Short Courses

Short courses will be offered on Monday, February 7, before the Conference program begins. Courses are open to both Conference registrants and nonregistrants. To register, go to **www.battelle.org/sedimentscon**, or use the form on page 36. ***Note: The maximum discount applies to fees paid by November 15.*** Prospective short course attendees should preregister no later than December 15—classroom space allocations and production of materials will be determined by the number registered for each course by that date. If insufficient registrations are received for a given course by December 15, the course will be canceled, with registrants' fees being transferred to other courses selected by the registrants or refunded. Course registrations will be accepted after December 15 if space is available. Cancellations received by December 15 will be refunded less a $10 service fee. No course refunds will be made after December 15, but paid no-shows will receive all course materials. Substitutions will be accepted at any time, preferably with advance notice.

The description for each course is followed by information on whether students will need to bring a laptop to class for use in doing exercises. Course materials will include the instructors' presentation slides and other supporting materials as appropriate to the course, such as references from the literature, reprints, files, or publicly available software.

Monday, 8:00 a.m.–5:00 p.m.

1-hour break at 12:00 for lunch on own

Evaluating Sediment Transport: Tools, Techniques, and Application to Site Management

Instructors: Craig Jones, Ph.D. (Sea Engineering, Inc.)
C. Kirk Ziegler Ph.D., P.E. (Anchor QEA, LLC)

Objective: Provide a solid understanding of sediment stability and the most common methods for sediment characterization and transport quantification. The course will be useful to site managers.

Overview: Because many contaminants of concern at aquatic sites are bound in the bottom sediments, sediment stability and subsequent sediment transport have been of great interest to site managers for decades. To help standardize the management of contaminated sediment sites, the EPA has developed guidance documents including the *Principles for Managing Contaminated Sediment Risk at Hazardous Waste Sites* and the *Contaminated Sediment Remediation Guidance for Hazardous Waste Sites* manual. To address the need to evaluate sediment transport, many tools and techniques have been developed to characterize and quantify the fundamental processes involved. One of the biggest challenges remaining for site managers is determining how best to utilize these tools to address common site management questions. During the morning section, this course will present common site management questions that rely on sediment stability information. The questions will be presented in the context of a "generic" conceptual site model for sediment transport to illustrate how sediment transport relates to overall site management. The most commonly employed devices and techniques for determining sediment stability will be outlined, and specific features of each method will be highlighted. Then the discussion will move to a more detailed description of sediment erosion measurements. The description will include data from real-world sites to showcase qualitatively what the data mean and how the dataset can be used with other commonly acquired site measurements. This will be followed by a discussion of how the common field and analytic tools and techniques can be integrated to provide information of direct use in answering site management questions. The afternoon section will be concerned with quantitative numerical modeling, covering model selection based on problem specification, model development, reliability, and application. The focus will be on developing a technically rigorous hydrodynamic and sediment transport modeling effort that minimizes uncertainty while maximizing efficiency in addressing site management questions. The model applications will be conducted with real-world sites so that the modeling link to the site management questions is clearly illustrated.

Draft course outline:

1. Common Sediment Management Questions Related to Sediment Transport
2. Development of a Conceptual Site Model
3. Hydrodynamic Processes
4. Sediment Bed Properties—*cohesive and noncohesive beds*
5. Sediment Transport Processes—*erosion; deposition; suspended load transport; bed load transport*
6. Revisit the Conceptual Site Model—*rules of thumb; quantitative measures; data gaps*
7. Field Measurements—*bathymetry; hydrodynamics; water column transport; bed properties; cohesive sediment erodability*
8. Revisit Conceptual Site Model—*quantitative measures; data gaps; response to management questions*
9. Develop Model—*phased approach; hydrodynamic models; sediment transport models*
10. Evaluate Reliability of Model—*calibration; validation*
11. Apply Model—*sediments stability during high-flow/storm events; long-term, multiyear periods, evaluating various remedial alternatives; refining conceptual site model*

Students will <u>not</u> need laptops to use during the course.

The Use of Spatially Explicit Methods in Site Investigations

Instructors: Philip E. Goodrum, Ph.D., and
William Stiteler, Ph.D. (ARCADIS)

Objective: Provide information on designing sampling plans and analyzing data to support risk assessments and remedy selection. The target audience are scientists and engineers engaged in these activities.

Overview: It is generally recognized that constituents in floodplain soils and sediment systems exhibit spatial patterns that should be considered in the development and optimization of remedial options. In addition, software tools and guidance on incorporating spatial information in site investigations are readily available. This short course will present recent advances in spatially explicit assessment techniques that may be applied to both floodplain soils and sediment systems. Participants will learn how to maximize the use of spatial information in both the sampling design and the statistical analysis of site data. In addition, pitfalls and underlying assumptions about commonly used spatial weighting techniques will be exposed. Case studies will demonstrate applications of Thiessen polygons, inverse distance weighting, and kriging, and compare these spatial weighting techniques to nonspatial methods for different sampling designs. In addition, spatially explicit methods for outlier and cluster analysis will be demonstrated. Particular attention will be given to practical scenarios in which data on multiple constituents are collected over time and estimates of post-remediation conditions are needed. Methods for investigating relationships between biotic and abiotic data collected at different spatial scales also will be demonstrated. Case studies will be incorporated throughout the course. Expertise in statistics is not a prerequisite—the course will include a review of relevant statistical principles.

Draft course outline:

1. Statistical Principles for Sampling Design—*random and nonrandom sampling; parameter estimation and confidence intervals; spatial autocorrelation; stationarity and isotropy; discrete, composite, and incremental samples*
2. Exploratory Data Analysis—*graphical analysis; bivariate plots; post plots; estimating unsampled areas (concept of spatial weighting); outlier analysis (spatial vs. nonspatial)*
3. Declustering and Interpolation—*Thiessen polygons (What to do with remnants?); inverse distance weighting (What is the weighting factor?); kriging (chasing the elusive semivariogram); do's and don'ts for parameter estimation from an interpolated surface; how to use geostatistics to guide supplemental sampling efforts*
4. Risk Assessment—*establishing a background screening level; exposure point concentrations (95UCLs); pre- and post-remediation scenarios*
5. Relating Biotic and Abiotic Data—*similarity indices; regression analysis; hypothesis testing*
6. Advanced Methods—*river-straightening routines; cross validation; random walk scenarios for ecological receptors*

Students will <u>not</u> need laptops to use during the course.

Monday, 8:00 a.m.—Noon

Building a Better Background Data Set

Instructors: Jonathan Myers, Ph.D., and Karen Thorbjornsen, P.G. (Shaw Environmental, Inc.)

Objective: Provide practical approaches for establishing background distributions of constituents in sediment, soil, groundwater, and surface water. The course is recommended for regulatory personnel as well as consultants, site managers, and others with an interest in improving their background studies.

Overview: This course presents practical approaches for establishing background distributions of constituents in sediment, soil, groundwater, and surface water. These methods are applicable to naturally occurring elements and radionuclides, as well as anthropogenic compounds such as polycyclic aromatic hydrocarbons. The course expands on existing regulatory background guidance by including tools for dealing with real-world (nonideal) analytical data: handling nondetects, evaluating outliers, how and when to combine subgroups of data, and extracting background data from existing datasets when the collection of new samples is not an option. The importance of considering geochemistry is emphasized. Incorporating geochemical evaluations of the data, in addition to the purely statistical methods provided in guidance documents, results in more representative background datasets, provides insight into the processes controlling the concentrations, and enhances their utility in site-to-background comparisons. The concepts are illustrated with case studies from the instructors' work on more than 50 background studies across the United States and Puerto Rico. Prior knowledge of statistics is not required.

Course outline:

1. Definitions of "Background" and Uses of Background Data
2. Use of Local (Site-Specific) vs. Regional Background Data
3. Background Sampling—*locating background samples; sampling methods*
4. Statistical Data Evaluation—*determining required sample size; statistical characterization of distributions; reporting limits; handling nondetects; outlier tests*
5. Background Screening Values and Site-to-Background Comparisons
6. Geochemical Data Evaluation
7. Comparing Subgroups to Determine the Appropriateness of Combining Their Data—*surface vs. deep soil; different aquifers; different surface-water body types*
8. Evaluating the Effects of Organic Contamination on Natural Metals Concentrations
9. Extracting Background Data from Existing Site Data

Students will <u>not</u> need laptops to use during the class.

A Survey of the Sediment Evaluation Toolbox: The Use of Radionuclides and Chemical Markers in Understanding Sediment Contamination

Instructors: Ed Garvey, Ph.D., P.G.; Solomon Gbondo-Tugbawa, Ph.D., P.E.; and AmyMarie Accardi-Dey, Ph.D. (The Louis Berger Group, Inc.)

Objective: Convey information on new techniques for better characterization of contaminated sediments and promote a better understanding of the fate-and-transport mechanisms affecting contaminated sediments. Course is recommended for technical practitioners and high-level decision-makers.

Overview: Contaminated sediment investigations are frequently more complex than those of upland sites, largely because of the capacity of water to transport sediments and associated contaminants over great distances, often apparently haphazardly. Several standard geochemical techniques can simplify the interpretation of contamination patterns and greatly enhance understanding of fate and transport. This course will survey several of the interpretative techniques and provide participants with a basic description of the theory and application in real-world settings. The key to understanding sediment contamination is to recognize its close link with water-borne sediment transport, leading to the question of how to obtain a record of water-borne transport in the absence of an active sampling program over the period of interest. The course will explain how the sediments themselves actually can provide the record if measurements of radionuclide and chemical markers are carefully applied to establish the approximate year of deposition and to establish long-term and recent levels of water-borne contamination. With this information, the practitioner may characterize concentrations in terms of the year in which such levels were delivered. In addition, normalization to chemical and physical properties provides another line of evidence. With recognition of the importance of time in examining the record, the issue of current versus historical sources becomes important. Application of environmental forensics to identify unique contaminant ratios or combinations of contaminant levels through polyvector analysis (PVA) represents a more sophisticated level of analysis that can be greatly facilitated by the geochemical techniques described above. Case study materials will be provided.

Draft course outline:

Application of Radionuclide and Chemical Marker Measurements to Determine Sediment Chronology

1. Geochemical Background—*radionuclides (Cs-137, Pb-210, Be-7); chemical markers (e.g., perfluorooctane sulfonate)*
2. Sampling and Analysis of Sediment for Radionuclides and Markers
3. Dating Sediment Cores

Use of Radionuclide Data to Establish Loading History of Contaminants

4. Applying Sediment Dates from Radionuclide to Sediment Contaminant Profiles
5. Using Physical Properties, Chemical Normalization, and Other Information to Determine Spatial and Temporal Trends of Contamination
6. Determining Contaminant Half-Life and Sediment Recovery

Apply Empirical Forensic Techniques to Infer Geochemical Fate and Transport of Contaminant

7. Review of Simple Ratios of Chemicals
8. Application of Principal Component Analysis
9. Application of Polytopic Vector Analysis (PVA)
10. Application of an Empirical Chemical Mass Balance Approach

Participants will need laptops with Microsoft® Excel installed. Trial versions of additional software may be distributed for use during class.

Monday, 1:00 p.m.–5:00 p.m.

A Hands-On Introduction to Databases and Geographic Information Systems for Contaminated Sediment Remediation Projects

Instructors: Jamey Rosen, P.Geo., and Peter de Haven, P.E. (Geosyntec Consultants)

Objective: Provide the concepts and vocabulary required to pursue more advanced training on use of databases and geographical information systems (GIS) for sediment remediation projects, or to appropriately scope and manage work in these areas. The course is designed for regulators, scientists, engineers, and project managers who have little or no experience with databases and/or GIS.

Overview: Sediment remediation projects typically have significant and sometimes intimidating data management requirements. The wealth of data collection activities spanning several biotic and abiotic media plus the broad range of analytical parameters to be considered present challenges as well as myriad opportunities for sophisticated and efficient data management and analysis. At the end of this course, participants will have an understanding of available data management tools and how they can be used to compile, verify, analyze, and present physical and chemical sediment data in an efficient manner. This course will cover a range of topics pertinent to using relational database management system (RDBMS) software and geographic information system (GIS) technology to manage sediment remediation projects. The topics will include an introduction to the concepts of relational database structure and usage, the proper development of a database for sediment parameter data and laboratory electronic data deliverables (EDDs), the creation of a database "dashboard" to support real-time operational decisions, and the application of GIS to location-based data in sediment remediation projects. Hands-on exercises using real sediment-related data will allow students the opportunity to experience and address data management challenges. The RDBMS software used during the class will be Microsoft® Access; expertise in this software is not required. No GIS software will be required because demonstrations using ArcMap™ software will be performed by the instructors.

Draft course outline:

1. Demonstration of a Complete RDBMS/GIS for a "typical" sediment project
2. RDBMS Concepts
3. Hands-On Exercise: Compute Biota-to-Sediment Accumulation Factors (BSAFs)
4. Analysis of an Electronic Data Deliverable (EDD)
5. Automatic Processing and Verification of EDDs and Field Data
6. Hands-on Exercise: Create Updateable Data-Screening Table
7. Linking an RDBMS to a GIS to Map Sediment Data Trends
8. Using On-Line Database and GIS Tools

Participants will need laptops with Microsoft® Access (any version) installed.

Managing the 4 Rs of Environmental Dredging

Instructors: Michael R. Palermo, Ph.D., P.E. (Mike Palermo Consulting, Inc.)
Norman R. Francingues (OA Systems Corporation)
Paul R. Schroeder, Ph.D., P.E. (U.S. Army Engineer Research and Development Center)
Don Hayes, Ph.D., P.E., BCEE (University of Louisiana at Lafayette)

Objective: Provide guidelines for evaluation and management of sediment resuspension, contaminant release, residual sediments, and risk associated with environmental dredging as a remedy component. Stakeholders (agency personnel, potentially responsible parties, design consultants, and contractors) are the target audience.

Overview: The 4Rs of environmental dredging—resuspension, release, residuals, and risk—continue to be important aspects of design and implementation of sediment remedies. This course provides methods to assess and predict the potential impact of sediment resuspension, contaminant release to the water column, and residual sediments following dredging, as well as the risks associated with these processes. The short course also will provide methods of managing the 4Rs to include operational approaches and engineered controls. Lessons learned from recent case studies such as the Fox River and Hudson River projects will be included for each topic.

Draft course outline:

1. Overview of the 4Rs of Environmental Dredging—*environmental dredging as a remedy component; definitions and interactions of the 4Rs*
2. Sediment Resuspension during Dredging—*turbidity vs. suspended solids; assessment and prediction of resuspension; resuspension monitoring*
3. Contaminant Releases to Water and Air—*performance standards for releases; laboratory tests for water column and air releases; models for release assessment; contaminant release monitoring approaches*
4. Operational and Engineered Controls for Resuspension and Releases—*managing resuspension during dredging; operational controls; best management practices; silt curtains and hard-containment structures*
5. Dredging Residuals—*prediction of residual thicknesses and concentrations; operational strategies for residuals control; residual caps; residuals monitoring*
6. Risk Implications—*water column risks; risks to benthic organisms; human health exposures and risks; safety considerations; general discussion*

Students will not need laptops to use during the course.

Geochemical Evaluations of Metals in Environmental Media: How to Distinguish Naturally Elevated Concentrations from Site-Related Contamination

Instructors: Karen Thorbjornsen, P.G., and Jonathan Myers, Ph.D. (Shaw Environmental, Inc.)

Objective: Provide practical geochemistry-based approaches for identifying metals contamination in sediment, soil, surface water, and groundwater. Course is recommended for regulatory personnel, consultants, and site managers.

Overview: Do you really have metals contamination at your site? Metals concentrations in environmental media often exceed screening criteria, but they may be naturally elevated. It is well known that trace elements naturally associate with a limited number of minerals in sediment or soil (or with specific suspended particulates in groundwater and surface water) under a given set of environmental conditions. In most oxic soils, for example, arsenic and vanadium are almost exclusively associated with iron oxide minerals at consistent ratios. These processes result in positive correlations between specific trace vs. major element concentrations, which can be visualized with scatter plots. Contaminated samples are identified by their anomalously high elemental ratios relative to uncontaminated samples. For groundwater and surface water, additional factors considered include pH, redox effects, aqueous complexation, salinity gradients, and (for groundwater) well-construction materials. Unlike a purely statistical approach, geochemical evaluation greatly reduces the probability of falsely identifying contamination; does not require a statistically valid background data set; identifies contaminated locations, thereby focusing remediation efforts; and provides mechanistic explanations for elevated concentrations. This course will present geochemical evaluation techniques that use existing data to distinguish natural metals concentrations from potential contamination without performing geochemical modeling or adding significantly to project cost. Insightful case studies are presented from the instructors' work at hundreds of investigation sites across the U.S. and its territories. The material is presented in an accessible style, and prior knowledge of geochemistry is not required.

Draft course outline:

1. Standard Techniques for Inorganics Data: Limitations of Purely Statistical Approaches
2. Geochemical Mechanisms Controlling Trace Element Concentrations in Solid and Aqueous Media
3. Preparation and Interpretation of Geochemical Correlation Plots and Elemental Ratio Plots
4. Supporting Lines of Evidence
5. Case Studies
6. Worst-Case Scenarios
7. How and When to Apply Geochemical Evaluations
8. Keys to the Successful Presentation of Geochemical Evaluations to Regulatory Agencies and Project Teams.

Students will not need laptops to use during the course.