SWAT+

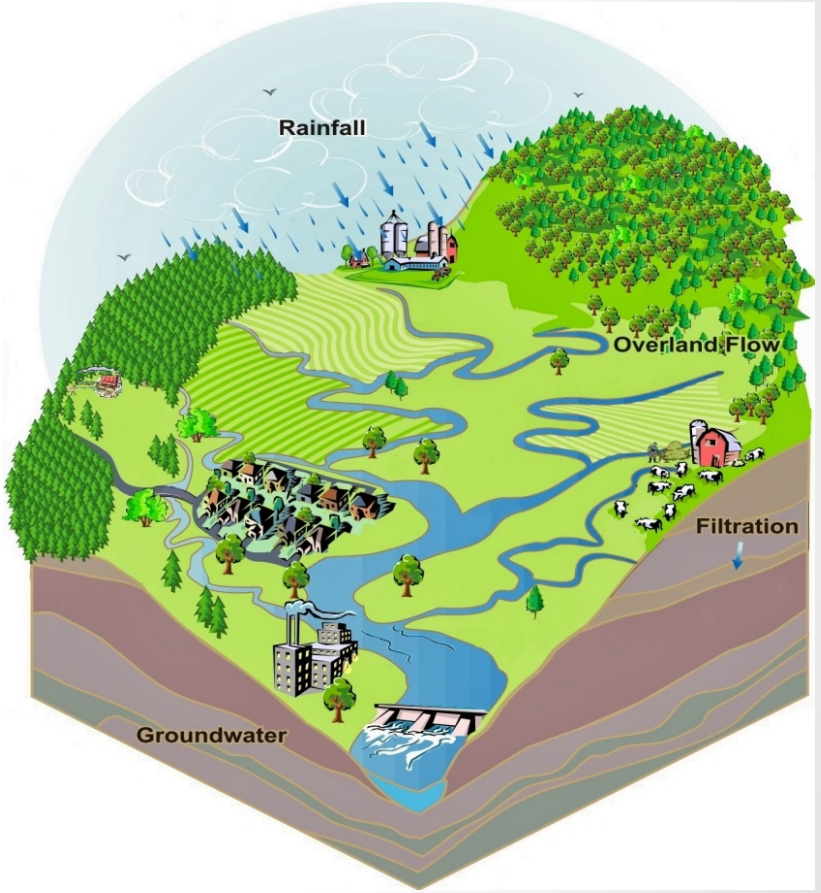
Land Management Overview

Land Management

- Encompasses
  - Land use/Land cover
  - Field operations (planting, tillage, fertilization, harvest)
  - Structural conservation practices
- Most complicated part of SWAT+
- Critical to accurate predictions
- Often most readily understood by stakeholders
- Todays presentation content
  - SWAT file structure
  - Management components
  - Data sources

SWAT / SWAT+ Differences

- Watershed processes are largely unchanged.
- File structure completely different
  - Far Fewer Files
  - All Files are Free Format
    - Easy to Edit
  - More Relational Database Type Structure



SWAT+ Data Storage

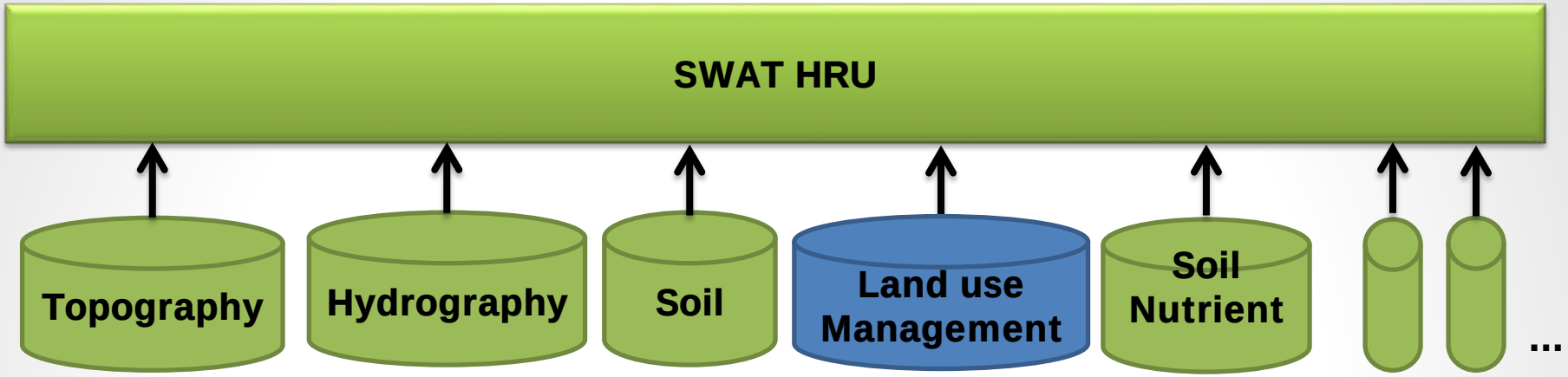
- 2,309 Different I/O Variables
- 152 Text Files
- Interfaces and Tools use Databases
- Use Common Database Schema

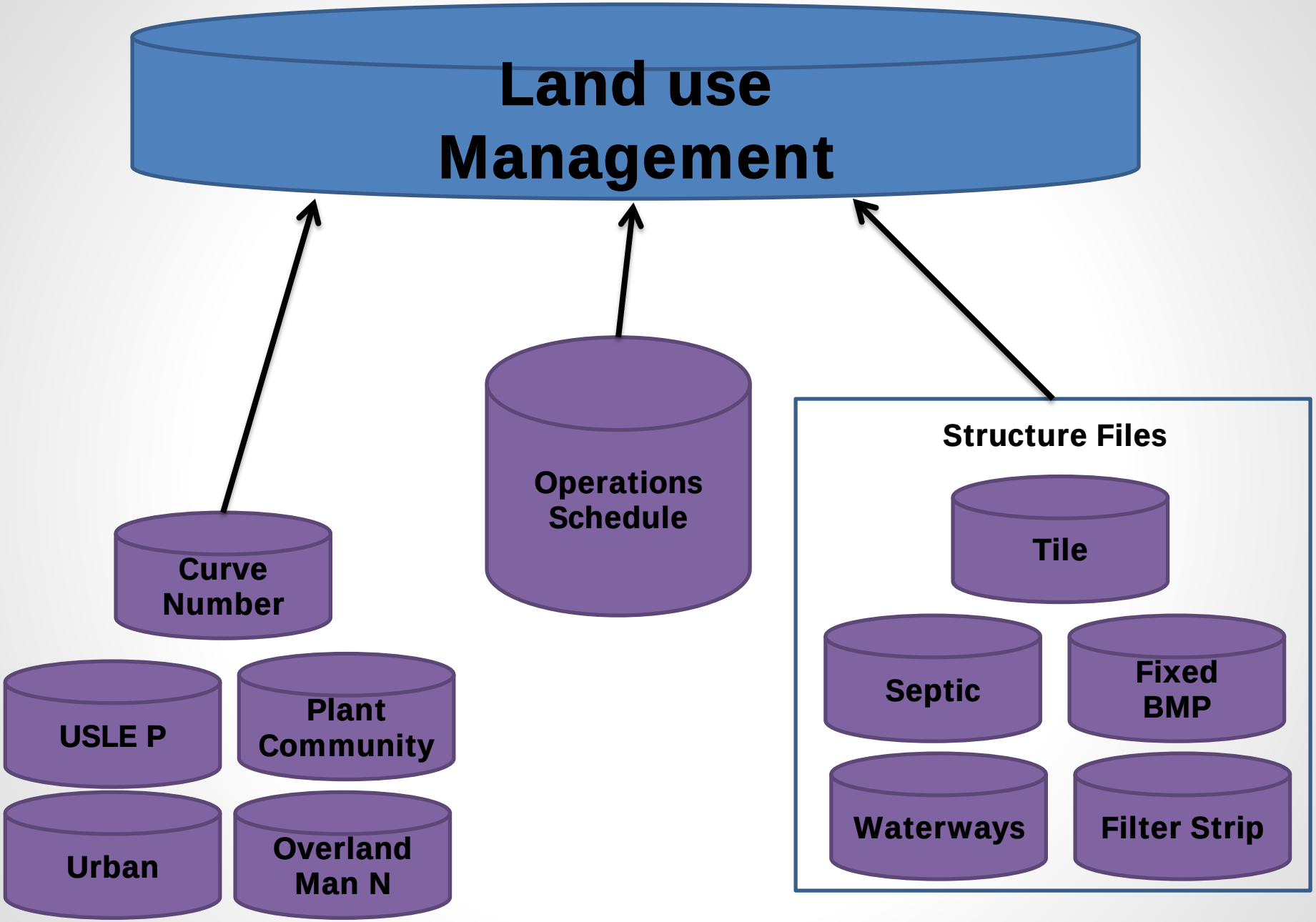
SWAT+ File/Database Structure

SWAT File	DATABASE TABLE	FIELD NAME	Print Position	Line	Sourcecode name	Description	Units	Data_Type
harv.ops	HARV_OPS	HARV_OP_NAME	1	*	name	Harvest operation name	NA	string
harv.ops	HARV_OPS	DESC	*	*	*	Description, not used in the model	NA	string
harv.ops	HARV_OPS	HARV_TYPE	2	*	typ	Harvest Type (grain;biomass;residue;tree;tuber)	NA	string
harv.ops	HARV_OPS	HARV_INDEX	3	*	hi_ovr	Harvest index target specified at harvest (kg/ha)/(kg/ha)	fraction	numeric
harv.ops	HARV_OPS	HARV_EFF	4	*	eff	Harvest efficiency	fraction	numeric
harv.ops	HARV_OPS	HARV_BIO_MIN	5	*	bm_min	Minimum biomass to allow harvest	kg/ha	numeric
graze.ops	GRAZE_OPS	GRZ_OP_NAME	1	*	name	Grazing operation name	NA	string
graze.ops	GRAZE_OPS	DESC	*	*	*	Description, not used in the model	NA	string
graze.ops	GRAZE_OPS	FERT_NAME	2	*	fertnm	Fertilizer name for manure deposited during grazing	NA	string
graze.ops	GRAZE_OPS	GRZ_DAYS	3	*	days	Duration of grazing operation	days	integer
graze.ops	GRAZE_OPS	BIO_EAT	4	*	eat	Dry weight of biomass removed by grazing daily	kg/ha	numeric
graze.ops	GRAZE_OPS	BIO_TRAMP	5	*	tramp	Dry weight of biomass removed by trampling daily	kg/ha	numeric
graze.ops	GRAZE_OPS	MAN_AMT	6	*	manure	Dry weight of manure deposited	kg/ha	numeric
graze.ops	GRAZE_OPS	GRZ_BIO_MIN	7	*	bio_min	Minimum plant biomass for grazing to occur	kg/ha	numeric
irr.ops	IRR_OPS	IRR_OP_NAME	1	*	name	Irrigation operation name	NA	string
irr.ops	IRR_OPS	DESC	*	*	*	Description, not used in the model	NA	string
irr.ops	IRR_OPS	IRR_AMT	2	*	amt_mm	Amount of water to be applied	mm	numeric
irr.ops	IRR_OPS	IRR_SALT	3	*	salt	Concentration of salt in irrigation water	mg/l	numeric

Available by Request

Anatomy of an SWAT+ HRU




Land use Management
Curve Number
Operations Schedule
Structure Files
Tile
Septic
Fixed BMP
Waterways
Filter Strip
USLE P
Plant Community
Urban
Overland Man N

Land use Management

landuse.lum - Notepad

File Edit Format View Help

```
LULC_HRU Generated from V:\CEAP\Model_Constructor_Command_Line\HUC8_Models\07100001.accdb Time: 6/20/2017 10:40:28 AM
 LULC_NAME          PCOM_NAME                          MGT_NAME    CN2_NAME        PF_NAME URB_LU          URB_RO       OVN_NAME TILE_NAM
     666077 CORN1500SOYB1200   CORN_SOYB_CMZ_04_MULCH_Dry_5545 RC_SR_CR_G up_down_slope    null            null  chisplow_res       nul
     666078          FESC2100            PAST_CMZ_04__Dry_100085     PAST_G up_down_slope    null            null  bermudagrass       nul
     666079          FESC2100            PAST_CMZ_04__Dry_100085     PAST_G up_down_slope    null            null  bermudagrass       nul
     666080 CORN1500SOYB1200   CORN_SOYB_CMZ_04_MULCH_Dry_5545 RC_SR_CR_G up_down_slope    null            null  chisplow_res       nul
     666081          CORN1500      CORN_CMZ_04_INTENSE_Dry_7811    RC_SR_G up_down_slope    null            null  convtill_res       nul
     666082          FESC2100            PAST_CMZ_04__Dry_100085     PAST_G up_down_slope    null            null  bermudagrass       nul
     666083          FESC2100            PAST_CMZ_04__Dry_100084     PAST_G up_down_slope    null            null  bermudagrass       nul
     666084 SOYB1200CORN1500   SOYB_CORN_CMZ_04_MULCH_Dry_5587 RC_SR_CR_G up_down_slope    null            null  chisplow_res       nul
     666085 SOYB1200CORN1500 SOYB_CORN_CMZ_04_REDUCED_Dry_5547    RC_SR_G up_down_slope    null            null  convtill_res       nul
     666086          FESC2100            PAST_CMZ_04__Dry_100084     PAST_G up_down_slope    null            null  bermudagrass       nul
     666087          FESC2100            PAST_CMZ_04__Dry_100085     PAST_G up_down_slope    null            null  bermudagrass       nul
     666088          FESC2100            PAST_CMZ_04__Dry_100085     PAST_G up_down_slope    null            null  bermudagrass       nul
     666089          WETN1500            WETL_CMZ_04__Dry_100135     FRST_G up_down_slope    null            null  forest_heavy       nul
```

Plant Community

initial.plt - Notepad

File Edit Format View Help

```
PTCOM_DB Generated from V:\CEAP\Model_Constructor_Command_Line\HUC8_Models\07100001.accdb Time: 6/20/
        PCOM_NAME PLT_CNT PLT_NAME  IGRO LAI_INI BM_INI PHU_ACC_INI   POP YRS_INI RSD_INI
         ALFA1400       1
                              ALFA1400    0       0      0           0     0       0    1000
          CORN1500       1
                              CORN1500    0       0      0           0     0       0    1000
 CORN1500SOYB1200       2
                              CORN1500    0       0      0           0     0       0    1000
                              SOYB1200    0       0      0           0     0       0    1000
          FESC2100       1
                              FESC2100    0       0      0           0     0       0    1000
```

Land use Management

landuse.lum - Notepad

File Edit Format View Help

LULC_HRU Generated from V:\CEAP\Model_Constructor_Command_Line\HUC8_Models\07100001.accdb Time: 6/20/2017 10:40:28 AM

LULC_NAME	PCOM_NAME	MGT_NAME	CN2_NAME	PF_NAME	URB_LU	URB_RO	OVN_NAME	TILE_NAM
666077	CORN1500SOYB1200	CORN_SOYB_CMZ_04_MULCH_Dry_5545	RC_SR_CR_G	up_down_slope	null	null	chisplow_res	nu
666078	FESC2100	PAST_CMZ_04__Dry_100085	PAST_G	up_down_slope	null	null	bermudagrass	nu
666079	FESC2100	PAST_CMZ_04__Dry_100085	PAST_G	up_down_slope	null	null	bermudagrass	nu
666080	CORN1500SOYB1200	CORN_SOYB_CMZ_04_MULCH_Dry_5545	RC_SR_CR_G	up_down_slope	null	null	chisplow_res	nu
666081	CORN1500	CORN_CMZ_04_INTENSE_Dry_7811	RC_SR_G	up_down_slope	null	null	convtill_res	nu
666082	FESC2100	PAST_CMZ_04__Dry_100085	PAST_G	up_down_slope	null	null	bermudagrass	nu
666083	FESC2100	PAST_CMZ_04__Dry_100084	PAST_G	up_down_slope	null	null	bermudagrass	nu
666084	SOYB1200CORN1500	SOYB_CORN_CMZ_04_MULCH_Dry_5587	RC_SR_CR_G	up_down_slope	null	null	chisplow_res	nu
666085	SOYB1200CORN1500	SOYB_CORN_CMZ_04_REDUCED_Dry_5547	RC_SR_G	up_down_slope	null	null	convtill_res	nu
666086	FESC2100	PAST_CMZ_04__Dry_100084	PAST_G	up_down_slope	null	null	bermudagrass	nu
666087	FESC2100	PAST_CMZ_04__Dry_100085	PAST_G	up_down_slope	null	null	bermudagrass	nu
666088	FESC2100	PAST_CMZ_04__Dry_100085	PAST_G	up_down_slope	null	null	bermudagrass	nu
666089	WETN1500	WETL_CMZ_04__Dry_100135	FRST_G	up_down_slope	null	null	forest_heavy	nu

cntable.lum - Notepad

File Edit Format View Help

CN_DB Generated from Time: 6/20/2017 12:59:40 PM

CN_NAME	CN_A	CN_B	CN_C	CN_D	Description
PAST_G	39	61	74	80	Pasture Pasture, grassland, or range-continuous forage for grazing. Condition-Good
PAST_P	68	79	86	89	Pasture Pasture, grassland, or range-continuous forage for grazing. Condition-Poor
RC_C_CR_G	64	74	81	85	Row crops Contoured_Crop residue cover Condition-Good
RC_C_CR_P	69	78	83	87	Row crops Contoured_Crop residue cover Condition-Poor
RC_C_G	65	75	82	86	Row crops Contoured Condition-Good
RC_C_P	70	79	84	88	Row crops Contoured Condition-Poor
RC_C_T_CR_G	61	70	77	80	Small grain Contoured & terraced_Crop residue cover Condition-Good
RC_C_T_CR_P	65	73	79	81	Row crops Contoured & terraced_Crop residue cover Condition-Poor
RC_C_T_G	62	71	78	81	Row crops Contoured & terraced Condition-Good
RC_C_T_P	66	74	80	82	Row crops Contoured & terraced Condition-Poor
RC_SR_CR_G	64	75	82	85	Row crops Crop residue cover_Straight row Condition-Good
RC_SR_CR_P	71	80	87	90	Row crops Crop residue cover_Straight row Condition-Poor
RC_SR_G	67	78	85	89	Row crops Straight row Condition-Good
RC_SR_P	72	81	88	91	Row crops Straight row Condition-Poor

Curve Number

Land use Management

landuse.lum - Notepad

File Edit Format View Help

```
LULC_HRU Generated from V:\CEAP\Model_Constructor_Command_Line\HUC8_Models\07100001.accdb Time: 6/20/2017 10:40:28 AM
 LULC_NAME          PCOM_NAME                          MGT_NAME     CN2_NAME        PF_NAME URB_LU          URB_RO        OVN_NAME TILE_NAM
    666077 CORN1500SOYB1200    CORN_SOYB_CMZ_04_MULCH_Dry_5545 RC_SR_CR_G up_down_slope    null            null    chisplow_res       nul
    666078          FESC2100           PAST_CMZ_04__Dry_100085     PAST_G up_down_slope    null            null    bermudagrass       nul
    666079          FESC2100           PAST_CMZ_04__Dry_100085     PAST_G up_down_slope    null            null    bermudagrass       nul
    666080 CORN1500SOYB1200    CORN_SOYB_CMZ_04_MULCH_Dry_5545 RC_SR_CR_G up_down_slope    null            null    chisplow_res       nul
    666081          CORN1500      CORN_CMZ_04_INTENSE_Dry_7811    RC_SR_G up_down_slope    null            null    convtill_res       nul
    666082          FESC2100           PAST_CMZ_04__Dry_100085     PAST_G up_down_slope    null            null    bermudagrass       nul
    666083          FESC2100           PAST_CMZ_04__Dry_100084     PAST_G up_down_slope    null            null    bermudagrass       nul
    666084 SOYB1200CORN1500    SOYB_CORN_CMZ_04_MULCH_Dry_5587 RC_SR_CR_G up_down_slope    null            null    chisplow_res       nul
    666085 SOYB1200CORN1500 SOYB_CORN_CMZ_04_REDUCED_Dry_5547    RC_SR_G up_down_slope    null            null    convtill_res       nul
    666086          FESC2100           PAST_CMZ_04__Dry_100084     PAST_G up_down_slope    null            null    bermudagrass       nul
    666087          FESC2100           PAST_CMZ_04__Dry_100085     PAST_G up_down_slope    null            null    bermudagrass       nul
    666088          FESC2100           PAST_CMZ_04__Dry_100085     PAST_G up_down_slope    null            null    bermudagrass       nul
    666089          WETN1500           WETL_CMZ_04__Dry_100135     FRST_G up_down_slope    null            null    forest_heavy       nul
```

ovn_table.lum - Notepad

File Edit Format View Help

```
OVN_DB Generated from V:\CEAP\Model_Constructor_Command_Line\HUC8_Models\07:
          OVN_NAME MANN_N OVN_MIN OVN_MAX                                DESC
       bermudagrass   0.41     0.3    0.48                        Bermudagrass
         densegrass   0.24    0.17     0.3                         Dense_grass
         shortgrass   0.15     0.1     0.2                  Short_grass_prairie
     chisplow_nores   0.09    0.06    0.12                Chisel_plow_no_residue
       chisplow_res   0.13     0.1    0.16                   Chisel_plow_residue
     convtill_nores   0.09    0.06    0.12 Conventional_tillage_no_residue
       convtill_res   0.19    0.16    0.22    Conventional_tillage_residue
       falldisk_res    0.4     0.3     0.5                 Fall_disking_residue
       fallow_nores   0.01   0.008   0.012                   Fallow_no_residue
       forest_heavy    0.8     0.7     0.9                       Forest_heavy
       forest_light    0.4     0.3     0.5                  Forest_light_fair
         forest_med    0.6     0.5     0.7               Forest_medimum_good
    notill_0.5-1res   0.12    0.07    0.17      No_till_0.5-1_t/ha_residue
      notill_2-9res    0.3    0.17    0.47        No_till_2-9_t/ha_residue
       notill_nores   0.07    0.04     0.1              No_till_no_residue
     range_20cover    0.6     0.6     0.6          Rangeland_20%_cover
      range_sparse   0.13    0.13    0.13       Rangeland_sparse_cover
     urban_asphalt   0.11    0.11    0.11                 Urban_asphalt
    urban_concrete  0.012   0.012   0.012                Urban_concrete
      urban_rubble  0.024   0.024   0.024                  Urban_rubble
```

Overland Man N

Land use Management

landuse.lum - Notepad

File Edit Format View Help

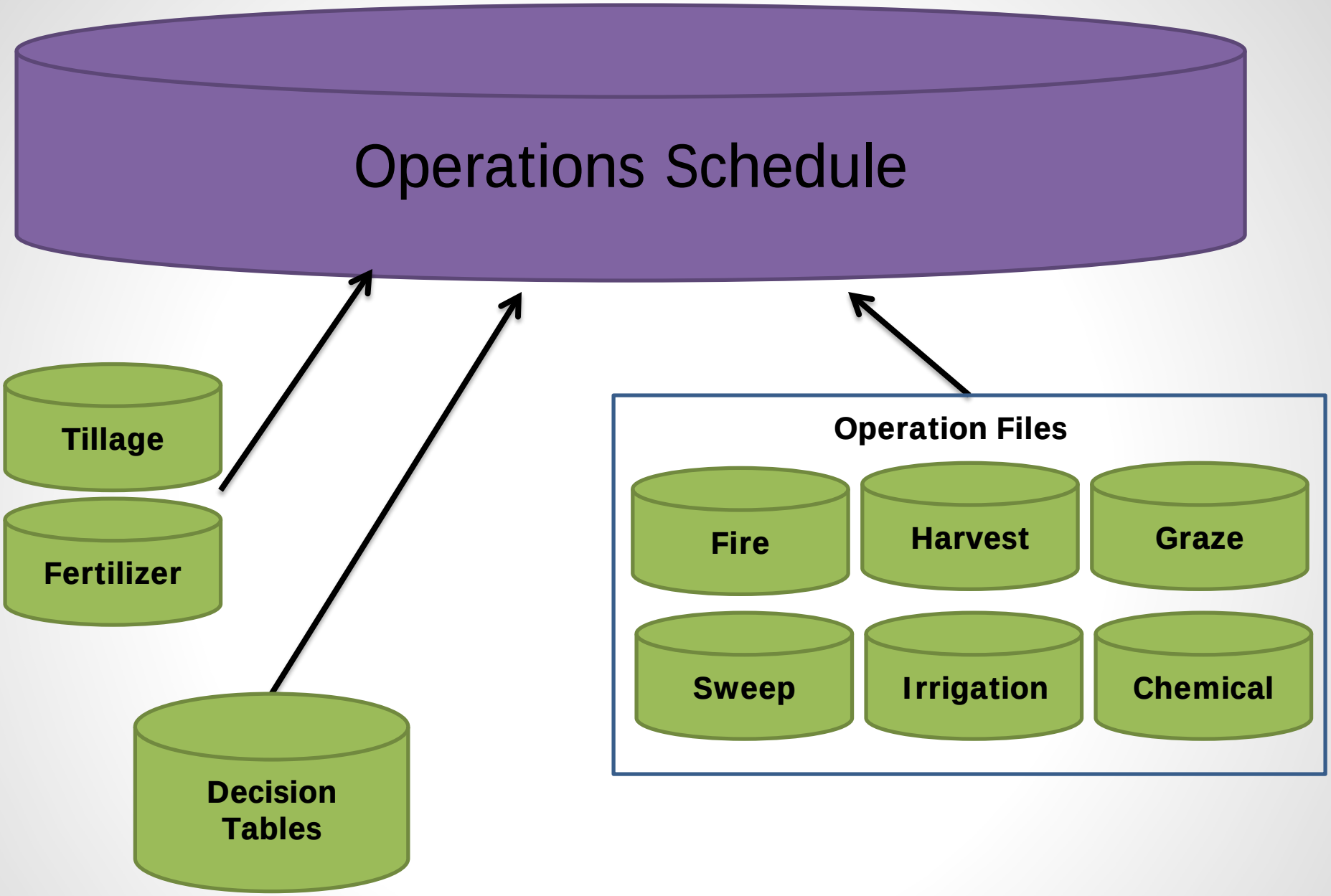
```
LULC_HRU Generated from V:\CEAP\Model_Constructor_Command_Line\HUC8_Models\07100001.accdb Time: 6/20/2017 10:40:28 AM
 LULC_NAME          PCOM_NAME                    MGT_NAME          CN2_NAME        PF_NAME URB_LU          URB_RO       OVN_NAME TILE_NAM
    666077 CORN1500SOYB1200 CORN_SOYB_CMZ_04_MULCH_Dry_5545 RC_SR_CR_G up_down_slope    null          null   chisplow_res       nul
    666078           FESC2100          PAST_CMZ_04__Dry_100085      PAST_G up_down_slope    null          null   bermudagrass       nul
    666079           FESC2100          PAST_CMZ_04__Dry_100085      PAST_G up_down_slope    null          null   bermudagrass       nul
    666080 CORN1500SOYB1200 CORN_SOYB_CMZ_04_MULCH_Dry_5545 RC_SR_CR_G up_down_slope    null          null   chisplow_res       nul
    666081          CORN1500     CORN_CMZ_04_INTENSE_Dry_7811     RC_SR_G up_down_slope    null          null   convtill_res       nul
    666082           FESC2100          PAST_CMZ_04__Dry_100085      PAST_G up_down_slope    null          null   bermudagrass       nul
    666083           FESC2100          PAST_CMZ_04__Dry_100084      PAST_G up_down_slope    null          null   bermudagrass       nul
    666084 SOYB1200CORN1500 SOYB_CORN_CMZ_04_MULCH_Dry_5587 RC_SR_CR_G up_down_slope    null          null   chisplow_res       nul
    666085 SOYB1200CORN1500 SOYB_CORN_CMZ_04_REDUCED_Dry_5547    RC_SR_G up_down_slope    null          null   convtill_res       nul
    666086           FESC2100          PAST_CMZ_04__Dry_100084      PAST_G up_down_slope    null          null   bermudagrass       nul
    666087           FESC2100          PAST_CMZ_04__Dry_100085      PAST_G up_down_slope    null          null   bermudagrass       nul
    666088           FESC2100          PAST_CMZ_04__Dry_100085      PAST_G up_down_slope    null          null   bermudagrass       nul
    666089           WETN1500          WETL_CMZ_04__Dry_100135      FRST_G up_down_slope    null          null   forest_heavy       nul
```

Operations Schedule

management.sch - Notepad

File Edit Format View Help

```
                        MGT_NAME NUMB_OPS NUMB_AUTO AUTO_NAME OP_TYPE   MON   DAY HU_SCH OP_DATA1  OP_DATA2 OP_OVERRIDE
    CORN_SOYB_CMZ_04_MULCH_Dry_5545       18         0      null
                                                                fert     4    28      0        P broadcast    6.828193
                                                                fert     4    28      0        N broadcast        41.6
                                                                till     5     1      0  Nom_mod       null           0
                                                                till     5     1      0 Shal_mod       null           0
                                                                plnt     5     2      0 CORN1500       null           0
                                                                fert     5     3      0        N broadcast        41.6
                                                                fert     5     3      0        P broadcast    6.828193
                                                                kill    10    20      0 CORN1500       null           0
                                                                harv    10    20      0 CORN1500      grain           0
                                                                till    11     1      0  Nom_mod       null           0
                                                                till     5     5      0  Nom_mod       null           0
                                                                till     5    10      0 Shal_mod       null           0
                                                                plnt     5    11      0 SOYB1200       null           0
                                                                fert     5    12      0        N broadcast         4.2
                                                                fert     5    12      0        P broadcast    4.052863
                                                                kill    10    10      0 SOYB1200       null           0
                                                                harv    10    10      0 SOYB1200      grain           0
                                                                skip     0     0      0      null       null           0
CORN_SOYB_CMZ_04_REDUCED_Dry_5513       19         0      null
                                                                till     4    28      0  Nom_mod       null           0
                                                                fert     4    30      0        N broadcast        41.6
```


Operations Schedule
Tillage
Fertilizer
Decision Tables
Operation Files
Fire
Harvest
Graze
Sweep
Irrigation
Chemical

Operations Schedule

management.sch - Notepad

File Edit Format View Help

MGT_NAME	NUMB_OPS	NUMB_AUTO	AUTO_NAME	OP_TYPE	MON	DAY	HU_SCH	OP_DATA1	OP_DATA2	OP_OVERRIDE
CORN_SOYB_CMZ_04_MULCH_Dry_5545	18	0	null							
				fert	4	28	0	P	broadcast	6.828193
				fert	4	28	0	N	broadcast	41.6
				till	5	1	0	Nom_mod	null	0
				till	5	1	0	Shal_mod	null	0
				plnt	5	2	0	CORN1500	null	0
				fert	5	3	0	N	broadcast	41.6
				fert	5	3	0	P	broadcast	6.828193
				kill	10	20	0	CORN1500	null	0
				harv	10	20	0	CORN1500	grain	0
				till	11	1	0	Nom_mod	null	0
				till	5	5	0	Nom_mod	null	0
				till	5	10	0	Shal_mod	null	0
				plnt	5	11	0	SOYB1200	null	0
				fert	5	12	0	N	broadcast	4.2
				fert	5	12	0	P	broadcast	4.052863
				kill	10	10	0	SOYB1200	null	0
				harv	10	10	0	SOYB1200	grain	0
				skip	0	0	0	null	null	0
CORN_SOYB_CMZ_04_REDUCED_Dry_5513	19	0	null							
				till	4	28	0	Nom_mod	null	0
				fert	4	30	0	N	broadcast	41.6

Harvest

harv.ops - Notepad

File Edit Format View Help

HARV_OPS Generated from V:\CEAP\Model_Constructor_Command_Line\

HARV_OP_NAME	HARV_TYPE	HARV_INDEX	HARV_EFF	HARV_BIO_MIN
grain	grain	0	0.95	0
grass_mulch	biomass	0.5	0	2000
grass_bag	biomass	0.5	1	2000
silage	biomass	0.9	0.95	0
forest_cut	tree	0.95	0.99	0
stover_high	residue	0.9	1	1000
stover_med	residue	0.6	1	2000
stover_los	residue	0.3	1	3000
hay_cut_high	biomass	0.8	1	3000
hay_cut_low	biomass	0.8	1	1000
potatoes	tuber	1.1	0.95	0
peanuts	tuber	1.1	0.95	0
vegetables	biomass	0.5	1	2000
orchard	biomass	0.01	1	0

Operations Schedule

management.sch - Notepad

File Edit Format View Help

```
                        MGT_NAME NUMB_OPS NUMB_AUTO AUTO_NAME OP_TYPE   MON   DAY HU_SCH OP_DATA1  OP_DATA2 OP_OVERRIDE
    CORN_SOYB_CMZ_04_MULCH_Dry_5545       18         0      null
                                                                fert      4    28      0        P broadcast    6.828193
                                                                fert      4    28      0        N broadcast        41.6
                                                                till      5     1      0  Nom_mod       null           0
                                                                till      5     1      0 Shal_mod       null           0
                                                                plnt      5     2      0 CORN1500       null           0
                                                                fert      5     3      0        N broadcast        41.6
                                                                fert      5     3      0        P broadcast    6.828193
                                                                kill     10    20      0 CORN1500       null           0
                                                                harv     10    20      0 CORN1500      grain           0
                                                                till     11     1      0  Nom_mod       null           0
                                                                till      5     5      0  Nom_mod       null           0
                                                                till      5    10      0 Shal_mod       null           0
                                                                plnt      5    11      0 SOYB1200       null           0
                                                                fert      5    12      0        N broadcast         4.2
                                                                fert      5    12      0        P broadcast    4.052863
                                                                kill     10    10      0 SOYB1200       null           0
                                                                harv     10    10      0 SOYB1200      grain           0
                                                                skip      0     0      0      null       null           0
    CORN_SOYB_CMZ_04_REDUCED_Dry_5513       19         0      null
                                                                till      4    28      0  Nom_mod       null           0
                                                                fert      4    30      0        N broadcast        41.6
```

fertilizer.frt.txt - Notepad

File Edit Format View Help

```
fertilizer.frt: Fertilizer parameters - Water_LS2_Take2
   FERT_NAME    FR_MINN    FR_MINP    FR_ORGN    FR_ORGP   FR_NH3N    BACT_L
           N      1.000      0.000      0.000      0.000     0.000        0.(
           P      0.000      1.000      0.000      0.000     0.000        0.(
      anh-nh3     0.820      0.000      0.000      0.000     1.000        0.(
        urea      0.460      0.000      0.000      0.000     1.000        0.(
    46-00-00      0.460      0.000      0.000      0.000     0.000        0.(
    33-00-00      0.330      0.000      0.000      0.000     0.000        0.(
    31-13-00      0.310      0.057      0.000      0.000     0.000        0.(
    30-80-00      0.300      0.352      0.000      0.000     0.000        0.(
    30-15-00      0.300      0.066      0.000      0.000     0.000        0.(
    28-10-10      0.280      0.044      0.000      0.000     0.000        0.(
    28-03-00      0.280      0.013      0.000      0.000     0.000        0.(
```

Automatic Operations

- ~~Auto fertilization~~ ~~Auto Irrigate~~
- Decision tables - Far more options

Auto Irrigation

		Rules
Conditions	Soil Water < .75 Field Capacity	TRUE
	PHU_Plant > .95	FALSE
Actions	Irrigate with 50mm	Take Action

Auto Nitrogen Fertilizer

		Rules	
Conditions	Nitrogen Stress > 0.9	TRUE	TRUE
	PHU_Base > .15 (After Planting)	TRUE	FALSE
Actions	Inject Anhydrous Ammonia	-	Take Action
	Sidedress Urea	Take Action	-

Fully Automatic Management

Auto Plant – Corn Soybean Rotation

		Rules	
Conditions	Soil Water < 0.9 Field Capacity	TRUE	TRUE
	PHU_Base > .15	TRUE	TRUE
	Rotation Year 1	TRUE	FALSE
	Rotation Year 2	FALSE	TRUE
Actions	Plant Soybeans	-	Take Action
	Plant Corn	Take Action	-

Auto Harvest

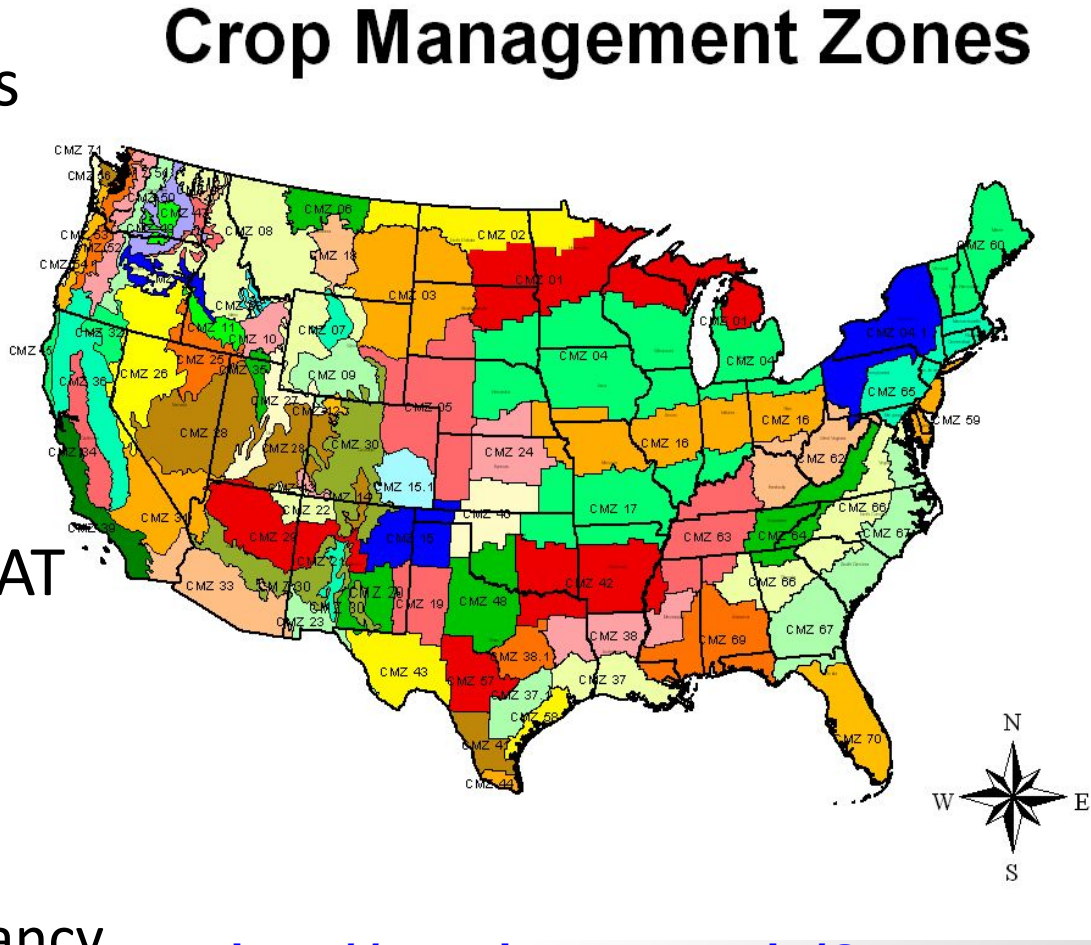
		Rules
Conditions	Soil Water < 0.9 Field Capacity	TRUE
	PHU_Plant > 1.15	TRUE
Actions	Harvest Kill	Take Action

US SWAT Data Sources

- Philosophy with National Assessments
- Release and Publish Data as Developed
  - Management
  - Soils
  - Weather
  - Conservation practices
- Future work
  - Connectivity

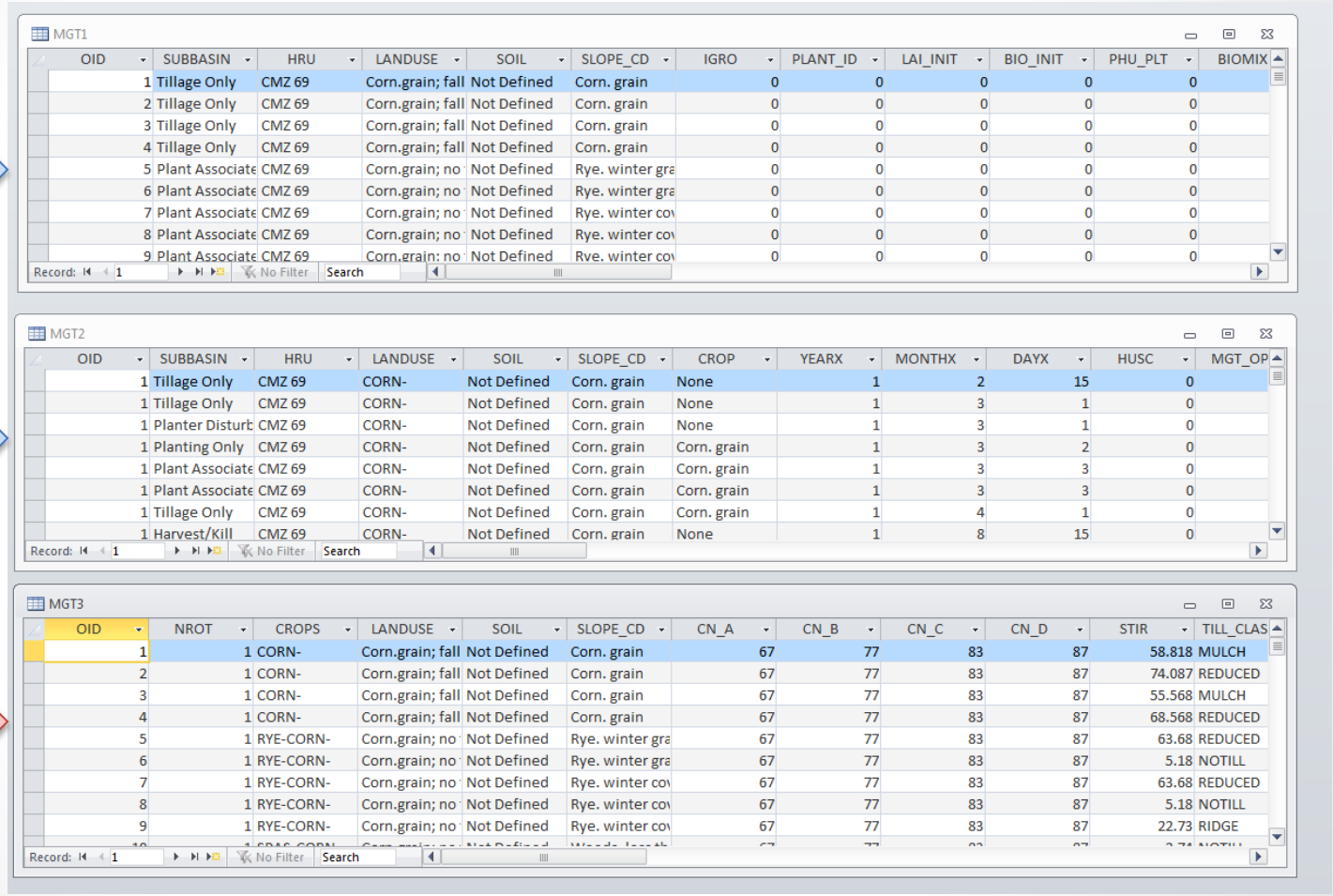
US SWAT Management Database

- 25,000 USDA Templates
  - By CMZ
  - Up to 10 yr rotations
  - With Fertilizer
- Publication in JAWRA
- Data Online
- Used in Large Scale SWAT Assessments
  - HAWQS - USEPA
  - CEAP II – USDA
  - Western Lake Erie - USDA/Nature Conservancy



http://ceap.brc.tamus.edu/Swat

Access Database Organization



MGT1

OID	SUBBASIN	HRU	LANDUSE	SOIL	SLOPE_CD	IGRO	PLANT_ID	LAI_INIT	BIO_INIT	PHU_PLT	BIOMIX
1	Tillage Only	CMZ 69	Corn.grain; fall	Not Defined	Corn. grain	0	0	0	0	0	
2	Tillage Only	CMZ 69	Corn.grain; fall	Not Defined	Corn. grain	0	0	0	0	0	
3	Tillage Only	CMZ 69	Corn.grain; fall	Not Defined	Corn. grain	0	0	0	0	0	
4	Tillage Only	CMZ 69	Corn.grain; fall	Not Defined	Corn. grain	0	0	0	0	0	
5	Plant Associate	CMZ 69	Corn.grain; no	Not Defined	Rye. winter gra	0	0	0	0	0	
6	Plant Associate	CMZ 69	Corn.grain; no	Not Defined	Rye. winter gra	0	0	0	0	0	
7	Plant Associate	CMZ 69	Corn.grain; no	Not Defined	Rye. winter cov	0	0	0	0	0	
8	Plant Associate	CMZ 69	Corn.grain; no	Not Defined	Rye. winter cov	0	0	0	0	0	
9	Plant Associate	CMZ 69	Corn.grain; no	Not Defined	Rye. winter cov	0	0	0	0	0	

MGT2

OID	SUBBASIN	HRU	LANDUSE	SOIL	SLOPE_CD	CROP	YEARX	MONTHX	DAYX	HUSC	MGT_OP
1	Tillage Only	CMZ 69	CORN-	Not Defined	Corn. grain	None	1	2	15	0	
1	Tillage Only	CMZ 69	CORN-	Not Defined	Corn. grain	None	1	3	1	0	
1	Planter Disturb	CMZ 69	CORN-	Not Defined	Corn. grain	None	1	3	1	0	
1	Planting Only	CMZ 69	CORN-	Not Defined	Corn. grain	Corn. grain	1	3	2	0	
1	Plant Associate	CMZ 69	CORN-	Not Defined	Corn. grain	Corn. grain	1	3	3	0	
1	Plant Associate	CMZ 69	CORN-	Not Defined	Corn. grain	Corn. grain	1	3	3	0	
1	Tillage Only	CMZ 69	CORN-	Not Defined	Corn. grain	Corn. grain	1	4	1	0	
1	Harvest/Kill	CMZ 69	CORN-	Not Defined	Corn. grain	None	1	8	15	0	

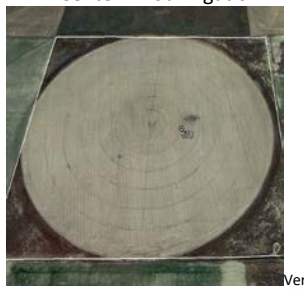
MGT3

OID	NROT	CROPS	LANDUSE	SOIL	SLOPE_CD	CN_A	CN_B	CN_C	CN_D	STIR	TILL_CLAS
1	1	CORN-	Corn.grain; fall	Not Defined	Corn. grain	67	77	83	87	58.818	MULCH
2	1	CORN-	Corn.grain; fall	Not Defined	Corn. grain	67	77	83	87	74.087	REDUCED
3	1	CORN-	Corn.grain; fall	Not Defined	Corn. grain	67	77	83	87	55.568	MULCH
4	1	CORN-	Corn.grain; fall	Not Defined	Corn. grain	67	77	83	87	68.568	REDUCED
5	1	RYE-CORN-	Corn.grain; no	Not Defined	Rye. winter gra	67	77	83	87	63.68	REDUCED
6	1	RYE-CORN-	Corn.grain; no	Not Defined	Rye. winter gra	67	77	83	87	5.18	NOTILL
7	1	RYE-CORN-	Corn.grain; no	Not Defined	Rye. winter cov	67	77	83	87	63.68	REDUCED
8	1	RYE-CORN-	Corn.grain; no	Not Defined	Rye. winter cov	67	77	83	87	5.18	NOTILL
9	1	RYE-CORN-	Corn.grain; no	Not Defined	Rye. winter cov	67	77	83	87	22.73	RIDGE

Conversion to SWAT to SWAT+ Format in Progress

Structural Conservation From Google Earth

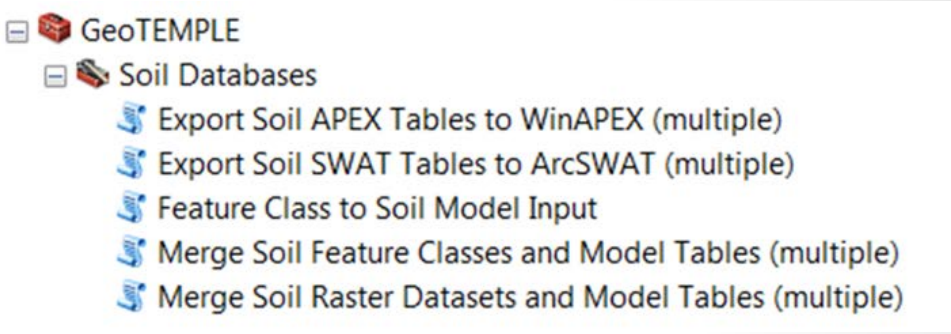
- 13,500 fields manually surveyed
- Identified visible conservation
- Multi-year imagery
- Field boundaries
- Details in JAWRA

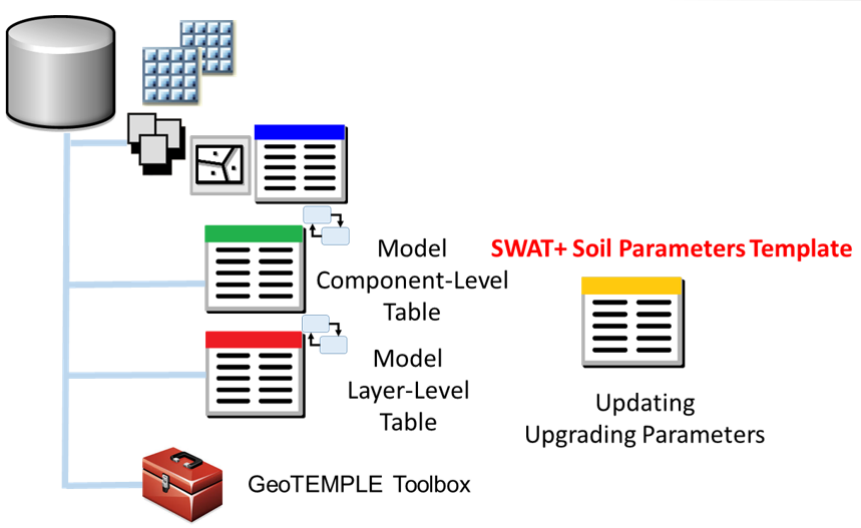
Terraces	Waterways	Filter Strip/Field Borders
		
Roughly parallel lines, running cross slope, sometimes accompanied by shadows. Terraces follow contour lines and are usually accompanied by contour planting. The distance between terraces is related to field slope. Terraces are permanent and are generally visible in multiple past images.	• Strips of grass following field drainage. usually they have a strong color contrast as compared to the crop area. Waterways generally appear green, but may vary depending on season. Waterways are generally visible in past images.	A strip of grass that borders one or more sides of a field, a stream. The strip or border is generally uniform in thickness and much wider than a waterway. The filter stips are almost always a shade of green in one or more past images.
Contour Planting	**Center Pivot Irrigation**	**Strip Crops**
		
The implement marks follow contour lines and share the same patterns as seen on topographical maps. Practice is most often associated with terraces, but may be found singularly.	Very clear and distinct lines that form a circular pattern. Most fields with a center pivot are fully circular, but half and quarter coverages are common. The center pivot itself is often visible.	Crops grown in alternating strips, which can be easily distinguished from aerial photography due to the contrast may not be present in past images, so the most recent image is used to make the final determination.

Data Online:
https://nlet.brc.tamus.edu/Home/Conservation

US Seamless Soils Data

- SSURGO + DGSM
- Data + Processing Tools
- Developer - Mauro DiLuzio
- Published
  - Journal of Geographic Information System International
  - Journal of Geospatial and Environmental Research

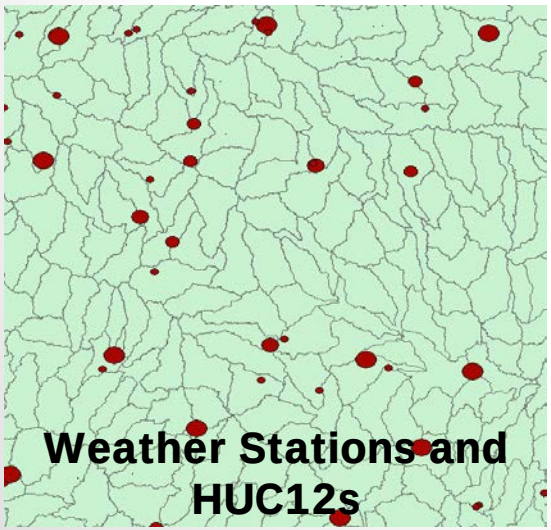




Data Online:
http://soilandwaterhub.azurewebsites.net/

Station Based Climate Data

- Precipitation, Temperature, Wind
- 20,000 + Stations
- SWAT, ArcSWAT, and APEX formats
- Patched nearly seamless (1950-2016)
- Details Published in Water



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Thank You

mike.white@ars.usda.gov