Outline of DRAINMOD Instruction Modules

Module 1. Introduction to the Course, Objectives and Scope, Introduction to DRAINMOD.

a. PowerPoint introduction to DM
b. Walk through of DM interface and input screens
c. Initial simulations and display of output files

Module 2. Statics of Soil Water in Shallow Water Table Soils. Part 1

a. Head relationships at "drained to equilibrium" conditions
b. Head distributions in saturated and unsaturated conditions
c. Soil water characteristics
d. Soil water content
e. Volume drained
f. Drainable porosity
g. Layered soils

Module 3. Statics of Soil Water in Shallow Water Table Soils. Part 2

a. Darcy's Law
b. Darcy- Buckingham Equation
c. Conservation of mass
d. Richards Equation
e. Dupuit- Forchhimer (D-F) assumptions
f. Hooghoudt Equation
g. Kirkham Equation
h. Drainage Coefficent

Module 4. Introduction to DM. Summary of Inputs and Outputs (Example for trafficability).

a. Explanation of project input screen
b. Basic project inputs (type of simulation, length of simulation, type of outputs)
c. Manage input files
d. Basic inputs for Drainage Design
e. Basic inputs for Soil
f. Basic inputs for Weather
g. Basic inputs in Crop screen, but not yield inputs
h. Basic outputs in Yearly hydrology file
i. Basic outputs in Rank file (emphasis of working days)

Module 5. DM Soil Water Balance Including Soil Water Distribution, Drainage Flux, ET, and Upward Flux.

a. How DM calculates the water balance
b. Day by day calculations of water balance without Rainfall
c. Hour by hour calculations of water balance with Rainfall
d. How DM calculates ET
e. Interaction of Upward Flux, Root depth, Dry zone, and Wet zone

Module 6. Objective Functions (Working Days, Wetland Outputs, Stresses Due to Wet and Dry Conditions, Yields), Monthly Rankings Feature (MRANK, Sensitivity Analysis, Effect of Seepage).

a. Explanation of SEW30
b. How to preserve old files by "Save as"
c. Explanation of Trafficability inputs
d. Explanation of Advanced Monthly Ranking
e. How to perform Sensitivity Analysis

Module 7. Effects of Surface Drainage, Drainage Coefficient.

a. How DM uses surface storage to calculate runoff
b. How DM switches between Hooghoudt and Kirkham equations.
c. How DM uses Drainage Coefficient

Module 8. Unsaturated Soil Water Property Inputs to DM, Soil Prep.

a. Methods to Estimate Unsaturated K as function of h
b. How maximum Upward Flux is calculated from Unsaturated K
c. Demonstration of Soil Prep

Module 9. Analyzing Wetland Hydrology with DM.

a. Complete Soil Prep demonstration
b. Determining wetland hydrology
c. Wetland hydrologic Criteria
d. Challenges in determining if site meets criteria
e. Inputs for wetland analysis

Module 10. Methods for Determining Wetland Hydrologic Status and Lateral Impact of a Ditch.

a. Effect of surface storage and drainable porosity on wetland hydrology

b. Discuss lateral impact of ditch

Module 11. Threshold Method for Wetland Hydrology.

a. Demonstrate program and method for determining lateral impact of ditch
b. Demonstrate Threshold method with DM

Module 12. Weather Data to DM Format, Contributing Area Method for Wetland Hydrology. (Dr. Chip Chescheir)

a. Demonstrate utility program to convert rainfall, temperature and PET files in simple column format to DM format for weather files
b. Demonstrate procedure and utility program to simulate runoff and drainage that flows into a wetland from an adjacent area

Module 13. Determining Saturated Hydraulic Conductivity.

a. Calculations of saturated hydraulic conductivity from auger hole test data.
b. Making estimates of soil properties with little information.

Module 14. Drainage Intensity and the Relationship between Drainage Flux and Water Table Depth.

a. Method to determine saturated hydraulic conductivity from measured water table depth and drain flow data
b. Variability of q vs. m relationship due to transient conditions
c. Method to identify main drainage curve

Module 15. Predicting Crop Yield with DM. (Dr. Robert Evans)

a. Crop susceptibility factors and stress day index for wet stress
b. Crop susceptibility factors and stress day index for dry stress
c. Stress day index method for Planting delay
d. Sample simulations in DM showing yield inputs and outputs

Module 16. Simulation of Drainage (D), Controlled Drainage (CD), and Subirrigation (SI).

a. Discussion of how CD and SI are implemented in DM—inputs for weir depths
b. Example runs for relative yields (% of potential yield) and hydrology (ET, D, RO) for data set DHY—effects of CD compared to D
c. Simulation for subirrigation (SI). Effects on water use, discussion of how wet stresses and drought stresses are affected by D, CD, & SI.

d. Simulation of combination of practices (D, CD, & SI) during year—effects on hydrology and yields.
e. Evolution of water table profiles for D, CD, & SI following a rainfall event that raises WT close to surface.
f. Methods to determine field effective (pseudo) ditch dimensions to represent storage in canal/ditch/drain tube system for CD.

Module 16.B. Simulating Drainage Water Management (D, CD, SI) for Midwest USA.

a. Demo of application of DM to simulate D, CD, SI, Combo
b. How to determine ditch related input parameters (repeat of 16 f above)
c. Factors affecting performance of CD or DWM (ppt presentation)
d. Run simulations for D&CD and discuss results for data set from Iowa for Kossuth-Ottosen soil series.

Module 16 C. Effect of Soil Properties and Surface Storage on Performance of CD or DWM.

a. Soil property inputs for an uncalibrated data set for Falaya silt loam from Boot Heel of Missouri.
b. Adjusting inputs to get "reasonable" yield predictions.
c. How to define "reasonable yield predictions".
d. How to adjust soil property inputs for uncalibrated data set to achieve "reasonable" yield predictions.
e. Run analyses using adjusted inputs and interpret results.
f. What is the effect of CD on drainage outflows? What happens to the water?
g. How do soil properties affect performance of DWM or CD?
h. How does surface drainage affect yields for D&CD for a range of drain spacings.

Module 16 D. Analysis of Subirrigation with DM.

a. Subirrigation under steady state conditions.
b. Simulation of SI on Falaya soil. Effect of control depth or elevation of water in drains during SI.
c. Effect of surface drainage on performance of SI systems
d. Effect of soil properties on performance of SI
e. Effect of elevation interval in control zones for SI on yield variation within the zone—how to determine with DM.

Module 16 E. Review of Performance of CD and SI on Different Soils and Locations.

a. Effects on yields, differences between soils

b. Effects on drainage volumes, how to interpret predicted drainage volumes for cases with subirrigation. Differences between soils.
c. Comparing results for SI versus D for existing drainage system design.
d. CD and SI reduced drainage amounts. What happened to the difference? The difference varies between soils.

Module 16 F. Effect of Seepage on Performance of D, CD and Si and Use of DM to Predict the Effects.

a. Seepage usually small in poorly drained lands and is often ignored.
b. Method to estimate natural seepage based on soil drainage class.
c. Seepage inputs for DM
d. Effect of seepage on percent reduction of drainage.

Module 16 G. Effects of surface drainage, seepage and subirrigation management on predicted yields and drainage flows.

a. CD more effective for good than for poor surface drainage
b. Effect of Cd and SI on outflows much less for poor surface drainage than for intensive surface drainage.
c. Some the effect of guidelines for some management decisions for SI can be simulated with DM. Others can't be easily simulated. Examples discussed.
d. Managing SI to reduce irrigation water requirements.

Module 17. Application of DM for Onsite Wastewater Management. Dr. Robert O. Evans

a. State of North Carolina Rules for onsite wastewater management in high water table soils.
b. Use of DRAINMOD to determine when has sufficient drainage to permit onsite wastewater treatment.

Module 18. Onsite Wastewater Treatment—Example Problem. Dr. Robert O. Evans

a. Calibrating DM for a wastewater application site in eastern NC using water table and weather data collected specifically for that purpose.

Module 19. Methods for Computing Potential Evapotranspiration for Estimating Actual Evapotranspiration in DRAINMOD.

Module 20. Onsite Wastewater Treatment. Part 2

a. Assignment of a problem for calibrating model based on data on actual site.

b. Methods for simulating water balance for interconnected ditches and nonparallel or random ditches.
c. How to estimate inputs for considering lateral seepage in calibration.

Module 21. Onsite Wastewater Treatment. Part 3

a. Calibration of DM for a Roanoke soil near Elizabeth City, NC
b. Determined seepage inputs to consider seepage to adjacent canal
c. Determined wastewater load per unit area
d. Ran simulation to show water table would be within requirements

Module 22. Onsite Wastewater Treatment. Part 4

a. Determine if calibration in previous module was for typical weather conditions
b. Examine other configurations for drain fields

Model 23. DRAINMOD-NII Nitrogen Balance in DRAINMOD. Dr. Mohamed Youssef

a. Model description
b. Field testing

Module 24. Applications of DRAINMOD-NII for Drained Agricultural Lands.

Module 25. Use of DRAINMOD to Simulate Performance of Storm Water Detention Basins or Bio-Retention Areas. Part 1

a. Definition of bioretention treatment facilities and how DM can be used to simulate them.
b. How they work
c. Application of DM for example bioretention area.

Module 26. Application of DRAINMOD to simulate the performance of a Storm Water Detention Basin. Part 2

Module 27. DRAINMOD for Salinity Control.

a. Discussion of drainage for salinity control in India
b. Application of DRAINMOD-S for predicting effects of drainage design and irrigation management on yields in the Nile Delta.
c. Discussion of salinity buildup in non-irrigated croplands of western Australia.

Module 28. Wrap Up.