Schlumberger
WATER SERVICES

Who should attend this course?

This course would be of interest to the hydrogeologist and groundwater modeler who are interested in advancing their modeling knowledge, and apply finite elements, using FEFLOW, to more complex modeling designs.

When do I register?

Register now and take advantage of the **Early Registration Special**. Register 3 months prior to the course date and receive a $100 USD discount!

How do I register?

- Register online at: **www.swstechnology.com**
- Or complete the registration form on the back and fax it to us!

Can't make the Course?

Contact us about our "ON-SITE Custom Training" program. We're ready to deliver any one of our popular courses or tailor the course topics to address your specific organizational needs!

Questions? Contact Us!

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Course Objectives

Upon completion of the course, you will learn:

- Approaches to conceptualizing complex flow and transport problems
- Fundamentals of building a 3D model in FEFLOW
- Applications of FEFLOW in unsaturated zone flow, density-dependent transport, fracture flow, and heat effects
- How to apply PEST to help calibrate your finite element flow and transport model
- Guidance with FEFLOW tools/utilities from expert instructors

Course Schedule

Note: Breaks & lunches are not listed

Day 1

Lecture:	Principles of Finite Differences and Finite Elements
Lecture:	How to Build a Model - FEFLOW Style
Lecture:	Simulating Groundwater Flow In FEFLOW
Exercise:	Intro to FEFLOW: Waterville Groundwater Protection Model

Day 2

Exercise:	Intro to FEFLOW: Waterville Groundwater Protection Model
Lecture:	Introduction to Interface Manager (IFM)
Lecture:	PEST Description and Implementation in FEFLOW
Exercise:	Valley Model - Calibrating a Transient Flow Model
Lecture:	Principles of Contaminant Transport
Lecture:	Simulating Contaminant Transport in FEFLOW
Exercise:	Chemco Model - Simulating Transport and Remediation Options

Day 3

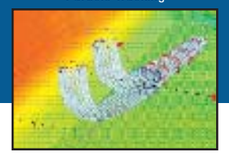
Lecture:	Groundwater Protection Modeling
Lecture:	Principles of Unsaturated Flow
Exercise:	Riverbank Farm Model
Lecture:	Discrete Element Features
Exercise:	Sudicky & McLaren Case Study Model
Exercise:	Sinkhole Flooding - Flow and Transport using

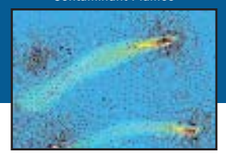
Day 4

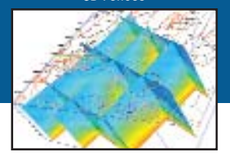
Lecture:	Density-Dependent and Thermal Flow & Transport
Exercise:	Saltwater Intrusion Model - Density-Driven Transport
Exercise:	Thermal Transport - Geothermal Heat Production
Exercise:	Unsaturated Flow through an Earthen Dam
Exercise:	Waterville Quarry Impact Analysis (Heat Transport)
Optional:	***3D Saltwater Intrusion***


Dewatering


3D Cut-Aways


Particle Tracking


Contaminant Plumes


3D Fences

Finite Element Groundwater Modeling

Applications for Saturated/Unsaturated Flow & Transport, Density-Dependent Flow & Heat Transport

FEFLOW (Finite Element subsurface FLOW system) is one of the most sophisticated software packages available for the modeling of flow and transport processes in porous media under saturated and unsaturated conditions. Advanced applications of groundwater flow and contaminant transport models using the Finite Element method are covered in this 4-day hands-on course. The course includes the principles of finite element mesh design, model parameterization, boundary condition development, model calibration, and effective visualization of the results.

This course emphasizes the difference between the finite element and finite difference approach, and the advantages/disadvantages of each. This course provides a more complete understanding of the use and applicability of finite elements in groundwater modeling, and includes such topics as groundwater flow and transport modeling, principles of unsaturated flow, fracture flow modeling, thermal transport and density-dependent flow modeling.

This course will give you the experience you need to reach the next level in groundwater modeling when faced with projects involving complex topography and complicated geology using the finite element technique.

Important Course Topics

- The benefits of finite elements versus finite difference models
- Fundamental concepts and theory of finite element modeling using FEFLOW
- Basic principles of mesh design, refinement and optimization
- Buiding finite element models from GIS files using FEFLOW
- Basic principles of boundary selection and implementation in FEFLOW
- Saturated flow and transport modeling
- Density-driven saline intrusion modeling
- Heat transport modeling
- Unsaturated zone modeling
- Fracture flow modeling
- An introduction to the Interface Manager in FEFLOW
- Computer assisted model calibration

Saturated Flow and Transport

The analysis of saturated flow and transport covered in this course will include relatively complex applications where flow models developed using finite-difference codes such as MODFLOW can be problematic. Lectures and lab exercises will cover the entire modeling process from conceptual model development to numerical implementation, model calibration and results simulation.

Unsaturated Zone Flow and Transport

Unsaturated zone modeling can be challenging because of the highly non-linear relationship between hydraulic conductivity and moisture content. You will learn about unsaturated zone input parameters, where they come from, and some pitfalls to avoid in this type of analysis. Participants will have an improved ability to simulate physical processes such as groundwater recharge and solute transport through the unsaturated zone.

Density-dependent Flow and Heat Transport

The analysis of density-dependent flow and heat transport is required for applications such as seawater intrusion, heat storage, industrial water cooling and brine disposal. FEFLOW is capable of solving the three simultaneous equations needed for this type of analysis: groundwater flow, solute concentration and heat transport. In the course, the link between head, concentration and temperature will be explained and you will experiment with its implementation in FEFLOW.

Simulating Flow in Fractured Media

Simulating the effect of flow in fractured media sometimes requires a discrete-fracture modeling approach. In this course, you will learn the theory and benefits of using the 'fracture element feature' in FEFLOW by experimenting with the effects of fracture aperture, spacing and orientation on the flow system and assessing the benefits and limitation of a discrete-fracture approach.

Course Software: FEFLOW

"Very impressed with the course content, location and lectures. Very knowledgeable about subject matter and local area."

- Waterloo, Tony Windsor

http://www.swstechnology.com