The fact sheets and white paper presented on the ITRC Environmental Data Management Best Practices website provide guidance on all major aspects of environmental data management, from development of a data management plan to communication of environmental data to the public.

1 INTRODUCTION

Environmental data management (EDM) is a broad field that encompasses data about all aspects of environmental research and regulation, from habitat studies and wildlife management plans to health advisories and remediation of hazardous waste sites. Regulatory agencies accumulate vast quantities of data about environmental concerns in areas within their jurisdiction, but these data sets are often collected, stored, analyzed, and shared in poorly organized and uncoordinated ways that can lead to "data silos"—collections of data that are accessible only to a limited number of staff within their own regulatory programs. Such data can sit idle and be difficult to locate, share, and use when needed. There is a great need for guidance on the best practices for managing large stores of environmental data.

The ITRC Environmental Data Management Best Practices Team (EDMBP Team) has addressed this need with a series of guidance documents on best practices for all phases of EDM. The overall process of data management is covered in the Data Management Planning, Data Quality, Field Data Collection, Data Exchange, and Public Communication sections, while best practices in specialized but important areas of EDM are described in the Geospatial Data and Traditional Ecological Knowledge sections.

2 DATA MANAGEMENT PLANNING

Data governance is the overarching organization of and control over data access, use, storage, and retention at an agency or organization level. This provides the framework necessary to make data accessible, defensible, and usable, as described in the Data Lifecycle Fact Sheet. A central practice of effective data governance is development of a data management plan that extends beyond the life of an individual project. While data management plans are unique to a specific project or task, data governance policies should apply to all projects and data management activities across numerous projects and be incorporated into data management plans.

The Data Governance Fact Sheet provides a variety of guidance on the overall management of environmental data throughout all steps of the data lifecycle. Development of a data management plan involves many interrelated steps, and the Data Governance Fact Sheet includes a Data Management Planning Tool to guide managers through this process. Another fact sheet covers the central principles of Data Storage, Documentation, and Discovery. Accumulated data must be accessed and used to have any value, and extensive guidance on these facets of data management is provided in the Data Access, Sharing, and Security Fact Sheet. Data security considerations are outlined in the Data Disaster Recovery Fact Sheet.

3 DATA QUALITY

An essential consideration in data management is the quality of the data. Environmental data that are too inaccurate, imprecise, ambiguous, poorly described, incomplete, or outdated for a project cannot be relied on to provide a good basis for analyses and policy decisions. On the other hand, collecting, evaluating, and maintaining higher quality data frequently requires greater investments of time, money, and other resources. The documents in the Data Quality section provide guidance on planning, evaluating, and maintaining data quality in ways that are appropriate for different project needs.

The overall considerations for data quality are described in the Data Quality Overview Fact Sheet. Specific data quality considerations at different stages of the data lifecycle are spelled out in the Using Data Quality Dimensions to Assess and Manage Data Quality subtopic sheet. The choice of analytical laboratory can have a significant impact on the quality of data for some projects, and the Considerations for Choosing an Analytical Laboratory subtopic sheet provides guidance on choosing the best lab. The fact sheet on Analytical Data Quality Review: Verification, Validation, and Usability provides detailed advice for assessing data quality within a project plan. Step-by-step instructions for conducting quality assessment and quality control on a hypothetical data set can be found in the Tutorial on Active Quality Control During Screening-level Assessments, which includes a Companion Workbook of data.

4 FIELD DATA COLLECTION

Data from the field are central to most environmental regulatory programs; consequently, proper planning of field data collection is an essential step in EDM. The fact sheets in the Field Data section provide guidance on a wide range of considerations for planning data collection programs in the environment. The first step is to determine what kinds of data will be collected and how; the considerations for this are detailed in the Defining Data and Collection Methods Fact Sheet. This fact sheet is accompanied by a Decision Tree Tool to help determine whether field data is best collected digitally or on paper. The next step is designing the data collection process, as described in the Field Data Collection Process Development Considerations Fact Sheet. The collection of data in the field can present an array of challenges that require specific quality control plans, as detailed in the Field Data Collection Quality Assurance and Quality Control (QA/QC) Fact Sheet. Training of field staff is a critical part of successful data collection, and the Field Data Collection Training Best Practices Fact Sheet covers important aspects of training programs. Other Considerations for Field Data Collection, such as budgets, hardware, software, and data storage and security, are covered in the final fact sheet of this section.

5 DATA EXCHANGE

After environmental data have been collected, the data must be shared with staff within the collecting agency and other internal and external stakeholders to develop and carry out environmental regulatory programs. Adding data to an EDMS or exchanging data between systems is sometimes difficult when it is necessary to fit data sets of different complexity or completeness together, or when data fields and values differ in name or definition between systems. The distinctions between data exchange, which uses an existing data import/export process, and data migration, which does not involve an existing process, are discussed in the Data Exchange Overview Fact Sheet. The details of conducting data migration are covered in the Data Migration Best Practices Fact Sheet. Details about the production and use of electronic data deliverables (EDDs) are explained in the Electronic Data Deliverables and Data Exchange Fact Sheet. An important aspect of managing environmental data and exchanging it between different EDMS is development and management of valid values for different kinds of data, as discussed in the Valid Values Fact Sheet. These principles of data exchange are illustrated in case studies from the Minnesota Pollution Control Agency and U.S. Geological Survey.

6 TRADITIONAL ECOLOGICAL KNOWLEDGE

Traditional ecological knowledge (TEK) and local ecological knowledge (LEK) are collections of knowledge held by people in communities with a long history of direct dependence on local resources about the relationship of living beings to one another and to the natural environment. TEK and LEK are increasingly important areas of environmental regulation that present special challenges for environmental data managers. The TEK section addresses these challenges by first discussing the definition and components of TEK and LEK in the What is Traditional Ecological Knowledge Fact Sheet. Guidelines for working with traditional communities to obtain TEK data are presented in the Acquiring Traditional Ecological Knowledge Data subtopic sheet. The unique considerations for managing and using TEK data are described in the Managing Traditional Ecological Knowledge Data subtopic sheet and Using and Consuming Traditional Ecological Knowledge Data subtopic sheet. The principles discussed in these fact sheets are illustrated in six case studies:

- Improving Coastal Resilience in Point Hope, Alaska
- Use of TEK to Support Revegetation at a Former Uranium Mill Site, Saskatchewan, Canada
- Local Ecological Knowledge of Historic Anthrax in a Natural Gas Field
- Rest in Peace? (disturbance of a traditional gravesite)
- Integration of TEK to the Remediation of Abandoned Uranium Sites
- Collection and Application of Local Knowledge to Local Environmental Management in Duluth, Minnesota

7 GEOSPATIAL DATA

Environmental data are intrinsically linked to specific geographic locations, and geographic information system (GIS) data is an essential component of EDM. The basis for management of geospatial data is organization GIS standards, described in the Organization Standards for Geospatial Environmental Data Management subtopic sheet. Important aspects of maintaining the quality of geospatial data are detailed in the Geospatial Data Collection Consistency subtopic sheet and Geospatial Data Standards subtopic sheet. The logistics of collecting geospatial data in the field are discussed in the

Geospatial Data Field Hardware subtopic sheet. Important factors in the management and use of GIS data are covered in the Geospatial Data: GIS Hardware, Geospatial Data Software, and Geospatial Metadata subtopic sheets. Finally, different methods and considerations for visualizing and analyzing geospatial data and sharing it with the public are described in the Geospatial Visualization of Environmental Data and Geospatial Data Dissemination—Web Format subtopic sheets.

8 PUBLIC COMMUNICATION AND STAKEHOLDER ACCESS

A final but essential and challenging component of EDM is communicating environmental data with stakeholders and the general public in an effective way. Good communication of environmental data is important to inform the public about the bases for regulatory decisions, to warn of environmental hazards, to promote environmental programs, and to enable citizens to make informed decisions about their own use of resources. The white paper on Public Communication and Stakeholder Engagement provides a wealth of information and guidance about effectively relaying environmental data to specific stakeholders and the wider public. Topics covered in the white paper include the CARE and FAIR principles, the Plain English Act, data accessibility, stakeholder identification, communication plans, a variety of communication tools, and suggestions on how to develop a flexible database with stakeholder usability in mind.

9 ENVIRONMENTAL DATA MANAGEMENT SYSTEMS

An environmental data management system (EDMS) can be valuable for comprehensive management of data for an environmental agency, organization, or program. The Environmental Data Management Systems White Paper details the various considerations in choosing or building an EDMS: assessing the program or project needs; identifying appropriate data models for tracking locations, samples, and measurements; and reviewing the different types of data systems to choose the one that best suits program needs. The guidance in this fact sheet can be of great assistance in the complex decisions about developing an EDMS.