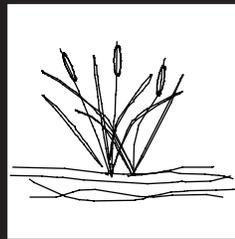
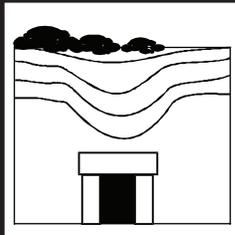
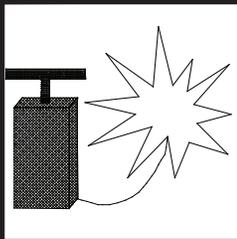
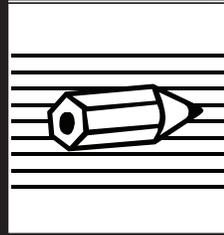
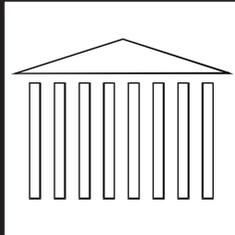
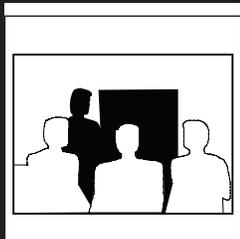

TECHNICAL INNOVATION AND PROFESSIONAL SERVICES COURSE DESCRIPTIONS



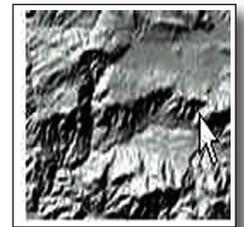
U.S. Department of the Interior
Office of Surface Mining Reclamation & Enforcement
National Technical Training Program



ARCGIS Spatial Analyst for Mining and Reclamation

This course explores how the ArcGIS Spatial Analyst extension uses raster and vector data in an integrated environment. This course teaches the basic raster concepts and shows how to create, run and edit spatial models. It focuses on problems that are best solved in a raster environment such as Approximate Original Contour topographic analysis, view-shed modeling, and reclaimed slopes hydrologic analysis.

Duration: 3 days
Course Code: GSA



TOPICS COVERED

Basic Concepts

- ▼ Raster Concepts
- ▼ Spatial Analyst Interface
- ▼ Querying Raster Themes
- ▼ Advanced Raster Display

Raster Structure Themes

- ▼ Creating Raster Datasets
- ▼ Raster Storage and Management
- ▼ Raster Projection
- ▼ Importing and Exporting Raster Datasets

Surface Analyses

- ▼ Calculating Density
- ▼ Interpolation Methods
- ▼ Interpolating
- ▼ Contours and Hillshading
- ▼ Visibility Analysis

Map Algebra Functions

- ▼ Writing Expressions
- ▼ Expression Syntax

Distance Measurements

- ▼ Euclidean Distance
- ▼ Cost Distance

Surface Hydrology

- ▼ Identifying Watershed Basins
- ▼ Surface Runoff Characteristics

WHO SHOULD ATTEND: Regulatory or AML scientist with degrees in geology, soil science, hydrology, civil or mining engineering, or related natural sciences.

COURSE PRE-REQUISITES: Students must have taken the **Introduction to GIS for Mining and Reclamation I** class and be very familiar with GIS concepts. **Class size is limited to 12-17 students, depending on location.**



ArcGIS Pro for Mining and Reclamation 200



This course is designed to help existing GIS users in the SMCRA community learn a new ESRI GIS software called ArcGIS Pro and transition to Pro from ArcGIS Desktop (Map/Catalog). The course covers new functionality, user interface, and beginner to intermediate uses as applied to the SMCRA community and GIS workflows. Some advanced topics may be briefly covered or discussed based on overall student skill levels, interest, and time.

Duration: 3 days

Course Code: GEP

TOPICS COVERED

Course Objective:

- ▼ Provide SMCRA practitioners new Esri functionality and user interface, as well as beginner to intermediate SMCRA and GIS workflow applications.

Who Should Attend: Regulatory or AML scientists with degrees in geology, ecology, soil science, hydrology, civil or mining engineering, or related natural sciences who desire to learn more skills in the use of the Esri GIS software.

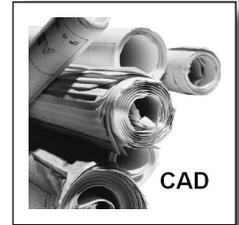
COURSE PRE-REQUISITES: Students must be familiar with basic GIS concepts and applications, and preferably taken TIPS' "Introduction to GIS for Mining and Reclamation" class. This course does not cover the fundamentals of GIS concepts. **Class size is limited to 12–17 students.**

CAD 100: AutoCAD Essentials – Online Self Study

CAD 100 is for the occasional CAD user who may need to open and work within CAD drawings on a very basic level. Lessons cover navigation, selection, and plotting. CAD 100 is available online only.

**This course is administered online in the Training Virtual Campus.
Registration is open year-round; please inform your TIPS Training Contact
or the TIPS Training Program Lead for registration.**

Duration: Self Study
Course Code: VECE



TOPICS COVERED

- ▼ Creating drawings
- ▼ Selecting objects
- ▼ Layer properties and control
- ▼ Importing and exporting data
- ▼ Paper space and plotting

COURSE PRE-REQUISITES: None

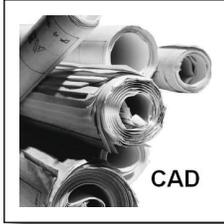


CAD 101: AutoCAD for Permitting and Reclamation

This course covers the fundamentals of AutoCAD and provides exposure to other AutoCAD and Carlson Mining products.

Duration: 3 days

Course Code: ECA



TOPICS COVERED

- ▼ Review file utilities and layer management
- ▼ Define drawing templates and the drawing environment
- ▼ Identify various configuration and customization settings
- ▼ Examine blocks, feature attributes, drawing tools, hatching, text types, and editing tools
- ▼ Perform property changes
- ▼ Discuss the CUI and Tool Palettes
- ▼ Import and export files
- ▼ Discuss plotting and paper space
- ▼ Briefly review additional AutoCAD and Carlson Mining products

WHO SHOULD ATTEND: Regulatory or AML scientists with a degree in reclamation, geology, soil science, hydrology, civil or mining engineering, or related natural sciences.

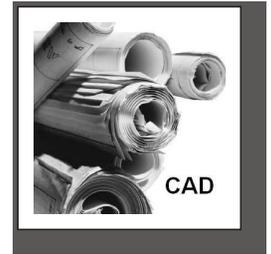
COURSE PRE-REQUISITES: Basic understanding of the Windows operating system and knowledge of maps and drafting concepts are required. **Class size is limited to 12-17 students, depending on location.**

CAD 200: AutoCAD Map 3D with Raster Design

AutoCAD Map 3D is an automated mapping tool used to create, maintain, and communicate mapping and GIS information while using the AutoCAD drawing environment. Map 3D features GIS topology combined seamlessly with AutoCAD. This software contains all AutoCAD functionality and adds features specifically designed for the mapping professional. The student will learn to scan maps, vectorize and clean the mapping data, correlate to other tabular data, and incorporate it into a GIS.

Duration: 3 days

Course Code: EAM



TOPICS COVERED

- ▼ Define GIS
- ▼ Utilize drawing sets, source drawings, and external data
- ▼ Perform drawing queries
- ▼ Identify and define object data
- ▼ Define and edit global coordinate systems
- ▼ Perform coordinate transformations
- ▼ Import and export map files
- ▼ Perform image editing (cleaning)
- ▼ Explain and perform rubber sheeting
- ▼ Discuss and use external databases

- ▼ Identify important steps to scanning mine maps and manipulating images
- ▼ Geo-reference imported mine maps and quality control
- ▼ Digitize and vectorize images
- ▼ Perform attribute data tagging
- ▼ Practice cleaning and building topology
- ▼ Verify feature mapping
- ▼ Practice exporting data to ESRI format
- ▼ Determine and discuss need for metadata

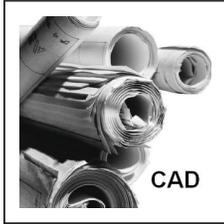
WHO SHOULD ATTEND: Regulatory or AML scientists with degrees in reclamation, geology, soil science, hydrology, civil or mining engineering, or related natural sciences.

COURSE PRE-REQUISITES: Prospective students need to have basic CAD skills, or completion of CAD 101: AutoCAD for Permitting and Reclamation. Basic AutoCAD skills will not be covered in this course.

Class size limited to 12 -17 students, depending on location.



CAD 201: Carlson Mining Site Design for Permitting and Reclamation



Carlson Mining is a design software for engineering, surveying, reclamation and mining professionals. AutoCAD serves as its graphics engine and drawing editor. Carlson Mining is an extension of AutoCAD that adds commands and enhancements for earthmoving and engineering.

Duration: 3 days

Course Code: ESC

TOPICS COVERED

- ▼ Review Carlson configuration and modules
- ▼ Define drawings and setup options
- ▼ Import and Export Points
- ▼ Use Carlson Design Tools such as breaklines, contouring, and 3D polylines
- ▼ Work with site designs; 3D slope lines, grids, volumes, and contours
- ▼ Work with cross-sections and profiles, create, draw, section design, volumes, and create contours from section files

WHO SHOULD ATTEND: Regulatory or AML scientists with degrees in civil or mining engineering, geology, or related disciplines.

COURSE PRE-REQUISITES: Prospective students must have taken introductory course CAD 101: AutoCAD for Permitting and Reclamation or have a working knowledge of AutoCAD. Basic AutoCAD skills will not be covered in this course. **Class size limited to 12–17 students, depending on location.**

CAD 300: Bridging the CAD and GIS Gap in the SMCRA Workflow

The purpose of this course is to assist personnel in integrating both CAD and GIS processes into SMCRA workflows. Students will review the basic foundation of GIS and CAD, identify similarities and differences, update and maintain permit data, and manipulate spatial data and database connectivity. Exercises will include use of Title IV and V data to show mechanisms of interoperability between CAD and GIS.

Duration: 3 days

Course Code: EBG



TOPICS COVERED

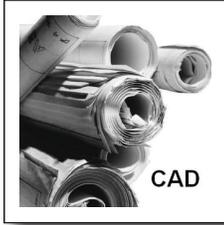
- ▼ Similarities and Differences in CAD and GIS
- ▼ Common Data Misconceptions
- ▼ Updating/Maintaining Permit Data
- ▼ Manipulating Spatial Data in CAD
- ▼ CAD Object Data
- ▼ FDO Connections
- ▼ SQL and SDE Databases
- ▼ Spatial Analysis

WHO SHOULD ATTEND: Regulatory or AML scientists with degrees in reclamation, geology, soil science, hydrology, civil or mining engineering, or related natural sciences.

COURSE PRE-REQUISITES: Prospective students should have attended CAD 201: Carlson Mining Site Design for Permitting and Reclamation or have a working knowledge of AutoCAD. Basic AutoCAD skills will not be covered in this course. **Class size is limited to 12-17 students, depending on location.**



CAD 301: Carlson Mining Field, Hydrology, and Natural Regrade for Permitting and Reclamation



This course will teach practicing Carlson Mining users advanced topics that have not been covered in the introductory CAD 201: Carlson Mining Site Design for Permitting and Reclamation. Students will round out their skills and learn new tools and techniques that will increase their design quality, efficiency, and productivity.

Duration: 3 days

Course Code: EAS

TOPICS COVERED

- ▼ Overview of Modules
- ▼ Survey Module Review
- ▼ Survey Module and Field to Finish
- ▼ Field Module Configuration
- ▼ Alignment in the Field
- ▼ GIS Tools in Carlson
- ▼ Hydrology Module and Watershed Menu
- ▼ Runoff and Watershed Analysis
- ▼ Design of Hydrologic Structures
- ▼ Geomorphic Reclamation Principles
- ▼ Natural Regrade Module

WHO SHOULD ATTEND: Regulatory or AML scientists with degrees in reclamation, geology, soil science, hydrology, civil or mining engineering, or related natural sciences.

COURSE PRE-REQUISITES: Prospective students should have attended CAD 201: Carlson Mining Site Design for Permitting and Reclamation or have a working knowledge of AutoCAD. Basic AutoCAD skills will not be covered in this course. **Class size is limited to 12-17 students, depending on location.**



Collector 200

This course will expand on basic navigation, photo, and geospatial field data collection application training provided in the "Mobile Devices for SMCRA" course. Students will learn more advanced capabilities of the Esri Collector App as well as administrative and user settings in ArcGIS Online that affect web map and feature layer functionality. We will focus on techniques to optimize the end user experience in the field, including creation of domains, tile packages, and 3D metadata.

Duration: 2 days

Course Code: GEC

TOPICS COVERED

Course Objective:

- ▼ Provide SMCRA practitioners more advanced skills in the use of Esri Collector Spatial Data Mapping.

Who Should Attend: Regulatory or AML scientists with degrees in geology, ecology, soil science, hydrology, civil or mining engineering, or related natural sciences who desire to learn more advanced skills in the use of the Esri Collector App.

COURSE PRE-REQUISITES: Students must have taken the "Mobile Devices for SMCRA" class or equivalent coursework to qualify for this class. **Class size is limited to 12–17 students.**



Concepts of Remote Sensing (Online Self-Study)



This course provides an introduction to the concepts and principles underlying the science of Remote Sensing.

Duration: Self-Study

Course Code: VRRS

TOPICS COVERED

- ▼ Basics of electromagnetic energy (EM) and the properties of light, how EM energy interacts with the atmosphere and various targets on the earth.
- ▼ Spectral response patterns and the mechanisms of absorption, transmission, and reflection will be addressed.
- ▼ How sensors record energy, and about the four types of resolution; spatial, spectral, radiometric, and temporal.
- ▼ Image analysis techniques of restoration, enhancement, and transformation will be introduced with a few examples of remote sensing applications.

WHO SHOULD ATTEND: Course is designed for beginners.

COURSE PRE-REQUISITES: None but some knowledge of elementary physical science could be helpful.



Esri ArcGIS Online



These course offerings are designed to help GIS users in the SMCRA community have access to additional Esri ArcGIS learning opportunities.

Duration: Self-Study
Course Code: VGEG

TOPICS COVERED

Course Objective:

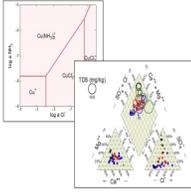
- ▼ Provide SMCRA practitioners with additional Esri ArcGIS courses.

COURSE PRE-REQUISITES: Students must request an Esri account and obtain approval to gain access to Esri ArcGIS Online courses.



Geochemist Workbench

This course is aimed at providing attendees with an understanding of how to use Geochemist Workbench to model mine drainage chemistry and treatment. The workshop is focused on the practical application of modeling and will use data collected from various coal mine discharges and treatment systems.



Duration: 3 days
Course Code: GWB

TOPICS COVERED

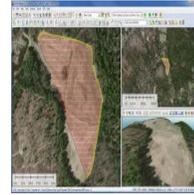
- ▼ Creating activity and Eh/pH diagrams to identify solubility controls on mine drainage
- ▼ Developing strategies to constrain a model to produce usable "real-world" results
- ▼ Modeling chemical consumption, treatment pH, and effluent chemistry for NaOH, CaO, Ca(OH)₂, CaCO₃, and Na₂CO₃ treatment systems and predicting the treatment costs (both active and passive treatment systems)
- ▼ Analyzing the effect of exsolving CO₂ (decarbonation step) prior to alkali dosing. The effect on chemical consumption, mineral precipitation, and treatment costs will be analyzed
- ▼ Using a model to develop a comprehensive watershed restoration strategy to achieve in-stream restoration goals for abandoned mine land scenarios
- ▼ Modeling heterogeneous and homogenous ferrous iron oxidation to size ferrous reactor tanks and passive treatment

COURSE PRE-REQUISITES: Attendees should have an understanding of geochemistry and prior experience with mine drainage is desired, but not necessary. **Class size limited to 12–17 students.**

Global Mapper for Mining and Reclamation



This course provides users instruction on basic and advanced usage of Global Mapper as it pertains to mining and reclamation. Students will be introduced to the GIS, CAD, mobile computing and remote sensing functionality of Global Mapper, as well as basic understanding of each discipline to assist them in analysis. Students will work with various forms of geospatial data to generate end products.



Duration: 3 days
Course Code: GGM

TOPICS COVERED

Course Objective

- ▼ Provide students a clear understanding of use of geospatial data in Global Mapper

WHO SHOULD ATTEND: All disciplines that work with geospatial data.

COURSE PRE-REQUISITES: None. **Class size limited to 12-17 students, depending on location.**

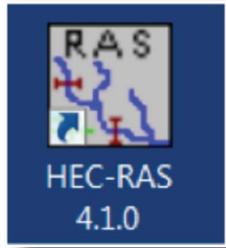


HEC-RAS

This course provides an overview of HEC-RAS modeling capabilities and shows each attendee how to use the model as a permitting/evaluation tool in flooding investigations. The course covers the most common uses of HEC-RAS, such as water surface profiles, floodplain delineation, and the effects of bridges and culverts in the floodplain. Hands-on exercises allow participants to enter/edit flow and geometric data, perform flow simulations, develop water surface profiles, and generate reports and graphics.

Duration: 3 days

Course Code: HER



TOPICS COVERED

- ▼ Introduction to Open Channel Hydraulics and Flooding, and HEC-RAS Overview
- ▼ Basic Steps in Developing a Hydraulic Model Using HEC-RAS
 - ◇ *Starting a new project*
 - ◇ *Entering geometric data*
 - ◇ *Entering steady flow data and boundary conditions*
 - ◇ *Perform calculations*
 - ◇ *View and print results*
- ▼ Water Surface Profile Simulation with Bridges and Culverts
- ▼ Stable Channel Design
- ▼ Floodplain Encroachment Analysis Using HEC-RAS
- ▼ Floodplain Mapping
- ▼ Importing GIS Data into HEC-RAS
- ▼ Others

COURSE PRE-REQUISITES: Undergraduate degree (or equivalent experience) and basic computer skills are highly recommended. **Class size limited to 12-17 students, depending on location.**



Introduction to earthVision 2D and 3D Modeling



This course provides an introduction to earthVision using actual data from an abandoned mine drainage site in north central Pennsylvania that was later permitted for new mining. Using 2D and 3D data, the class will learn to build structure and acid-base accounting models to assess site conditions and make a “permitting” decision. Class topics include: data import, validation, editing; 2D and 3D modeling; and volume calculation. *Course is certified for 24 Professional Development Hours.*

earthVision has application to many other situations in the mining industry (e.g., soils, materials handling, highly accurate cut-and-fill volumes mine pool modeling). Contact TIPS to discuss your special needs and the possibility of a tailored on-site training class.

Duration: 3 full days

Course Code: GSM

TOPICS COVERED

Import data

- ▼ Horizon (stratigraphy) and property data from spreadsheets
- ▼ Linework and data from CAD and GIS
- ▼ Elevation models from DEMs and grids
- ▼ Data “exploration” in 3D viewer
- ▼ Image files

Introduce 2D gridding using topography

- ▼ Discuss 2D gridding (how “grids” differ, what makes a good grid, gridding controls, etc.)
- ▼ Create 2D contour map of grid and explore in 3D viewer
- ▼ Introduce Graphic Editor and Grid Editing
- ▼ QC grid - Use formula processor and EDA for QA/QC and explore tools to improve model
- ▼ Segue to Workflow Manager

Introduce Workflow Manager by building and validating multi-layer horizon/structure/ models using depositional and stratigraphic controls.

Introduce 3D gridding for Property Modeling

- ▼ 3D View of property data within structure model for visualization, QC, and editing
- ▼ Discuss property grids and gridding parameters

- ▼ Calculate single property model with default settings; examine and QC
- ▼ Discuss property features and distribution characteristics
- ▼ Adjust parameters, remodel, and QC
- ▼ Model additional properties and QC

Volumetrics

- ▼ Discuss EV volumetrics; introduce types and methods
- ▼ Calculate Bulk Rock Volumes of layers and areas of interest
- ▼ Calculate property volume for single property with layer and area controls
- ▼ QC volumes - compare Volumetric results among methods
- ▼ Discuss individual property volumes and their implications

COURSE PRE-REQUISITES: Experience and/or education (preferably in the Regulatory/AML fields) with geologic, geochemical, soil, materials volumes, or hydrologic conditions that affect mining and reclamation. Familiarity with spreadsheets, mapping, and GIS software will enhance the learning experience. **Class size limited to 12-17 students, depending on location.**

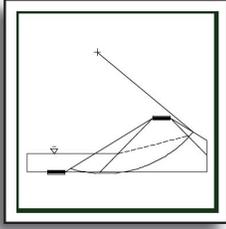


Introduction to GIS for Mining and Reclamation I

This course is an introduction to the basics of ArcGIS Desktop software. This course is designed around mining and reclamation examples and exercises. The various types of GIS data and how they are used in Desktop will be covered. Techniques for using the features of this software to generate high quality maps and analyzing selected data sets are taught. Specific training areas will be ArcCatalog, ArcMap & ArcToolbox.

Duration: 3 days

Course Code: GAD



TOPICS COVERED

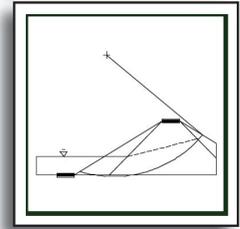
The course will provide a basic understanding of ArcGIS and include:

- ▼ A basic understanding of various ArcGIS screens and functions
- ▼ A basic understanding of coordinate systems, datums, and projections
- ▼ Locating and adding baseline data from online sources (e.g., imagery, topography)
- ▼ Importing external data (Excel tables, CAD drawings, GPS points)
- ▼ Digitizing and georeferencing spatial data
- ▼ Performing basic data analysis using ArcGIS tools (editing, clip, buffer, selection)
- ▼ Properly displaying the data through the use of symbology, transparency, etc.
- ▼ Designing and printing maps for publication

WHO SHOULD ATTEND: Regulatory or AML staff with degrees in geology, soil science, hydrology, civil or mining engineering, or related natural sciences with little or no experience with GIS.

COURSE PRE-REQUISITES: Familiarity with GIS or mapping concepts is helpful. **Class size limited to 12–17 students, depending on location.**

Introduction to GIS for Mining and Reclamation I – Online



This course is an introduction to the basics of the ArcGIS Desktop software. The course is designed around mining and reclamation examples and exercises. Techniques for using the features of this software to generate high quality maps and analyzing selected data sets are taught. Specific training areas will be ArcCatalog, ArcMap, and ArcToolbox.

Students will learn to recognize various file types and differences between formats, e.g., Raster vs. Vector, Shapefile, Aerial photos/Satellite images, DRG's, DOQQ's, GPS and CAD layers. Students will learn what coordinate systems, datum's, and projections are and why understanding them is vital to working with spatial data. Extraction of CAD layers into the GIS, modifying attributes of shapefiles, geo-rectification and scanning will be covered. Introduction to various mobile computing software and hardware that TIPS supports and how it relates to the permitting process workflow will be examined.

This course is administered online in the Training Virtual Campus and is available during scheduled times throughout the year. Please follow the standard TIPS scheduling and registration procedures to enroll. Contact your TIPS Training Contact or the TIPS Training Program Lead with questions.

Duration: 5-week Period
Course Code: VGAD

TOPICS COVERED

The course will provide a basic understanding of ArcGIS and include:

- ▼ A basic understanding of various ArcGIS screens and functions
- ▼ A basic understanding of coordinate systems, datums, and projections
- ▼ Locating and adding baseline data from online sources (e.g., imagery, topography)
- ▼ Importing external data (Excel tables, CAD drawings, GPS points)
- ▼ Digitizing and georeferencing spatial data
- ▼ Performing basic data analysis using ArcGIS tools (editing, clip, buffer, selection)
- ▼ Properly displaying the data through the use of symbology, transparency, etc.
- ▼ Designing and printing maps for publication

WHO SHOULD ATTEND: Regulatory or AML staff with degrees in geology, soil science, hydrology, civil or mining engineering, or related natural sciences with little or no experience with GIS.

COURSE PRE-REQUISITES: Familiarity with GIS or mapping concepts is helpful. **Class size limited to 12–17 students.**



Mobile Devices for SMCRA: Introduction to Mobile Devices as a Utility for SMCRA Related Business Practices



Android/iOS/Windows based devices loaded with a tool set of applications (APPs) that can be used to navigate, take notes/pictures, and utilize geospatial data in the field. This course provides an introduction to Android, iOS, and Windows devices as a utility for SMCRA related business practices. Through lectures and classroom/field exercises, students learn about tools, menus, GPS, and geospatial data capabilities that come with Android/iOS/Windows devices. The course emphasizes best practice principles and considerations for common field tasks utilizing a number of Android/iOS/Windows APPs.

Duration: 3 days

Course Code: GMD

TOPICS COVERED

Course Objectives:

- ▼ Provide an introduction to Android/iOS/Windows devices as a utility for SMCRA related tasks.
 - ▼ Explore tools, menus, GPS, and geospatial data capabilities that comes with Android/iOS/Windows devices.
 - ▼ Recommend best practice principles and considerations for common filed tasks utilizing a number of apps for Android/iOS/Windows.
-
- ▼ Android/iOS/Windows devices
 - ▼ Applications (APPs)
 - ▼ Understanding basic GIS/GPS
 - ▼ Relative GPS accuracy of Android/iOS/Windows devices
 - ▼ How to prepare a project (download/upload)
 - ▼ How to navigate
 - ▼ How to collect data
 - ▼ How to display data
 - ▼ How to edit data
 - ▼ How to leverage data with ArcGIS/AutoCAD

WHO SHOULD ATTEND: Inspectors, Hydrologist, Soil scientist, Biologist, Mining Engineers, Reclamation specialist, Geospatial staff, and Other field staff.

COURSE PRE-REQUISITES: Familiarity with Android, iOS, and/or Windows tablets and/or smart phones. **Class size is limited to 12–17 students, depending on location.**



Modeling and Analysis with Groundwater Vistas

This hands-on course will review the underlying assumptions, theories, and practical utilization of numerical flow models. The fundamental underpinnings of the course revolve around conceptually modeling ground-water flow and the application of the Groundwater Vistas software. Students will work examples applying this software to coal mining and reclamation related analysis.

Duration: 3 full days

Course Code: HGV



TOPICS COVERED

Review of Scientific Theory

- ▼ Geology Aquifer, Aquitard, Aquiclude
 - ◇ *Confined, Unconfined, Porosity*
 - ◇ *Fractures and Structures Permeability*
- ▼ Basic Ground—Water Hydrology
 - ◇ *Darcy's Law, Hydrologic Balance*
 - ◇ *Equilibrium Versus Nonequilibrium*
 - ◇ *Homogeneous Versus Heterogeneous*
 - ◇ *Anisotropic Versus Isotropic*
 - ◇ *De-pressurizing*
- ▼ Basic Modeling
 - ◇ *Numerical modeling, Types of models*
 - ◇ *Inverse versus forward modeling*
 - ◇ *Transient versus equilibrium*

Groundwater Vistas Software Use

- ▼ Types of Numerical Models/Solutions
- ▼ Finite Difference, Finite Element
- ▼ Diffusion Equation, Grids, Layers
- ▼ Initial Conditions, Dimensionality
- ▼ Space Discretization, Boundary Conditions
- ▼ Water Budget Error, Error Criteria
- ▼ Steady—State Case Analysis
 - ◇ *Site Description, Conceptual Model*
 - ◇ *Building the Model, Run Model*
 - ◇ *Calibration, Sensitivity Analysis*
 - ◇ *Model Adjustment*
 - ◇ *Model Output Analysis, Interpreting Results Validation*

Reviewing Permitting Information done by Models

- ▼ Model Representation of Groundwater Systems
- ▼ Input Parameter Estimation
- ▼ Real World Coal Mining Case Study

WHO SHOULD ATTEND: Regulatory or AML scientists with degrees or college credit in hydrology, or current experience in ground-water hydrology, with six months to one year of experience with SMCRA.

COURSE PRE-REQUISITES: Prospective students should possess a working knowledge of terminology including hydraulic conductivity, storativity, transmissivity, and Darcy's law. Prospective students should have also successfully completed the NTPP course Quantitative Hydrogeology. **Class size is limited to 12–17 students, depending on location.**

SDPS: Surface Deformation Prediction System – Online Self Study



SDPS is a nationally-validated prediction program developed for OSMRE to quantify anticipated subsidence deformations and strains from underground longwall and high-extraction room and pillar mining operations. This course gives students a predictive tool to assist in evaluating the effects of subsidence.

This course is administered online in the Training Virtual Campus. Registration is open year-round; please inform your TIPS Training Contact or the TIPS Training Program Lead for registration.

Duration: Self Study
Course Code: VESD

TOPICS COVERED

Review of Subsidence Mechanisms And Theories

- ▼ Overview of Subsidence Parameters

Software Overview

- ▼ Configuration Options
- ▼ File Conventions

Required Field and Input Parameters Prediction of Surface Deformations

- ▼ Data Collection
- ▼ Maximum Subsidence Factor
- ▼ Location of the Inflection Point
- ▼ Angle of Principal Influence
- ▼ Horizontal Strain Coefficient
- ▼ Limitations of Empirical Parameters

Software Modules

- ▼ Profile Function
 - ◇ *Angle of Draw*
 - ◇ *Subsidence Profile*
- ▼ Influence Function
 - ◇ *Input Data*
 - ◇ *Mine Plan*
 - ◇ *Prediction Points*
 - ◇ *Empirical Parameters*
 - ◇ *Calculation Options*

- ▼ Graphing Module

- ◇ *2-D*
- ◇ *3-D*

- ▼ Pillar Stability

- ◇ *Conventional Pillar Stability*
- ◇ *Analysis of Longwall Pillar Stability (ALPS)*
- ◇ *Analysis of Retreat Mining Pillar Stability (ARMPS)*

Data Import and Export

- ▼ Importing Mine Plan through AutoCAD
- ▼ Importing Prediction Points through AutoCAD
- ▼ Exporting Subsidence Profiles to AutoCAD

Exercises with AutoCAD

Plotting and Printing

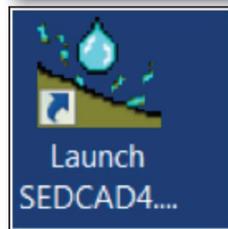
Peripheral Hardware

WHO SHOULD ATTEND: For engineers and/or geologists who work with subsidence prediction.

COURSE PRE-REQUISITES: None



SEDCAD Applications and Extensions for Mine Permitting and Reclamation



This course covers a broad review of the basic hydrologic concepts and assumptions, defines the input parameters for watershed modeling and design of sediment control structures utilizing SEDCAD for mine permitting and reclamation. The participants will learn how to use SEDCAD to model peak flow, runoff volume, design erosion and sediment control structures and to evaluate permit applications. In addition, the course will cover utilizing SEDCAD

to evaluate peak flow in preparation of Cumulative Hydrologic Impact Assessments. An introduction to the Revised Universal Soil Loss Equation will also be covered. Students will work example problems applying this software to model watersheds, analyze peak flow and design sediment basins, channels, culverts, silt fence and other drainage control structures.

Duration: 3 days

Course Code: HSA

TOPICS COVERED

At the end of this course, students will be able to:

- ▼ Design and evaluate sediment and drainage control structures
- ▼ Predict the effectiveness of sediment basins
- ▼ Apply RUSLE to calculate sediment load
- ▼ Calculate peak flow and runoff volume; develop peak flow hydrograph and sedimentgraph
- ▼ Perform watershed modeling including structure networking and Muskingum routing
- ▼ Evaluate hydrology and sedimentology input parameters
- ▼ Generate and review final report

WHO SHOULD ATTEND: regulatory or AML scientists with degrees in hydrology, civil or mining engineering, or soil scientists who design or review designs of diversions, sediment control structures, and impoundments, with six months to one year of experience with SMCRA.

COURSE PRE-REQUISITES: Students should have some knowledge of surface water hydrologic principles and computer experience. Completion of the NTTP courses “Applied Engineering Principles” and Surface and Groundwater Hydrology would be helpful. **Class size is limited to 12–17 students, depending on location.**

Testing and Analysis of Aquifer Characteristics with AQTESOLV

This hands-on course will review the underlying assumptions and theories of aquifer characterization and the practical utilization of analytical ground-water models. The course will provide an introduction to the use of AQTESOLV including analysis of confined, unconfined, leaky, and fractured aquifers. Students will work examples applying this software to coal mining and reclamation-related examples using pump test, slug test, drawdown and recovery data.

Duration: 3 days

Course Code: HAA



TOPICS COVERED

- ▼ Basic Ground-Water Hydrology:
 - ◇ *Aquifer Types, Confining Layers, Darcy's Law, Fracture Flow, Hydraulic Head, Well Completions, Theis Equation, Pumping Tests, Slug Tests, Recovery Tests, Forward Solution*
- ▼ Aquifer Characteristics:
 - ◇ *Hydraulic Conductivity, Transmissivity, Storativity, Intrinsic Permeability, Specific Storage, Specific Yield*
- ▼ Ground-Water Modeling:
 - ◇ *Physical, Conceptual, Analytical, Numerical, Inverse vs. Forward, Transient vs. Equilibrium*

AQTESOLV

- ▼ Slug Tests, Extensive Suite of Test Solutions for Slug Pumping Tests
- ▼ Determination of Well Bore Storage, Boundary Effects
- ▼ Automatic and Manual Curve Matching
- ▼ Diagnostic Plots
- ▼ Data Sensitivity Analysis
- ▼ Statistical Evaluations of Data

Reviewing Permit Information Obtained with Models

- ▼ Model Representation of the Ground-Water System Using Various Test Solutions
- ▼ Realistic Input Parameters
- ▼ Coal Mine Case Study Examples

WHO SHOULD ATTEND: Regulatory and AML scientists with degrees or college credit in hydrology or current experience in ground-water hydrology with 6 months to 1 year of experience with SMCRA.

COURSE PRE-REQUISITES: Prospective students should possess a working knowledge of ground-water terminology and concepts including hydraulic conductivity, storativity, transmissivity, and Darcy's law. Prospective students should have also successfully completed the NTTP course Quantitative Hydrogeology. **Class size limited to 12–17 students, depending on location.**