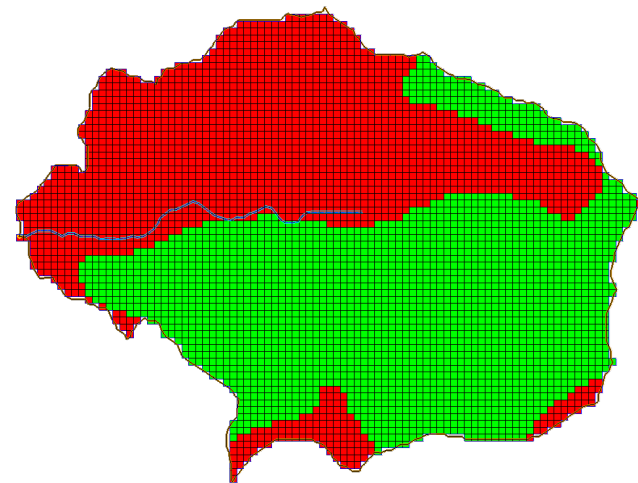




Watershed and Groundwater
Modeling Solutions

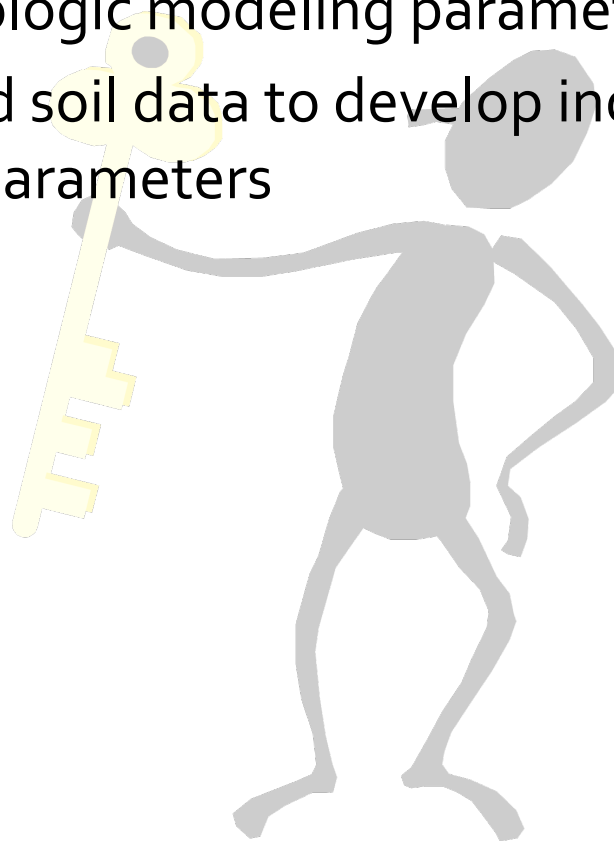
Developing Index Maps with Spatial Data





Objectives

- Use the 2D grid as a basis for overlaying coverages to compute important hydrologic modeling parameters
- Use land use and soil data to develop index maps and initial mapping table parameters

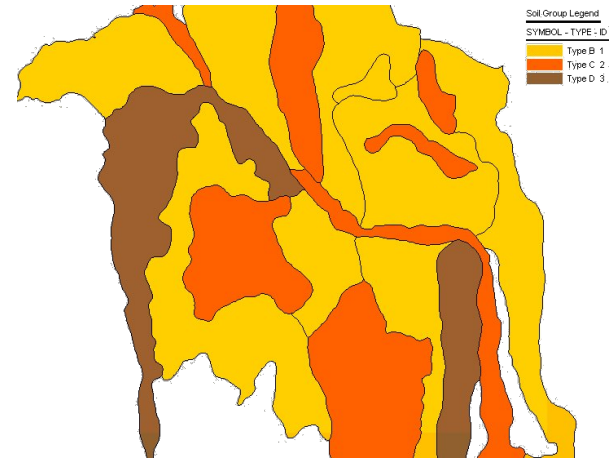
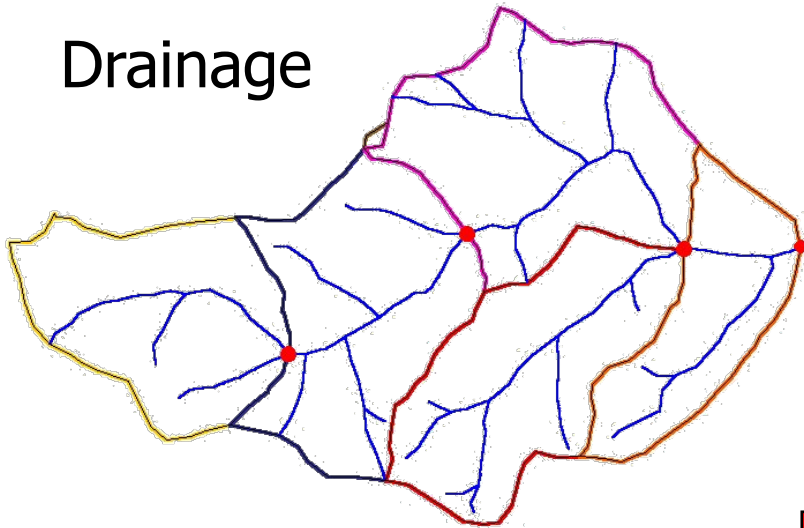




Watershed and Groundwater
Modeling Solutions

Mapping GIS

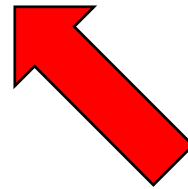
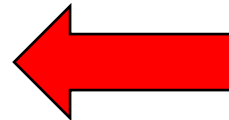
Drainage



Soils

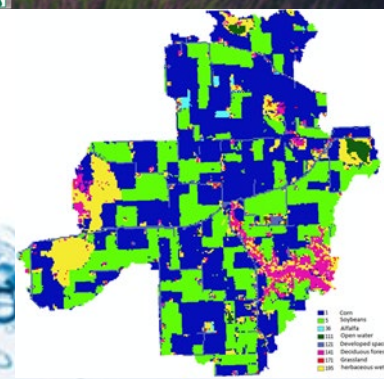
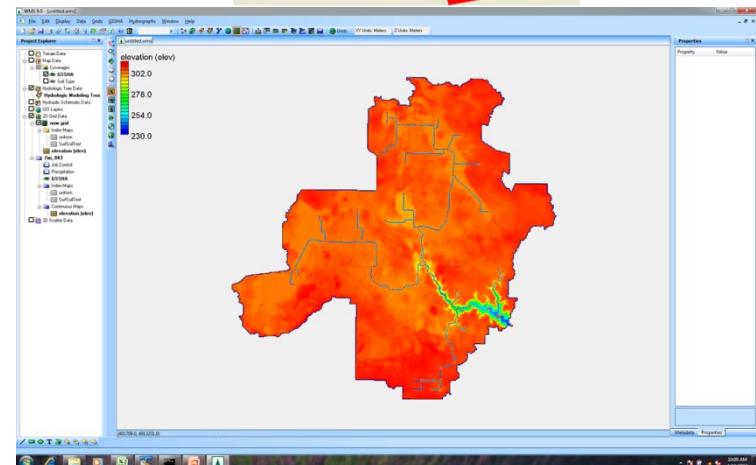


Land Use



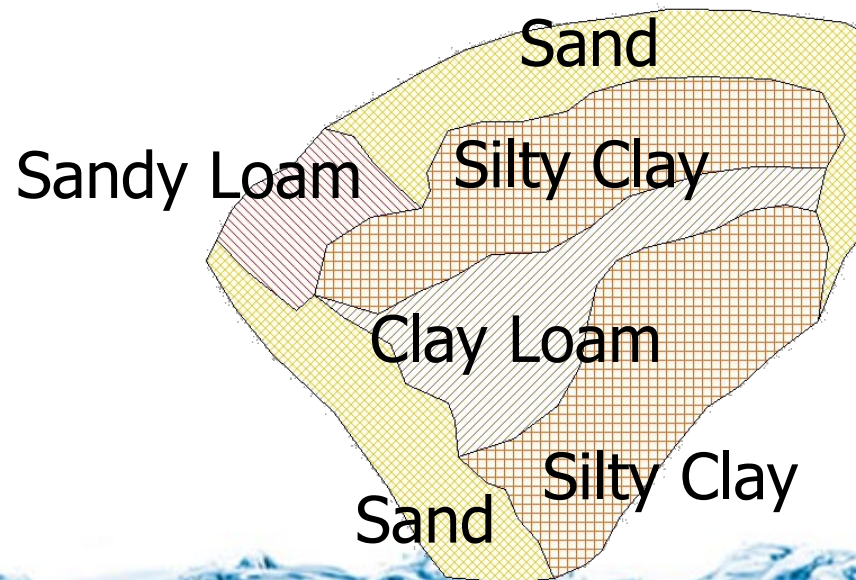
2D Parameters in GSSHA

- Uniform
 - Preliminary models
- A unique value for every grid cell
 - Elevations
- Index map
 - Integer value
 - Derived from some physical property
 - Soils
 - Land use
 - Disturbance
 - Parameter values for each process specified with table of values linked to the index map
 - Used for most processes



Soil Classifications

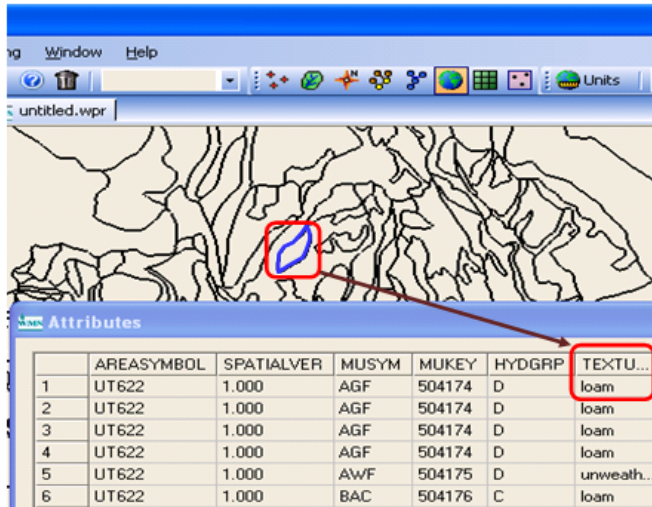
- Soil classifications are saved in the database of a shapefile for most soil surveys
- Soil Index map is created to use the soil information
- You can tie each soil classification to initial Green-Ampt infiltration values using the table in Rawls et al (1983)





Soil data and Infiltration Parameters

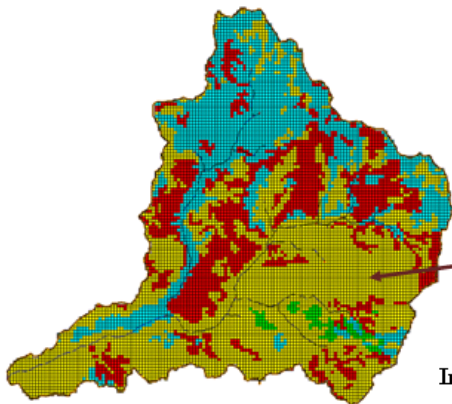
Watershed and Groundwater
Modeling Solutions



Attributes

| | AREASYMBOL | SPATIALVER | MUSYM | MUKEY | HYDGRP | TEXTU... |
|---|------------|------------|-------|--------|--------|------------|
| 1 | UT622 | 1.000 | AGF | 504174 | D | loam |
| 2 | UT622 | 1.000 | AGF | 504174 | D | loam |
| 3 | UT622 | 1.000 | AGF | 504174 | D | loam |
| 4 | UT622 | 1.000 | AGF | 504174 | D | loam |
| 5 | UT622 | 1.000 | AWF | 504175 | D | unweath... |
| 6 | UT622 | 1.000 | BAC | 504176 | C | loam |

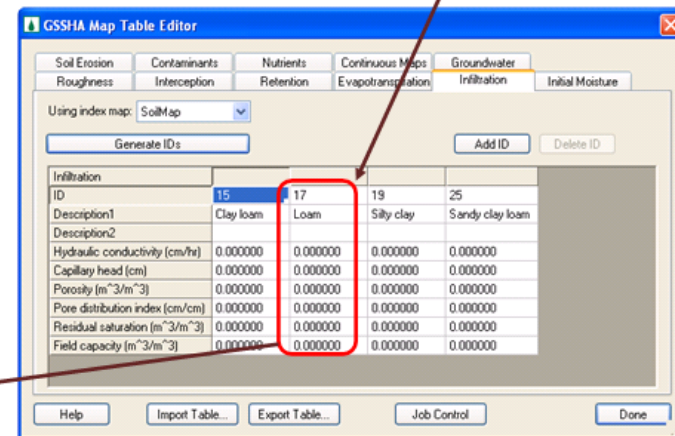
SSURGO soil attributes



Index Map

Rawls and Brakensiek Table

| USDA Textural Classification | θ_s | θ_e | θ_f | θ_{wp} | θ_r | ψ_b (cm) | λ | K_s (cm/h) | ψ_f (cm) |
|------------------------------------|------------|------------|------------|---------------|------------|------------------|-----------|-----------------|------------------|
| Sand | 0.437 | 0.417 | | 0.033 | 0.02 | 7.26 | 0.694 | 23.56 | 4.95 |
| Loamy sand | 0.437 | 0.401 | | 0.055 | 0.035 | 8.69 | 0.553 | 5.98 | 6.13 |
| Sandy loam | 0.453 | 0.412 | | 0.095 | 0.041 | 14.66 | 0.378 | 2.18 | 11.01 |
| Loam | 0.463 | 0.434 | | 0.117 | 0.027 | 11.15 | 0.252 | 1.32 | 8.89 |
| Silt loam | 0.501 | 0.486 | | 0.133 | 0.015 | 20.79 | 0.234 | 0.68 | 16.68 |



GSSHA Map Table Editor

Soil Erosion Roughness Contaminants Interception Nutrients Retention Continuous Maps Evapotranspiration Groundwater Infiltration Initial Moisture

Using index map: SoilMap

Generate IDs Add ID Delete ID

| Infiltration | 15 | 17 | 19 | 25 |
|---|-----------|----------|------------|-----------------|
| ID | 15 | 17 | 19 | 25 |
| Description1 | Clay loam | Loam | Silty clay | Sandy clay loam |
| Description2 | | | | |
| Hydraulic conductivity (cm/hr) | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| Capillary head (cm) | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| Porosity (m ³ /m ³) | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| Pore distribution index (cm/cm) | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| Residual saturation (m ³ /m ³) | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| Field capacity (m ³ /m ³) | 0.000000 | 0.000000 | 0.000000 | 0.000000 |

Help Import Table... Export Table... Job Control Done

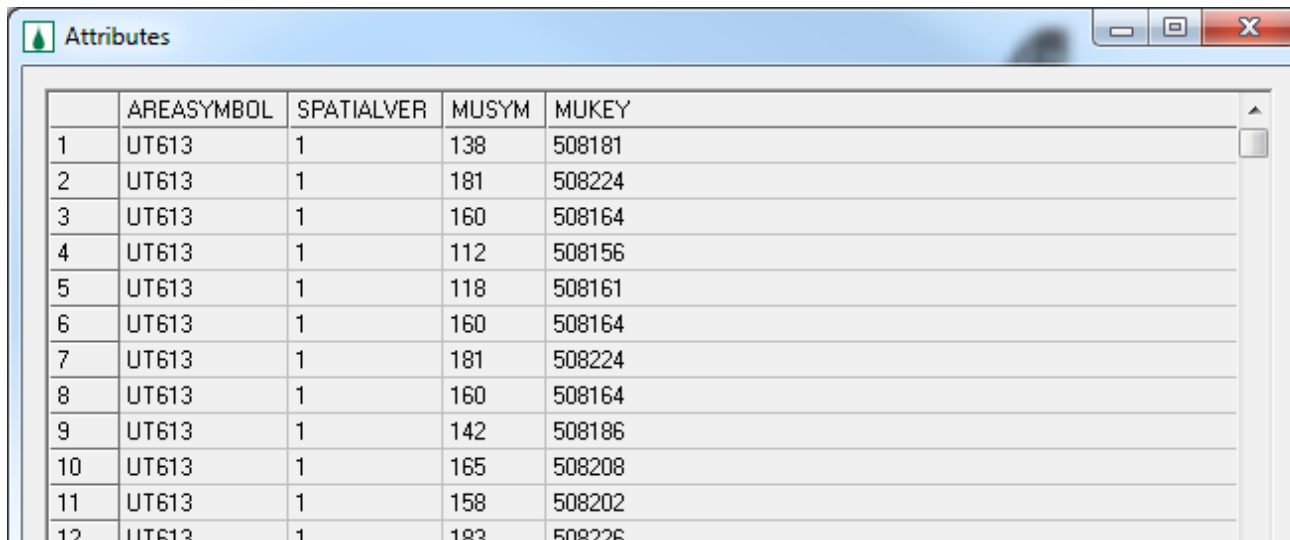
Mapping Table



Geospatial data processing

Watershed and Groundwater
Modeling Solutions

- The SSURGO data you download does not have attributes such as soil texture joined to the shape file.



| | AREASYMBOL | SPATIALVER | MUSYM | MUKEY |
|----|------------|------------|-------|--------|
| 1 | UT613 | 1 | 138 | 508181 |
| 2 | UT613 | 1 | 181 | 508224 |
| 3 | UT613 | 1 | 160 | 508164 |
| 4 | UT613 | 1 | 112 | 508156 |
| 5 | UT613 | 1 | 118 | 508161 |
| 6 | UT613 | 1 | 160 | 508164 |
| 7 | UT613 | 1 | 181 | 508224 |
| 8 | UT613 | 1 | 160 | 508164 |
| 9 | UT613 | 1 | 142 | 508186 |
| 10 | UT613 | 1 | 165 | 508208 |
| 11 | UT613 | 1 | 158 | 508202 |
| 12 | UT613 | 1 | 183 | 508226 |

In SSURGO data, the attributes are stored as separate tables and they need to be linked with the shapefile before you can use them.





Geospatial data processing

- WMS has a utility to join SSURGO tabular data to the shapefile

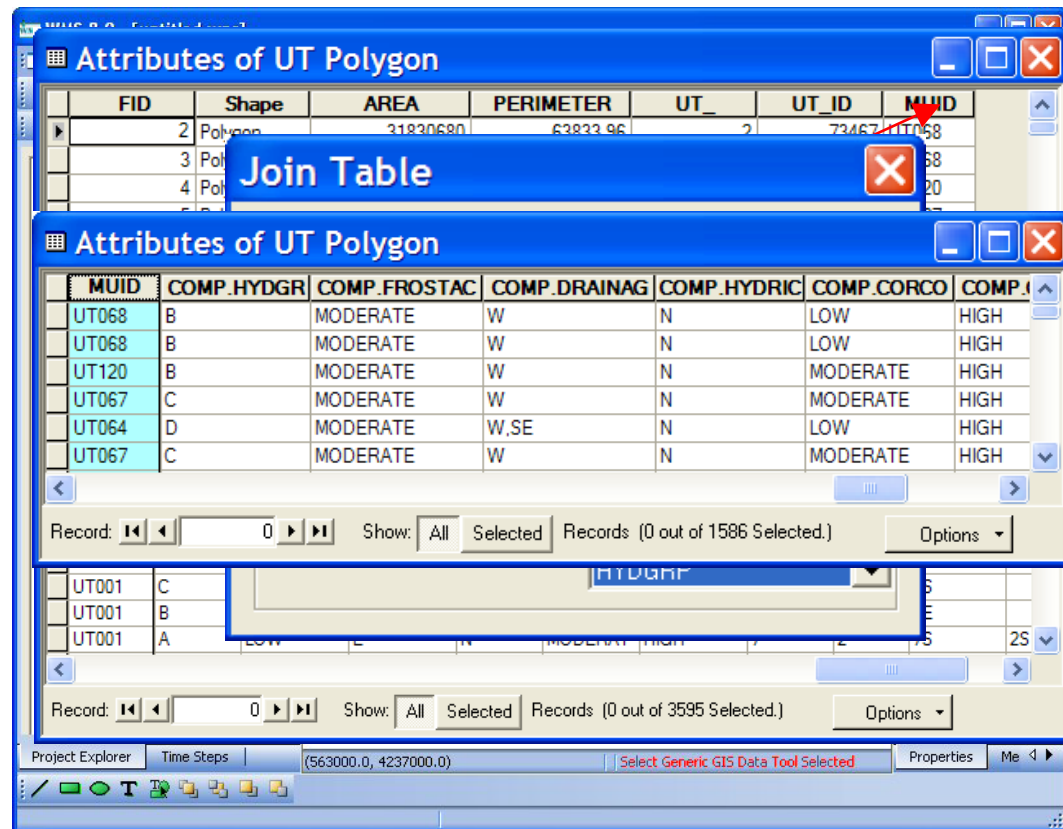
The screenshot shows the WMS software interface. The 'Project Explorer' on the left lists various data layers, including 'Terrain Data', 'DEM', 'Map Data', 'Coverages', 'GSSHA', 'Hydrologic Tree Data', 'Hydrologic Modeling Tree', 'Hydraulic Schematic Data', 'GIS Layers', '2D Grid Data', 'new grid', 'default', 'Index Map', 'GSSHAMod', 'Job Contr', 'Precipitati', 'GSSHA', 'Index Map', 'Continuou', and '2D Scatter Data'. The 'Join SSURGO Data' dialog box is open, showing 'Soil Group' as 'B' and 'Soil Texture' as 'Silty clay loam'. The 'Attributes' table is displayed, showing a list of attributes for 13 rows of data. The table is circled in red.

| | AREASYMBOL | SPATIALVER | MUSYM | MUKEY | TEXTURE | KSAT | MOISTURE | FIELD CAP | WILTINGPT | HYDGP |
|----|------------|------------|-------|--------|-----------------|----------|----------|-----------|-----------|-------|
| 1 | UT613 | 1 | 138 | 508181 | Clay loam | 2.171893 | 0.160000 | 28.800000 | 14.800000 | B |
| 2 | UT613 | 1 | 181 | 508224 | Clay loam | 1.077243 | 0.100000 | 15.900000 | 9.100000 | C |
| 3 | UT613 | 1 | 160 | 508164 | Loam | 5.636535 | 0.100000 | 14.000000 | 9.900000 | B |
| 4 | UT613 | 1 | 112 | 508156 | Loam | 3.611269 | 0.130000 | 12.300000 | 8.300000 | B |
| 5 | UT613 | 1 | 118 | 508161 | Sandy clay loam | 6.193469 | 0.100000 | 14.000000 | 9.900000 | B |
| 6 | UT613 | 1 | 160 | 508164 | Loam | 5.636535 | 0.100000 | 14.000000 | 9.900000 | B |
| 7 | UT613 | 1 | 181 | 508224 | Clay loam | 1.077243 | 0.100000 | 15.900000 | 9.100000 | C |
| 8 | UT613 | 1 | 160 | 508164 | Loam | 5.636535 | 0.100000 | 14.000000 | 9.900000 | B |
| 9 | UT613 | 1 | 142 | 508186 | Clay loam | 1.039157 | 0.130000 | 15.900000 | 12.400000 | C |
| 10 | UT613 | 1 | 165 | 508208 | Loam | 0.010498 | 0.070000 | 0.000000 | 0.000000 | D |
| 11 | UT613 | 1 | 158 | 508202 | Clay loam | 0.059855 | 0.150000 | 23.100000 | 13.700000 | C |
| 12 | UT613 | 1 | 183 | 508226 | Clay loam | 0.000000 | 0.000000 | 0.000000 | 0.000000 | B |
| 13 | UT613 | 1 | 160 | 508164 | Loam | 5.636535 | 0.100000 | 14.000000 | 9.900000 | B |



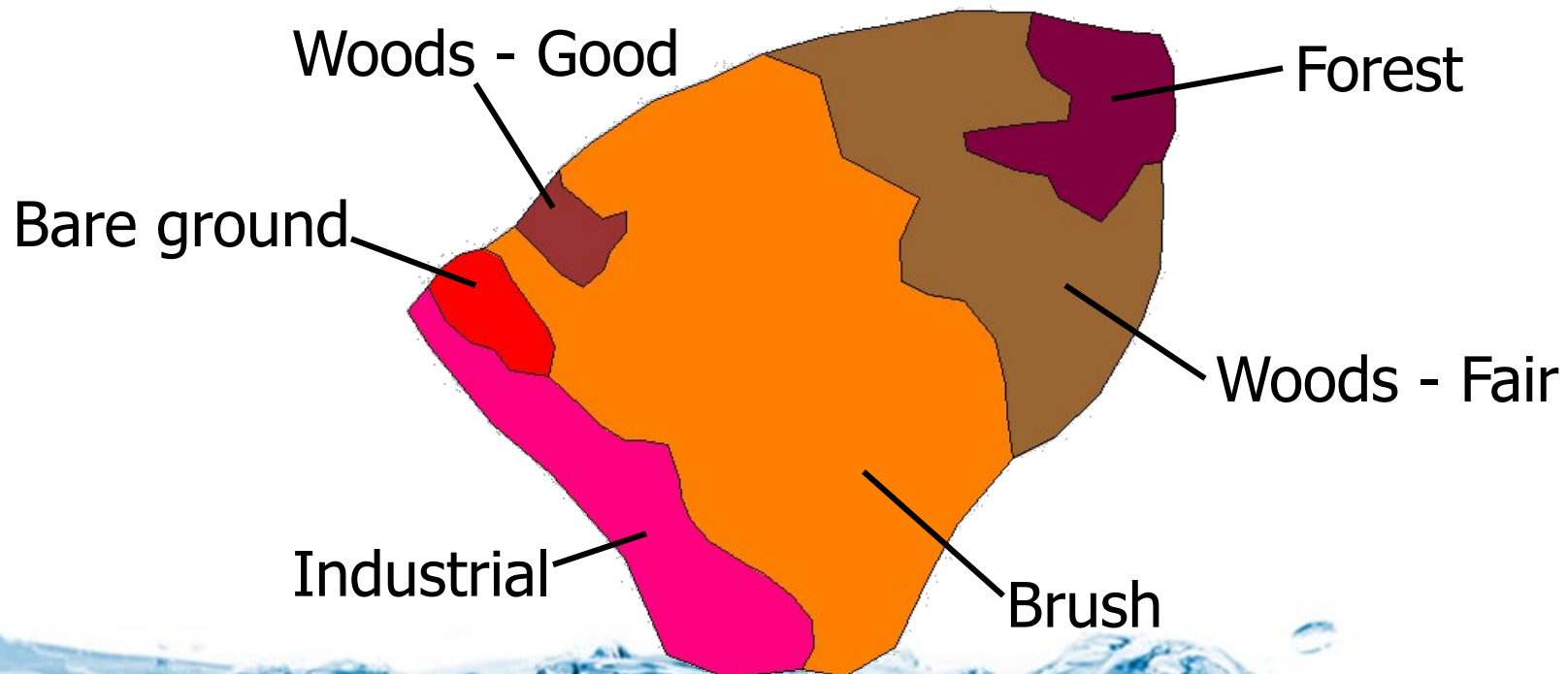
Joining STATSGO Tables

- Joining the HYDGRP attribute
 - Open soils file as a GIS layer
 - Join to COMP.DBF based on MUID



Land Use

- How well water is retained on the land surface until it can transpire, evaporate, or infiltrate





Use of Land use data

Standard Text book values for
roughness based on land cover

GSSHA .cmt file relating LU Code and
Manning's n

GSSHA mapping table relating .cmt file
to the index map

ROUGH
0.011000
0.012000
0.010000

| | | |
|----------|----|----------------|
| Grass: | 14 | Transportation |
| | 15 | Industrial and |
| | 16 | Mixed Urban or |
| | 17 | Other Urban or |
| Range (n | 21 | Cropland and |
| | 22 | Orchards, Grov |
| Woods | 23 | Confined Feedi |
| | 24 | Other Agricult |
| | 31 | Herbaceous Ran |

GSSHA Map Table Editor

| | | | |
|--------------|--------------|------------------|--------------------|
| Contaminants | Nutrients | Continuous Maps | Groundwater |
| Roughness | Interception | Retention | Evapotranspiration |
| | Infiltration | Initial Moisture | Soil Erosion |

Using index map: Land use

Index map type: Grid

Generate IDs

Add ID Delete ID

| | | | | | | |
|-------------------|------------------|------------------|------------------|------------------|------------------|------------------|
| Roughness | | | | | | |
| ID | 11 | 12 | 14 | 16 | 21 | 41 |
| Description1 | Untitled land... | Untitled land... | Untitled land... | Untitled land... | Untitled land... | Untitled land... |
| Description2 | ... | ... | ... | ... | ... | ... |
| Surface roughness | 0.011000 | 0.012000 | 0.011000 | 0.011000 | 0.035000 | 0.100000 |





Watershed and Groundwater Modeling Solutions

Land Use Classification

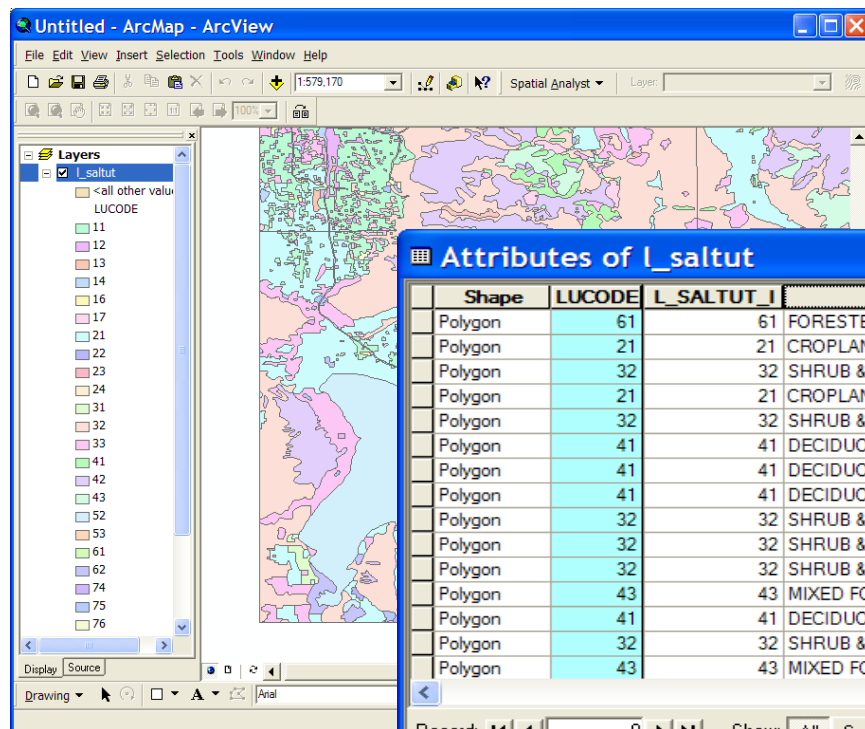


Table 1. Anderson Land Use Classification Codes

| Classification Code | Land Use Description |
|---------------------|--|
| 11 | Residential |
| 12 | Commercial Services |
| 13 | Industrial |
| 14 | Transportation, Communications |
| 15 | Industrial and Commercial |
| 16 | Mixed Urban or Built-Up Land |
| 17 | Other Urban or Built-Up Land |
| 21 | Cropland and Pasture |
| 22 | Orchards, Groves, Vineyards, Nurseries |
| 23 | Confined Feeding Operations |
| 24 | Other Agricultural Land |
| 31 | Herbaceous Rangeland |
| 32 | Shrub and Brush Rangeland |
| 33 | Mixed Rangeland |
| 41 | Deciduous Forest Land |
| 42 | Evergreen Forest Land |
| 43 | Mixed Forest Land |
| 51 | Streams and Canals |
| 52 | Lakes |
| 53 | Reservoirs |
| 54 | Bays and Estuaries |
| 61 | Forested Wetlands |
| 62 | Nonforested Wetlands |
| 71 | Dry Salt Flats |
| 72 | Beaches |
| 73 | Sandy Areas Other than Beaches |
| 74 | Bare Exposed Rock |
| 75 | Strip Mines, Quarries, and Gravel Pits |
| 76 | Transitional Areas |
| 77 | Mixed Barren Land |
| 81 | Shrub and Brush Tundra |
| 82 | Herbaceous Tundra |
| 83 | Bare Ground |
| 84 | Wet Tundra |
| 85 | Mixed Tundra |
| 91 | Perennial Snowfields |
| 92 | Glaciers |



Creating and Using Index Maps in GSSHA

Watershed and Groundwater
Modeling Solutions

1. Read your land use and/or soil shapefiles
2. Join tables to values in other tables if necessary
3. Convert land use/soil shapefiles to map module polygons
4. Create index maps from land use/soil shapefiles
5. Define GSSHA mapping table properties and initial conditions





Review & Discuss

- Objectives
 - Use the 2D grid as a basis for overlaying coverages to compute important hydrologic modeling parameters
 - Use land use and soil data to develop index maps and initial mapping table parameters
- Applications

