Water & Environmental Training Schedule

FLOW-3D®

Day 1

8:15 – 8:30	Registration
8:30 – 9:15	Introduction & Technical Foundations of ***FLOW-3D***
9:15 – 9:30	Files, Units, and the User Interface
9:30 – 10:15	Results Analysis
10:15 – 10:30	Break
10:30 – 11:00	**Exercise 1 – Running and Post-Processing an Example Simulation**
11:00 – 11:30	Geometry
11:30 – 12:15	**Exercise 2 – Building Geometry**
12:15 – 1:00	Lunch (provided by Flow Science)
1:00 – 1:30	Meshing
1:30 – 2:30	**Exercise 3 – Building a Mesh**
2:30 – 2:45	Break
2:45 – 3:30	Boundary Conditions
3:30 – 4:15	Model Initialization
4:15 – 5:15	**Exercise 4 – Setting Boundaries, Initial Conditions, and Physics**

Day 2

8:30 – 9:15	Modeling Turbulence
9:15 – 10:00	**Exercise 5 – Results Analysis**
10:00 – 10:15	Break
10:15 – 11:15	Modeling Variable Density and Multiphase Flow
11:15 – 12:15	Modeling Sediment Scour
12:15 – 1:00	Lunch (provided by Flow Science)
1:00 – 2:00	**Exercise 6 – Air Entrainment**
2:00 – 2:15	Modeling Cavitation
2:15 – 2:30	Modeling Depth-Averaged Flow, Wind, and Coriolis Effects
2:30 – 2:45	Break
2:45 – 3:15	Modeling Moving Objects
3:15 – 4:00	**Exercise 7 – General Moving Object**
4:00 – 4:45	Numerical Options
4:45 – 5:15	Diagnostics & Troubleshooting

Day 3

8:30 – 9:15	Modeling Porous Media
9:15 – 10:15	**Exercise 8 – Porous Media**
10:15 – 10:30	Break
10:30 – 11:45	Minimizing Errors
11:45 – 12:00	Questions & Graduation, End of Class
12:00 – 1:00	Lunch (on your own)
1:00 – 5:00	**Consultation**

FLOW Science
Improving the world through accurate flow modeling

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Course Details

The Hydraulics Training course consists of two and a half days of application-specific lectures and hands-on work. The intent of this format is to reinforce the lectures with exercises that demonstrate the application of ***FLOW-3D*** to real-world simulations. The last half of the third day is set aside for client consultation.

The content of each lecture is given below:

Technical Foundations of ***FLOW-3D***:

The technical foundations of ***FLOW-3D*** are presented. Users will gain an understanding of the governing equations, the structured gridding methodology, TruVOF free surface tracking, and the FAVOR™ method for embedding complex geometries in structured grids.

Files, Units, and the User Interface:

A guided tour of the ***FLOW-3D*** interface will be provided to help users understand how to manage simulations, recognize the input and output files, create, copy, and restart simulations, and run and terminate simulations. A general overview of the interface layout is provided, along with guidance on selecting and applying unit systems.

Results Analysis:

This lecture provides post-processing basics: opening and reloading results files, generating 1-D, 2-D, and 3-D graphical and text output, and visualizing streamlines and path lines. Other output options will be mentioned that will be covered in detail in later lectures.

Geometry Building:

The fundamentals of geometry building are covered including the meaning and creation of components and subcomponents. Various methods of creating geometry will be covered including ***FLOW-3D*** primitives, CAD files, and topographic data. Techniques for checking and fixing stereolithography CAD files will be discussed. Geometry used to measure flow will also be covered: baffles, sampling volumes, and history probes.

Meshing:

The basics of creating computational meshes will be covered along with best practices for meshing and multi-block meshing. The relationship between mesh and geometry will be discussed, along with approaches to minimize mesh-related error.

Boundary Conditions:

Options for boundary conditions and adding/subtracting fluid within domains will be discussed, including symmetric boundaries, wall boundaries, continuative and outflow boundaries, velocity and volumetric flow rate boundaries, pressure boundaries, wave boundaries, and grid overlay boundaries. Special objects for adding and removing fluid inside a mesh will be demonstrated (mass sources and mass-momentum sources). Boundary conditions common in hydraulic simulations will be presented for modeling reservoirs, inflow hydrographs, tailwater effects, and situations where upstream depth is unknown. Avoiding boundary over-specification will also be discussed.

Initialization:
Methods of initializing fluid in the simulation will be discussed with the goal of increasing stability and accelerating the simulation to steady-state. Techniques for initializing pressure, temperature, density, and velocity distributions will be discussed. Defining fluid regions will be illustrated for both simple and complex shapes.

Physical Models:
The following physical models will be discussed:

Turbulence and wall shear stress	Cavitation
Variable density flows	Sediment scour and transport
Buoyant flows (density gradients)	Porous media (saturated and unsaturated)
Drift-flux (two-phase continuous/discrete flow)	Depth-averaged flow (aka shallow water)
Particles (with and without drag)	Forces on structures
Air entrainment at free surfaces	Chemistry
Discrete bubble models	Solid motion (gates, valves, machinery, debris)

Numerical Options:
Mathematical options for improving the solutions for pressure, iterative and explicit physics, geometry, and special cases will be presented. The focus will be on increasing simulation speed, maintaining stability, and improving accuracy by identifying situations where higher order numerical methods are warranted.

Simulation Diagnostics and Troubleshooting:
This lecture describes how to fix models that aren't running well, and includes interpretation of solver output, guidelines for troubleshooting, and the proper use of advanced numerical options.

Consultation
Attendees may optionally purchase an additional half-day to work on their simulations hands-on with Flow Science staff. This option is recommended for users who are already developing complex simulations, or who wish for additional hands-on training specific to their application.