |
| 1099532 | 6 | 0 | 6 | 0 | 0% | 0% |
| 1099533 | 4 | 2 | 6 | 0 | 50% | 0% |
| 1099534 | 5 | 0 | 5 | 0 | 0% | 0% |
| | | | **Overall Frequency** | | **11.5%** | **0.0%** |

The overall frequency met the required criteria for FD of 5%. Laboratory duplicates were not possible for these matrices due to insufficient media. An "F" flag was applied to the parent and duplicate congeners that was greater than 50% RPD.

**Representativeness**

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

* Comparing the chain-of-custody procedures to those described in the QAPP;
* Evaluating holding times; and
* Examining method blanks for contamination of samples during analysis.

The samples in this SDG were collected and analyzed following the QAPP, COC and analytical procedures. All samples were prepared and analyzed with the holding times required for the analysis.

All initial calibration criteria were met.

All continuing calibration criteria (BS) were met.

All LOQ standard criteria were met, with the exception of those listed in "PCB_QC_Fish_Pace_UH_2009(P2)" worksheet "PCB Fish Flags".

There was at least one method blank analyzed with each batch associated with the PCBs analyses in each SDG. The method blanks had some PCBs of concern above the RLs. The sample results that were less than five (5) times the amount found in the blank were "B" flagged for having blank contamination.

**Completeness**

Completeness has been evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

No reported results for samples in this SDG have been rejected or invalidated. The completeness for this SDG is 100% compared to the minimum acceptance limit of 90%.

## COMPARABILITY

All data was generated using contract-specific standard methods and reported with known data quality, type of analysis, units, etc.

## DATA USABILITY

All calculations were spot checked and verified. All data in this SDG are considered usable for the purposes of this project.