APPENDIX B. DATA MANAGEMENT

B.1 LABORATORY REPLICATES

Chemical concentrations obtained from the analysis of laboratory duplicates or replicates (two or more analyses on the same sample) are averaged for a closer representation of the "true" concentration as compared to the results of a single analysis. Averaging rules are dependent on whether the individual results are detects or non-detects. If all concentrations are detects for a given parameter, the values are simply averaged arithmetically. If all concentrations are undetected for a given parameter, the minimum detection limit is reported. If the concentrations are a mixture of detects and non-detects, any two or more detected concentrations are averaged arithmetically and detection limits ignored. If there is a single detected concentration and one or more non-detects, the detected concentration is reported. The latter two rules are applied regardless of whether the detection limits are higher or lower than the detected concentration.

B.2 SIGNIFICANT FIGURES AND ROUNDING

The laboratory reports results with different numbers of significant figures depending on the instrument, parameter, and the concentration relative to the reporting limit (RL). The reported (or assessed) precision of each observation is explicitly stored in the project database as a record of the number of significant figures assigned by the laboratory. The tracking of significant figures becomes important when calculating averages and performing other data summaries.

When a calculation involves addition, such as totaling polychlorinated biphenyls (PCBs) or polycyclic aromatic hydrocarbons (PAHs), the calculation can only be as precise as the least precise number that went into the calculation. For example (assuming two significant figures):

> 210 + 19 = 229, but this would be reported as 230 because the trailing zero in the number 210 is not significant.

When a calculation involves multiplication or division, such as when carbon normalizing is used, all significant figures are carried through the calculation, and then the total result is rounded at the end of the calculation to reflect the value used in the calculation with the fewest significant figures. For example:

> 59.9 x 1.2 = 71.88, to be reported as 72 because there are two significant figures in the number 1.2.

When rounding, if the number following the last significant figure is less than 5, the digit is left unchanged. If the number following the last significant figure is equal to or greater than 5, the digit is increased by 1.

B.3 DILUTIONS

All analyte concentrations within the calibration range of the instrument in the lowest analytical dilution are selected as the final result. Any analyte concentrations that exceed the calibration range and are qualified as estimated by the laboratory as an exceedance (E-qualified) are rejected by the data validator. The values for these analytes are selected from the analysis of the sample dilution in which the analyte concentration is within the calibration range of the instrument. In cases where the result from the lowest analytical dilution is qualified by the laboratory or the validator, the validator uses best professional judgment to determine whether or not the qualification warrants the selection of the result from another analytical dilution as the final result.

B.4 MULTIPLE RESULTS FOR THE SAME ANALYTE USING ONE ANALYTICAL METHOD

Multiple analyses of a sample for a group of analytes can occur as a result of laboratory quality assurance (QA) issues that may only affect a subset of the analyte group. In these cases, there may be multiple results for certain analytes. The data validator uses the following rules to select a single value when multiple results are reported by the laboratory for a single analyte in a single sample using the same method.

- If all results are detected without qualification as an estimated value (i.e., J- or E-qualifier), then the result from the lowest analytical dilution is selected. If multiple, unqualified results from the same analytical dilution are available, the highest concentration is selected as a health-protective approach.
- If a mixture of estimated (i.e., J-qualified) and unqualified detected results are reported, then the unqualified detected result is selected.
- If all results are reported as detected with estimated qualification, the "best result" is selected using best professional, technical judgment.
- If both non-detected and detected results are reported, then the detected result is selected.
- If all results are reported as non-detected, then the lowest RL is selected.

B.6 CALCULATING TOTALS

Concentrations for analyte sums are calculated as follows:

- **Total PCBs** are calculated, in accordance with the test methods acceptable under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), using only detected values for seven Aroclor

mixtures.[1] For individual samples in which none of the seven Aroclor mixtures is detected, total PCBs are given a value equal to the highest RL of the seven Aroclors and assigned a U-qualifier indicating the lack of detected concentrations.

- **Total low-molecular-weight PAHs (LPAHs), high-molecular-weight PAHs (HPAHs), PAHs, and benzofluoranthenes** are also calculated in accordance with the test methods acceptable under CERCLA. Total LPAHs are the sum of detected concentrations for naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, and anthracene. Total HPAHs are the sum of detected concentrations for fluoranthene, pyrene, benzo(a)anthracene, chrysene, total benzofluoranthenes, benzo(a)pyrene, indeno(1,2,3,-c,d)pyrene, dibenzo(a,h)anthracene, and benzo(g,h,i)perylene. Total benzofluoranthenes are the sum of the b (i.e., benzo(b)fluoranthene), j, and k isomers. Because the j isomer is rarely quantified, this sum is typically calculated with only the b and k isomers. For samples in which all individual compounds within any of the three groups described above are undetected, the single highest RL for that sample represents the sum.
- **Total petroleum hydrocarbon (TPH)** is calculated as the sum of the detected concentrations of the diesel and motor oil fractions analyzed using the Northwest total petroleum hydrocarbon – diesel and oil extractable (NWTPH-Dx) test method. For individual samples in which neither diesel nor motor oil is detected, TPH is given a value equal to the highest RL of the individual fractions and assigned a U-qualifier indicating the lack of detected concentrations. Results generated using the Northwest total petroleum hydrocarbon – hydrocarbon identification (NWTPH-HCID) or Northwest total petroleum hydrocarbon – gasoline (NWTPH-G) methods are not calculated in this total.

B.7 CALCULATION OF CARCINOGENIC POLYCYCLIC AROMATIC HYDROCARBONS (CPAH)

Carcinogenic polycyclic aromatic hydrocarbons (cPAH) values are calculated using toxic equivalency factor (TEF) values (California EPA 1994; Ecology 2001) based on the individual PAH component's relative toxicity to benzo(a)pyrene. TEF values are presented in Table B-1. The cPAH is calculated as the sum of each individual PAH concentration multiplied by the corresponding TEF value. When the individual PAH component concentration is reported as non-detected, then the TEF is multiplied by half the RL.

[1] Aroclors 1016, 1221, 1232, 1242, 1248, 1254, and 1260.

Table B-1. cPAH TEF values

PAH	TEF VALUE (UNITLESS)
benzo(a)pyrene	1
benzo(a)anthracene	0.1
benzo(b)fluoranthene	0.1
benzo(k)fluoranthene	0.1
dibenz(a,h)anthracene	0.4
indeno(1,2,3-cd)pyrene	0.1
chrysene	0.01

B.8 REFERENCES

California EPA. 1994. Health effects of benzo(a)pyrene. Office of Environmental Health Hazard Assessment, California Environmental Protection Agency, Berkeley, CA.

Ecology. 2001. Model Toxics Control Act Cleanup Regulation, Chapter 173-340 WAC. Publication No. 94-06. Toxics Cleanup Program, Washington State Department of Ecology, Olympia, WA.