Addressing Data Quality Issues in the Development of a PCB TMDL

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Overview

- Objective: To provide information to other TMDL participants on our learnings on how data quality objectives impact TMDL process
  - All information is presented as a result of the ongoing work of many stakeholders
  - The existing data sets evaluated are not easily integrated, so that some information/conclusions may be altered as we improve the quality of and our understanding of the data
  - The information presented is the authors' best assessment of the information at hand – it is in essence a series of snapshots of the current data issues

What are PCBs (Polychlorinated Biphenyls)?

- A group of 209 manufactured chemicals with a biphenyl base structure and between 1 and 10 chlorine substitution patterns.
- Hydrophobic and tend to partition to organic matter, including carbon in sediments, suspended solids and tissues
- PCBs are Persistent, Bioaccumulative and Toxic Pollutants (PBTs)

What is a TMDL?

- A TMDL or Total Maximum Daily Load is a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and an allocation of the TMDL to point and non point sources.

What is a Water Quality Standard?

- Water quality standards are set by States, Territories, and Tribes. They identify the uses for each waterbody, for example, drinking water supply, contact recreation (swimming), and aquatic life support (fishing), and the scientific criteria to support that use.
- The PCB Water Quality Standard for the Delaware currently ranges from 7.9 to 44 pg/l (parts per quadrillion) – *Similar to finding 44 people anywhere on the planet*

How Data Quality Impacts a TMDL?

Data needs to be adequate to characterize the pollutant in all loadings, pathways, and ambient media so that:

- Determinations can be made as to significant sources of PCBs to the environment and identification of banks of PCBs in the environment.
- Data is collected that is suitable for use in models and other scientific tools that may be used to understand fate and transport of PCBs – The question is : Is a source impacting the environment or is it impacted by the environment?
- Techniques are identified to ensure that progress can be measured as the TMDL process reduces the ambient concentrations of PCBs in each media.

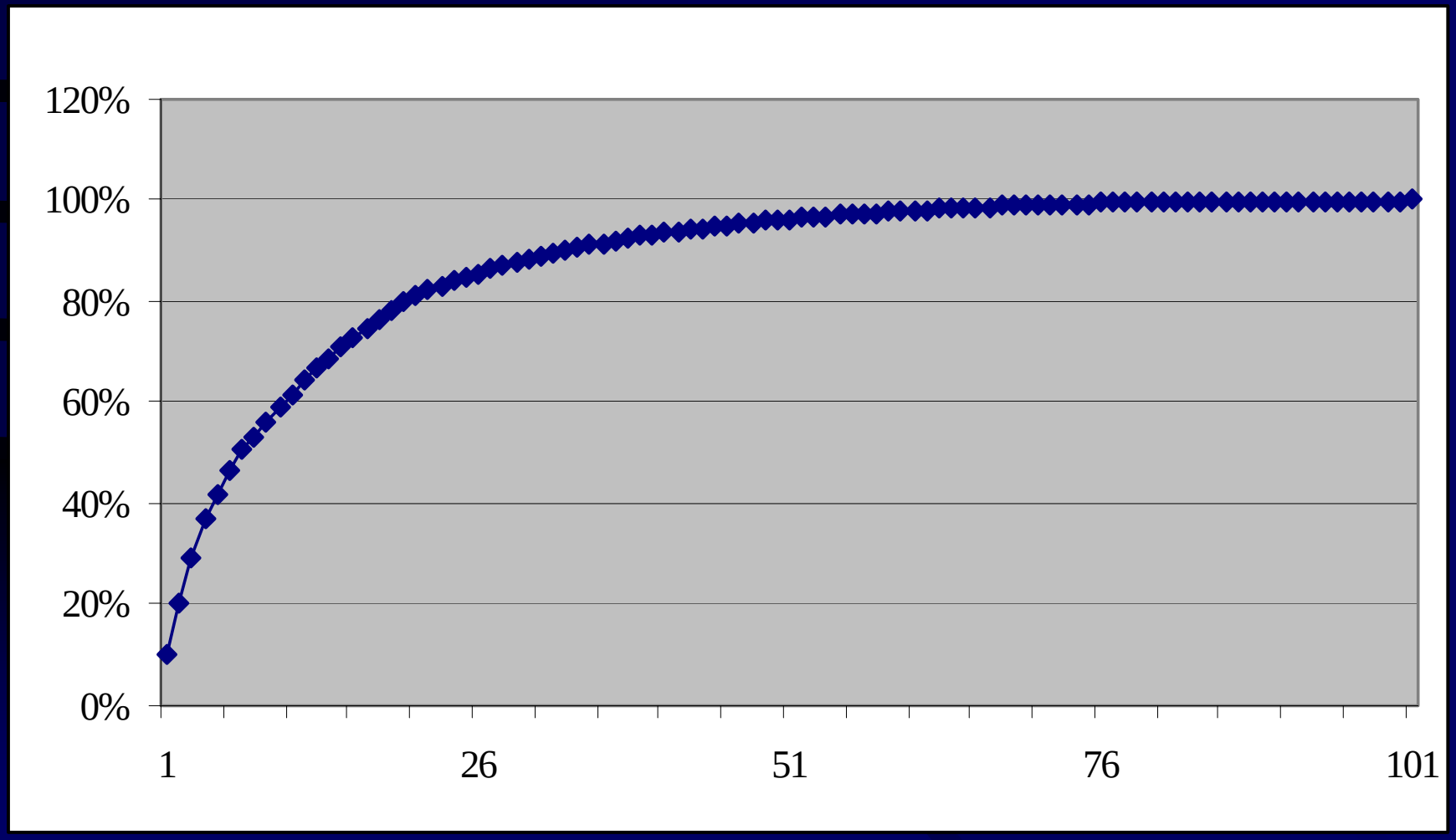
Some Key Issues that Drive the DQO Process for PCBs

- The Applicable Goal or Water Quality Standard
- Selection of Program Analytical Method
- Number of PCB Congeners to Quantify
- Methods to Aggregate Congener Data to Total
- Continuing assessment of the magnitude and variability of data to characterize each Loading, Bank or Pathway to further inform the data collection process
- Sampling Methodology
- Specific Analytical Techniques Required
- Performance Metrics for Analytical Labs

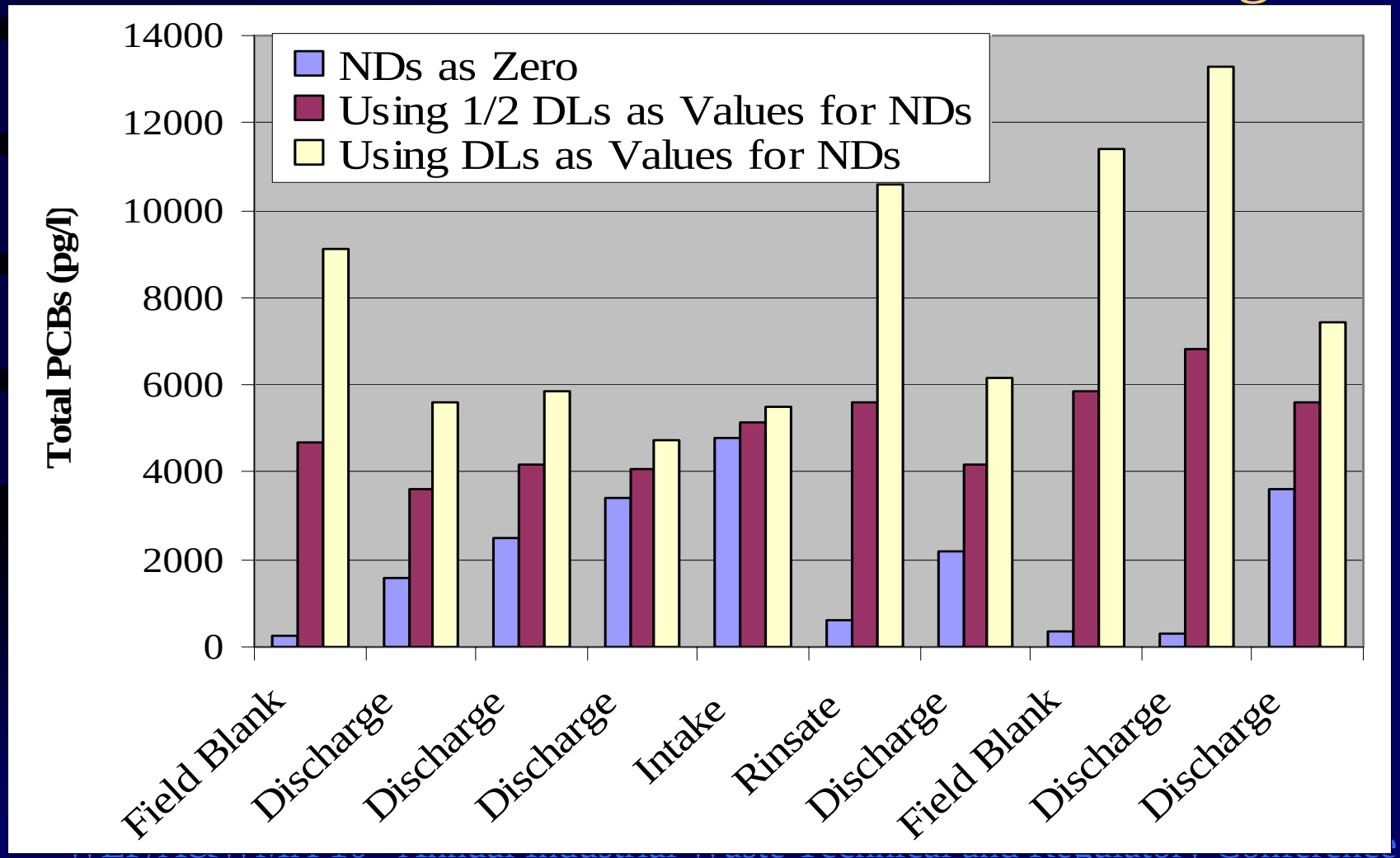
Program Analytical Method

- Potential Analytical Methods
  - EPA Method 8082
  - EPA Method 1668 (draft)
  - EPA Method 1668A (draft)
  - Custom Methods by Academic Researchers and Supporting Agencies

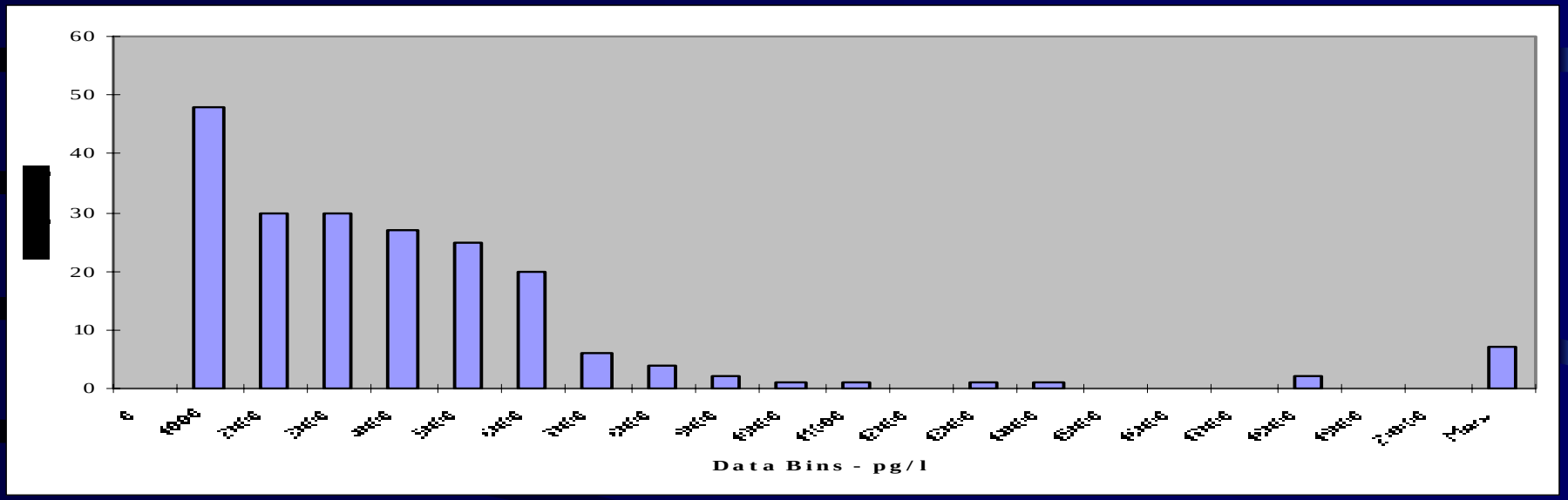
Cumulative Percent of Total for 101 Measured PCB Congeners

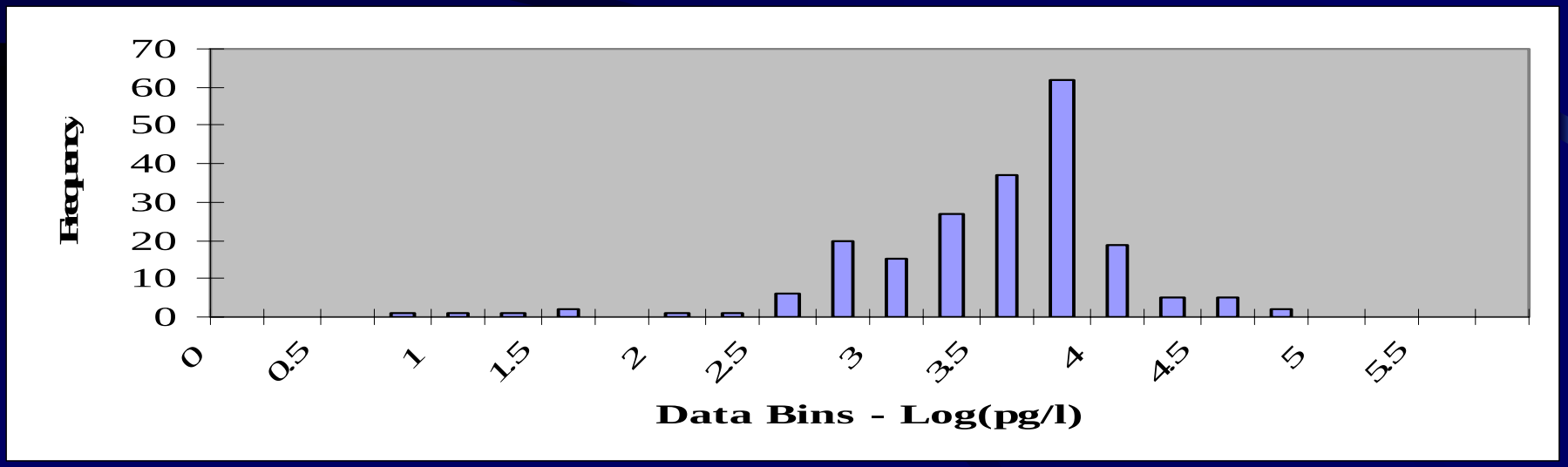


Impact of Treatment of Non Detects on Evaluation of a Point Source Discharge

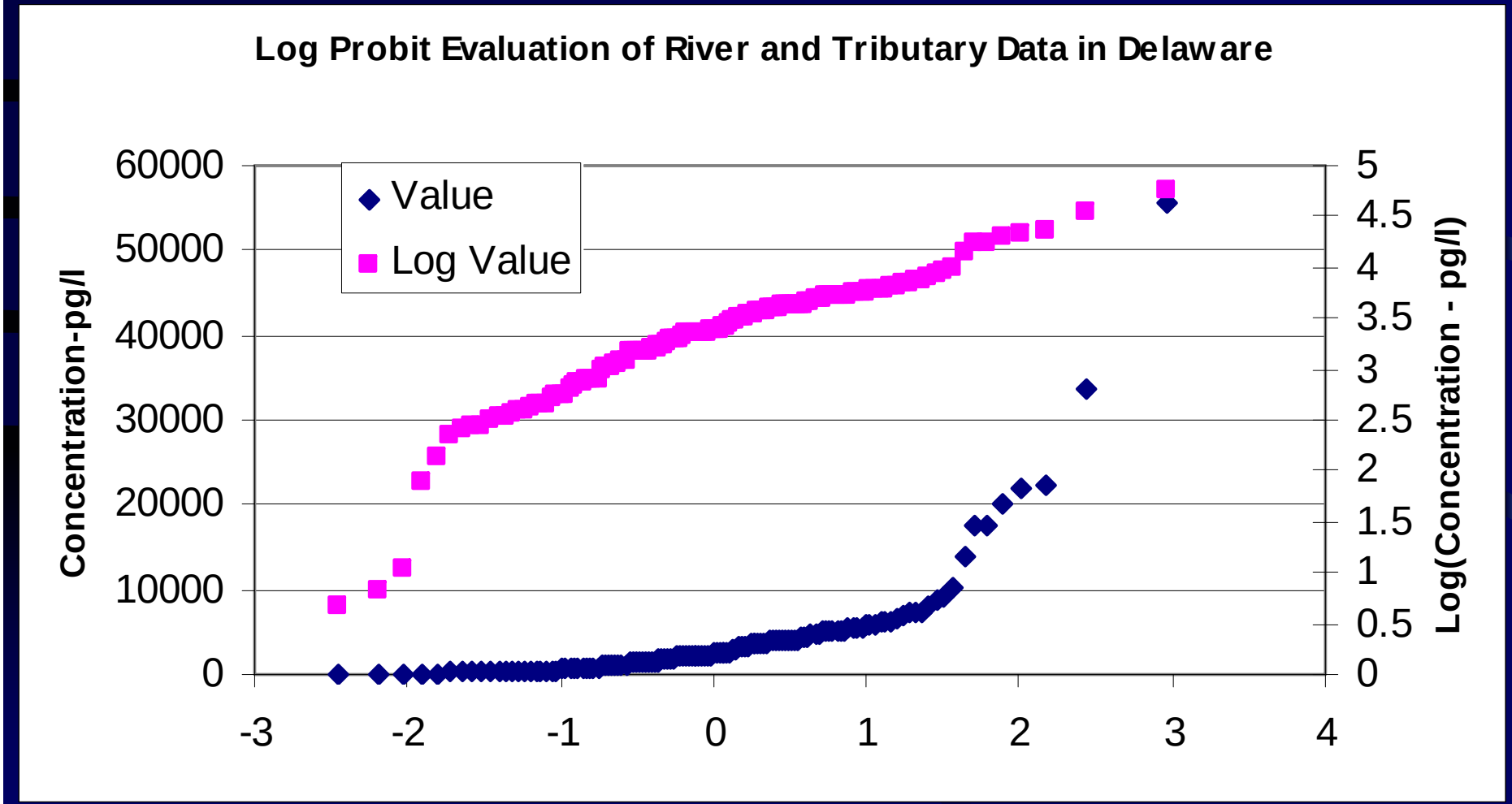


Histograms Detailing Distribution of River and Tributary Data





Probability Distribution - Normal and Log of River and Tributary Data



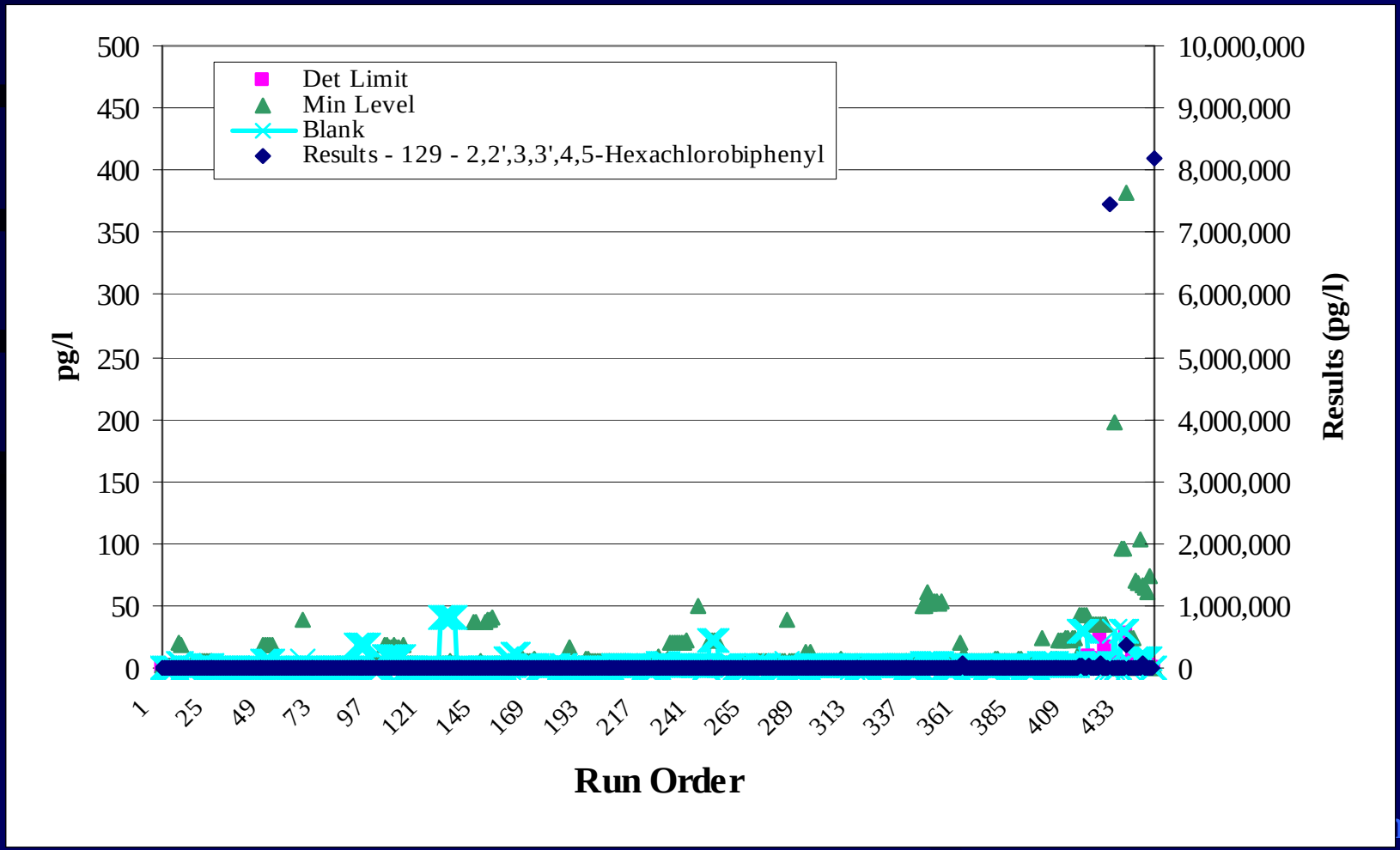
Decision Tool for Ensuring the Comparability of Future Data Collection Efforts

Source Category	% of Total from TMDL	Assigned Uncertainty	Product of % of Load and % Uncertainty	Rank
Contaminated Sites	13.9%	105%	15%	2
Non-Point Sources	7.7%	157%	12%	3
Delaware at Trenton	58.4%	74%	43%	1
Schuylkill	9.7%	73%	7%	4
Point Source	6.1%	30%	2%	6
CSOs	1.4%	77%	1%	7
Tributaries		32%		
Atmospheric Loads		32%		
MS-4s	2.8%	157%	4%	5

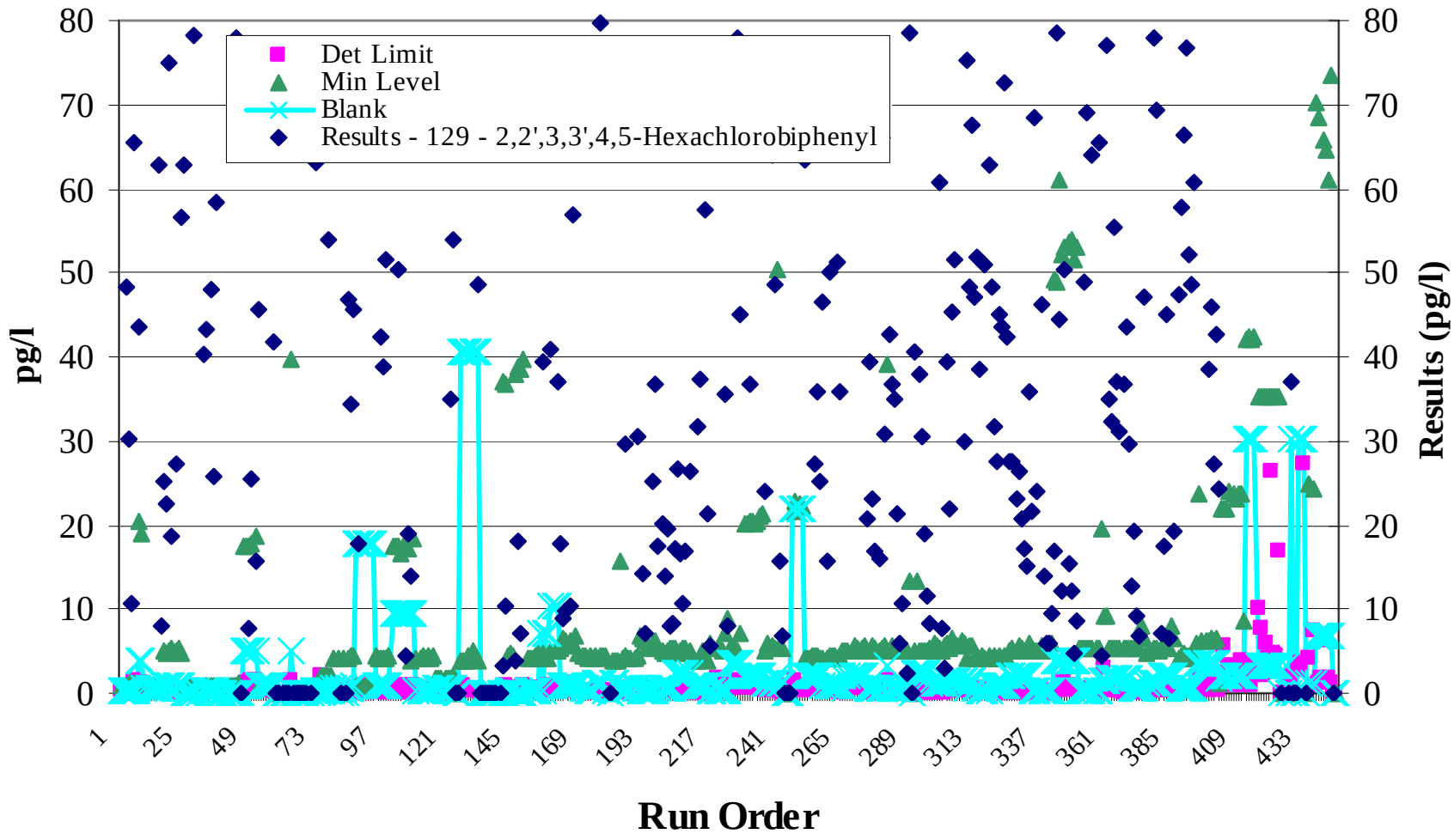
Analytical Issues Identified

- Data Collected by Different Methods is hard to aggregate and compare
- Laboratory Method Blank and Field Blank contamination is a far greater issue than analytical method sensitivity
- Analytical Terminology is confusing and a Data Quality Glossary is required
- Data Handling is a huge task that must be managed “up front”
- Data Review and Validation has been inadequate – probably due to the rapid pace of this groundbreaking program
- Laboratory performance metrics must be established and enforced

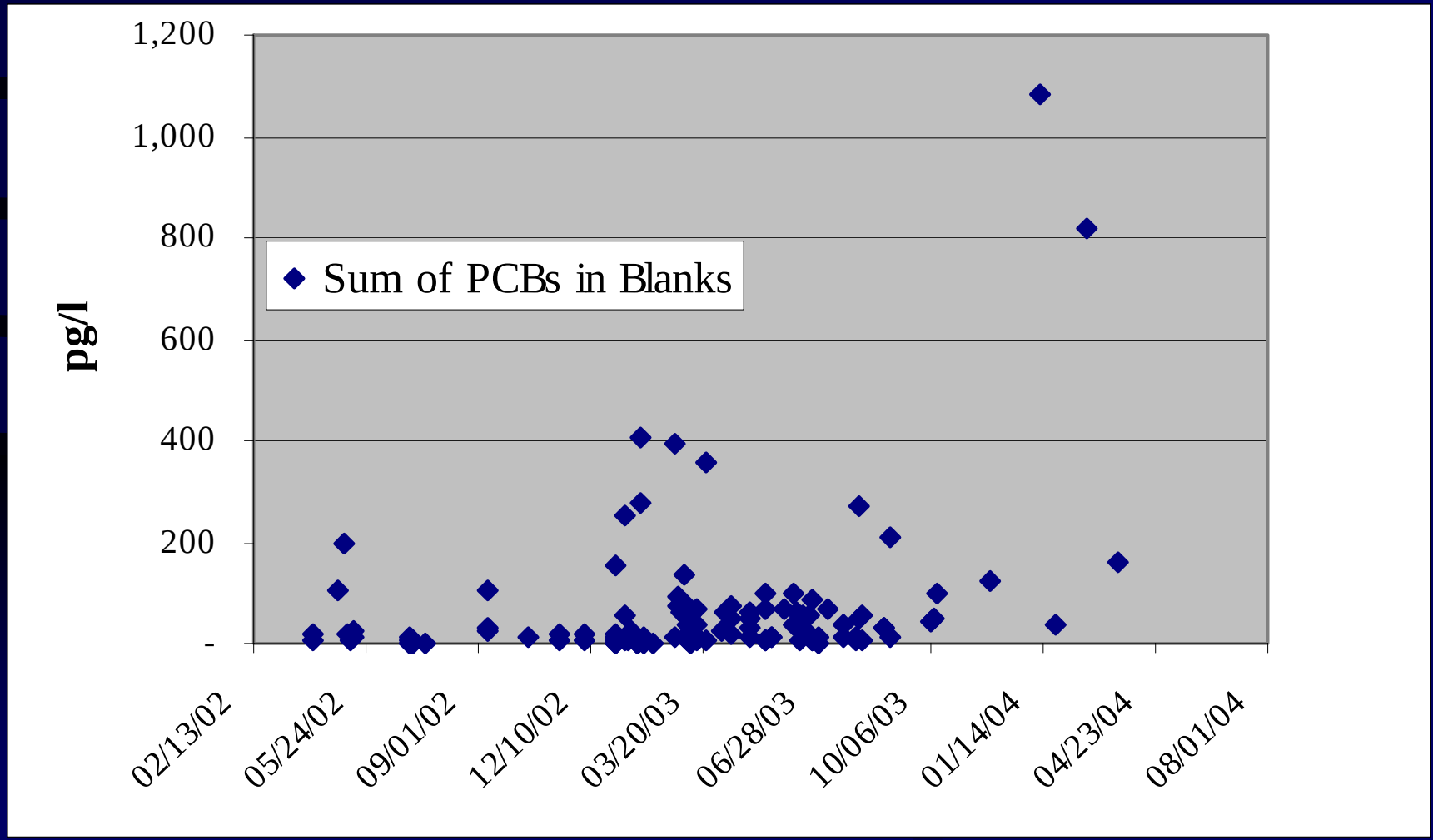
PCB 129 Analysis Results from April 2002 to April 2004 (Dual Scale: 0-500 pg/l for QA Information, 0-10,000,000 pg/l for Results)



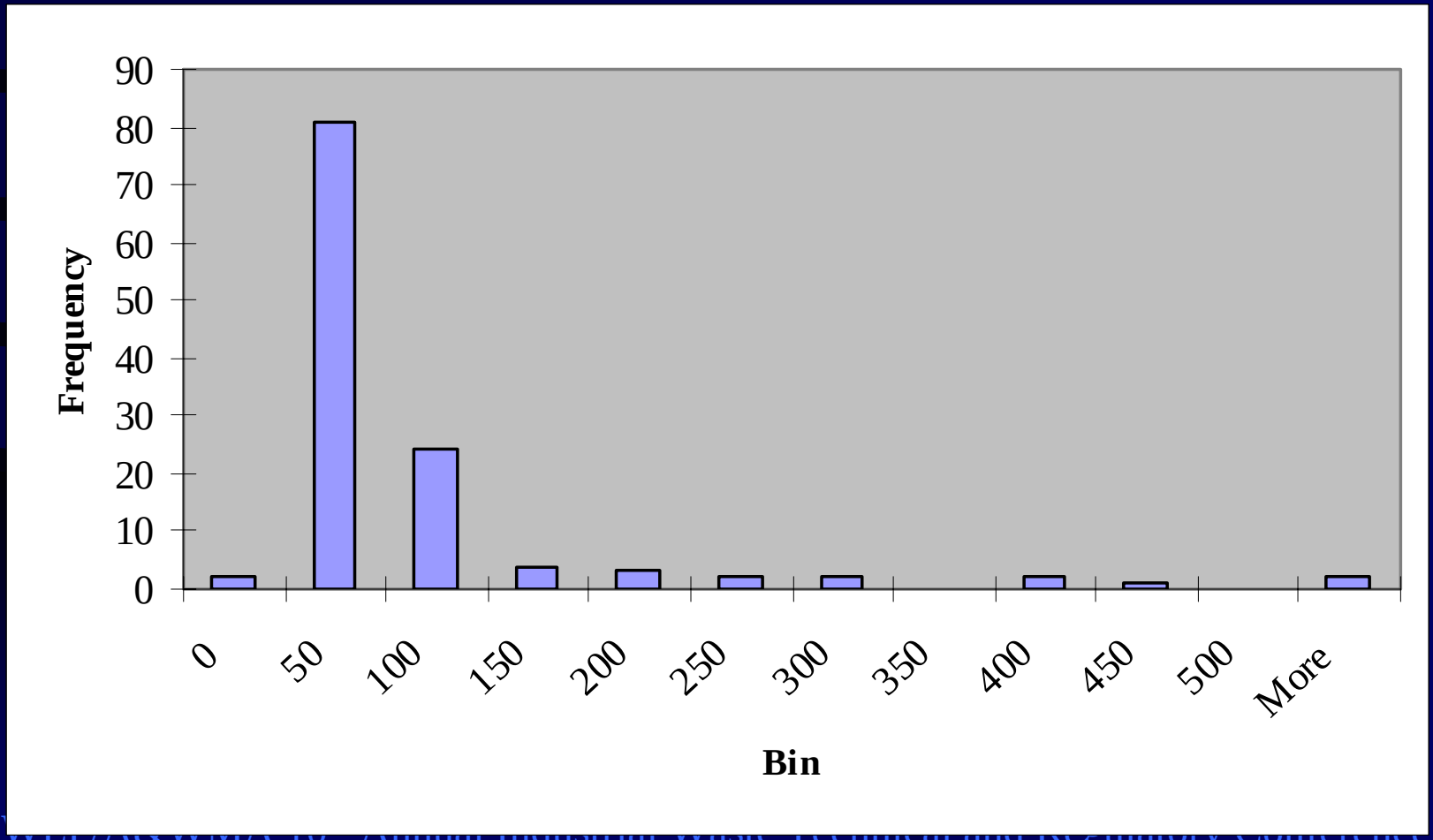
PCB 129 Analysis Results from April 2002 to April 2004 (0-80 pg/l Scale)



Sum of PCBs (NDs set at zero) for 1668A Method Blanks for a Single Laboratory



Histogram of Sum of PCB Data for 1668A Method Blank Data from a Single Laboratory



Outline of Simple Relational Data Store

Sample Information
Sample ID
Media
Total/Dissolved/Particulate
Location ID
Sample Type
Date

Location Information
Location ID
Location Name
Responsible Entity
Lat/Long
Zone
River Mile

Results
IUPAC #
Result
Qualifiers
Detection Limit
Reporting Limit
Unit of Measure (pg/l)
Sample ID
Analysis ID

Parameter Information
IUPAC #
PCB Name
PCB Number
Molecular Weight

Analysis Information
Analysis ID
Laboratory Name
Lot Number
Date of Analysis
Date of QA/QC
Method Blank ID
Calibration Standard ID
Method

Proposed Analytical DQO Improvements

- Ensure that all laboratories are consistent in applying the method – performance based methods give significant flexibility:
  - Determine Sample Volume for Analysis
    - Size of Sample to be Collected – 1L or 2L
      - Pro: Larger volume may lower Detection Limit
      - Con: Larger volume may increase noise in analysis
    - Size of Sample Container – To match analysis volume
      - Pro: To eliminate sub-sampling issues – it is hard to subsample when the target analytes are hydrophobic
      - Con: Increases the difficulty of collecting composite samples

Proposed Analytical DQO Improvements (Cont.)

- **Concentration of Extract – 100 ul vs 20 u/l**
  - Pro: Can lower detection limit by factor of 5
  - Con: Can drive increased cleanup requirements and may enhance effects of contamination
- **Consistent Application of Low Standard - .2, .5 or 1 ng/ml**
  - Enhances the comparability of the data – Lower is not necessarily better
  - Use of 0.2 ng/ml high sensitivity low standard not achievable for all laboratories for 1668A
- **Specify a standard GC Column**
- **Specify methods for calculating Detection Limit including:**
  - Selection of area of baseline for calculation
  - Direction to Labs with regard to smoothing of baseline noise

Proposed Sampling DQO Improvements

- Develop sampling plan to ensure that the most significant sources are targeted for the best characterization
- Ensure that sample container volume is equal to the volume to be analyzed
- Select grab sampling whenever possible to minimize sources of sampling error and blank contamination
- Train sampling personnel to ensure that the samples are collected and labeled properly and that meta data is collected.

Proposed Data Handling DQO Improvements

- Define how data will be used prior to the first sampling event
- Develop a database structure for handling the multiple analytical parameters (e.g.: 100+ PCB Congeners, TSS, TOC, POC, PDC, flow, etc.)
- Implement processes to ensure that data is reviewed prior to clearance for use in the TMDL
- Ensure that all stakeholders have access to a common set of data that is updated periodically.

Acknowledgements

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