2013 Annual Report

June, 2013

Adaptive Management Plan for Reducing PCBs in Stormwater Discharges

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City of Spokane
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2013 Annual Report

ADAPTIVE MANAGEMENT PLAN FOR REDUCING PCBS IN STORMWATER DISCHARGES

INTRODUCTION

Polychlorinated biphenyls (PCBs) are manmade compounds that have been identified ubiquitously throughout the environment. PCBs were sold under the trade name of "Aroclor" and were typically used in transformer fluids, adhesives, cements, additives, lubricants and fire retardants until manufacturing of PCBs was banned in the US in 1977. However, they persist in the environment and bio-accumulate in aquatic ecosystems as concentrations accumulate in organisms through the food chain. Although manufacturing of PCBs was banned in the 1970's, new sources of PCB contamination still exist in the environment. PCBs can be produced inadvertently in manufacturing processes that involve hydrocarbons, chlorine and heat such as pigments, printing inks, agricultural chemicals, plastics and detergent bars. Recycling facilities may process PCB contaminated materials such as paper products and asphalt roofing. Materials containing less than 50 parts per million (ppm) are not regulated under the Toxics Substances Control Act (TSCA) and are not considered "PCB-contaminated" (40 CFR 761.3). For comparison, current EPA human health surface water quality standards for PCBs is 170 picograms per liter, equivalent to 0.00000017 ppm (National Toxics Rule, 40 CFR 131.36). The Spokane Tribe adopted a water quality standard of 3.37 picograms per liter (0.00000000337 ppm) due to higher fish consumption rates used to derive the standard.

One pathway for PCBs to enter surface water bodies is through stormwater. Runoff from precipitation may collect pollutants along roadways, parking lots and other contributing areas, enter storm drains, and then discharge to water bodies with little pre-treatment. In addition to a separate storm sewer system, the City of Spokane also has a combined sanitary and storm sewer where stormwater and sewage are combined in the same pipes. When storm events exceed the capacity of the combined sewer system, it overflows and discharges into the Spokane River with little pre-treatment in what is called a Combined Sewer Overflow (CSO). The Spokane River courses through the City of Spokane, with nearly 100 stormwater and CSO outfalls along the 18 mile reach.

To assess concentration of PCBs in some common stormwater contaminants, samples of off-the-shelf motor oil, transmission fluid, and shredded tire scraps were sent for laboratory analysis in 2011. Table 1 shows results of this informal investigation. The shredded tire sample could not produce a definitive result due to sample matrix interference.

Table 1. Oil and Transmission Fluid Sample PCB Concentrations

Sample	Total PCB, micrograms per kilogram (ppb) (EPA Method 1668)
Pennzoil SAE5W-30	37.8
Quaker State SAE5W-30	14
Valvoline Mercon V	49.5
Red Line D4 Automatic Transmission Fluid	8.8
Valvoline Full Synthetic 5W-30	116

STUDY AREA

The Spokane River begins at the outlet of Lake Coeur d'Alene in north Idaho, about 12 miles east of the Washington-Idaho border. Its basin encompasses more than 6,000 square miles. The River flows through the Cities of Coeur d'Alene, Post Falls, Liberty Lake, Spokane Valley, and urban areas of Spokane County before flowing through the City of Spokane. Downstream of the City of Spokane is Long Lake and the Spokane Indian Reservation before the Spokane River discharges to the Columbia River. Mean monthly flow rates in the river, as measured at the USGS Spokane River at Spokane gage, range from 1,700 cubic feet per second (cfs) in August to 17,700 cfs in May with a median peak spring flow of 25,000 cfs (USGS, 2012). Much of the Spokane region upstream of Long Lake is situated over the Spokane Valley Rathdrum Prairie (SVRP) Aquifer, a sole-source aquifer contributing drinking water to nearly half a million people. The Spokane River and SVRP Aquifer are an intimately linked water resource. Figure 1 shows the Spokane River basin and SVRP aquifer.

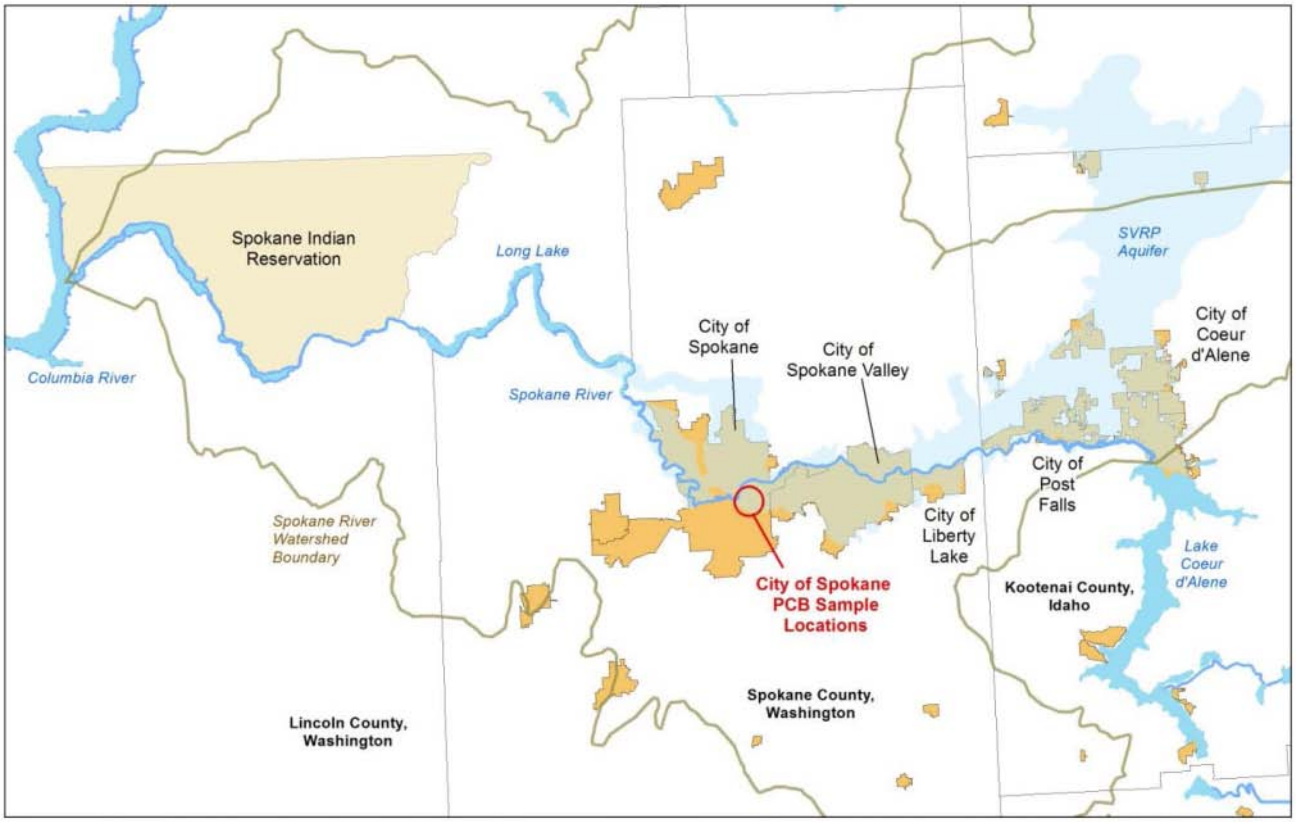

Figure 1. Spokane River Vicinity Map

BACKGROUND: PCBS AND THE SPOKANE RIVER

Several segments of the Spokane River violate water quality standards for the presence of PCBs and have been placed on the state Water Quality Assessments (303(d)) list of impaired water bodies. In 2007, the Washington State Department of Ecology (Ecology) published the "Spokane River PCB TMDL Stormwater Loading Analysis" (Parsons, 2007). In 2011, Ecology published the "Spokane River PCB Source Assessment, 2003-2007," originally as a draft PCB Total Maximum Daily Load (TMDL) (Ecology, 2011). However, rather than develop a PCB TMDL, Ecology elected to pursue an innovative straight-to-implementation strategy. The intent is to more directly approach PCB loading to the Spokane River instead of spending a decade or more establishing a TMDL and wasteload allocations before taking any actions to solve the problem. NPDES permits issued to waste discharge facilities in 2011, including the City of Spokane, require the formation of a regional task force and establishment of performance-based PCB limits within the first permit cycle. Thus, the Spokane River Regional Toxics Task Force was officially formed in early 2012. The City of Spokane is a Task Force member, addressing both wastewater and stormwater discharges.

REGULATORY REQUIREMENTS

In the 2007 and 2011 reports, Ecology concluded that there were significant concentrations of PCBs in both stormwater and CSO discharges and that PCBs in these systems needed to be reduced in order to meet both the State of Washington's and Spokane Tribe's water quality standards. The City of Spokane is subject to the regulatory requirements imposed by the NPDES Municipal Stormwater Permit. Specifically, section S.4, entitled "Compliance with Standards" allows permittees to follow an adaptive management plan compliance pathway when there is evidence that stormwater discharges may be causing or contributing to a violation of water quality standards. The City's adaptive management plan is intended to address this compliance pathway, and is also designed to reduce PCBs in stormwater that enters the combined sewer system as well as to support compliance with the NPDES Wastewater Permit that governs discharges from the Riverside Park Water Reclamation Facility and CSO outfalls. The City negotiated the Adaptive Management Plan with the Spokane Riverkeeper, Center for Justice and Gonzaga University Law School Environmental Law Clinic as a part of a Consent Decree resolving a Notice of Intent to Sue served on the City pursuant to the Clean Water Act. The Adaptive Management Plan's core goals and principles were based on these organizations' proactive interest in addressing PCBs in the City's stormwater discharges.

ADAPTIVE MANAGEMENT

The goal of the adaptive management plan is to reduce PCBs in stormwater through three main strategies: (1) to further analyze and interpret existing PCB data; (2) to identify likely sources of PCBs and prioritize the design and implementation of appropriate remedial actions and BMPs; and (3) to develop and design an adaptive approach for additional data collection and remedial action to further reduce PCBs in the Spokane River.

Phase I of the Adaptive Management Plan focuses on remedial maintenance, sampling, and analysis of existing information. Work began in 2010. Priority areas of investigation were selected where the highest PCB concentrations have been found in previous studies and where land use practices are likely to contribute elevated levels of PCBs. The Union stormwater basin, a separated stormwater basin covered by the NPDES Municipal Stormwater Permit, was selected for this purpose. For the CSO discharges covered under the NPDES Wastewater Permit, the portion of the CSO 34 basin located in the heavy industrial zone was selected. In 2011, remedial maintenance and sampling shifted south (upstream) in the CSO 34 basin, where light industrial and other mixed land uses are found. Because fewer PCBs were found in this area, sampling was again focused on the heavy industrial zones and Union basin in 2012 and 2013. Figure 2 shows the location of sampling activities.

Because PCBs in stormwater are typically adsorbed to sediments, sediments were removed from stormwater catch basins and the sediments were sampled for PCBs. Data from these locations are useful in measuring how much PCBs are removed from the system and may also be useful in tracing on-going sources of PCB to the stormwater catch basins. In collaboration with Ecology's Urban Waters Initiative, standard operating procedures were developed and staff was provided with extensive training prior to sampling.

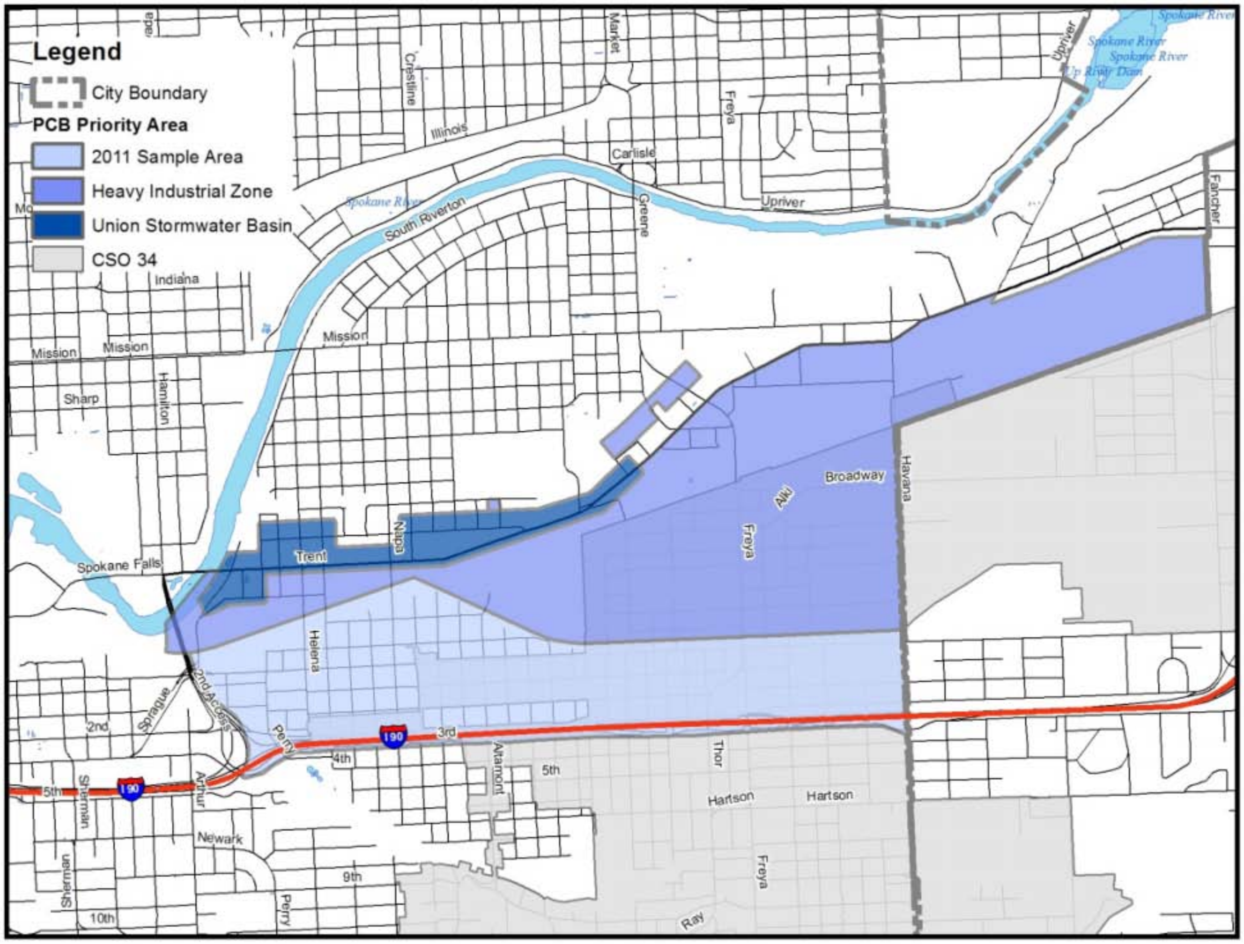

Figure 2. Priority Areas of Investigation

Research and Reconnaissance

Windshield Evaluations

Properties located within the 2010 priority sample areas were visually inspected to determine potential sources of PCBs to stormwater. Information gathered during evaluations included pictures of the site, type of business, paved or unpaved driving surfaces, stormwater flow direction and downstream inlets (if any), potential for sediment tracking onto City right of way, and potential current and past potential sources of PCBs.

For a site to contribute PCB to catch basins, stormwater may either flow off the property into City right of way, or soil could be tracked off the property into City right of way, where stormwater could then wash it into catch basins. Sediments are more likely to be contaminated with PCBs where past land uses and business operations have been associated with PCBs, such as handling transformers, paints and coatings, electrical transmission and distribution, industrial machinery, scrap yards, wood treatment, rail yards, used oil spread for dust control, and many other heavy industrial operations.

It is the City's policy that private properties contain all stormwater generated on site. In general, stormwater from most properties observed in the windshield survey did not flow onto City right of way except for on small portions of the property such as approaches that are sloped downhill toward the street. Several of the sites are not fully paved and allow minor sediment tracking into the right of way. A network of railroad properties crosses this heavy industrial area and there are several automotive repair and storage areas. However, the stormwater inspectors who performed the windshield evaluations did not detect any significant locations where high PCB loads are likely contributing to the storm sewer system. Rather, it is more likely a patchwork of smaller sources as well as widespread, low-level contamination from historic land uses.

Catch Basin Sediment Sampling

Prior to sampling, standing water in each catch basin was removed. Four sediment samples were collected from random locations in each catch basin and mixed thoroughly using a stainless steel spoon and bowl. A one-liter laboratory prepared jar was filled with the sample, then stored in a cooler on ice (between 0 and 6 degrees Celsius). After all catch basins in the group were sampled, the contents of each sample were added to a stainless steel bowl and homogenized with a stainless steel spoon. Three laboratory-prepared jars were filled with the homogenized sample and stored in a cooler on ice. Two jars were sent for laboratory analysis and one was kept in case of future need, stored in a freezer. Samples were allowed ½ inch headspace to allow for expansion. Equipment was carefully decontaminated before and after each sample to prevent inadvertent mixing and contamination. After sampling, equipment was decontaminated, rinsed with laboratory grade acetone, and wrapped with aluminum foil, shiny side out.

Remedial Maintenance

After sampling, remedial maintenance was performed on each catch basin. Before the large volume of catch basin sediments could be handled and disposed, samples were first sent to the laboratory for preliminary Aroclor analysis, with a detection limit of 0.1 milligrams per kilogram (mg/kg) per EPA Method 8082. None of the samples exceeded Ecology's residential cleanup standard of 1.0 mg/kg, so sediments were approved for disposal at the City's North Side Landfill. Remedial maintenance was then performed by pumping out sediments from each catch basin using vactor trucks for disposal at the landfill. The catch basins were then cleaned to prevent any residual PCB contamination from being detected in future catch basin samples.

Urban Waters Coordination

The City has worked in coordination with Ecology's Urban Waters Program staff to identify likely sources of PCBs in the priority areas of investigation. The most recent information published by Urban Waters can be found in the report, "Spokane River Urban Waters Source Investigation and Data Analysis Progress Report (2009-2011)" (Ecology, 2012). Specifically, the "PCB Section" discusses related investigations in the Union Basin and CSO 34.

2010 SAMPLING ACTIVITIES AND RESULTS

In 2010, all 432 catch basins located in the Union Basin and Heavy Industrial CSO 34 priority areas were sampled followed by remedial maintenance to remove all sediments. Due to lab analysis costs and quantity of samples, the sample area was broken into 41 groups, each having an average of about 10 catch basins. Sample group locations are shown in Figure 3. 2010 sample groups are shown in green. Groups are delineated by basin type, including CSO, drywell, and separated stormwater. 2011 sample groups are also shown on this map in purple.

Samples from all catch basins in each group were composited. After initial Aroclor analysis was performed to determine remedial maintenance measures, samples were sent to Pacific Rim Laboratories for congener analysis using EPA Method 1668. This method allows for the more detailed analysis of 209 PCB congeners to a detection limit of 0.003 micrograms per kilogram (ug/kg), or parts per billion.

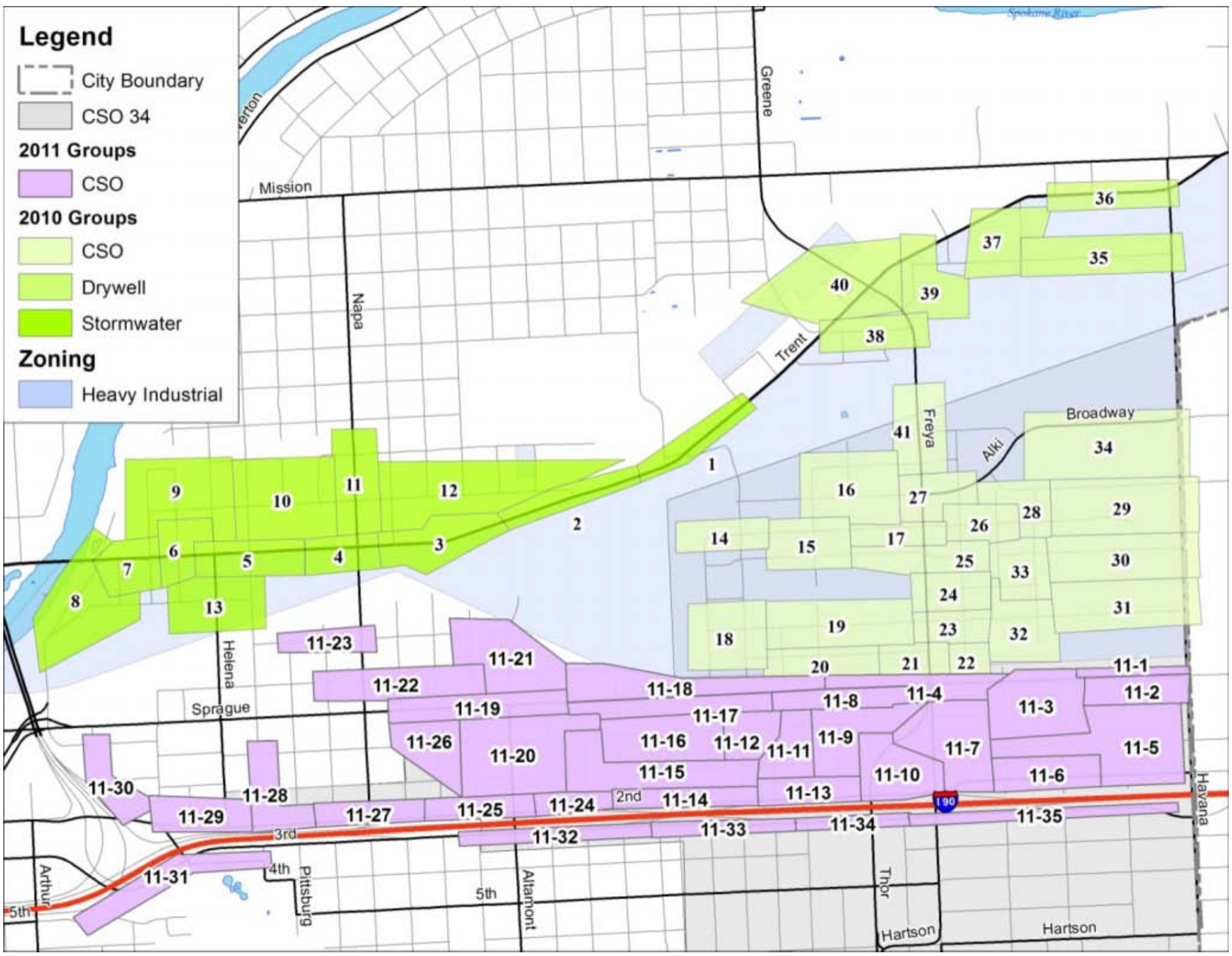

Figure 3. Group Composite Sample Locations

None of the sample detections in the Aroclor analysis exceeded the 1 mg/kg threshold, so all catch basin sediments were disposed at the North Side Landfill. Results from the congener analysis of 2010 composite sampling are shown in Figure 4. PCBs were detected in all composite samples, ranging from 40 to 1709 ug/kg (ppb). To compare known sources of PCB contamination, Ecology PCB cleanup sites are also shown in Figure 4.

Nearly 280,000 pounds of sediment were removed from 432 catch basins. Based on the congener analysis, a total of about 26 grams of PCBs were removed from the system and prevented from entering the Spokane River or aquifer. PCBs were found in all of the sample groups, ranging from a concentration of about 40 ug/kg to 1700 ug/kg (parts per billion).

2011 SAMPLING ACTIVITIES AND RESULTS

Composite Catch Basin Sediment Samples

In 2011, sampling and remedial maintenance was performed upstream in the CSO 34 basin. The area is zoned light industrial, commercial, and residential. A total of 362 catch basins are located in this area. Due to insufficient sediment depth in some of the basins, only 333 could be sampled. At least one inch of accumulated sediment in the basin is required for sample collection. The 2011 sample area was divided into 35 groups for composite sampling. Sampling activities were similar in scope to the 2010 study, and included both Aroclor and congener analysis and remedial maintenance.

Congener analysis sample concentrations are shown in Figure 5. The analysis shows that sample group PCB concentrations in the 2011 sample area are generally less than the heavy industrial 2010 sample groups. Concentrations in the 2011 sample groups range from about 25 to 219 ug/kg (ppb).

About 268,000 pounds of sediment were removed from the 2011 composite group sampled catch basins. The total mass of PCBs in these sediments was about 3.7 grams. Because a similar volume of sediment was removed in 2011 and 2010, it can be inferred that PCB sources are fewer in the 2011 sample area.

Individual Catch Basin Sediment Samples

In addition to composite sediment sampling, sediment samples were collected from individual basins from the highest concentration 2010 groups located in the separate stormwater or CSO areas. Sediment depth accumulated in the catch basins was again a limiting factor in sample collection. Of the 31 total catch basins in the selected locations, only 16 had enough sediment depth to collect a sample. This suggests that remedial maintenance can be temporarily effective in locations with low sediment loads. However, analysis results showed that PCB concentrations were detected in the individually-sampled catch basins, within the range of concentrations observed the previous year. Therefore, there is some form of a continual source of PCBs to catch basin sediments in these areas.

The City Parcel PCB Cleanup Site was formerly owned by Spokane Transformer, whose transformer repair and recycling activities contaminated site soils with PCBs. In 2008, remediation was performed at the site, removing soils with greater than 10 mg/kg PCBs. This is the equivalent of 10,000 parts per billion. For reference, water quality standards are 0.00017 parts per billion. Although remedial actions were complete, relatively high PCB concentrations were detected in the catch basins receiving stormwater from the vicinity of the site. The basin immediately downstream of the site is a drywell with an overflow structure that connects to the storm sewer system. The City inserted a plug into the overflow pipe, effectively disconnecting the City Parcel site's stormwater from entering the storm sewer system. Future sampling efforts will confirm if contamination from the City Parcel Site has been effectively prevented from entering the storm sewer system.

Sample Quality Control

The reported values in Figure 5 for the 2011 individual re-test samples are slightly lower than what was reported in previous reports. The laboratory data was analyzed further, and significant blank contamination was identified. For each set of samples, the laboratory analyzes a blank sample. Theoretically, the blank should not have detectable PCBs. However, the blanks for these sample sets had significant detectable levels of PCBs. Flags were noted in the data where an individual congener had less than five times the concentration detected in the blank sample. These congeners were subtracted from the total PCB concentration to come up with the reported values in Figure 5. Blank contamination, while present, was relatively insignificant in other PCB samples from 2010-2013.

2012 SAMPLING

Catch Basin Sediment Sampling

Based on the 2010 and 2011 sample area results, 2012 sampling focused on the higher PCB concentration areas in the 2010 sample groups (the Union Basin and heavy industrial CSO 34). To determine if there are ongoing PCB sources, composite samples of the 2010 groups were collected. Where each catch basin within the group designation had enough sediment to sample, a composite sample was collected and analyzed for PCB Aroclors and congeners, followed by remedial maintenance. Where the entire group could not be sampled and therefore a true composite sample could not be collected, individual catch basin sampling and analysis was performed. Sampling was intended to match previous group or individual samples for a more direct comparison of PCB sources from year to year.

Results of 2012 catch basin sediment sampling are shown in Figure 6. Composite samples were collected in Groups 1, 2, 8, 11, and 12. Individual samples were collected where sediment was present in Groups 3 through 6, 10, 13, 24, and 25 until a total of 50 samples was collected. The composite sample PCB concentrations decreased slightly. However, PCBs were still present in all locations. This suggests that remedial maintenance may be reducing PCB concentrations; however, there is an ongoing and diffuse source of PCBs. Comparisons in catch basins sampled more than once are shown in the following tables.

Table 2. Group Composite Sample Comparisons (2010 and 2012)

Group Number	2010 Concentration (ug/kg)	2012 Concentration (ug/kg)	% Reduction
Group 1-C	754.0	464.0	38%
Group 2-C	296.0	126.0	57%
Group 8-C	115.0	87.9	24%
Group 11-C	179.0	74.0	59%
Group 12-C	731.0	612.0	16%

Table 3. Individual Sample Comparisons (2011 and 2012)

Group Number	2011 Concentration (ug/kg)	2012 Concentration (ug/kg)	% Reduction
Group 13-id-3	1185.0	767.0	35%
Group 13-id-4	279.0	120.0	57%
Group 13-id-11	5.0	5.6	-12%
Group 24-id-10	103.0	69.4	33%
Group 24-id-11	121.0	95.1	21%
Group 25-id-1	115.0	93.9	18%

NOTES:
C = COMPOSITE SAMPLE;
ID = INDIVIDUAL SAMPLE;
UG/KG = MICROGRAMS PER KILOGRAM (PARTS PER BILLION)

About 39,600 pounds of sediment were removed from the 2012 sampled catch basins. The total mass of PCBs in these sediments was about 2.7 grams.

Additional sampling was performed on March 7, 2012. Individual catch basins in 2010 Group 1 were sampled at the request of Ecology's Urban Waters staff to aid in identification of PCB sources to stormwater. All basins had enough sediment depth to sample, and were sent to Anatek Laboratories for Aroclor analysis. Results of the sampling are shown in Figure 7.

Confirmation Sample

To date, all of the catch basin sediment samples have been collected in the Union Basin, heavy industrial zone, or the CSO 34 basin. To confirm that the PCB concentration in these samples are greater than typical catch basin sediment concentrations in other areas of the city, a catch basin was selected for PCB sampling in north Spokane. The selected catch basin was chosen in a residential area where the catch basin cleaning schedule was consistent with the previous 2010 PCB catch basin cleaning. The catch basin chosen for this confirmation sample is located at the intersection of Garland and Normandie. The PCB concentration was 13.1 ug/kg, which is lower than the majority of the PCB concentrations in the priority area of investigation.

Source Investigations

Individual catch basin sediment sampling in 2012 identified select catch basins that had relatively high PCB concentrations compared to others. On April 25, 2013, staff from the City of Spokane, Spokane Riverkeeper, and Urban Waters conducted a site visit in the Union Basin. The goal of the site visit was to identify potential sources of PCBs to catch basins, particularly those with the highest concentrations. No obvious sources could be identified. It was observed that the historic industrial land use and associated legacy sources are ubiquitous in the area.

The highest catch basin sediment concentration observed in 2012 was in Group 6 at the northeast corner of Hogan and Trent. Sample 6-id-5 had a concentration of 1551 ug/kg PCBs. The contributing area to this catch basin is the east half of Hogan north of Trent. An adjacent vacant field east of Hogan was also identified as a potential source of runoff to the catch basin. Soil samples were collected on the east side of the sidewalk and in the crack between the road and the sidewalk by Urban Waters and split samples were collected by the City of Spokane and analyzed using EPA Method 8082. All three of the City's samples were non-detect, indicating that the adjacent field is not a likely source of PCBs. Ecology's sample results had not been received at the time this report was written.

STORMWATER SAMPLING

Stormwater sampling began in fall 2012. Samples were initially collected in the Union stormwater basin, a municipal separate storm sewer (MS4) basin. Automatic flow-weighted composite samplers and flow monitors were installed in two locations within the Union stormwater basin as shown in Figure 8. Stormwater sampling may provide data that can be used to estimate PCB loadings from basins as well as track the stormwater PCB concentration over time.

The City, in coordination with Ecology's Urban Waters Initiative, developed a monitoring and sampling plan for stormwater sampling. The City's stormwater sampling equipment near the Union Basin outfall was installed in the same location where Urban Waters has been collecting stormwater samples. Therefore, the City's sampling data can be more closely correlated to data collected by Urban Waters. The upstream stormwater sampling equipment was installed near the intersection of Lee and Springfield. This is just downstream of a former PCB Cleanup Site known as City Parcel (formerly owned by Spokane Transformer). The catch basin closest to the City Parcel site had a relatively high PCB concentration during 2010 catch basin sediment sampling, so the Wastewater Management Department disconnected it to prevent contaminated stormwater and sediment from reaching the river. The stormwater sampler is intended to verify if this remedial action was successful.

Additional automatic flow-weighted composite stormwater sampling equipment was subsequently installed in two more MS4 basins in the City and one CSO basin. The Cochran stormwater basin encompasses about 5,300 acres of the north side of the City of Spokane and provides a good representative stormwater sample for the City. The Washington stormwater basin is located north of downtown and is located in a more urban area. Sampling equipment was also installed just downstream of the CSO 34 regulator in spring 2013. Stormwater basins and sample locations are shown in Figure 9.

Results

PCB samples have been collected in each of the stormwater sample locations and analyzed using EPA Method 1668. No results from CSO 34 were received from the laboratory at the time this report was written. Stormwater PCB sample results are shown in Table 4.

Ecology's Urban Waters staff sampled stormwater near the Union basin outfall from 2009 to 2011. Samples were collected in the same location as the City's Trent & Erie samples. Results showing Ecology and City of Spokane samples chronologically are shown in Table 5. Ecology collected grab samples and the City collected composite samples, so they are not directly comparable. However, the trend shows a decreasing PCB concentration after the City initiated remedial maintenance in the Union basin in fall 2010 and again in fall 2012.

The Liberty Lake Source Trace Study (Ecology, 2010) sampled PCBs in stormwater. The intent of the study was to identify urban "background" concentrations where there is no known point source of PCBs. Stormwater concentrations ranged from about 458 to 8,415 pg/l (parts per quadrillion, ppq). The City's PCB stormwater samples from the Cochran Basin and Washington Basin generally fall within this range. This indicates that there may not be significant individual PCB point sources in these basins, and that the PCB concentrations are likely coming from a plethora of nonpoint sources.

Suspended Solids Correlation

Total suspended solids (TSS) were analyzed for the Cochran and Washington stormwater basin samples. The results were plotted against the PCB sample results to determine if there is a correlation between the two parameters. It was assumed that a correlation between PCB concentration and TSS would be observed because PCBs tend to adsorb to fine particulates. However, there was no strong correlation between the two parameters.

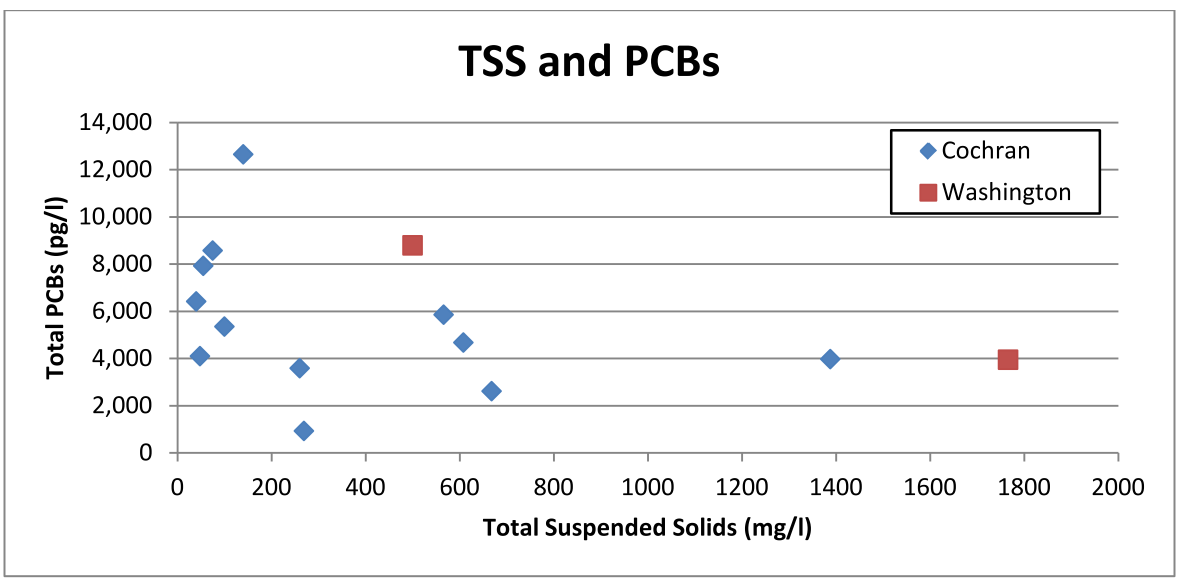

Figure 10. TSS and PCB Correlation

PATTERN TRACING

PCB molecules can have between one and ten chlorine atoms each. Homologues are a set of congeners with the same number of chlorine atoms. *Mono*chlorobiphenyls are PCBs with one chlorine, *di*chlorobiphenyls are PCBs with two chlorines, and so on. Homologue patterns can be useful in tracing PCB sources or differentiating separate PCB sources because they identify different mixes of PCB congeners in a sample.

Homologue patterns for 2011 individual catch basin sediment samples, 2012 catch basin sediment samples, and stormwater samples are shown in Appendix B. Composite samples from 2010 and 2011 were not analyzed due to the homogenous nature of the samples. For comparison to known PCB sources, homologue patterns for the sampled oils and hydraulic fluids are shown on page B-16. Patterns for standard Aroclor mixes are shown on page B-17.

Oils and fluids were tested off the shelf, and are primarily composed of the lower-chlorinated monoCB, diCB, and triCBs. These lighter PCBs are more susceptible to evaporation and less likely to be present in sediment samples that have been sitting at the bottom of a catch basin for one or two years.

Results

Patterns are fairly consistent through most of the catch basin sediment and stormwater samples. They most closely represent the pattern for Aroclor 1260, although there tends to be a greater percentage of lower-chlorinated congeners in the sediment and stormwater samples. Aroclor 1260 was commonly used in transformers, hydraulic fluids, synthetic resins, and dedusting agents.

Sample “Retest 07” on page B-1 is from the catch basin immediately downstream of the City Parcel PCB cleanup site (formerly Spokane Transformer) in Group 12. The pattern very closely mimics the pattern of Aroclor 1260. Similarly, the Lee & Springfield stormwater sample from 3/20/13 (page B-13) has a very similar pattern to Aroclor 1260 as did the 2012 Group 12 composite sample. Total PCBs in the 3/20/13 stormwater sample were elevated, and were about three times higher than the PCB concentration at Trent & Erie, near the Union Basin outfall. The plug that disconnects the drywell from the storm sewer system was checked, and no leaks were identified.

The 2012 Group 4 sample number 4-9 had an unusually high percentage of the “lighter” or lower-chlorinated congeners when compared to the other samples, especially monochlorobiphenyl. However, the total concentration was relatively low at 111 ug/kg. It is located underneath a railroad bridge on Trent Avenue.

2012 Group 6 sample number 6-5 and its duplicate also had a relatively high percentage of the “lighter” congeners and was dominated by pentachlorobiphenyl. It is located on the northeast corner of Hogan and Trent, and had the highest individual catch basin PCB concentration in 2012 of 1,551 ug/kg. The pattern is similar to Aroclor 1254, which was one of the most widely used Aroclors, and can be found in transformers, caulks, hydraulic fluids, rubbers, adhesives, inks, and cutting oils among other products.

While pattern tracing can give hints toward identifying varying PCB sources, it should be noted that this method is only approximate. The mix of PCB congeners in a compound changes over time and is altered through the environment as certain fractions adsorb to soils, are carried away in stormwater, or evaporate.

SUPPLEMENTAL ENVIRONMENTAL PROJECTS

In addition to the Adaptive Management Plan, five supplemental environmental projects were agreed to as part of the Consent Decree.

Supplemental Environmental Project I: Low Impact Development

In the Consent Decree, the City agreed to develop a Low Impact Development (LID) ordinance. "Low Impact Development," also referred to as "green infrastructure," involves stormwater management and land development strategies that use natural or man-made features to filter and retain stormwater before it reaches the City's separate storm sewer or combined storm and sanitary sewer systems. The City of Spokane convened an LID Main Committee and Subcommittee to coordinate and develop the City's LID efforts. The committees are composed of staff from Planning, Engineering Services, Capital Programs, Wastewater Management, Legal, Communications, Parks, and the environmental community.

Public Education Campaign

A public education campaign was launched to help inform the general public about low impact development opportunities. Initial campaign materials included a utility bill insert, informational brochure, and web page. The materials were made available to the public in spring 2012 through utility bill inserts, the Engineering Services brochure kiosk, in permit information packets, and online. A PDF copy of the brochure and website materials can be viewed at www.spokanewastewater.org/LID.aspx and Appendix A.

Interdepartmental Coordination

The Main Committee, which includes department directors, convened two internal, interdepartmental group meetings in fall 2011. The Main Committee determined that a staff-level Low Impact Development Subcommittee would meet regularly to accomplish strategic planning, with regular reporting to and review by the Main Committee. A third Main Committee meeting was held in winter 2012. The Main Committee was briefed and provided comments on the Utility Bill Insert, Educational Brochure, and Draft Action Plan for the Draft Low Impact Development Ordinance (detailed in the following section).

Preparation of Draft Ordinance

The City's LID Subcommittee prepared a Draft Action Plan to define the approach for preparing the Draft Ordinance (Appendix A). Originally, the Subcommittee planned to identify LID techniques appropriate for the City of Spokane and develop a draft ordinance based on these findings. However, Spokane County was awarded a grant from the Department of Ecology to produce an Eastern Washington Low Impact Development Guidance Manual. The City of Spokane has joined the associated Stakeholder Advisory Group in addition to several other Eastern Washington Phase II jurisdictions.

Technical standards and guidance for using LID principles and best management practices has been developed under the Eastern Washington Low Impact Development Guidance Manual process. The City of Spokane's draft ordinance is being developed in conjunction with the guidance manual, but as a separate process without involvement from other Phase II jurisdictions. The final guidance manual is to be completed by June 30, 2013. Under the Consent Decree, the City staff is preparing for City Council consideration a draft LID ordinance by August, 2013.

The City's draft ordinance process has involved the formation of an internal Technical Advisory Committee with representatives from each pertinent City department and an external Stakeholders Group to facilitate input from the development community, utilities, the environmental community, consultants, professionals, landowners, residents, and other interested parties. These groups have worked on the development of incentives for LID implementation, drafting ordinance language, and providing input on the Eastern Washington LID Guidance Manual.

Draft ordinance language has been prepared and includes provisions for stormwater fee discounts, allowance for the use of pervious concrete on sidewalks, encouragement to use LID in street layout design, and adoption of the Eastern Washington LID Guidance Manual as an optional reference for guidance on the design of stormwater facilities. Review of the draft ordinance is currently underway by Spokane's Planning Commission and Public Works Committee. City Council review is planned for July to August, 2013.

Supplemental Environmental Project II: Rose Foundation

The Rose foundation for Communities and the Environment was paid $125,000 by the City of Spokane to fund environmental project activities that improve water quality within the Spokane River Watershed. Payment to the Rose Foundation was made by the City in September, 2011 by City Warrant No. 433577. The Rose Foundation advertised the grant as the "Mike Chappell fund for the Spokane River." Grant proposals to the Rose Foundation were due in April, 2012 and the Rose Foundation announced grant recipients on June 6, 2012. Funded projects include the following:

- Two Spokane River Toxics Cleanup Projects
    - Reduce PCBs and other toxics in the river through public education and building public support for Clean Water Act enforcement and creation of a statewide water quality standard protective of human health
- Spokane River Shoreline Master Program Update Project
    - Protect shoreline habitat and water quality by participating in Shoreline Master Program updates along the Spokane River
- Latah Creek Watershed Restoration Project
    - Restore, enhance, and conserve four miles of riparian zone along Latah Creek
- Industrial Stormwater Dischargers Survey
    - Survey of industrial stormwater dischargers into the Spokane River in Kootenai County and Lake Coeur d'Alene
- Spokane River Watershed Restoration Project
    - Stream bank restoration and planting of 10,000 native trees along Latah Creek
- Spokane River Stormwater Initiative
    - Ensuring stormwater permit compliance and providing educational opportunities for students at Lewis and Clark High School and Gonzaga University

Supplemental Environmental Project III: Storm Drain Marking Program

The City has implemented a storm drain marking program, used as an educational tool to help prevent polluted discharges to the storm sewer system. Three curb markers were developed, one each for the MS4, CSO, and drywell locations as shown below, respectively.

Priority was given to locations with the highest incidence of PCB discharges in stormwater. At the completion of sampling and remedial maintenance for the 2010 and 2011 sample locations, curb markers were placed at each storm inlet. Curb markers inform the public not to dump waste down the drain, and include the City's stormwater hotline phone number for reporting illicit discharges. Curb markers, which are composed of flexible plastic with adhesive, were initially placed on the face of the curb. However, snow removal equipment scraped many of them off the curb face during the winter. To prevent this, curb markers are now placed on the top of the curb, and markers that were damaged were replaced with top-of-curb markers.

Wastewater Management staff continue to install curb markers in other areas throughout the City in coordination with regular maintenance activities. Over 4,200 curb markers have been installed. Priority areas were identified where the curb markers will have the most benefit. The priority locations for curb marker installations include the following:

- City of Spokane public schools
- Spokane Community College
- Problematic and high risk areas

Supplemental Environmental Project IV: GIS Layer

Wastewater Management has developed Geospatial Information System (GIS) layers, identifying the location of MS4 features such as pipes, catch basins, and outfalls. A read-only copy of the MS4 GIS layers were provided to the Spokane Riverkeeper in October, 2011. These layers can also be accessed by the public at the Wastewater Management web site as well as Spokane's "City Map" website, www.spokanegis.org/citymap2/.

Supplemental Environmental Project V: Stormwater Educational Guide

Funding was provided to the Spokane River Forum for producing a stormwater educational guide. The guide is intended to inform industry and the public about the effect of pollutants in stormwater on the Spokane River and regulatory requirements for stormwater management. The Spokane River Forum, City of Spokane, and Spokane Riverkeeper worked collaboratively to produce the educational guide. The guide can be obtained at City Hall or digitally on the Spokane River Forum's website, http://www.spokaneriver.net/spokanestormwater/book.swf.

ECOLOGY CONSULTATION; PUBLIC INVOLVEMENT

The Consent Decree requires the City to consult with Ecology in implementing and updating the Adaptive Management Plan. Several instances are noted above in this Annual Report where the City acted in consultation with Ecology staff.

The Consent Decree also requires the City to conduct public involvement when it issues this Annual Report. On June 5 and 6, the City participated in a two-day, comprehensive conference at the Gonzaga Law School titled "Spokane River Toxics Workshop." The purpose of the Workshop was to bring together stakeholders, regulators and technical experts to begin to identify and quantify sources of PCBs and to develop a work plan for reducing PCBs in the Spokane River. City staff made presentations describing the work the City completed in 2010-2011, as described in this Annual Report, to remove PCBs from the stormwater systems and to identify PCB sources. City staff also briefed the Workshop participants on the work the City has planned for 2012 and 2013 to continue removing PCBs from the stormwater system and identifying potential sources of PCBs to the Spokane River.

The City also presented this information at StormCon, held in Denver, Colorado in August 2012. StormCon is a national annual stormwater conference that brings together industry experts to present and discuss stormwater program management needs, BMP performance case studies, water quality monitoring, research, technology, and services.

The 2013 PCB Annual Report will be presented at the June, 2013 Spokane River Regional Toxics Task Force meeting. The task force is composed of staff from Ecology, EPA, IDEQ, jurisdictions, industries, and environmental entities involved in the identification and reduction of toxics in the Spokane River. Actions taken by the City of Spokane under the PCB Consent Decree are integral to the identification and reduction of PCB sources to the river.

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Act. Part 761: Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions. Retrieved April 24, 2012 from http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&tpl=/ecfrbrowse/Title40/40cfr761_main_02.tpl

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Table 4
Stormwater PCB Analytical Results

SAMPLE LOCATION	DATE	Hydrology		PCBs (pg/l)
		Volume (gal)	Precip. (in)	
Trent & Erie (Union Basin)	10/29/2012	157,300	0.43	37,346
	11/1/2012	22,300	0.11	43,841
	11/3/2012	73,700	0.24	47,972
	11/8-11/9	44,900	0.34	18,113
	11/12-11/13	61,300	0.33	48,862
	3/20/2013	85,560	0.26	19,403
	4/10/2013	8,112	0.07	13,766
Lee & Springfield (Union Basin)	10/29/2012	7,100	0.43	35,521
	11/19-11/20	15,400	1.18	35,611
	3/20-21/2013	11,489	0.68	66,071
Cleveland & Nettleton (Cochran Basin)	10/15/2012	3,703,300	0.37	12,647
	10/15/2012 (Dup)	3,703,300	0.37	11,020
	10/25/2012	352,700	0.03	8,571
	11/3/2012	1,868,600	0.20	7,924
	11/8-11/9	1,683,200	0.17	4,098
	11/12-11/13	2,941,000	0.27	3,586
	11/19-11/20	12,857,700	0.95	6,416
	12/4-12/5	3,641,300	0.23	5,350
	1/8-9/13	18,282,800	0.09	928
	1/25-26/13	12,838,900	0.34	2,614
	2/22/2013	[Instrument Error]	0.18	4,674
	3/6-7/13	3,279,000	0.25	3,972
	3/20/2013	3,504,100	0.34	5,854
Washington St Bridge (Washington Basin)	2/22/2013	260,300	0.18	8,791
	3/6-7/13	486,200	0.26	3,946
	4/10/2013	36,017	0.06	3,427
Equipment Blank	8/24/2012	--	--	168
Trip Blank	3/19/2013	--	--	123
Equipment Blank	3/19/2013	--	--	66

Notes:
pg/l = picograms per liter (parts per quadrillion); gal = gallons; in = inches
Samples analyzed per EPA Method 1668A

Table 5
Union Basin Outfall PCB Analytical Results

SAMPLE ORGANIZATION	DATE	Sample Type	Precipitation (inches)	PCBs (pg/l)
Ecology (UNIONLPT Sample Location)	6/8/2009	Grab	0.29	73,000
	10/2/2009	Grab	0.11	58,200
	2/16/2010	Grab	0.12	460,000
	4/29/2010	Grab	0.48	60,600
	9/9/2010	Grab	0.06	256,000
	1/7/2011	Grab	0.19	55,300
City of Spokane (Trent & Erie Sample Location)	10/29/2012	Composite	0.43	37,346
	11/1/2012	Composite	0.11	43,841
	11/3/2012	Composite	0.24	47,972
	11/8/2012	Composite	0.34	18,113
	11/12/2012	Composite	0.33	48,862
	3/20/2013	Composite	0.26	19,403
	4/10/2013	Composite	0.07	13,766

Notes:
pg/l = picograms per liter (parts per quadrillion)
Samples analyzed per EPA Method 1668A

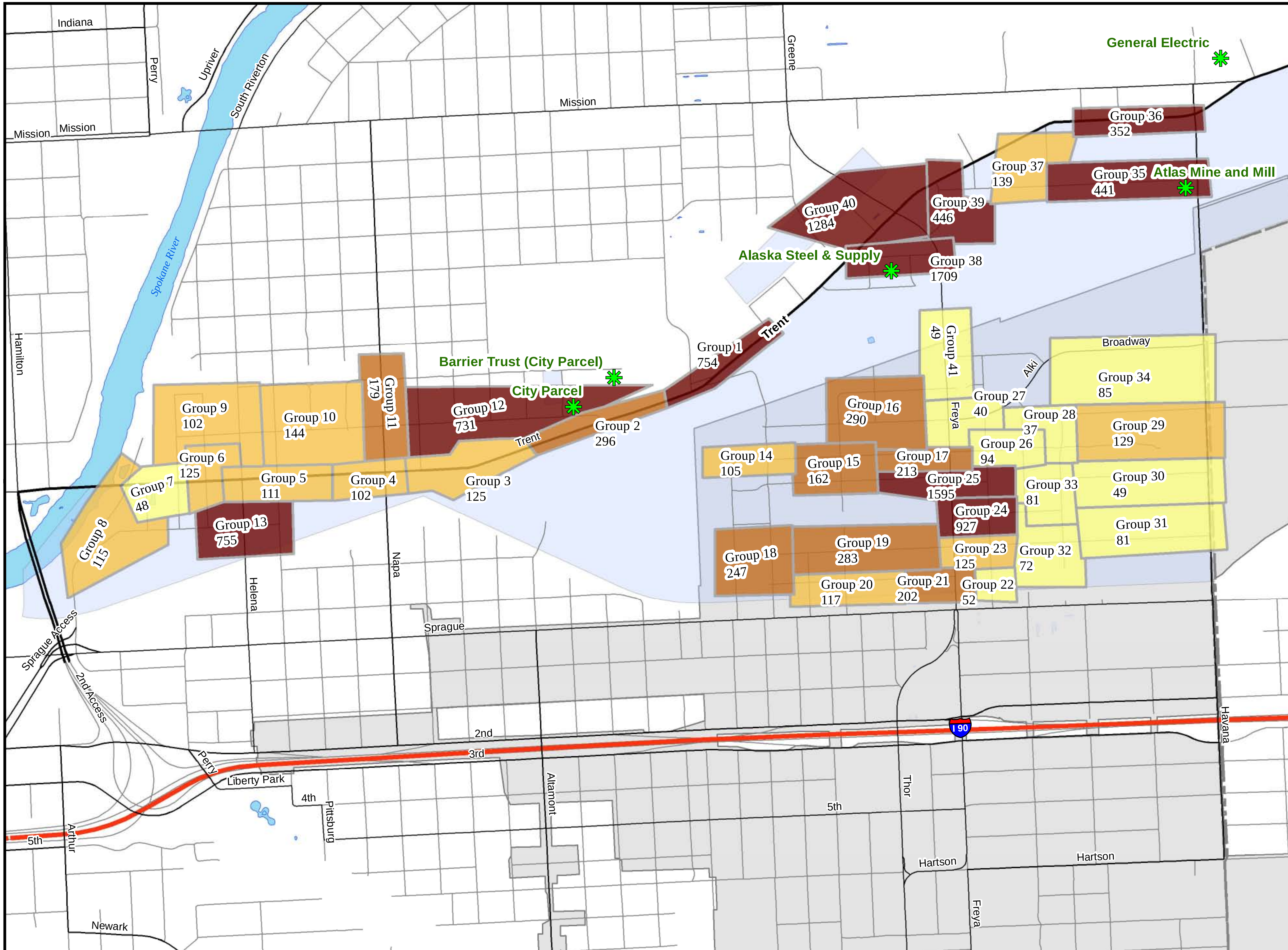

Figure 4
Group Composite PCB Samples 2010

Congener Analysis (Pacific Rim Lab)

Legend

- Ecology PCB Cleanup Sites

PCB Concentration (ug/kg)

- 0 - 100
- 101 - 150
- 151 - 300
- 301 - 1709
- City Boundary

Zoning

Zoning

- Heavy Industrial

Basin Boundary

- CSO 34

Concentrations are in micrograms per kilogram (ug/kg), equivalent to parts per billion (ppb).

0 500 1,000 Feet

N W E S

Geographic Information System

SPOKANE

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Map Produced: 5/29/2012 LMS

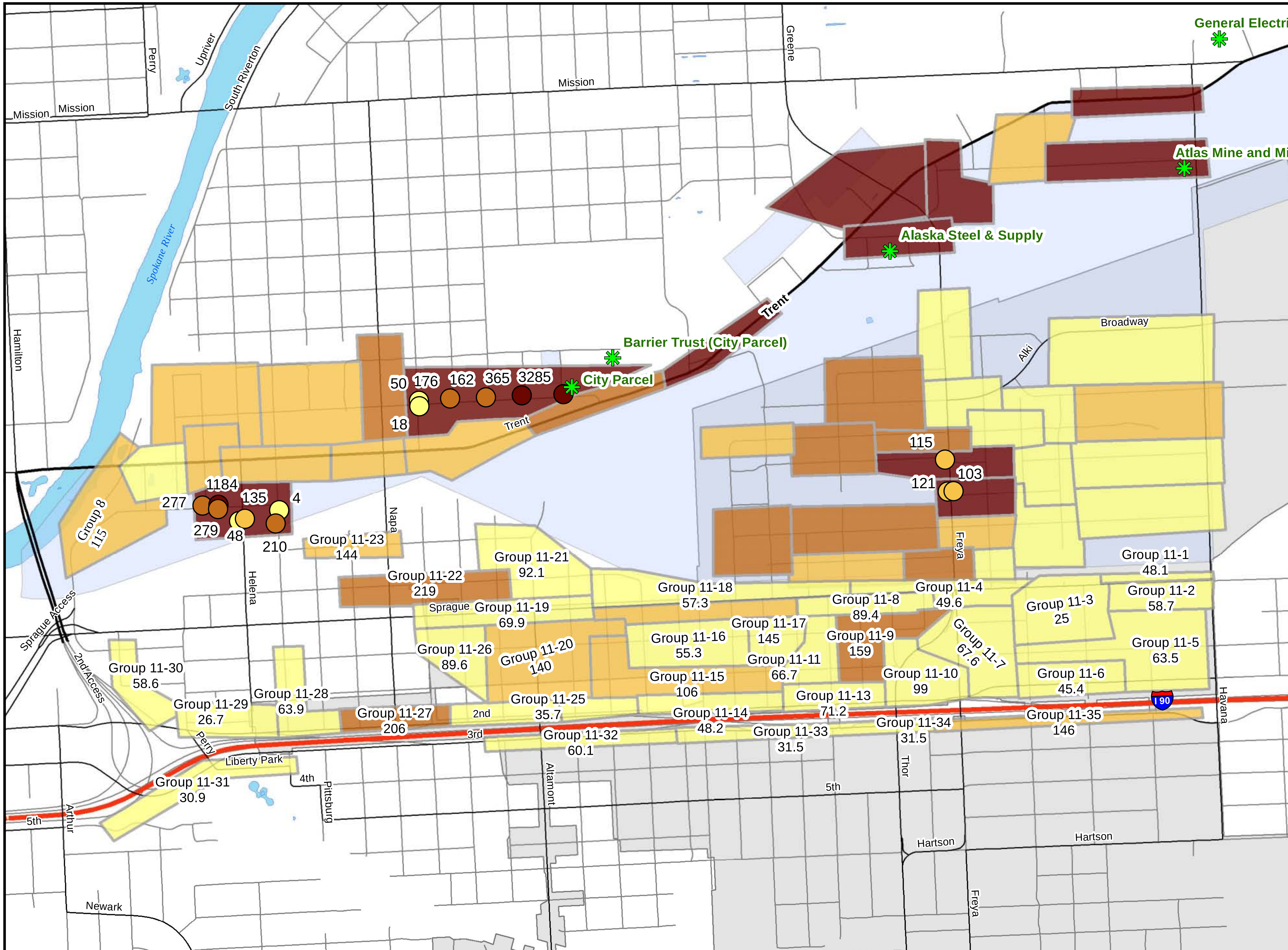

Figure 5
Group Composite and Individual PCB Samples 2011
Congener Analysis (Pacific Rim Lab)

Legend

Ecology PCB Cleanup Sites

PCB Concentration (ug/kg)

- 0 - 100
- 101 - 150
- 151 - 300
- 301 - 1709

City Boundary

Zoning

Zoning

Heavy Industrial

Basin Boundary

CSO 34

Concentrations are in micrograms per kilogram (ug/kg), equivalent to parts per billion (ppb).

0 500 1,000 Feet

N W E S

Geographic Information System

SPOKANE

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Map Produced: 6/5/2013 LMS

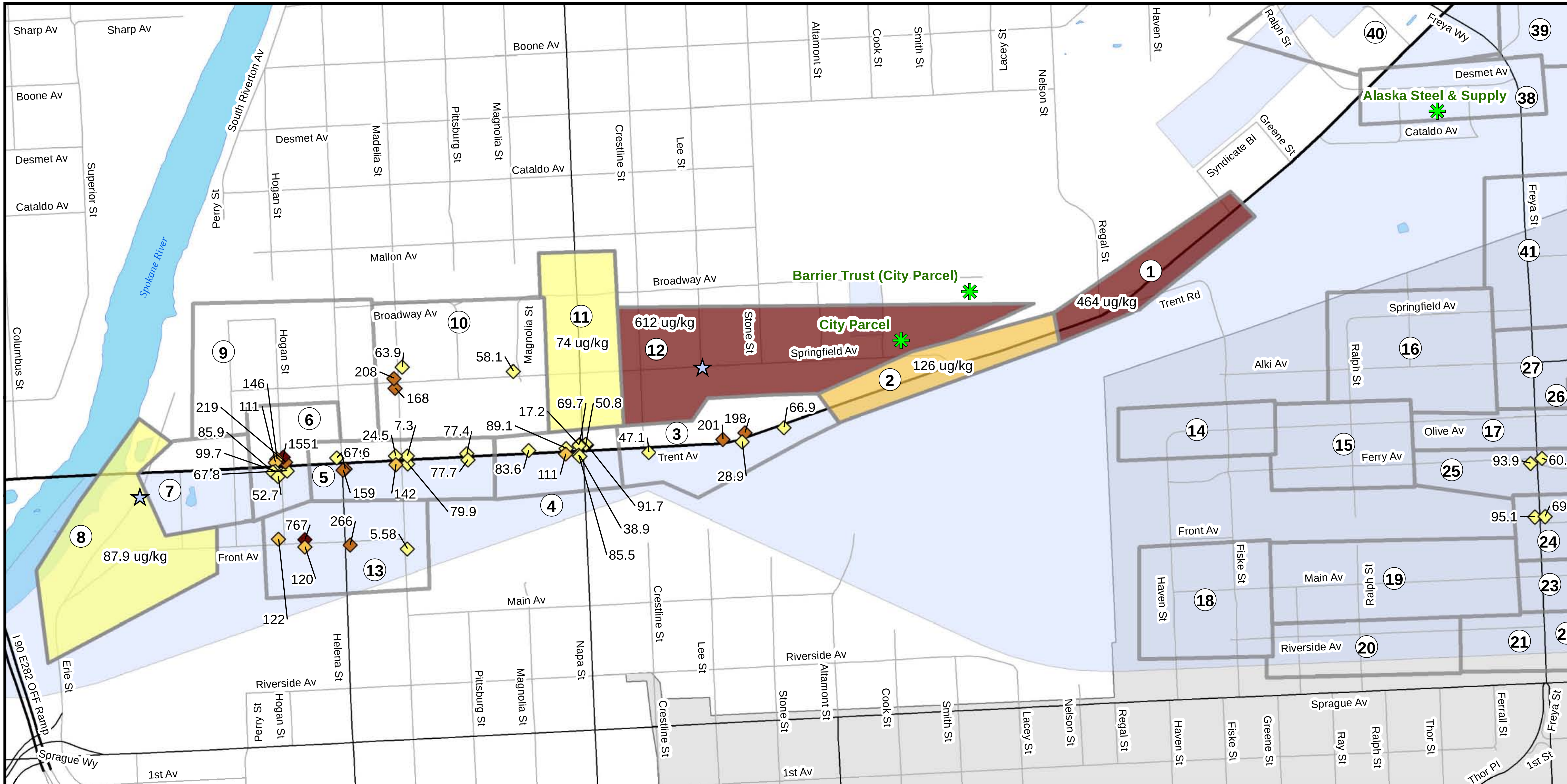

Figure 6
Group Composite and Individual PCB Samples 2012
Congener Analysis (Pacific Rim Lab)

Legend

- Stormwater Sample Locations
- Ecology PCB Cleanup Sites
- Groups

Zoning

- Heavy Industrial

CSO Basin

- CSO 34

2012 PCB Individuals (ug/kg)	2012 PCB Composites (ug/kg)
5.58 - 100	74 - 100
100 - 150	100 - 150
150 - 300	150 - 300
300 - 1551	300 - 612

ug/kg = ppb
ug/kg: micrograms per kilogram
ppb: parts per billion

600 300 0 600 Feet

N S E W

Geographic Information System

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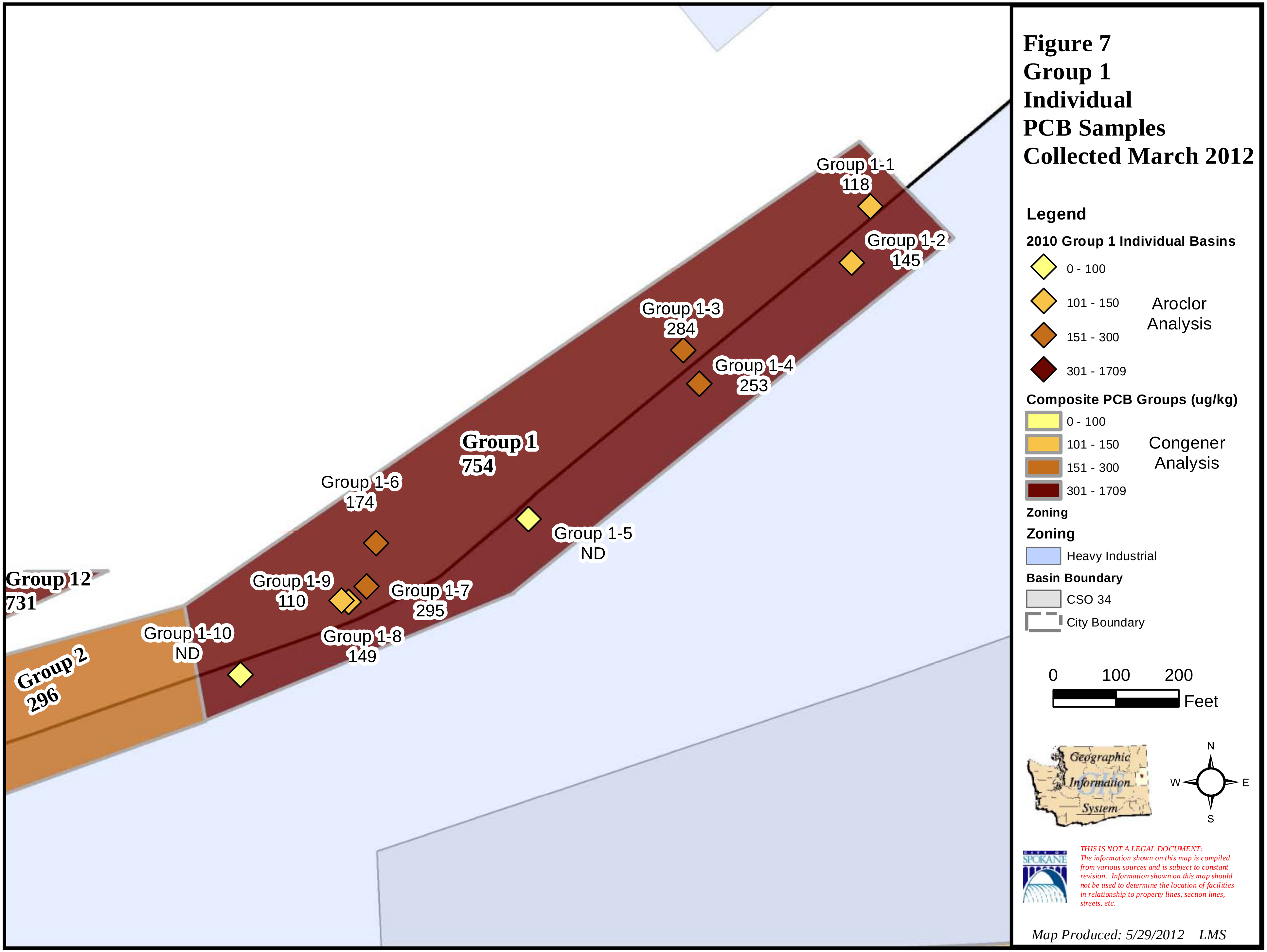

Figure 7
Group 1
Individual
PCB Samples
Collected March 2012

Figure 8
Union Basin Stormwater Sample Locations

1,000 500 0 1,000 Feet

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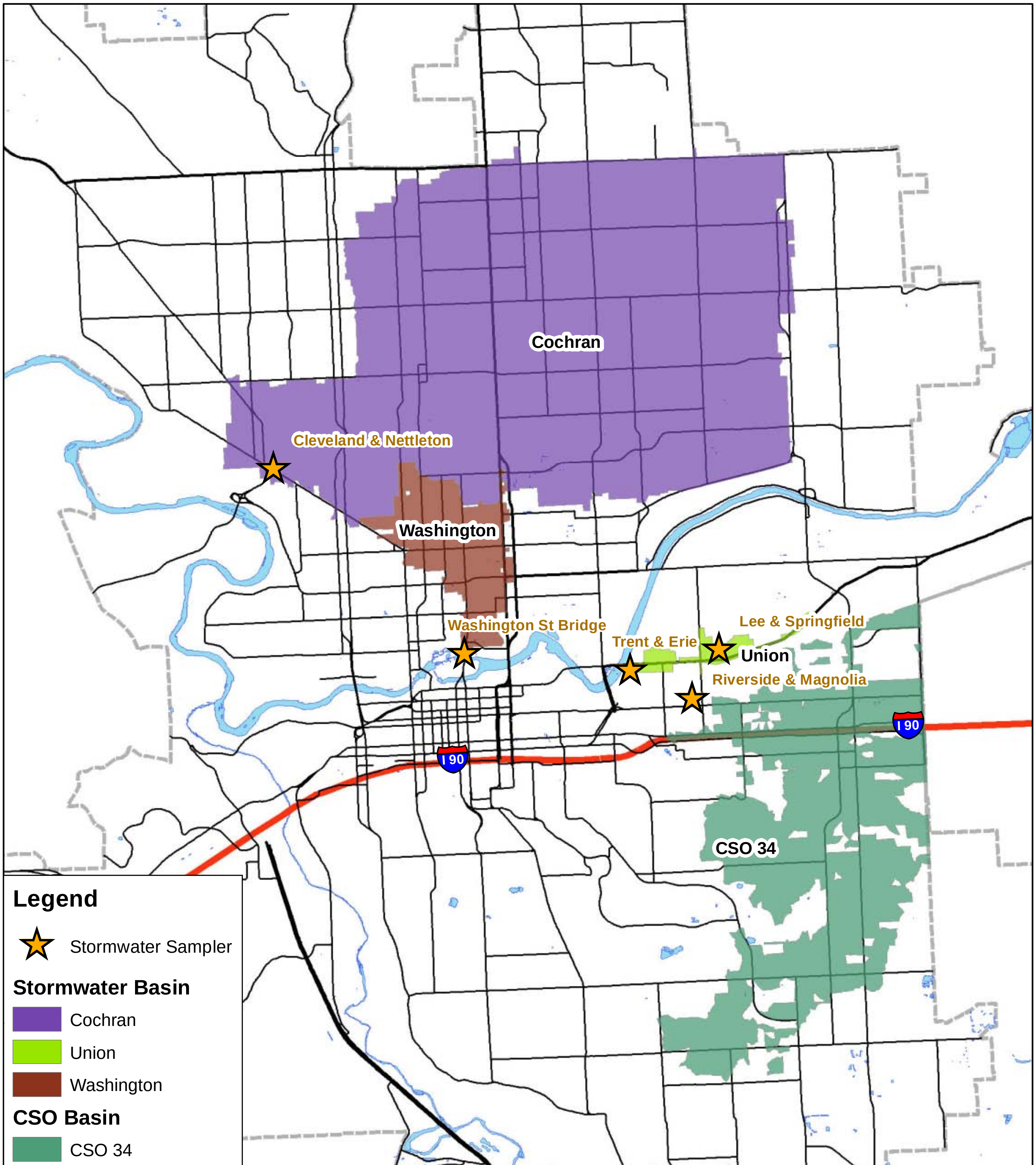
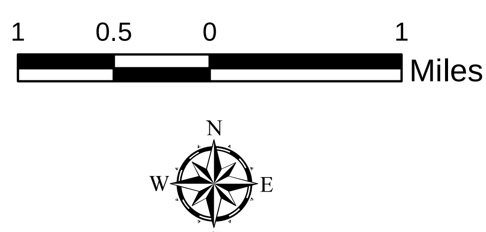


Figure 9
Stormwater Sample Locations and Stormwater Basins



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City of Spokane Wastewater Management Department LMS 4/24/2013 C:\Documents and Settings\lschmidt\My Documents\GIS\StormwaterSamplers.mxd

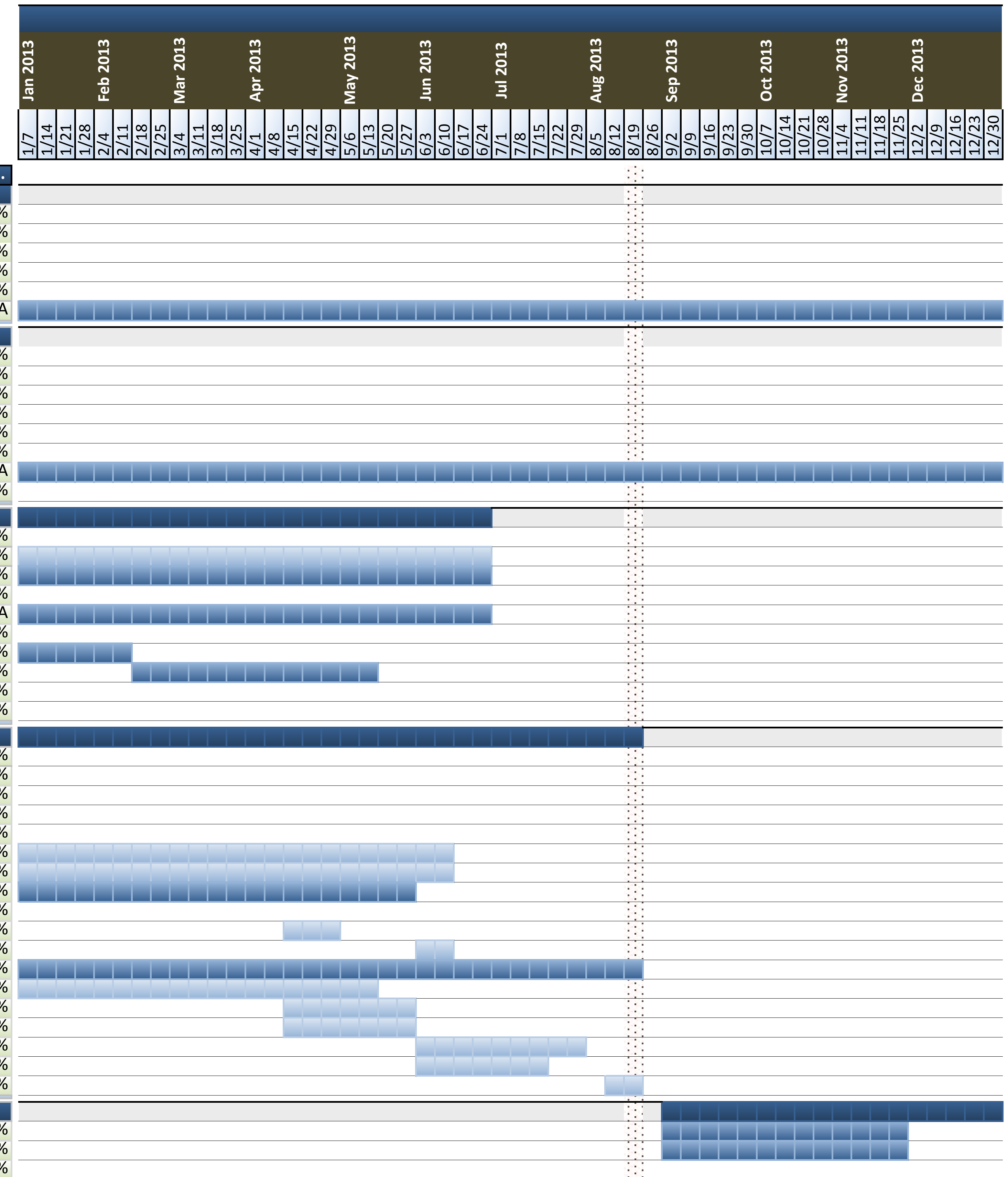
Appendix A

SUPPLEMENTAL ENVIRONMENTAL PROJECT 1: LOW IMPACT DEVELOPMENT

Events	Date
Begin Master Committee Meetings (CD IX.A.2 - 11/21/2011)	9/21/11
Quarterly Status Meetings with Riverkeeper (12/9/11, 3/16/12, 6/12)	Ongoing
Phase I education materials available to public (CD IX.A.1)	**5/1/12**
Draft ordinance progress report to Riverkeeper	**8/23/12**
Quarterly Status Meetings with Riverkeeper (9/12, 12/12, 3/13, 6/13)	Ongoing
Draft ordinance presented to City Council (CD IX.A.3)	**8/23/13**

Last Updated: 6/10/2013

	Start	End	% Compl.
City of Spokane Low Impact Development Committee Formation	9/21/11	9/21/11	
Main Committee Kickoff Meeting	9/21/11	9/21/11	100%
Build subcommittee team	9/21/11	10/10/11	100%
Inventory existing LID information and requirements	9/21/11	11/9/11	100%
Identify possible Stakeholder Group members	9/28/11	12/30/11	100%
Prepare Draft Action Plan	11/21/11	3/2/12	100%
Update Action Plan as necessary (i.e., more tasks defined, due dates revised)	3/2/12	Ongoing	N/A
Consent Decree Item IX.A.1. Initiation of Public Education Campaign	10/17/11	5/31/12	
First draft public information materials (brochure and utility bill mailer)	10/17/11	11/30/11	100%
Gather comments on draft information materials	11/23/11	12/30/11	100%
Submit draft to Riverkeeper for comment	11/30/11	12/30/11	100%
Subcommittee comments	11/23/11	12/30/11	100%
Master committee comments	12/8/11	2/10/12	100%
Information materials finalized & distribution plan completed	12/30/11	4/20/12	100%
Materials made available to public. Update website with new materials.	5/1/12	Ongoing	N/A
Materials sent in utility bill	5/1/12	5/31/12	100%
Eastern WA Low Impact Development Guidance Manual Development	3/14/12	6/30/13	
Create Eastern WA LID Stakeholder Advisory Group (SAG)	3/14/12	4/15/12	100%
SAG provides input and review throughout process	3/14/12	6/30/13	97%
Create LID Technical Review Committee to provide technical input throughout process	3/15/12	6/30/13	100%
Release RFQ and hire a consultant	3/15/12	8/15/12	100%
Public information and involvement throughout process	6/15/12	6/30/13	N/A
Consultant prepares 30% draft manual	9/15/12	12/15/12	100%
Consultant prepares 60% draft manual	12/15/12	2/15/13	100%
Consultant prepares 90% draft manual	2/15/13	5/15/13	100%
Consultant presents final Eastern WA LID Guidance Manual to SAG	6/30/13	6/30/13	0%
Consultant and Washington Stormwater Center Finalize Eastern WA LID Website	6/30/13	6/30/13	25%
City of Spokane Low Impact Development Ordinance Development	2/13/12	8/23/13	
Assign City staff and define City department ownership	2/13/12	3/1/12	100%
Finalize purpose	2/13/12	3/21/12	100%
Prepare and finalize Public Participation Plan	4/1/12	7/20/12	100%
Public Participation Plan to City Council	9/1/12	9/15/12	100%
Form City's Technical Advisory Committee	3/1/12	9/30/12	100%
Build LID knowledge (within City staff)	7/30/12	6/15/13	100%
Develop possible incentives	3/1/12	6/15/13	100%
Form Stakeholders Group with development community (plus other interested parties)	6/1/12	6/1/13	100%
First meeting	9/15/12	9/30/12	100%
Second meeting	4/15/13	4/30/13	100%
Third meeting	6/1/13	6/15/13	100%
Take Draft LID Ordinance through ordinance process	11/15/12	8/23/13	75%
Draft LID Ordinance language	11/15/12	5/15/13	100%
Comments from departments and agencies	4/15/13	6/1/13	100%
Public comment	4/15/13	6/1/13	100%
Present Guidance Manual and ordinance language to Plan Commission	6/1/13	7/31/13	50%
City Council committee review (i.e., Public Works and PCED)	6/1/13	7/15/13	100%
Present to City Council	8/9/13	8/23/13	0%
Post-LID Ordinance Program	9/1/13	4/1/14	
Produce public information materials: LID implementation and incentives for use	9/1/13	12/1/13	0%
City staff LID training (implementing ordinance)	9/1/13	12/1/13	0%
Informational seminars and public outreach	1/1/14	4/1/14	0%



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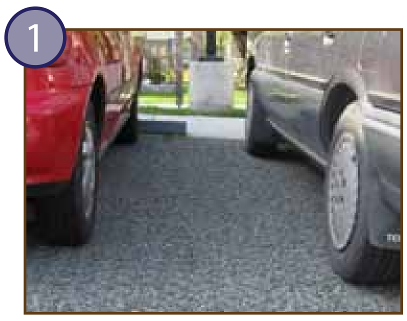
Visit: SpokaneWastewater.org/LID.aspx

www.ahbl.com

LOW IMPACT CASE STUDY

This case study demonstrates two approaches to a multi-family residential development. The site is characterized by shallow depth to bedrock requiring evaporative ponds to manage stormwater on-site. Through a low impact approach, the size of the evaporation ponds can be reduced, allowing for more flexible use of the site.

1


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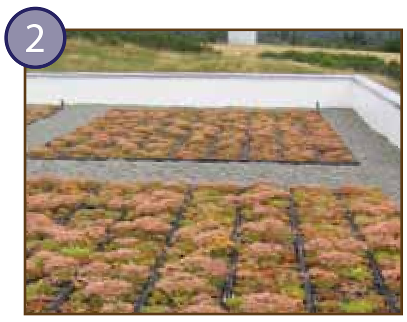

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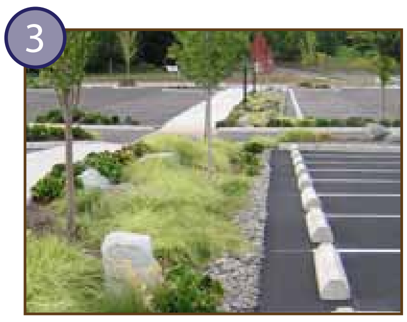
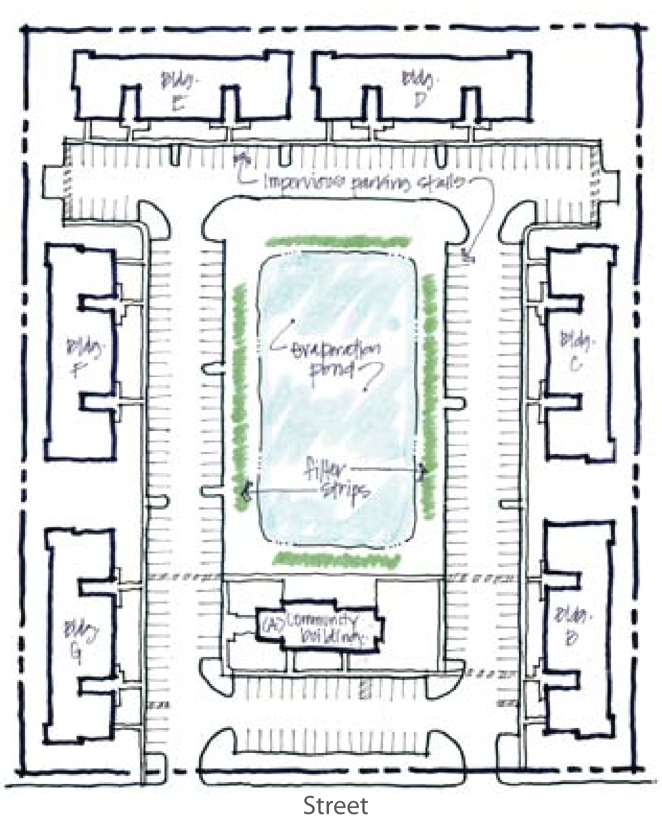


4

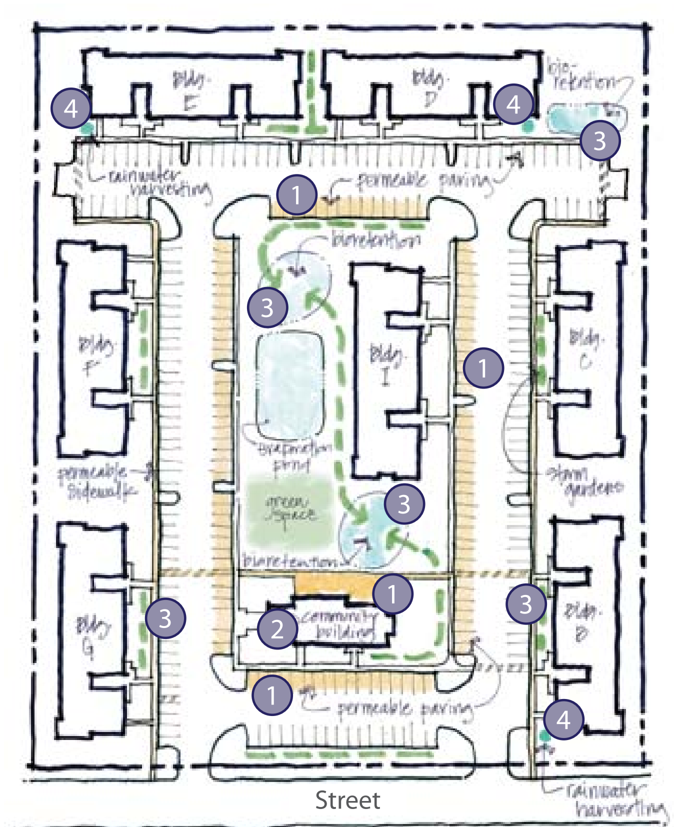

1. *Permeable Parking & Walkways*
2. *Vegetated Roofs*
3. *Storm Gardens*
4. *Rain Barrels & Cisterns*

Conventional Approach



The conventional design includes paved parking lots, walkways, and patios. Stormwater management is provided by infiltration basins, grass-lined swales, filter strips, and a large evaporation pond.

Low Impact Approach



The LID design includes the same mix of uses, but uses permeable paving, vegetated roofs, roof rainwater harvesting, and storm gardens for stormwater management and storage. By using low impact strategies the size of the project's evaporation pond is significantly reduced.

Low Impact Development

An Innovative Method for
Preserving & Protecting
Our Precious Water Resources

What is
LOW IMPACT DEVELOPMENT?

Low Impact Development (LID) is a stormwater management and land development strategy that mimics nature. LID emphasizes site conservation and uses natural features to filter and retain stormwater as close to where it falls as possible.

WAYS LOW IMPACT DEVELOPMENT BENEFITS YOU

Removes pollutants from stormwater

Reduces size of swales and evaporation ponds

Reduces flooding

Allows projects to be constructed on less land

Preserves open space

May result in construction and maintenance cost savings

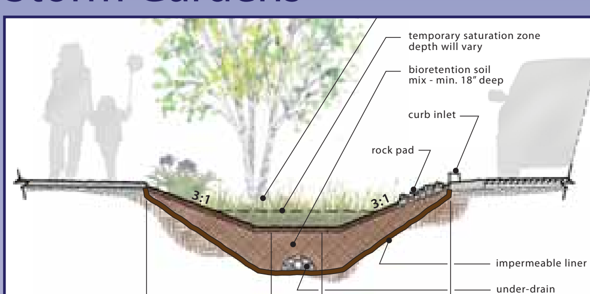
Replenishes streams, wetlands, and the aquifer

Improves appearance of neighborhoods

May store snow to help keep sidewalks clear in winter

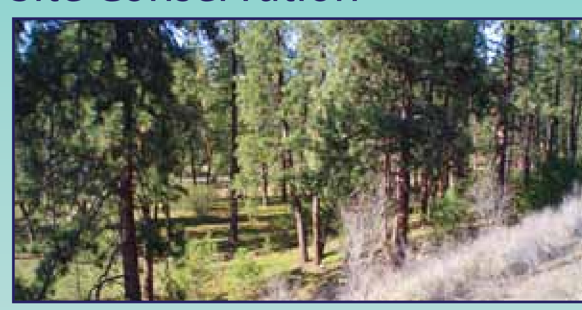
Low Impact Development METHODS

Storm Gardens



Storm gardens feature organic soils, mulch, drought-tolerant plantings, and when necessary, underdrains and overflow features.

Site Conservation

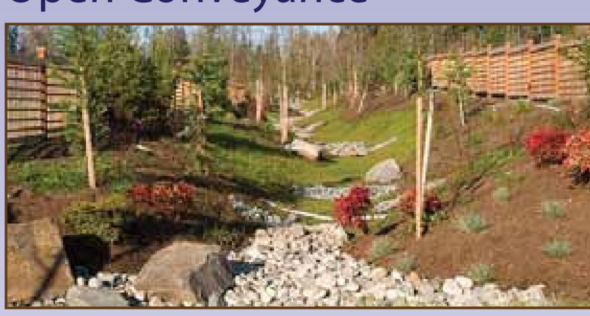


Preserve native landscapes where possible and amend soils and revegetate when not.

Reduced Lawn

Replacing lawn with drought-tolerant plantings where appropriate may save money on irrigation and maintenance and reduce runoff pollution.

Open Conveyance



Open conveyance may reduce the size of or entirely eliminate conventional underground piped conveyance systems.

Stormwater Reuse

Capturing roof runoff in a cistern or rain barrel allows for reuse for irrigation.

Limit Paved Surfaces

Narrowing street widths, using pervious pavement, and reducing building footprints may result in smaller storm drainage facilities.

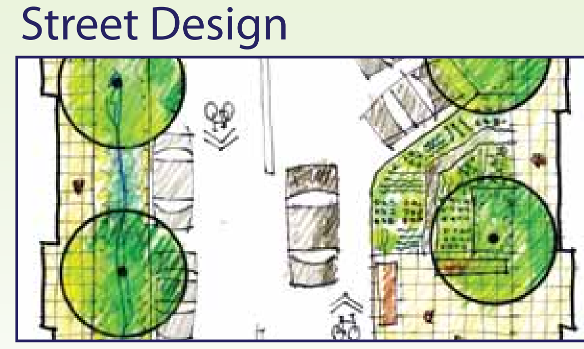
Clustered Development

Cluster homes and units to minimize building footprints, reduce road and driveway lengths, and maximize open space.

Permeable Pavement

Pavement that allows water to move through it. Some options include interlocking concrete pavers, pervious concrete, and porous asphalt. Permeable pavement is applicable to low-traffic areas such as parking areas and sidewalks.

Street Design

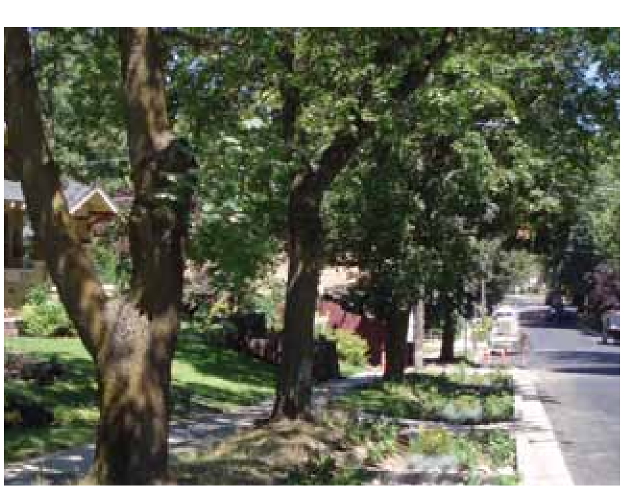


Traffic calming measures may be combined with specific LID methods, including storm gardens, narrower streets, and drought-tolerant landscaping.

RECENT PROJECTS

Lincoln Street

Lincoln Street from 29th Avenue to Cannon Hill Park



The storm gardens were installed as part of a street repair project. The storm gardens capture and treat street runoff, and drain to the pond in Cannon Hill Park.

Nevada-Lidgerwood Parking Lot

Intersection of Broad Avenue and Addison Street

As part of a parking expansion for the Nevada-Lidgerwood neighborhood / C.O.P.S. Shop, a pervious walkway and storm gardens were used to treat stormwater runoff.

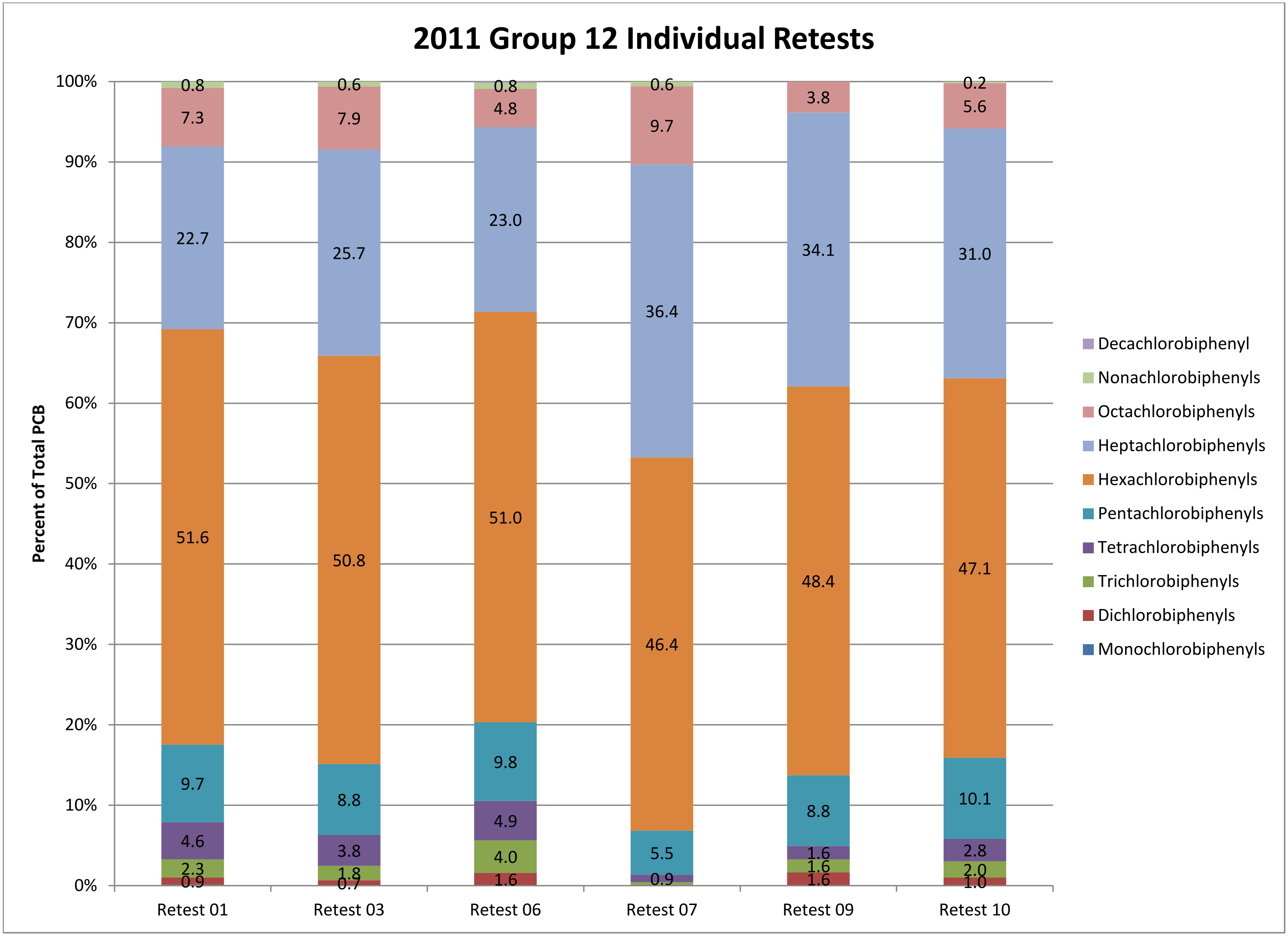
Broadway Avenue

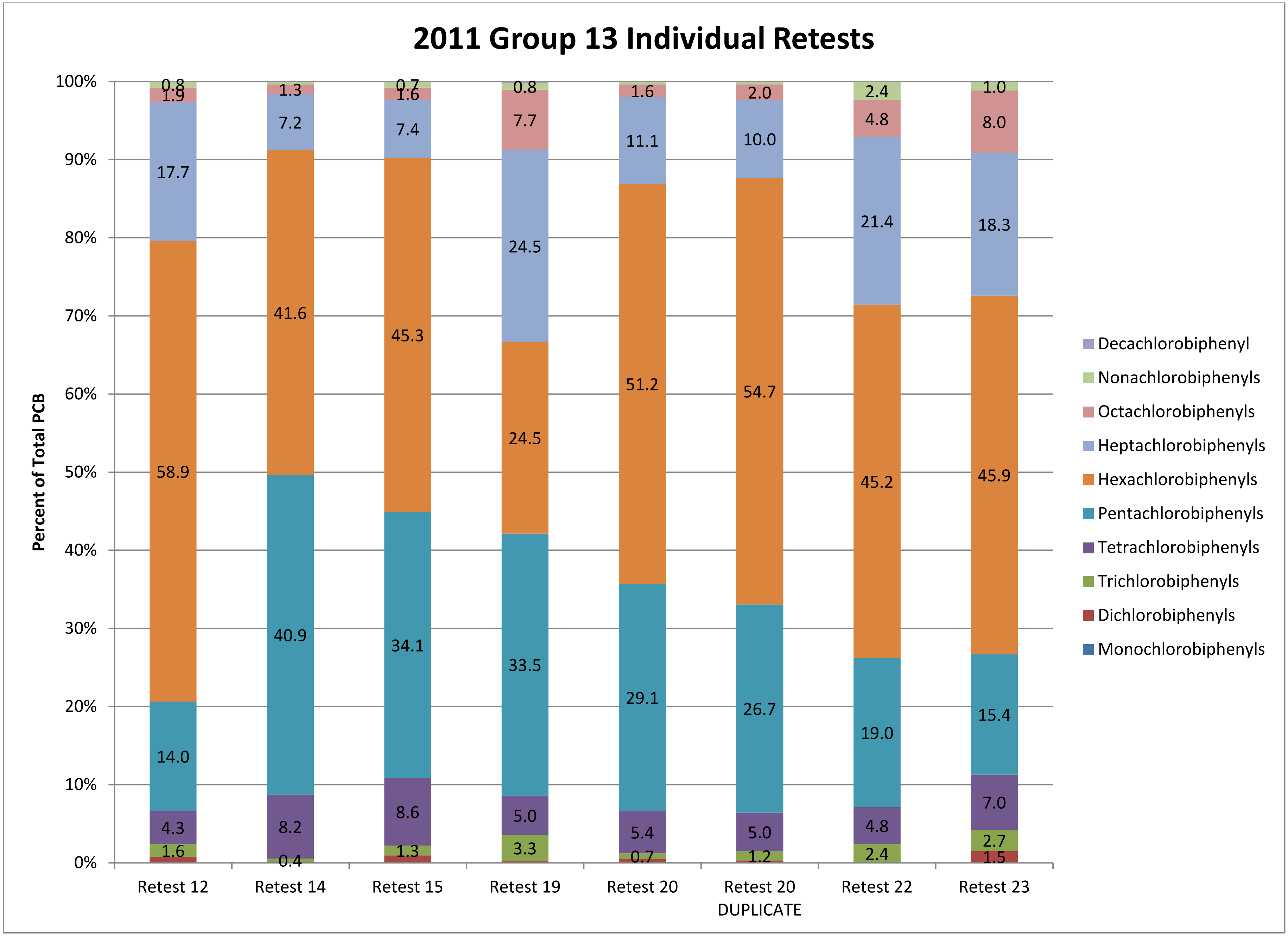
Broadway Avenue from Elm to Oak Streets

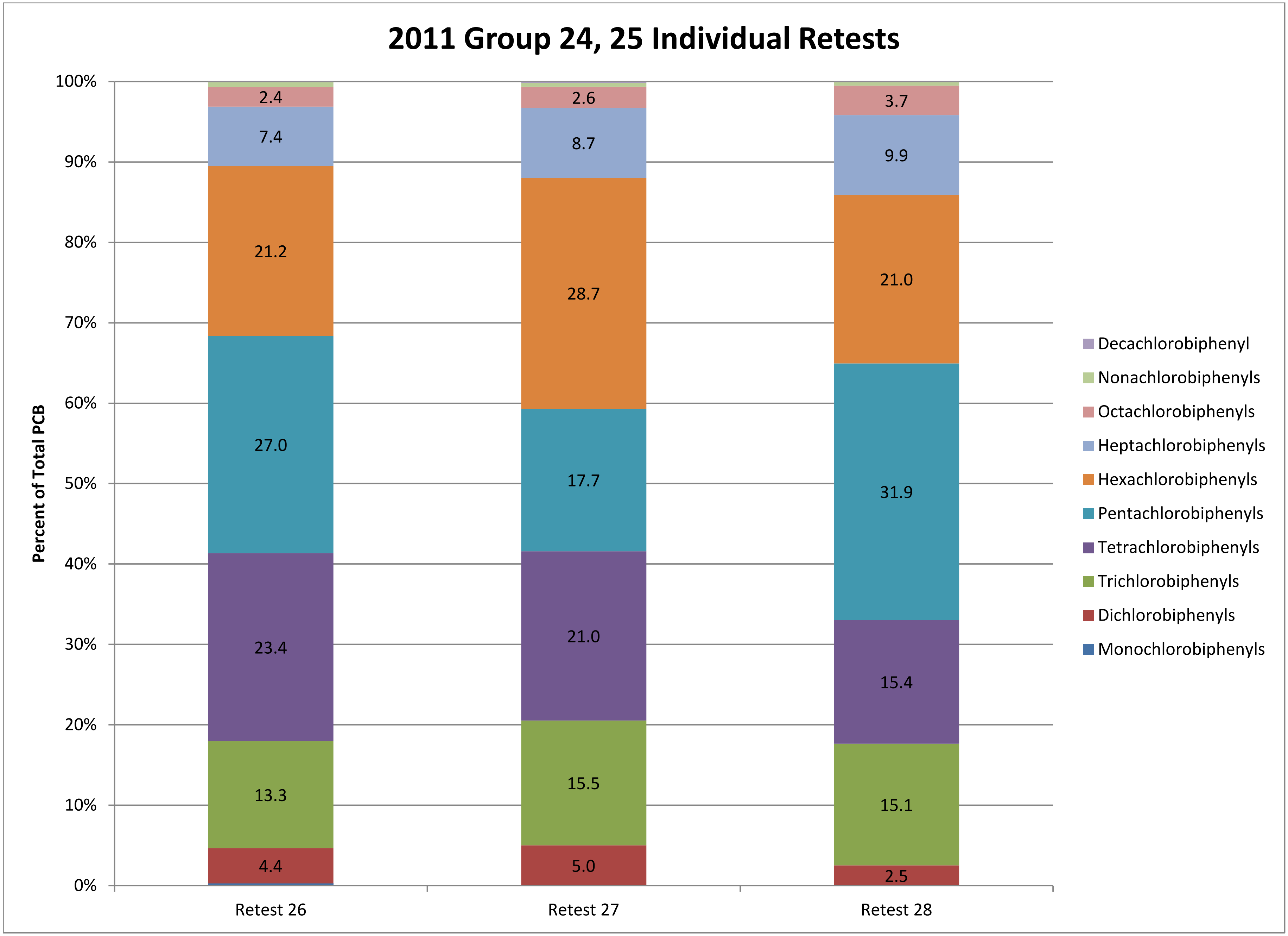
This street revitalization project uses storm garden planters to recharge the Spokane-Rathdrum aquifer.

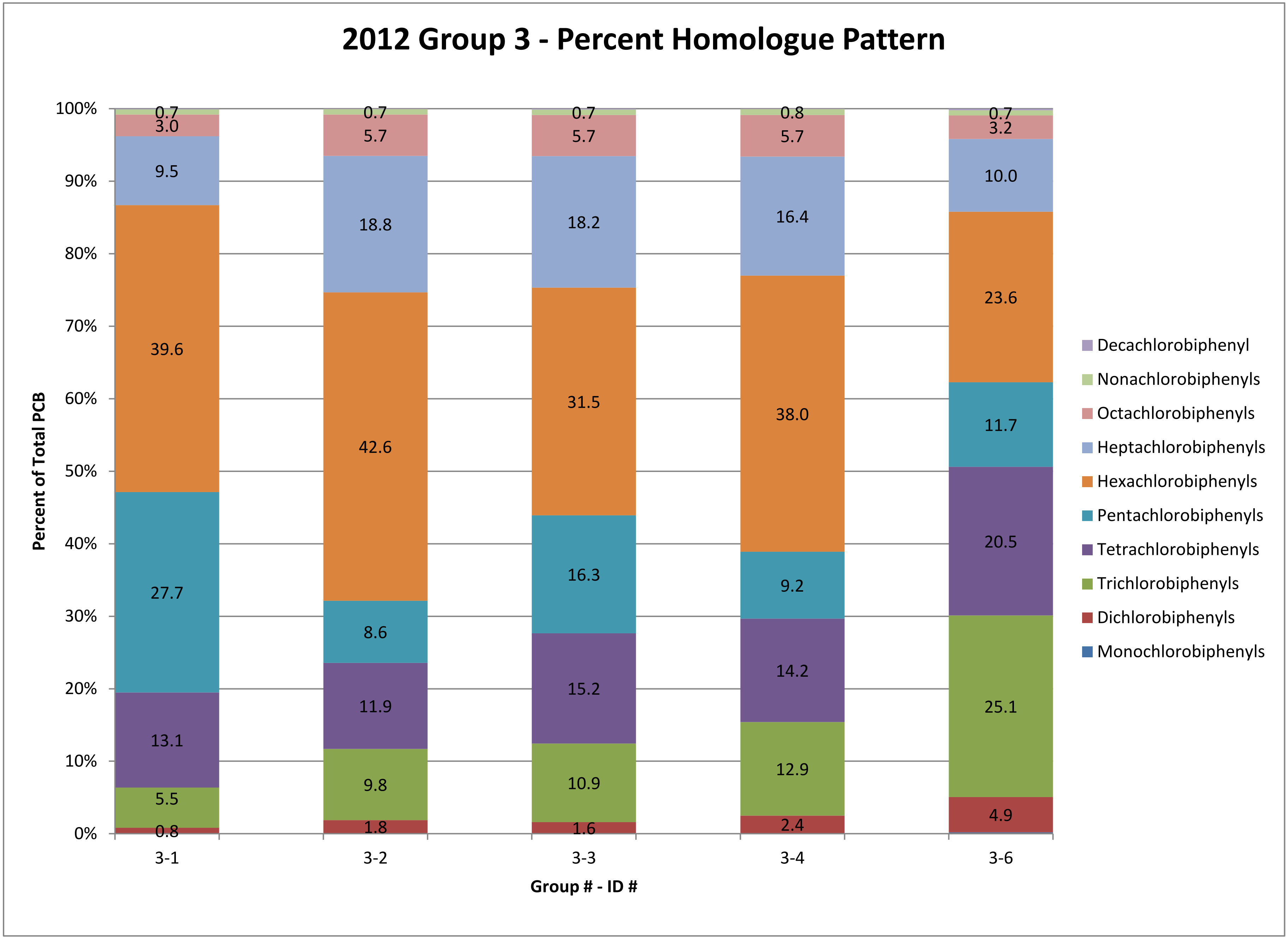
Appendix B

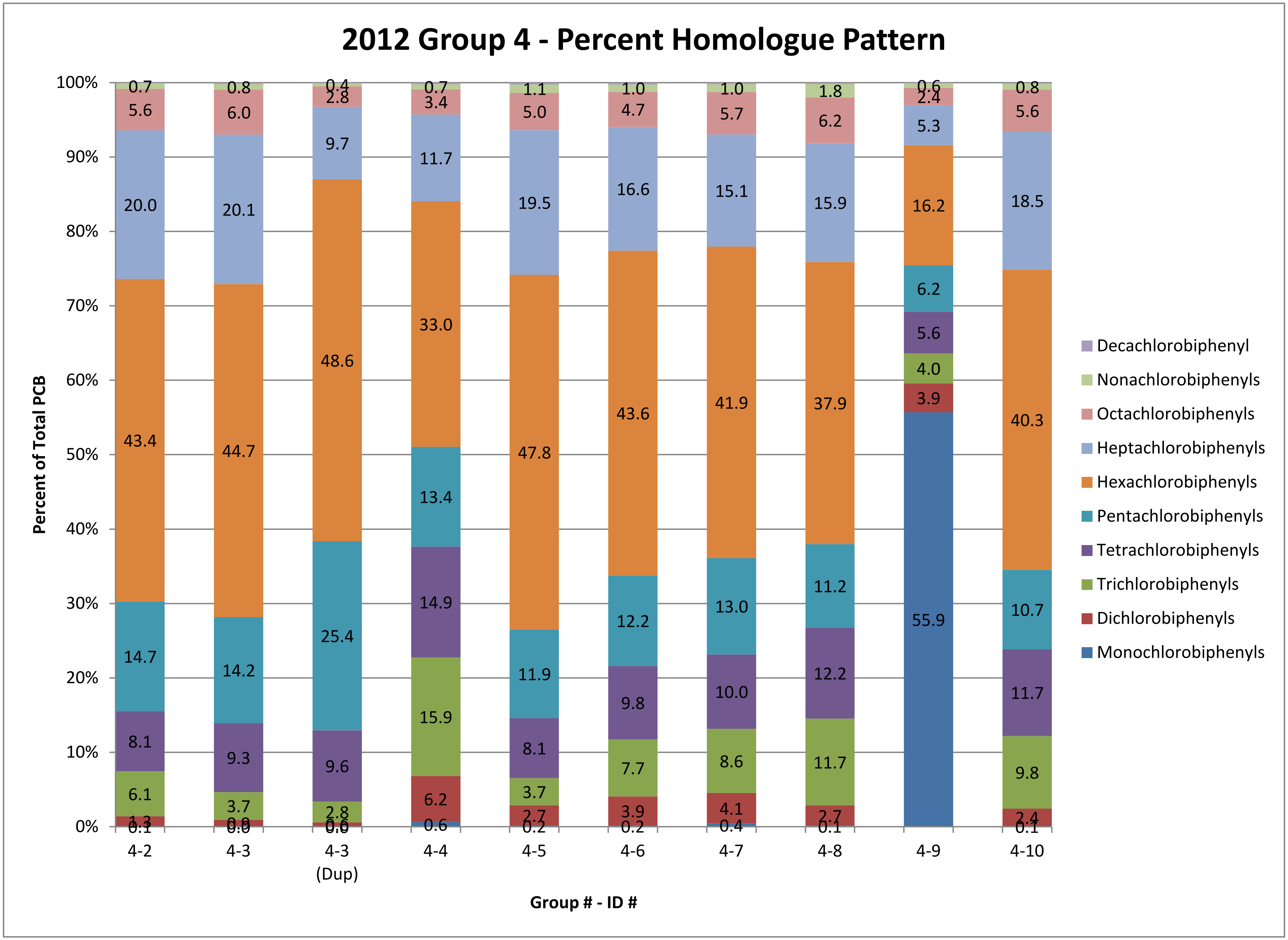
PCB HOMOLOGUE PATTERNS

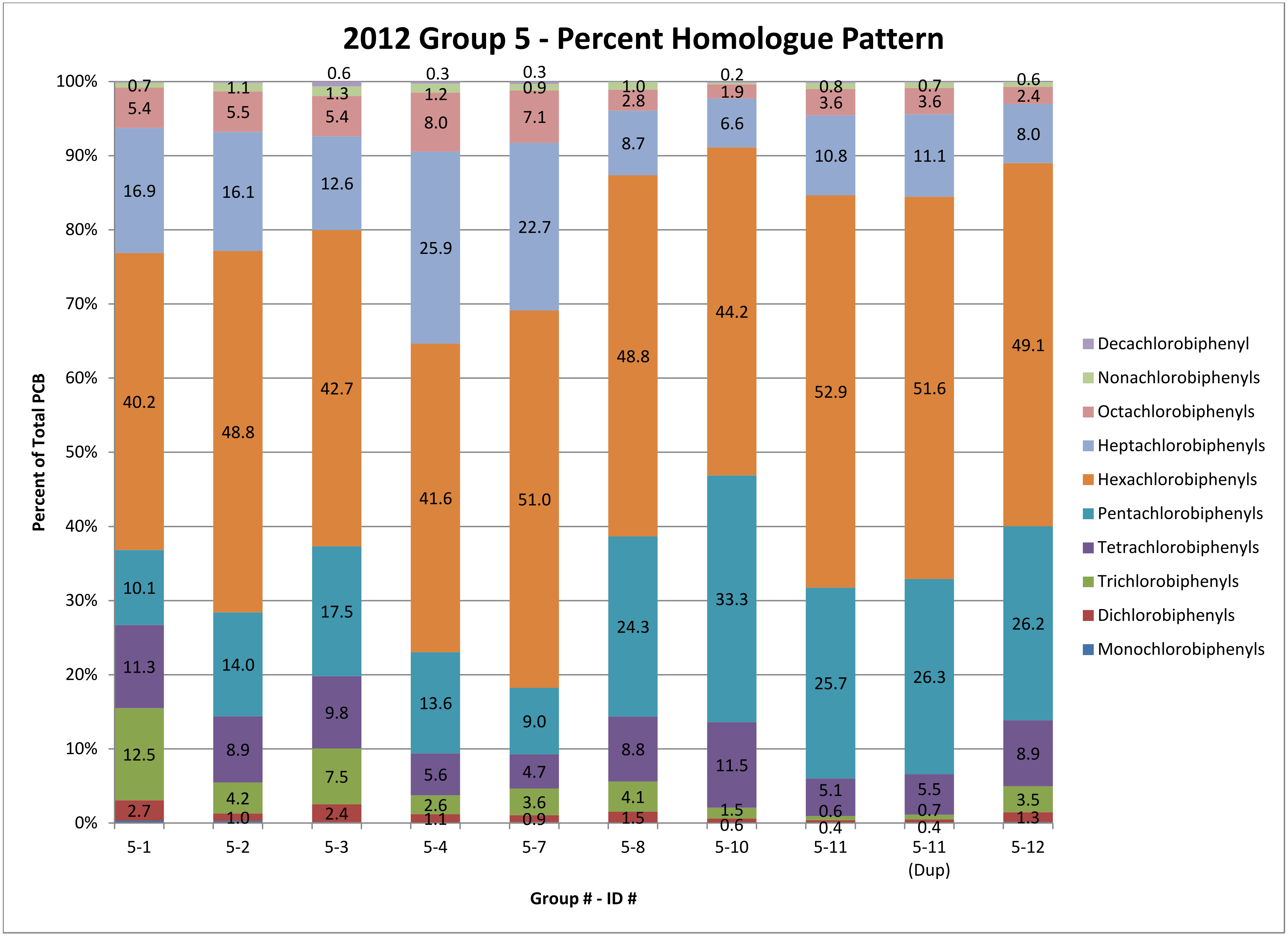

2011 Group 12 Individual Retests
Percent of Total PCB
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Retest 01
Retest 03
Retest 06
Retest 07
Retest 09
Retest 10
0.8
7.3
22.7
51.6
9.7
4.6
2.3
0.9
0.6
7.9
25.7
50.8
8.8
3.8
1.8
0.7
0.8
4.8
23.0
51.0
9.8
4.9
4.0
1.6
0.6
9.7
36.4
46.4
5.5
0.9
3.8
34.1
48.4
8.8
1.6
1.6
1.6
0.2
5.6
31.0
47.1
10.1
2.8
2.0
1.0
Decachlorobiphenyl
Nonachlorobiphenyls
Octachlorobiphenyls
Heptachlorobiphenyls
Hexachlorobiphenyls
Pentachlorobiphenyls
Tetrachlorobiphenyls
Trichlorobiphenyls
Dichlorobiphenyls
Monochlorobiphenyls

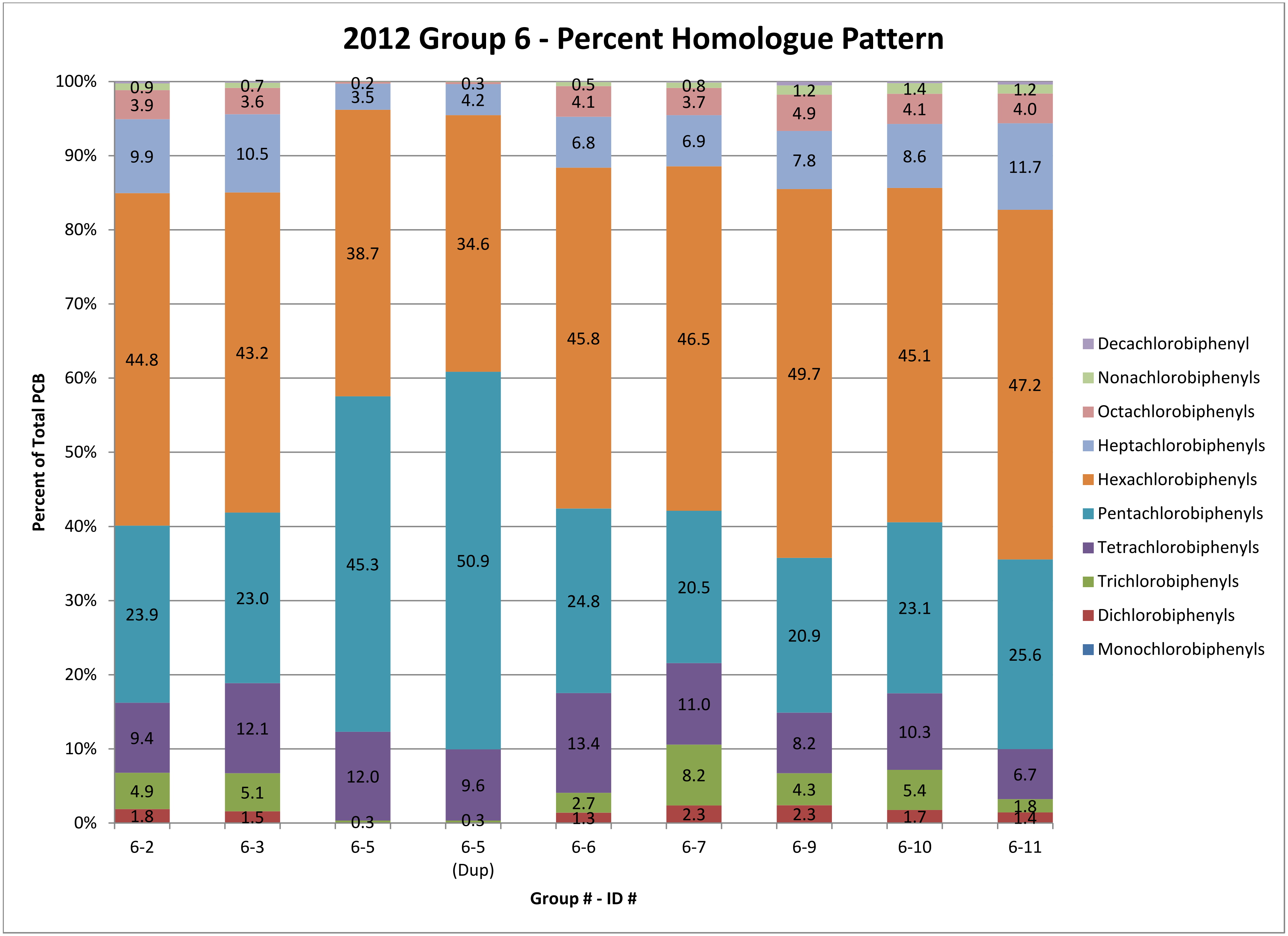

2011 Group 13 Individual Retests
Percent of Total PCB
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Retest 12
Retest 14
Retest 15
Retest 19
Retest 20
Retest 20 DUPLICATE
Retest 22
Retest 23
0.8
1.9
17.7
58.9
14.0
4.3
1.6
1.3
7.2
41.6
40.9
8.2
0.4
0.7
1.6
7.4
45.3
34.1
8.6
1.3
0.8
7.7
24.5
24.5
33.5
5.0
3.3
1.6
11.1
51.2
29.1
5.4
0.7
2.0
10.0
54.7
26.7
5.0
1.2
2.4
4.8
21.4
45.2
19.0
4.8
2.4
1.0
8.0
18.3
45.9
15.4
7.0
2.7
1.5
Decachlorobiphenyl
Nonachlorobiphenyls
Octachlorobiphenyls
Heptachlorobiphenyls
Hexachlorobiphenyls
Pentachlorobiphenyls
Tetrachlorobiphenyls
Trichlorobiphenyls
Dichlorobiphenyls
Monochlorobiphenyls

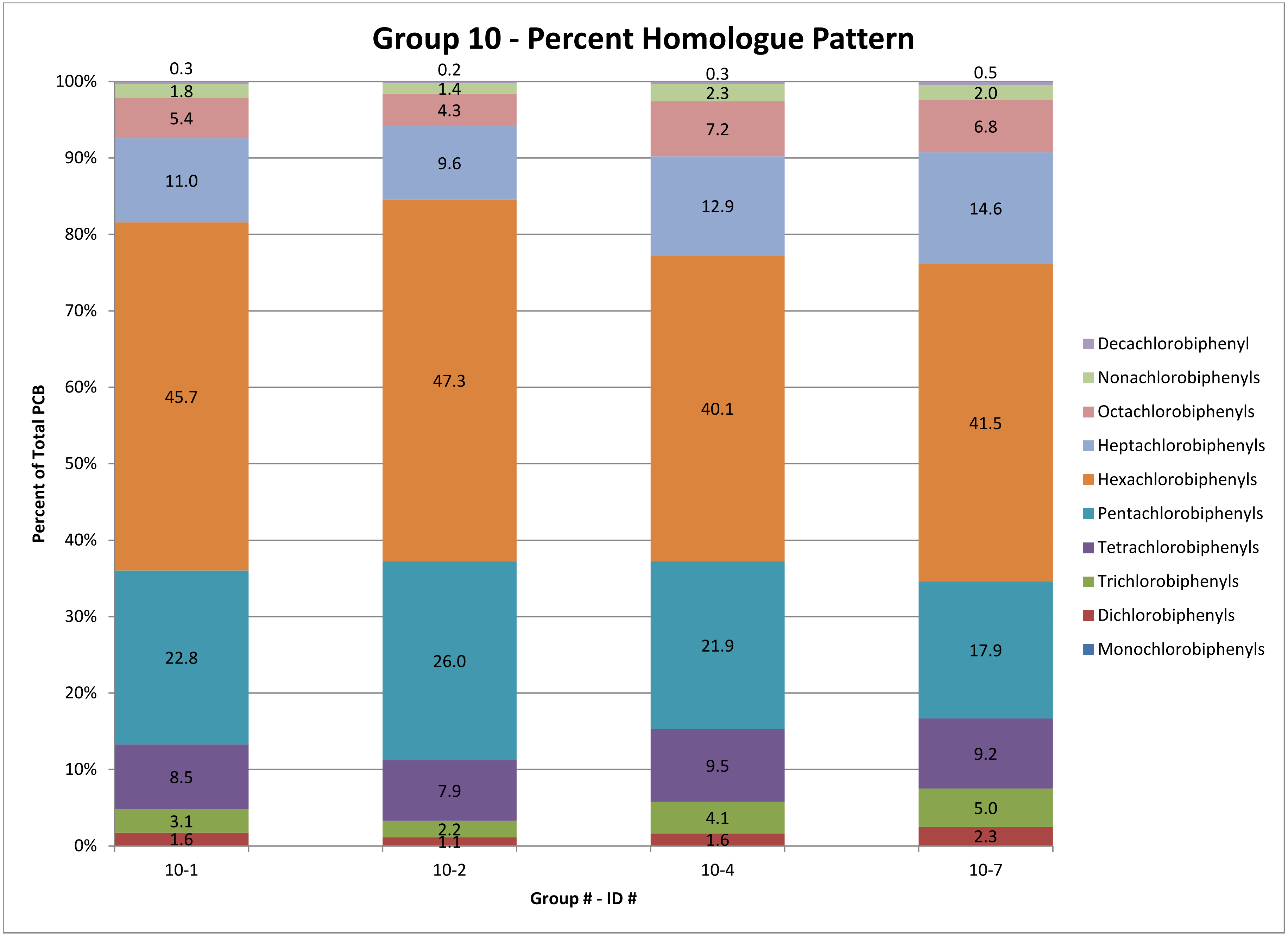

2011 Group 24, 25 Individual Retests
Percent of Total PCB
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Retest 26
Retest 27
Retest 28
2.4
7.4
21.2
27.0
23.4
13.3
4.4
2.6
8.7
28.7
17.7
21.0
15.5
5.0
3.7
9.9
21.0
31.9
15.4
15.1
2.5
Decachlorobiphenyl
Nonachlorobiphenyls
Octachlorobiphenyls
Heptachlorobiphenyls
Hexachlorobiphenyls
Pentachlorobiphenyls
Tetrachlorobiphenyls
Trichlorobiphenyls
Dichlorobiphenyls
Monochlorobiphenyls

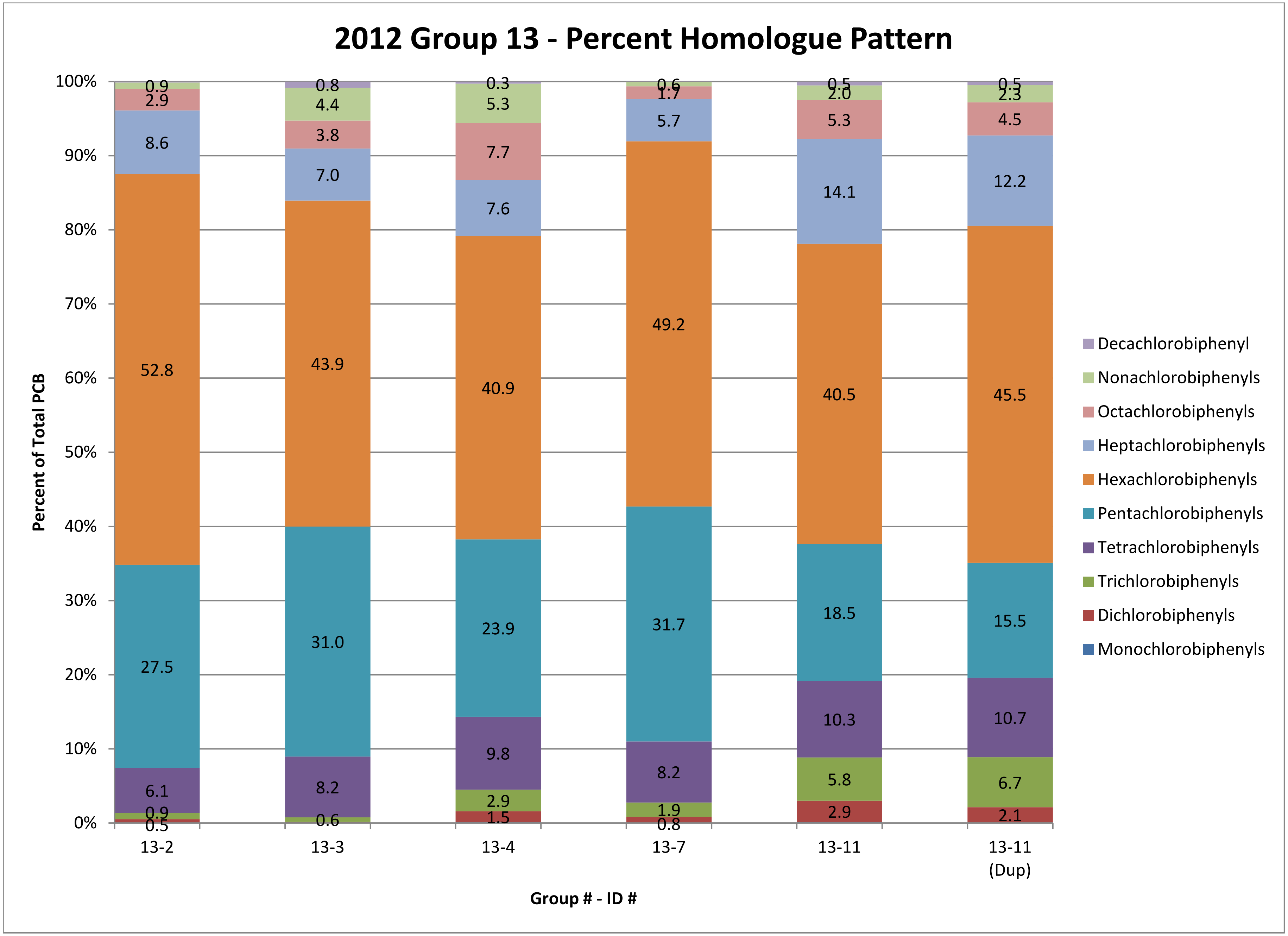

2012 Group 3 - Percent Homologue Pattern
Percent of Total PCB
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0.7
3.0
9.5
39.6
27.7
13.1
5.5
0.8
0.7
5.7
18.8
42.6
8.6
11.9
9.8
1.8
0.7
5.7
18.2
31.5
16.3
15.2
10.9
1.6
0.8
5.7
16.4
38.0
9.2
14.2
12.9
2.4
0.7
3.2
10.0
23.6
11.7
20.5
25.1
4.9
3-1
3-2
3-3
3-4
3-6
Group # - ID #
Decachlorobiphenyl
Nonachlorobiphenyls
Octachlorobiphenyls
Heptachlorobiphenyls
Hexachlorobiphenyls
Pentachlorobiphenyls
Tetrachlorobiphenyls
Trichlorobiphenyls
Dichlorobiphenyls
Monochlorobiphenyls

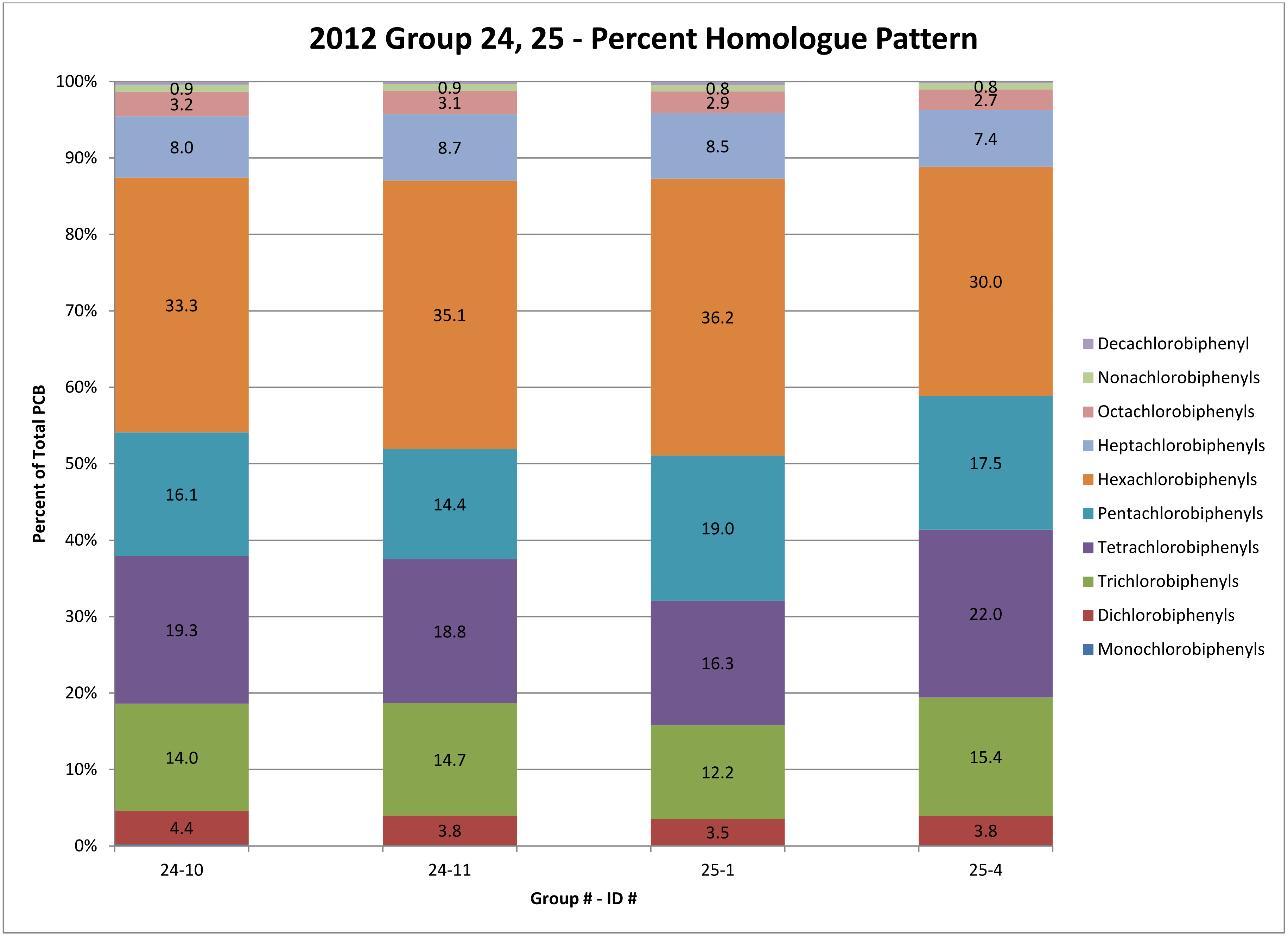

2012 Group 4 - Percent Homologue Pattern
Percent of Total PCB
Group # - ID #
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
4-2
4-3
4-3 (Dup)
4-4
4-5
4-6
4-7
4-8
4-9
4-10
Decachlorobiphenyl
Nonachlorobiphenyls
Octachlorobiphenyls
Heptachlorobiphenyls
Hexachlorobiphenyls
Pentachlorobiphenyls
Tetrachlorobiphenyls
Trichlorobiphenyls
Dichlorobiphenyls
Monochlorobiphenyls

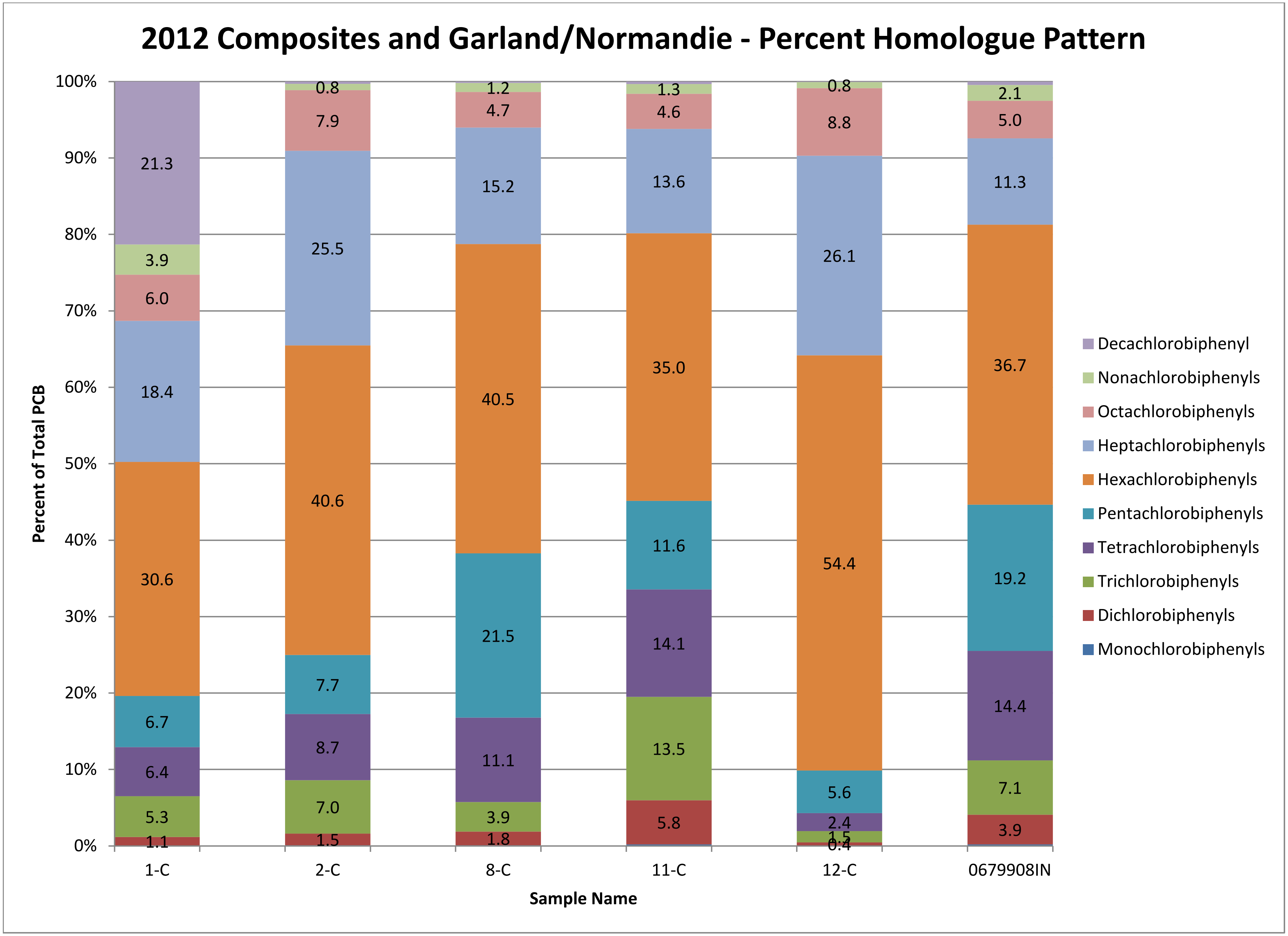

2012 Group 5 - Percent Homologue Pattern
Percent of Total PCB
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Group # - ID #
5-1
5-2
5-3
5-4
5-7
5-8
5-10
5-11
5-11 (Dup)
5-12
Decachlorobiphenyl
Nonachlorobiphenyls
Octachlorobiphenyls
Heptachlorobiphenyls
Hexachlorobiphenyls
Pentachlorobiphenyls
Tetrachlorobiphenyls
Trichlorobiphenyls
Dichlorobiphenyls
Monochlorobiphenyls
2.7 12.5 11.3 10.1 40.2 16.9 5.4 0.7
1.0 4.2 8.9 14.0 48.8 16.1 5.5 1.1
2.4 7.5 9.8 17.5 42.7 12.6 5.4 1.3 0.6
1.1 2.6 5.6 13.6 41.6 25.9 8.0 1.2 0.3
0.9 3.6 4.7 9.0 51.0 22.7 7.1 0.9 0.3
1.5 4.1 8.8 24.3 48.8 8.7 2.8 1.0
0.6 1.5 11.5 33.3 44.2 6.6 1.9 0.2
0.4 0.6 5.1 25.7 52.9 10.8 3.6 0.8
0.4 0.7 5.5 26.3 51.6 11.1 3.6 0.7
1.3 3.5 8.9 26.2 49.1 8.0 2.4 0.6


2012 Group 6 - Percent Homologue Pattern
Percent of Total PCB
Group # - ID #
6-2
6-3
6-5
6-5 (Dup)
6-6
6-7
6-9
6-10
6-11
Decachlorobiphenyl
Nonachlorobiphenyls
Octachlorobiphenyls
Heptachlorobiphenyls
Hexachlorobiphenyls
Pentachlorobiphenyls
Tetrachlorobiphenyls
Trichlorobiphenyls
Dichlorobiphenyls
Monochlorobiphenyls

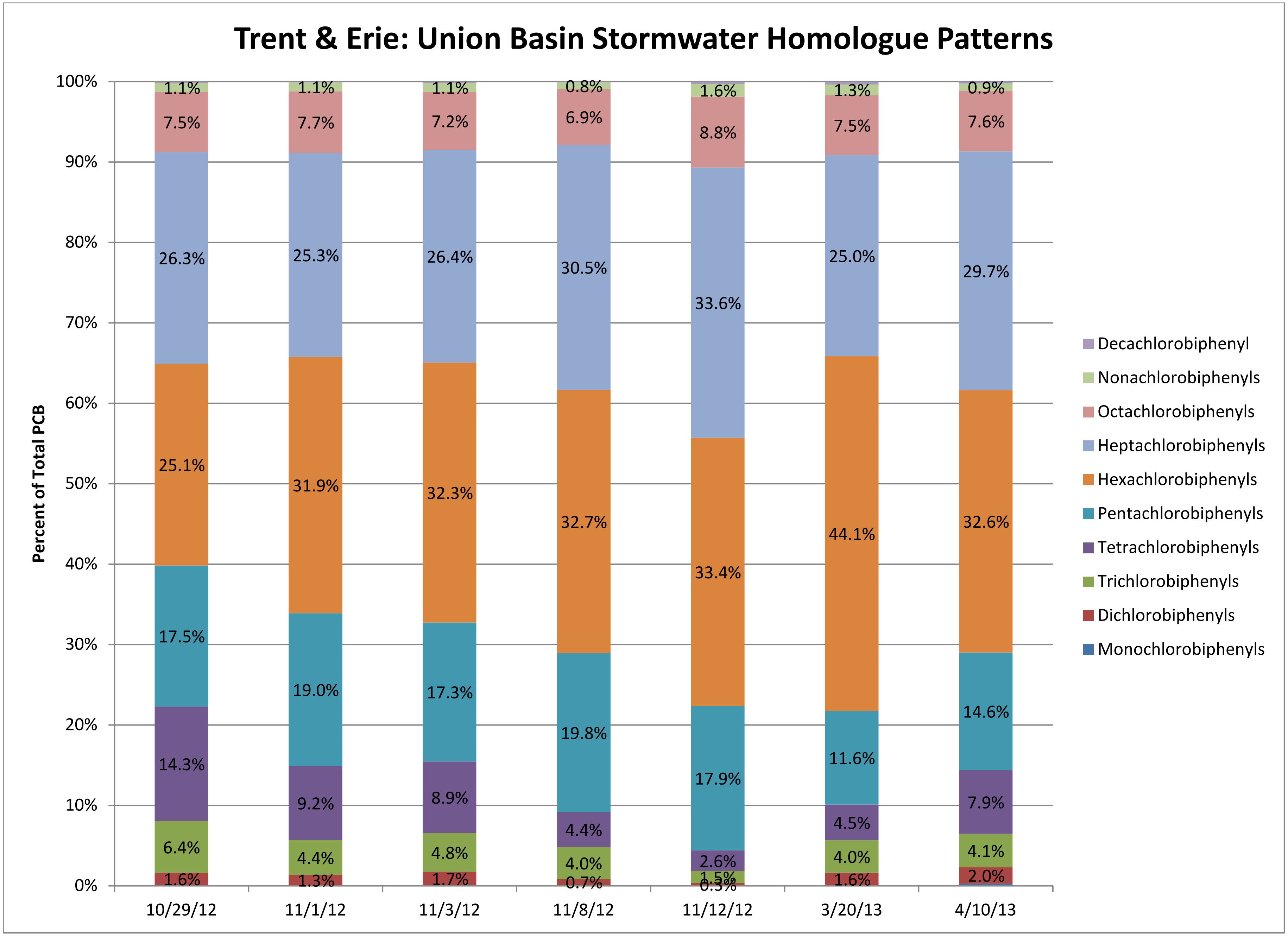

Group 10 - Percent Homologue Pattern
Percent of Total PCB
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0.3
1.8
5.4
11.0
45.7
22.8
8.5
3.1
1.6
0.2
1.4
4.3
9.6
47.3
26.0
7.9
2.2
1.1
0.3
2.3
7.2
12.9
40.1
21.9
9.5
4.1
1.6
0.5
2.0
6.8
14.6
41.5
17.9
9.2
5.0
2.3
10-1
10-2
10-4
10-7
Group # - ID #
Decachlorobiphenyl
Nonachlorobiphenyls
Octachlorobiphenyls
Heptachlorobiphenyls
Hexachlorobiphenyls
Pentachlorobiphenyls
Tetrachlorobiphenyls
Trichlorobiphenyls
Dichlorobiphenyls
Monochlorobiphenyls

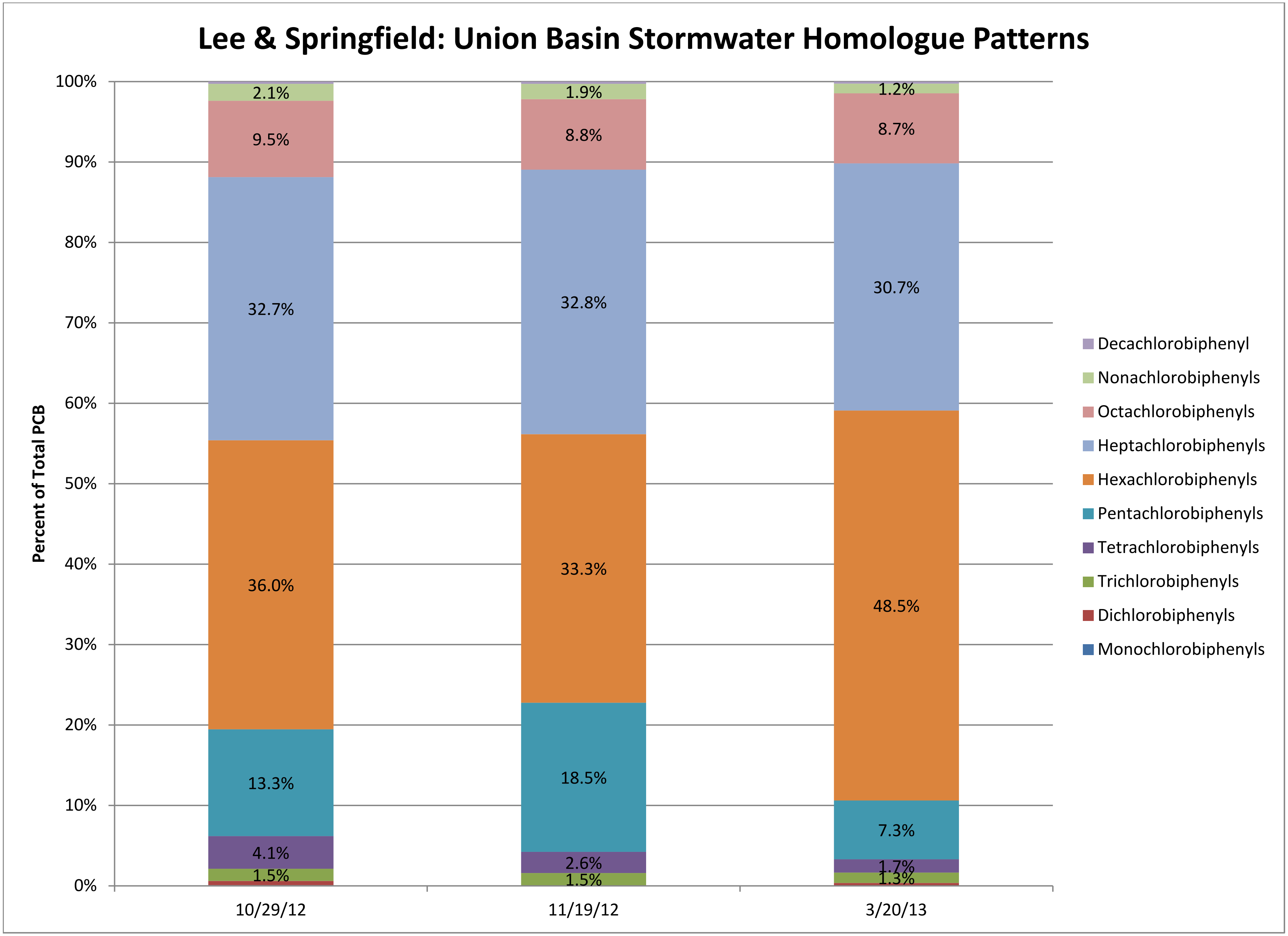

2012 Group 13 - Percent Homologue Pattern
Percent of Total PCB
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Group # - ID #
13-2
13-3
13-4
13-7
13-11
13-11 (Dup)
Decachlorobiphenyl
Nonachlorobiphenyls
Octachlorobiphenyls
Heptachlorobiphenyls
Hexachlorobiphenyls
Pentachlorobiphenyls
Tetrachlorobiphenyls
Trichlorobiphenyls
Dichlorobiphenyls
Monochlorobiphenyls
0.9
2.9
8.6
52.8
27.5
6.1
0.9
0.5
0.8
4.4
3.8
7.0
43.9
31.0
8.2
0.6
0.3
5.3
7.7
7.6
40.9
23.9
9.8
2.9
1.5
0.6
1.7
5.7
49.2
31.7
8.2
1.9
0.8
0.5
2.0
5.3
14.1
40.5
18.5
10.3
5.8
2.9
0.5
2.3
4.5
12.2
45.5
15.5
10.7
6.7
2.1

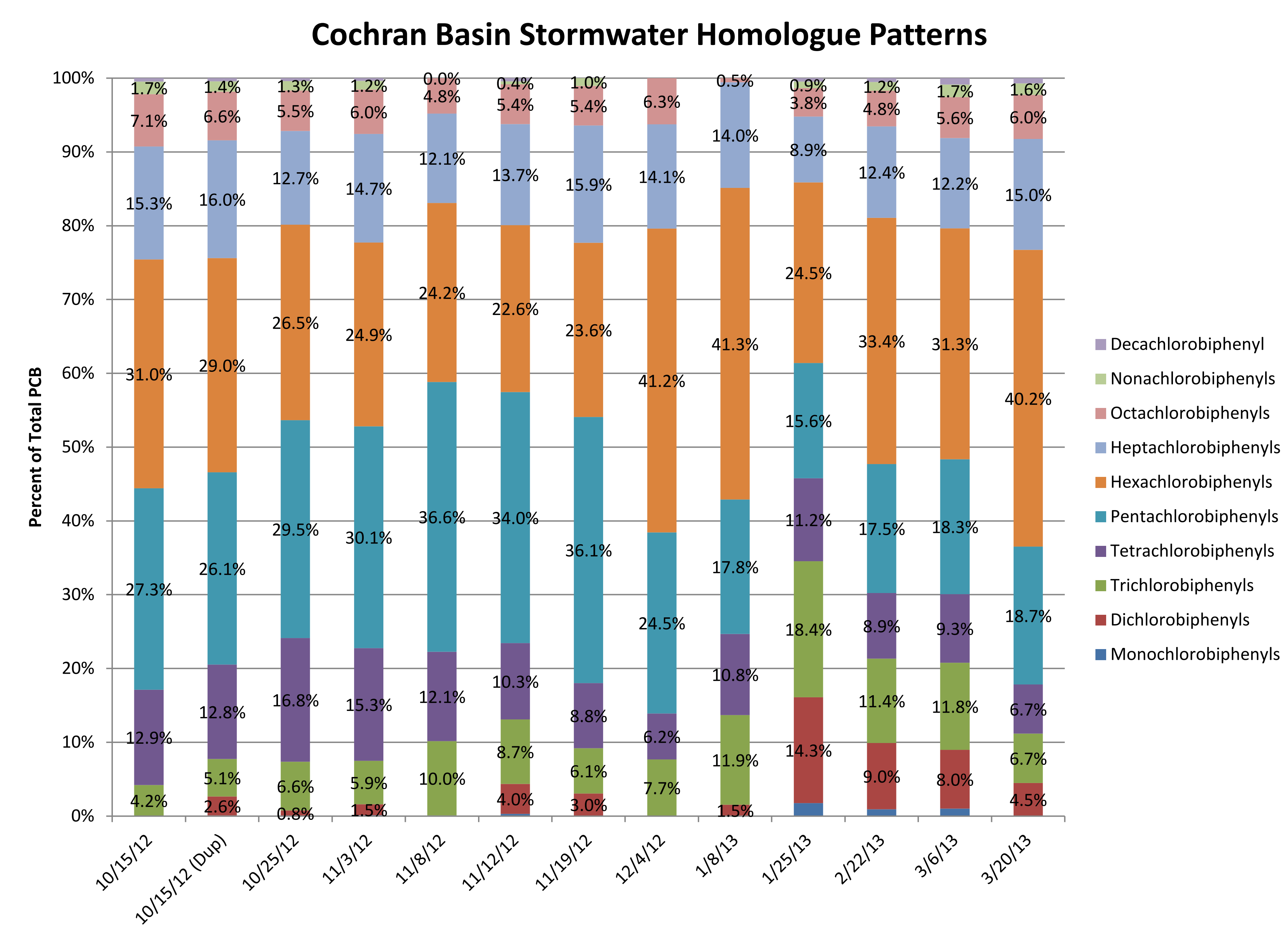

2012 Group 24, 25 - Percent Homologue Pattern
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Percent of Total PCB
0.9
3.2
8.0
33.3
16.1
19.3
14.0
4.4
0.9
3.1
8.7
35.1
14.4
18.8
14.7
3.8
0.8
2.9
8.5
36.2
19.0
16.3
12.2
3.5
0.8
2.7
7.4
30.0
17.5
22.0
15.4
3.8
24-10
24-11
25-1
25-4
Group # - ID #
Decachlorobiphenyl
Nonachlorobiphenyls
Octachlorobiphenyls
Heptachlorobiphenyls
Hexachlorobiphenyls
Pentachlorobiphenyls
Tetrachlorobiphenyls
Trichlorobiphenyls
Dichlorobiphenyls
Monochlorobiphenyls

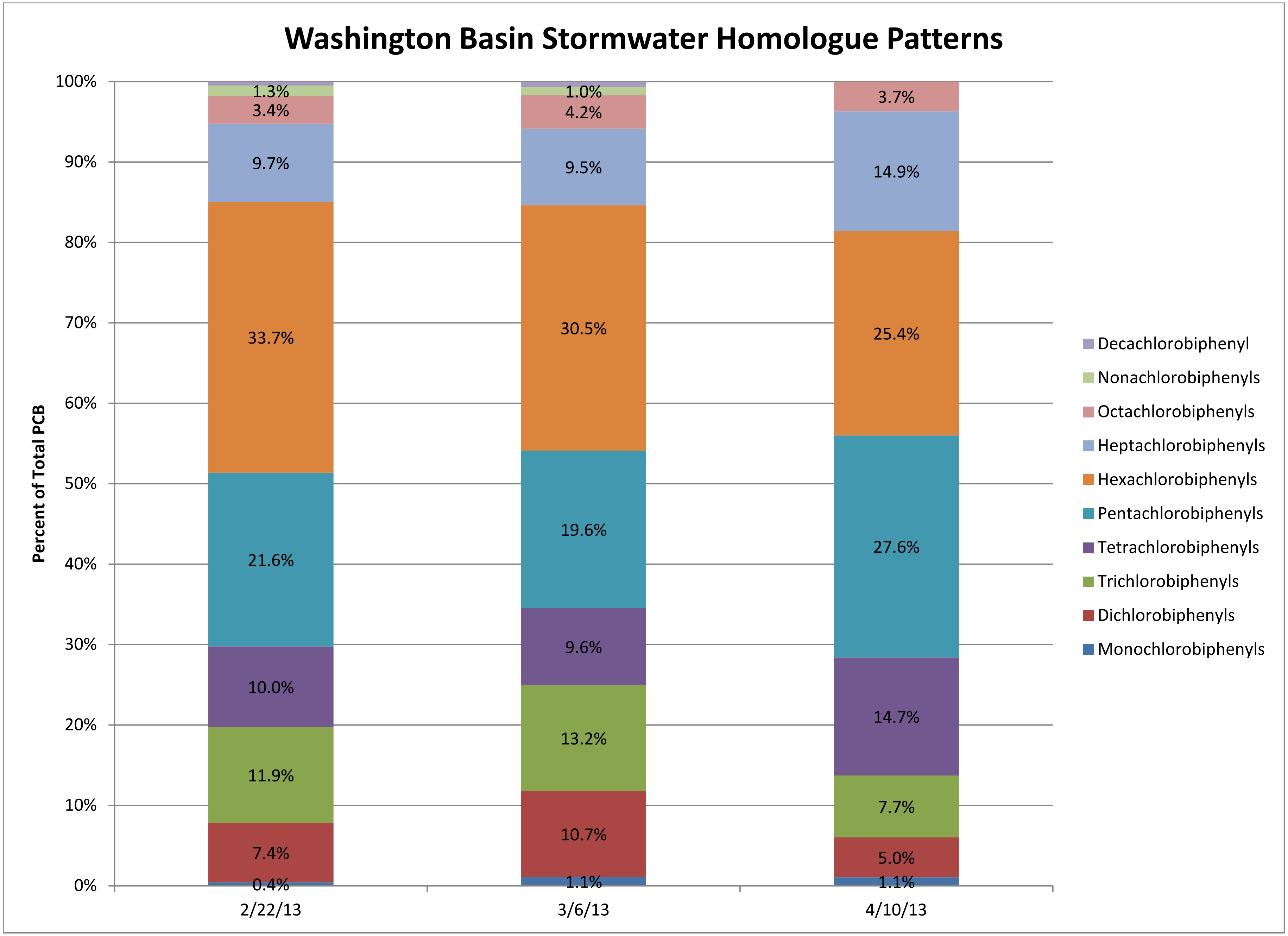


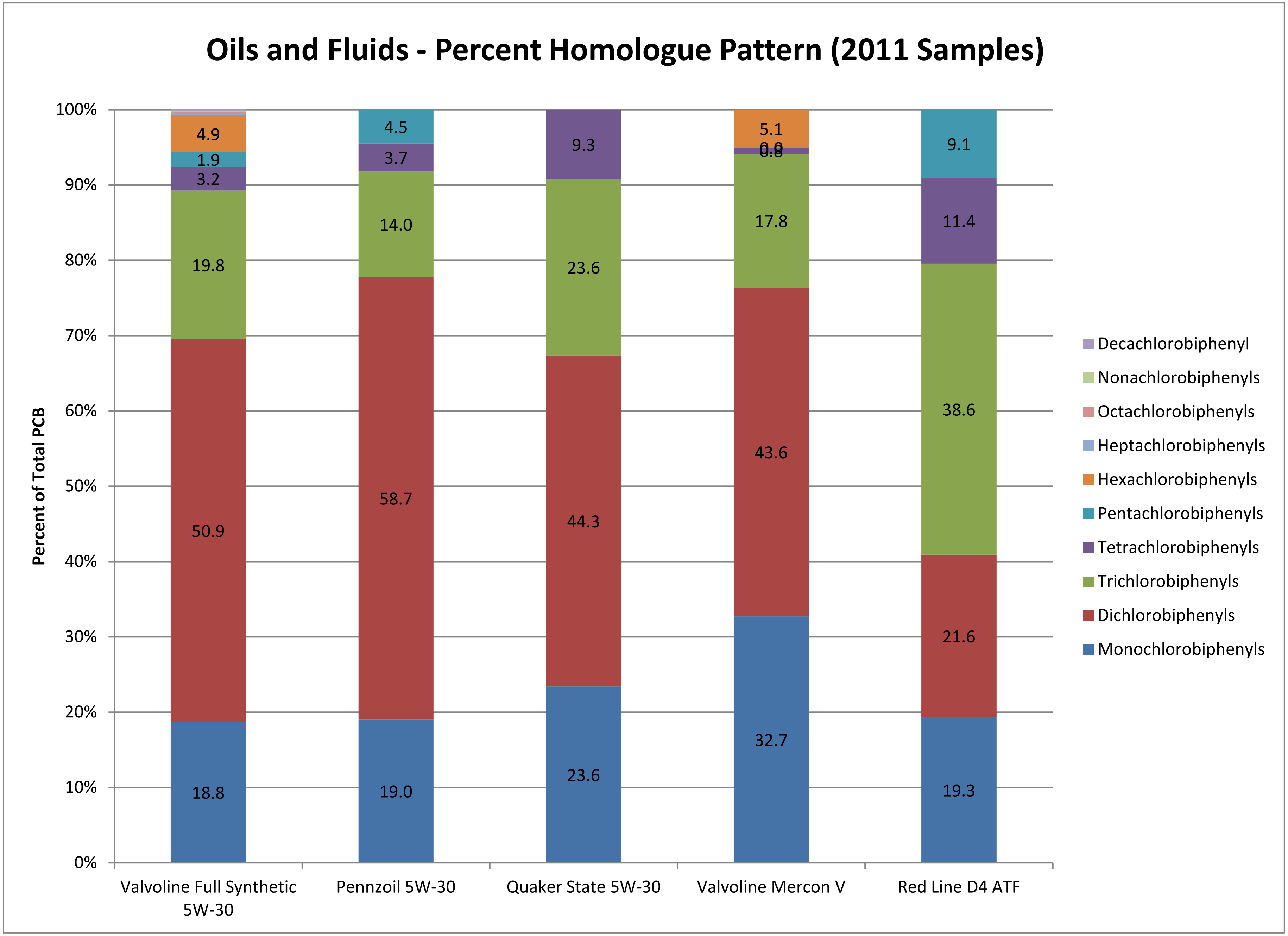
2012 Composites and Garland/Normandie - Percent Homologue Pattern
Percent of Total PCB
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
1-C
2-C
8-C
11-C
12-C
0679908IN
Sample Name
21.3
3.9
6.0
18.4
30.6
6.7
6.4
5.3
1.1
0.8
7.9
25.5
40.6
7.7
8.7
7.0
1.5
1.2
4.7
15.2
40.5
21.5
11.1
3.9
1.8
1.3
4.6
13.6
35.0
11.6
14.1
13.5
5.8
0.8
8.8
26.1
54.4
5.6
2.4
1.5
0.4
2.1
5.0
11.3
36.7
19.2
14.4
7.1
3.9
Decachlorobiphenyl
Nonachlorobiphenyls
Octachlorobiphenyls
Heptachlorobiphenyls
Hexachlorobiphenyls
Pentachlorobiphenyls
Tetrachlorobiphenyls
Trichlorobiphenyls
Dichlorobiphenyls
Monochlorobiphenyls

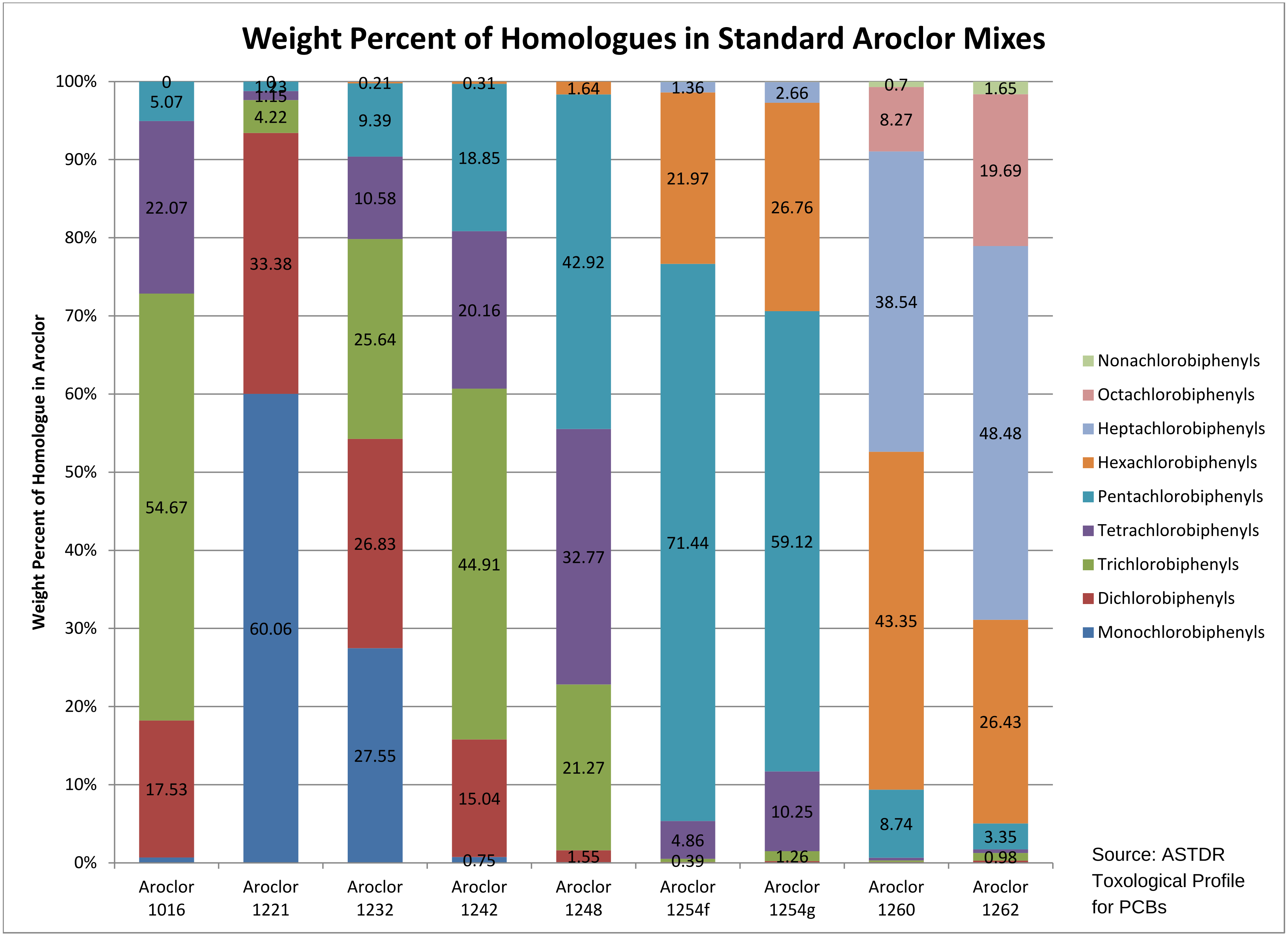

Trent & Erie: Union Basin Stormwater Homologue Patterns
Percent of Total PCB
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
10/29/12
11/1/12
11/3/12
11/8/12
11/12/12
3/20/13
4/10/13
1.1%
7.5%
26.3%
25.1%
17.5%
14.3%
6.4%
1.6%
1.1%
7.7%
25.3%
31.9%
19.0%
9.2%
4.4%
1.3%
1.1%
7.2%
26.4%
32.3%
17.3%
8.9%
4.8%
1.7%
0.8%
6.9%
30.5%
32.7%
19.8%
4.4%
4.0%
0.7%
1.6%
8.8%
33.6%
33.4%
17.9%
2.6%
1.5%
0.3%
1.3%
7.5%
25.0%
44.1%
11.6%
4.5%
4.0%
1.6%
0.9%
7.6%
29.7%
32.6%
14.6%
7.9%
4.1%
2.0%
Decachlorobiphenyl
Nonachlorobiphenyls
Octachlorobiphenyls
Heptachlorobiphenyls
Hexachlorobiphenyls
Pentachlorobiphenyls
Tetrachlorobiphenyls
Trichlorobiphenyls
Dichlorobiphenyls
Monochlorobiphenyls


Lee & Springfield: Union Basin Stormwater Homologue Patterns
Percent of Total PCB
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
10/29/12
11/19/12
3/20/13
2.1%
9.5%
32.7%
36.0%
13.3%
4.1%
1.5%
1.9%
8.8%
32.8%
33.3%
18.5%
2.6%
1.5%
1.2%
8.7%
30.7%
48.5%
7.3%
1.7%
1.3%
Decachlorobiphenyl
Nonachlorobiphenyls
Octachlorobiphenyls
Heptachlorobiphenyls
Hexachlorobiphenyls
Pentachlorobiphenyls
Tetrachlorobiphenyls
Trichlorobiphenyls
Dichlorobiphenyls
Monochlorobiphenyls


Cochran Basin Stormwater Homologue Patterns
Percent of Total PCB
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
10/15/12
10/15/12 (Dup)
10/25/12
11/3/12
11/8/12
11/12/12
11/19/12
12/4/12
1/8/13
1/25/13
2/22/13
3/6/13
3/20/13
Decachlorobiphenyl
Nonachlorobiphenyls
Octachlorobiphenyls
Heptachlorobiphenyls
Hexachlorobiphenyls
Pentachlorobiphenyls
Tetrachlorobiphenyls
Trichlorobiphenyls
Dichlorobiphenyls
Monochlorobiphenyls


Washington Basin Stormwater Homologue Patterns
Percent of Total PCB
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2/22/13
3/6/13
4/10/13
1.3%
3.4%
9.7%
33.7%
21.6%
10.0%
11.9%
7.4%
0.4%
1.0%
4.2%
9.5%
30.5%
19.6%
9.6%
13.2%
10.7%
1.1%
3.7%
14.9%
25.4%
27.6%
14.7%
7.7%
5.0%
1.1%
Decachlorobiphenyl
Nonachlorobiphenyls
Octachlorobiphenyls
Heptachlorobiphenyls
Hexachlorobiphenyls
Pentachlorobiphenyls
Tetrachlorobiphenyls
Trichlorobiphenyls
Dichlorobiphenyls
Monochlorobiphenyls


Oils and Fluids - Percent Homologue Pattern (2011 Samples)
Percent of Total PCB
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
4.9
1.9
3.2
19.8
50.9
18.8
4.5
3.7
14.0
58.7
19.0
9.3
23.6
44.3
23.6
5.1
17.8
43.6
32.7
9.1
11.4
38.6
21.6
19.3
Valvoline Full Synthetic 5W-30
Pennzoil 5W-30
Quaker State 5W-30
Valvoline Mercon V
Red Line D4 ATF
Decachlorobiphenyl
Nonachlorobiphenyls
Octachlorobiphenyls
Heptachlorobiphenyls
Hexachlorobiphenyls
Pentachlorobiphenyls
Tetrachlorobiphenyls
Trichlorobiphenyls
Dichlorobiphenyls
Monochlorobiphenyls


Weight Percent of Homologues in Standard Aroclor Mixes
Weight Percent of Homologue in Aroclor
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Aroclor 1016
Aroclor 1221
Aroclor 1232
Aroclor 1242
Aroclor 1248
Aroclor 1254f
Aroclor 1254g
Aroclor 1260
Aroclor 1262
0
5.07
22.07
54.67
17.53
0
1.93
1.15
4.22
33.38
60.06
0.21
9.39
10.58
25.64
26.83
27.55
0.31
18.85
20.16
44.91
15.04
0.75
1.64
42.92
32.77
21.27
1.55
1.36
21.97
71.44
4.86
0.39
2.66
26.76
59.12
10.25
1.26
0.7
8.27
38.54
43.35
8.74
1.65
19.69
48.48
26.43
3.35
0.98
Nonachlorobiphenyls
Octachlorobiphenyls
Heptachlorobiphenyls
Hexachlorobiphenyls
Pentachlorobiphenyls
Tetrachlorobiphenyls
Trichlorobiphenyls
Dichlorobiphenyls
Monochlorobiphenyls
Source: ASTDR Toxological Profile for PCBs