Evaluating the Fitness of Environmental Chemistry Data

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Scientists and engineers process, analyze, and interpret environmental chemistry data to draw conclusions regarding a wide variety of investigations, including contaminated sediment and hazardous waste site assessments, oil spill response, and natural resource damage assessments (NRDA), as well as evaluations of mining, smelting, and hydraulic fracturing sites. Multiple factors can contribute to the complexity of environmental data, including large site footprints, numerous potentially responsible parties, and long study periods. When investigators use multiple studies to understand site conditions, environmental data analyses can be further complicated.

Investigators must understand both the limitations of underlying data sets and whether available data are "fit for use." This can minimize the risk of using flawed conclusions to support cost allocation, insurance coverage, or litigation proceedings. Investigators can apply these four strategies to help evaluate and maximize data fitness.

Strategically Planning for Future Data Needs

It is important for investigators to fully define all data needs and then phase in data collections appropriately over time—from critical time-sensitive ephemeral data, to data defining longer-term trends. Partnering with subject matter experts (SMEs) early in the project life cycle can help investigators foresee the range of data needs and develop sampling plans that not only support immediate data needs but also anticipate future concerns, such as regulatory decisions, possible litigation, and apportionment and allocation of costs. This planning can minimize the need for additional costly field investigations.

A long-term but phased strategy is particularly important for emergency response situations, such as oil and chemical spills. If responders exclusively focus on answering immediate questions from state or national agencies, they may fail to collect appropriate sets or types of samples for future NRD, Clean Water Act (CWA), or private-party claims. Partnering with an SME early on can provide a line of sight to necessary analyses that cannot be performed later.

Selecting Qualified Laboratories and Appropriate Methods

Even with formal quality assurance and data collection and analyses plans (QAPPs) in place, analytical methods and data quality can vary among laboratories, especially for specialty analyses like per- and polyfluoroalkyl substances (PFAS), alkylated polycyclic aromatic hydrocarbons (PAHs), dioxins and furans, chemical biomarkers, and stable isotopes. SMEs can help investigators develop QAPPs, identify laboratories known for high-level quality and consistency, and select the appropriate laboratory methods.

Anchoring Data Through Analyses of Reference Materials

Combining data sets generated by different laboratories, sometimes over significant time frames, poses major challenges in ensuring the optimal uses of collected data. Standard reference materials (SRMs) provide a

"yard stick" to compare data from multiple laboratories or data obtained over the course of multiple years. Understanding variability between data sets is essential if data will be merged from multiple sources into a compiled data set for later use. SMEs, using results from reference material, can help investigators understand limitations and comparability of these data.

Evaluating the Data

SMEs can combine their experience of the full data planning, collection, analysis, and use process to assess and optimize the quality of the data collected to supporting a site investigation. This includes exploratory analyses to assess quality, quantity, and comparability; sub-set analyses to identify potential biases; and statistical analyses and graphical and spatial presentation of results to assess data fitness.

In litigation scenarios, SMEs can offer further support with decisions related to sampling objectives versus sampling implementation; sample collection, preparation, and analytical methods; sample fractionation; source and ephemeral sampling; and the type of screening, semiquantitative, or definitive data needed to support the intended use of the analysis. Alternatively, Exponent's SMEs can assess the work of opposing experts to evaluate whether their analyses were based on sound and defensible data.

Exponent's Expertise

Our team at Exponent supported response for the Deepwater Horizon oil spill, the largest oil spill in recent U.S. history. This included guiding the analysis process and supporting the laboratories with their planning and methodology. When we identified problems with detection limits, we redirected the analyses to obtain data fit for NRDA use. In addition to establishing that every laboratory would run source oil as the reference material, we compared samples to evaluate the degree of interlaboratory variability. We also evaluated all data used for NRDA to understand "Do these data make sense?" and "Are these data fit for NRDA?" Data deemed unfit-for-use were excluded from NRD exposure.

In addition to supporting the NRDA with our efforts, we are pleased to note that much of these data are now publicly available for other researchers to use in the Gulf Science Data collection on the Gulf of Mexico Research Initiative Information and Data Cooperative (GRIIDC) data portal.

Exponent's multi-disciplinary team of environmental chemists, geochemists, and statisticians has years of hands-on experience in all aspects of data planning, collection, and analysis. By ensuring data fitness, we can help site managers optimize field investigations, control costs, and make timely project decisions.

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