

# Application of New Tools and Technology in HEL Compliance

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11 February 2015

# Highly Erodible Land Conservation Compliance Provisions

## Overview:

Highly Erodible Land Conservation (HELC) and Wetland Conservation (WC) provisions aim to reduce soil loss on erosion-prone lands and to protect wetlands for the multiple benefits they provide. HELC and WC provisions apply to all land that is considered highly erodible or a wetland, and that is owned or farmed by persons voluntarily participating in USDA programs, unless USDA determines an exemption applies.

# Presentation Objectives

- \* Brief review of Highly Erodible Land Conservation and Wetland Conservation program provisions
- \* Review definitions of HEL
- \* Review tools for HEL determination and compliance

# Conservation Programs and HEL

Producers, and any affiliated individuals or entities who participate in most programs administered by the Farm Service Agency (FSA), the Natural Resources Conservation Service (NRCS), and the Risk Management Agency (RMA) are required to comply with these provisions. Non-compliance may affect the following types of USDA program benefits:

- FSA loans and disaster assistance payments
- NRCS and FSA conservation program benefits
- Federal crop insurance premium subsidies

## Highly Erodible Land

Highly erodible land is any land that can erode at excessive rates because of its soil properties. Highly erodible land is designated by field and based on the proportion of the total field acreage that contains highly erodible soils.

Producers participating in USDA conservation programs who produce agricultural commodities on land identified as highly erodible are required to farm such land in accordance with a conservation plan or system that is approved by NRCS and that substantially reduces soil loss.

Producing agricultural commodities on highly erodible land that has no crop history prior to Dec. 23, 1985, (Sodbusting) are required to farm such land in accordance with a conservation plan or system that provides for no substantial increase in soil erosion. A conservation plan or system to reduce soil erosion is not required for land that is not highly erodible.

## Highly Erodible Land and Wetland Conservation

### **When did Highly Erodible Land (HEL) and Wetland Conservation (WC) Compliance become law and what is its purpose?**

- \* The 1985 Farm Bill included conservation compliance requirements for HEL and WC for farmers who utilize certain USDA benefits.
- \* To reduce soil erosion, protect the fertility of agricultural land, protect water quality and to preserve the functions of the nation's wetlands.

## How does compliance with HEL and WC provisions affect USDA program eligibility?

- \* CRP, CCRP, CREP, DCP, EQIP, WHIP, CSP, WRP, GRP, FRPP and now RMA crop insurance premium subsidies require compliance with the HEL WC

# Wetlands

- Has a predominance of hydric soils (wet soils);
- Is inundated or saturated by surface or groundwater (hydrology) at a frequency and duration sufficient to support a prevalence of hydrophytic (water tolerant) vegetation typically adapted for life in saturated soil conditions and;
- Under normal circumstances supports a prevalence of such vegetation except that this term does not include lands in Alaska identified as having a high potential for agricultural development and a predominance of permafrost soils.

# NFSAM 512.0 (c)

(2) The conservation system shall include all treatments and measures needed to meet the HELC requirements, including treatment required —

- To result in a substantial reduction in erosion.
- To prohibit a substantial increase in erosion.
- For the control of —
  - Sheet and rill erosion
  - Wind erosion
  - Ephemeral gully erosion

# NRCS Role in Making HEL Determinations

When making HELC and WC compliance determinations, NRCS responsibilities for HELC include:

- Making highly erodible determinations;
- Working with producers to develop conservation plans and systems; and
- When required, determining if highly erodible land is being farmed in accordance with a conservation plan or system approved by NRCS.

For WC compliance:

- Making wetland determinations, including establishing if certain technical exemptions apply, such as prior converted cropland; and
- Determining if a wetland conversion has occurred.

# Highly Erodible Land and Wetland Identification

- \* FSA maintains the official USDA records of highly erodible land and wetland determinations. The determinations are recorded within a GIS and the automated farm and tract records maintained by FSA
- \* FSA, determinations may not include all of the producer's land. In addition, if a producer is uncertain about highly erodible land and wetland determinations during the NRCS planning process, specialized determinations will need to be conducted.

# Tools for determining HEL

## **Land Capability Classification System (Historic Tool)**

- \* Land Capability Classification System is defined as “a system of grouping soils primarily on the basis of their capability to produce common cultivated crops and pasture plants without deteriorating over a long period of time. Land capability classification is subdivided into capability class and capability subclass”

# Land Capability Classification System (Historic Tool)

Some of the assumptions for grouping soils into capability classes are:

- \* Assumes high level of management.
- \* Limitations such as presence of surface standing water or excess water within the soil; droughty conditions, lack of water for adequate crop production; presence of stones; and presence of soluble salts or exchangeable sodium, or both.

A “capability class is the broadest category in the land capability classification system. Class codes I (1), II (2), III (3), IV (4), V (5), VI (6), VII (7), and VIII (8) are used to represent both irrigated and nonirrigated land capability classes”

## Classes and definitions

- \* *Class I (1)* soils have slight limitations that restrict their use.
- \* *Class II (2)* soils have moderate limitations that reduce the choice of plants or require moderate conservation practices.
- \* *Class III (3)* soils have severe limitations that reduce the choice of plants or require special conservation practices, or both.
- \* *Class IV (4)* soils have very severe limitations that restrict the choice of plants or require very careful management, or both.
- \* *Class V (5)* soils have little or no hazard of erosion but have other limitations, impractical to remove, that limit their use mainly to pasture, range, forestland, or wildlife food and cover.
- \* *Class VI (6)* soils have severe limitations that make them generally unsuited to cultivation and that limit their use mainly to pasture, range, forestland, or wildlife food and cover.
- \* *Class VII (7)* soils have very severe limitations that make them unsuited to cultivation and that restrict their use mainly to grazing, forestland, or wildlife.
- \* *Class VIII (8)* soils and miscellaneous areas have limitations that preclude their use for commercial plant production and limit their use to recreation, wildlife, or water supply or for esthetic purposes.

## NEW TOOLS:

### USDA-ARS Water Erosion Prediction Project (WEPP). Next Generation Physically Based Cropland Hydrology and Erosion Tool

**Current Version - August 30, 2012 - WEPP Windows interface, model and data (28.5mb)**

WEPP Model Version 2012.8

Windows Interface

CLIGEN version 4.3 and 5.3 with climate data for 2600 US stations.

WEPP soil archives for US with data for about 20000 WEPP soils.

Sample crops, operations, managements

Forest landuse management files.

Compatible with GeoWEPP.

[Click here to download WEPP Version 2012.8](#)

The Water Erosion Prediction Project (WEPP) model is a process-based, distributed parameter, continuous simulation, erosion prediction model for use on personal computers running Windows 95/98/NT/2000/XP/Vista/Windows7.

## Continuous Corn 2 to 6 to 3 % slope

missouri corn example

Region Info

Example hillslope in Missouri

Slope File:

example1

Climate File:

missouri example

State: MO

Station: JEFF CITY RADIO KWS MO

Manager  
Slope  
Soil

JEFF CITY RADIO KWS MO



Climate

1 Year Simulation	Value	Units
Average Annual Precipitation	39.61	in
Average Annual Runoff	4.22	in
Average Annual Soil Loss	8.432	ton/A
Average Annual Sediment Yield	8.432	ton/A

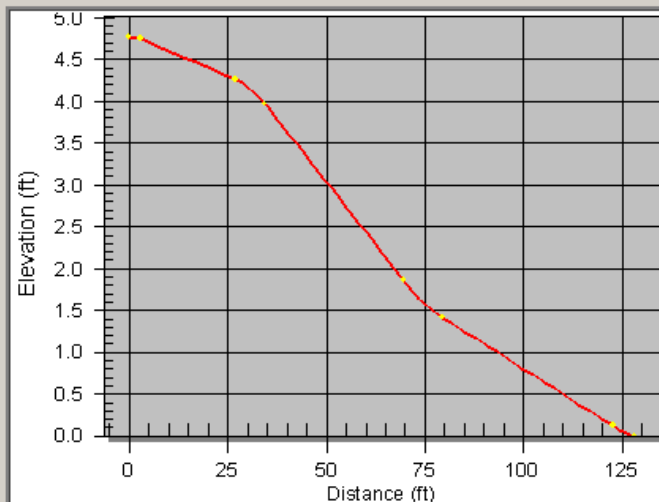
Hydrology and Erosion Output

In the Hillslope Interface, the user must enter as a minimum the 4 basic WEPP input files: Climate, Management, Slope, and Soil.

continuous corn - spring chisel system

128.0

Feet



Segmt	Length (ft)	Slope(%)
1	30.007	2.00
2	44.006	6.00
3	54.006	3.00
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		

Units

 English
  Metric

Advanced

PreView

SaveAs

Save

Cancel

Help



# Continuous corn no-till



**missouri corn example**

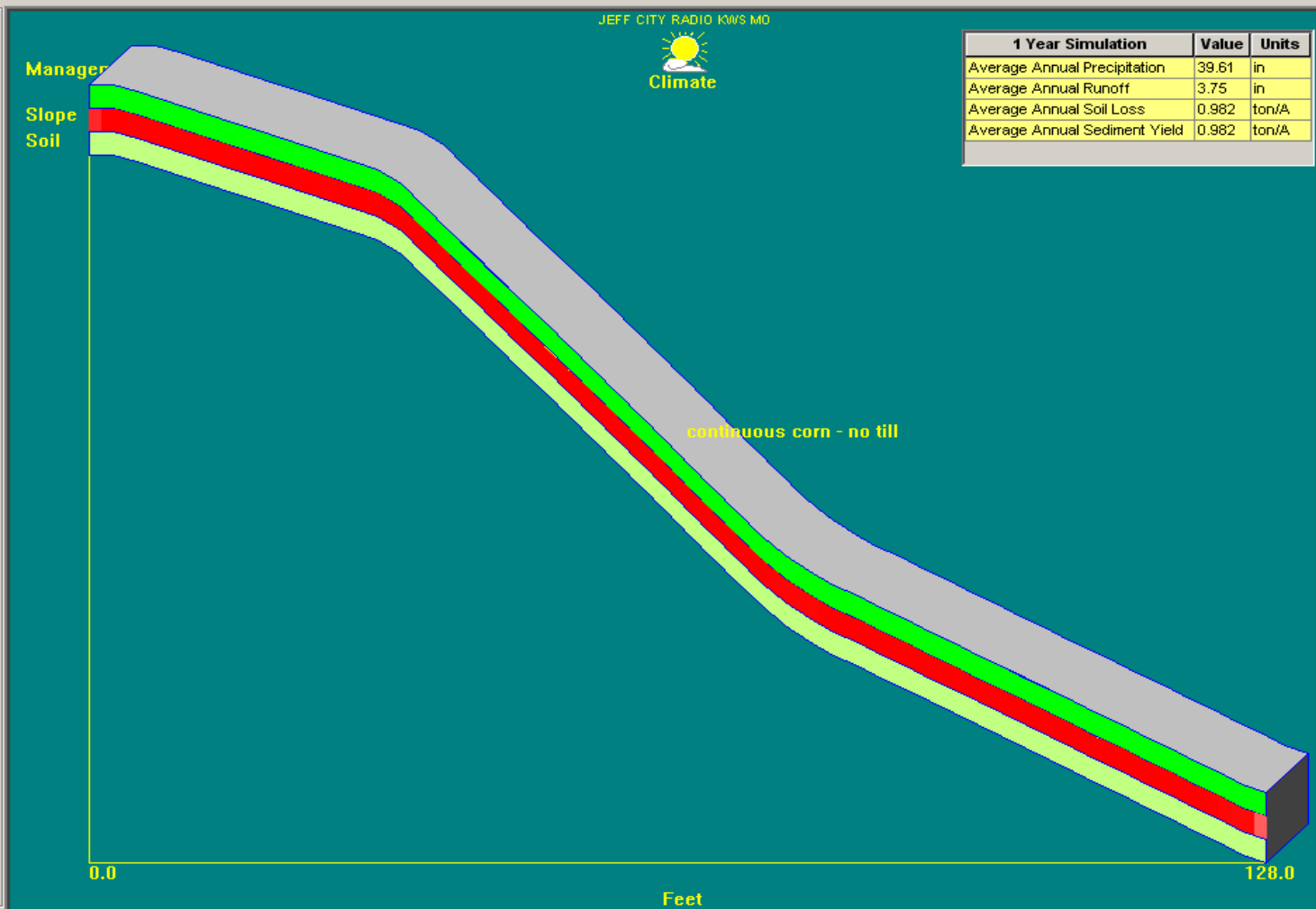
Region Info

Example hillslope in Missouri

Slope File: example1

Climate File: missouri example

State: MO  
Station: JEFF CITY RADIO KWS MO

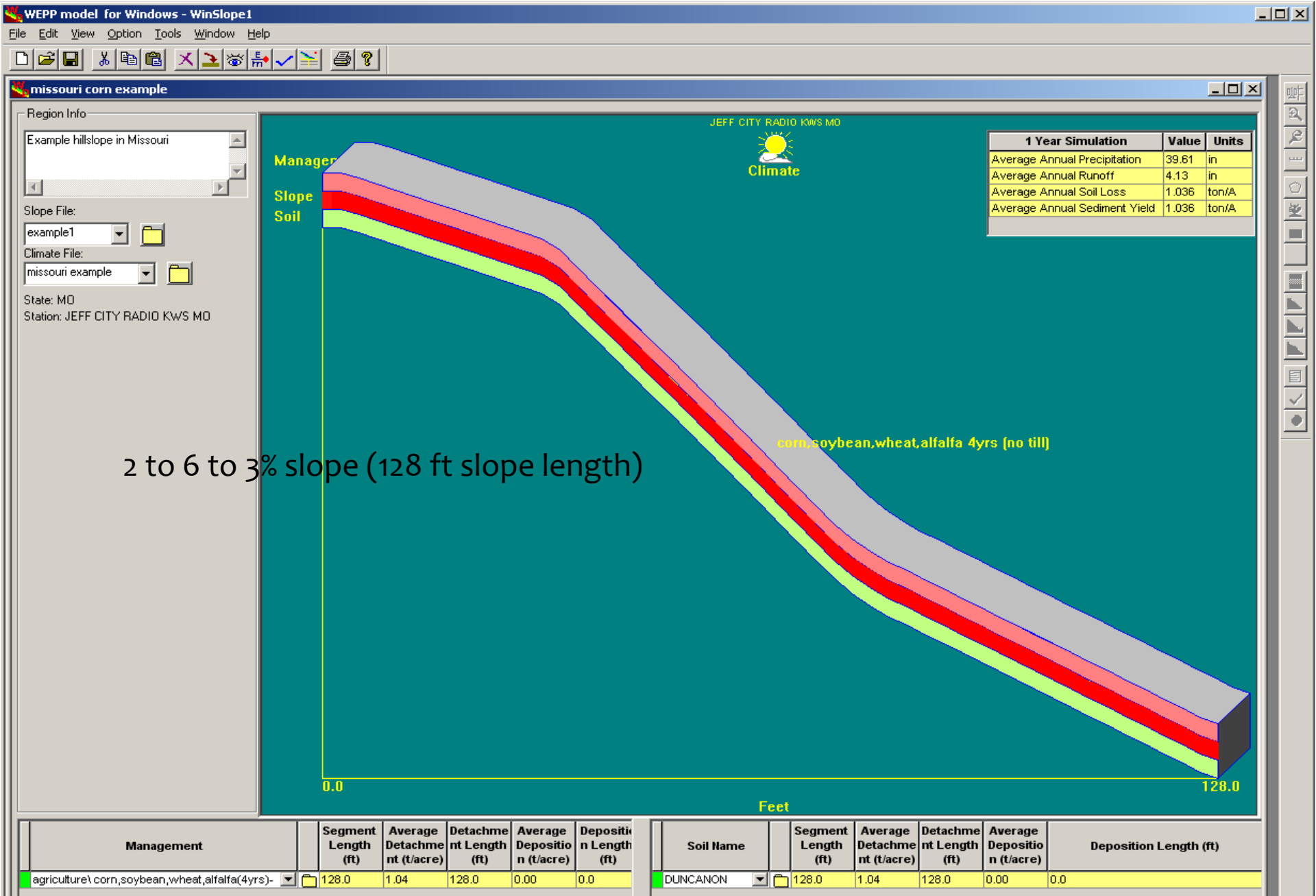


1 Year Simulation	Value	Units
Average Annual Precipitation	39.61	in
Average Annual Runoff	3.75	in
Average Annual Soil Loss	0.982	ton/A
Average Annual Sediment Yield	0.982	ton/A

Management	Segment Length (ft)	Average Detachment (t/acre)	Detachment Length (ft)	Average Deposition (t/acre)	Deposition Length (ft)
agriculture\corn-no till	128.0	0.98	128.0	0.00	0.0

Soil Name	Segment Length (ft)	Average Detachment (t/acre)	Detachment Length (ft)	Average Deposition (t/acre)	Deposition Length (ft)
DUNCANON	128.0	0.98	128.0	0.00	0.0

Soil Loss Graph Graphical Output Return Periods Text Output Run Options Run



Corn, Soybean, Wheat, Alfalfa (4yrs) no-till

# Remote Evaluation of HEL Compliance Tracts

- Sheet & Rill Erosion
- Ephemeral Gully Erosion

## **RUSLE 2 Technology**

RUSLE2 was developed primarily to guide conservation planning, inventory erosion rates and estimate sediment delivery. Values computed by RUSLE2 are supported by accepted scientific knowledge and technical judgment, are consistent with sound principles of conservation planning, and result in good conservation plans. RUSLE2 has a new, modern graphical user interface. It makes the model easy to use, but is extremely powerful in the information that it displays and the types of situations that it can represent.

# NFSAM

- \* **512.2 Determining Systems Based on RUSLE Technology**
- \* A. RUSLE and Previously Approved Conservation Systems
- \* (1) The soil loss levels for conservation systems developed using other sheet and rill erosion soil loss prediction technology, as documented in the FOTG for HELC purposes, will be recalculated using the current version of RUSLE to establish the new soil loss value for the conservation system.
- \* (2) USLE factor values must not be used in RUSLE calculations; RUSLE estimates must not be compared to USLE estimates.
- \* (3) RUSLE soil-loss estimates must be used to make comparisons with actual RUSLE soil losses determined during a conservation system review or a Compliance Status Review. (See NFSAM, Part 518)
- \* (4) Where maximum USLE or RUSLE<sub>1</sub> CP values have been used to establish an acceptable HEL conservation system, a corresponding current version of RUSLE soil loss must be established for the same system.
- \* (5) All new conservation systems will be developed and/or evaluated using the current version of RUSLE.

# RUSLE2 Inputs

- \* Climate
- \* Management
  - \* Cropping History
  - \* Crop Yields
  - \* Tillage Information
  - \* Row Grade
  - \* Structural Practices
- \* Slope – Percent & Length
- \* Soil

# RUSLE<sub>2</sub>

## Inputs:

<i>Location</i>	<i>Soil</i>	<i>Slope length (horiz)</i>	<i>Avg. slope steepness, %</i>
USA\Missouri\Johnson County	Johnson County, Missouri\40094 Summit silty clay loam, 5 to 9 percent slopes, eroded\Summit silty clay loam 94%	170	5.0

<i>Management</i>	<i>Vegetation</i>	<i>Yield units</i>	<i># yield units, #/ac</i>
managements\CMZ 16\c.Other Local Mgt Records\t1888 f2 3 corn bean 10-2-14	vegetations\Corn, grain	bushels	128.00
managements\CMZ 16\c.Other Local Mgt Records\t1888 f2 3 corn bean 10-2-14	vegetations\Soybean, mw 15 - 20 in rows	bu	38.000

<i>Contouring</i>	<i>Strips/barriers</i>	<i>Diversion/terrace, sediment basin</i>	<i>Subsurface drainage</i>	<i>Adjust res. burial level</i>	<i>General yield level</i>	<i>Rock cover, %</i>
e. relative row grade 50 percent of slope grade	(none)	(none)	(none)	Normal res. burial	Set by user	0

## Outputs:

<i>T value</i>	<i>Soil loss erod. portion</i>	<i>Detachment on slope</i>	<i>Soil loss for cons. plan</i>	<i>Sediment delivery</i>	<i>Net C factor</i>	<i>Net K factor</i>	<i>Crit. slope length</i>	<i>Surf. cover after planting, %</i>
5.0	9.7	9.7	9.7	9.7	0.17	0.34	170	

# Data Requirements – for each compliance tract

- \* High resolution digital elevation models (e.g. 1m DEM derived from Q3 or better LiDAR data) to produce average field slopes, slope length, contours and hillshades
- \* SSURGO soils summarized by field to determine representative K and T values
- \* High-resolution aerial imagery (3-6in pixels) for assessing ephemeral gullying, tillage and residue
- \* Traditional crop history and tillage data (from FSA case files)

# Tools for RUSLE2 Calculations

- \* Cropping History, Crop Yields & Tillage Information
  - \* FSA-578
  - \* Tillage Information Worksheet

FSA-578 (02-01-91)

REPORT OF COMMODITIES

PROGRAM YEAR 2010

FARM NUMBER: [REDACTED]

FARM AND TRACT DETAIL LISTING

DATE: 07-29-2010

Operator Name and Address

[REDACTED]  
[REDACTED]

Original: \_\_\_\_\_

Revision: \_\_\_\_\_

Cropland: 114.0

Farmland: 170.0

Tract Number	CLU/Field	C/C	Var/Type	Irr/Prc	Int Use	Lnd Use	C/C Stat	Rpt Unt	Reported Quantity	Determined Quantity	Crp Lnd	O/M	Planting Date
[REDACTED]	1	CORN	YEL	Ni	Grain		I	A	3.67		Y		04-20-2010
			Producer	[REDACTED]					Share 1.0000	RMA Unit			Opt Unit
	2	CORN	YEL	Ni	Grain		I	A	5.50		Y		04-20-2010
			Producer	[REDACTED]					Share 1.0000	RMA Unit			Opt Unit
	3	CORN	YEL	Ni	Grain		I	A	35.76		Y		04-20-2010
			Producer	[REDACTED]					Share 1.0000	RMA Unit			Opt Unit
	4	CORN	YEL	Ni	Grain		I	A	42.33		Y		04-20-2010
			Producer	[REDACTED]					Share 1.0000	RMA Unit			Opt Unit
	5	CORN	YEL	Ni	Grain		I	A	16.94		Y		04-20-2010
			Producer	[REDACTED]					Share 1.0000	RMA Unit			Opt Unit
	7	CORN	YEL	Ni	Grain		I	A	1.75		Y		04-20-2010
			Producer	[REDACTED]					Share 1.0000	RMA Unit			Opt Unit
	11	CORN	YEL	Ni	Grain		I	A	8.05		Y		04-20-2010
			Producer	[REDACTED]					Share 1.0000	RMA Unit			Opt Unit

THOMPSON RD

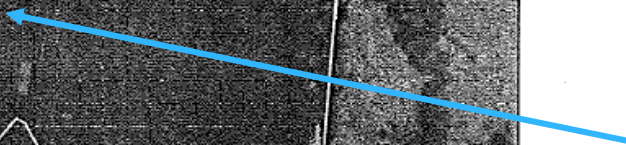
1  
32.54  
NHEL

4  
75.91  
HEL

11  
1.43

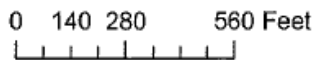
Crop History  
Designations on  
Aerial Photocopy

Crop Designation  
with Date  
Planted



Prepared by Johnson County FSA

Date printed: March 11, 2008



Crop Year: 2011  
Legend



## Tillage Information Worksheet

County:	Tract Number:	Farm Number:	Operator Name:	Date:
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Please complete this worksheet by providing the tillage, planting practices, and crop rotation used on the crop fields within the tract identified. We are asking that you complete this information for the 2010-2014 crop years. See the example given for the type of information to be included. Similar managed fields can be grouped together. The more accurate and complete information you provide, the better we will be able to service this request. Return in the self addressed stamped envelope upon completion.

Y	Crop	Field(s) #	Tillage Implement Used	# of Times Used	Date Used	Planter/Drill Type	Date Planted	Width of Rows Planted	Date Harvested	Ave Yield for Crop Type	Comments
<b>Example</b>											
2014	corn	1, 2, 5, 6	Field Cultivator	1	11/1/2013						
			Kelly Diamond Harrow	1	4/30/2014	Kinze Split Row Planter	5/1/2013	30	10/30/2013	130 bu/ac	
2014	CORN	1,2,3,4,5,11	Field <sup>row</sup> Cultivator	1	5-6-14	case split row planter	5-6-14	30			



# Tools for RUSLE2 Calculations

- \* Slope & Slope Length, Row Grade & Physical Practices
  - \* LiDAR – hillshades & contours
  - \* High Resolution Aerial Photography

# Data Preparation

- \* Selected compliance tracts were pulled from county CLU layers. NRCS FO staff worked with FSA to insure HEL field status attributes were current in the CLU.
- \* Aerial photography footprint polygons were made from geographic extents of selected CLU tracts and provided to the aerial photography contractor.

# About Photography Contracting

- \* *USACE-St. Louis Center of Expertise for Photographic Mapping* maintains ID/IQ contracts with pre-qualified firms and purchasing capacity and will serve as Contract Manager for a small service fee. Working through them greatly facilitated contracting for the imagery.
- \* Photography timing – after spring field work and before crop canopies the ground. Contractor needs to allow NRCS to make the “go-no go” call on flights based on field conditions.
- \* Ground truthing – timing as close to aerial flight as possible

# Preparation Notes

- \* LiDAR DEMs were used to calculate average slope percent by field and generate 1 foot contours and hillshade relief maps for each tract
- \* Soils were quantified (map unit %) by field.
- \* Folder structure and file naming conventions were consistent to assist evaluators

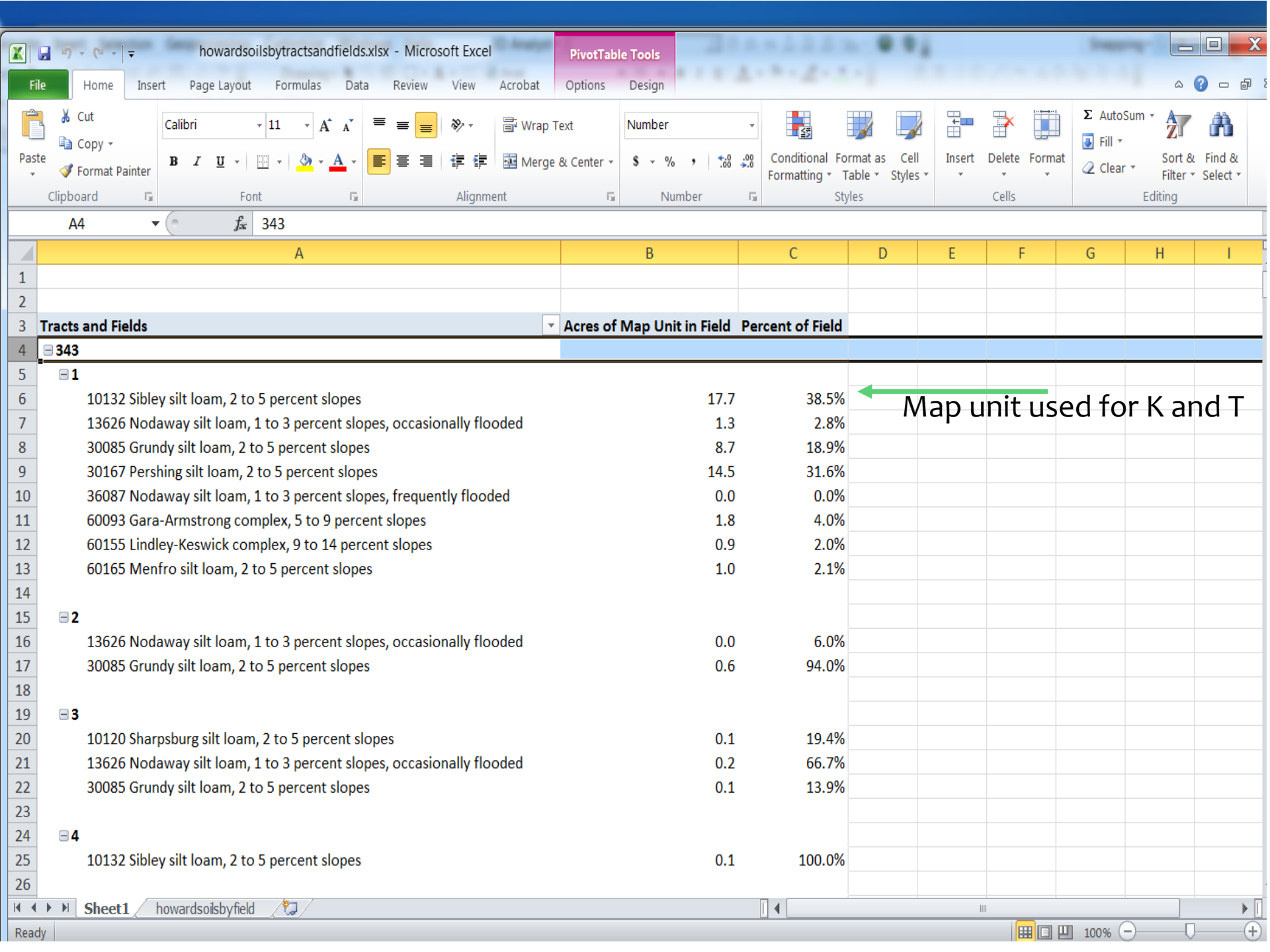
# Example of Products

## T1169

- \* ***t1169.shp*** – polygon shapefile with fields of t1169, from CLU
- \* ***t1169hs.img*** – hillshade raster produced from the LiDAR-derived digital elevation model (DEM) covering the tract
- \* ***t1169slope.img*** – percent slope raster calculated from DEM covering the tract
- \* ***t1169slopebyfield*** – table with mean slope by field (CLUNBR) for the tract
- \* ***089-t1169.tif*** – county FIPS, Tract file of aerial imagery

# Soils Summary Table

- \* For each county, an Excel spreadsheet pivot table has been made to summarize soils by tract and by field. They are named <countyname>soilsbytractsandfields.xlsx
- \* Ex. ***howardsoilbytractsandfields.xlsx***



File Home Insert Page Layout Formulas Data Review View Acrobat Options Design

Clipboard Font Alignment Number Styles Cells Editing

Calibri 11 Wrap Text Merge & Center Number \$ % .00 .00 Conditional Formatting Format as Table Cell Styles Insert Delete Format AutoSum Fill Clear Sort & Filter Find & Select

A4 343

	A	B	C	D	E	F	G	H	I
1									
2									
3	<b>Tracts and Fields</b>	<b>Acres of Map Unit in Field</b>	<b>Percent of Field</b>						
4	<b>343</b>								
5	<b>1</b>								
6	10132 Sibley silt loam, 2 to 5 percent slopes	17.7	38.5%						
7	13626 Nodaway silt loam, 1 to 3 percent slopes, occasionally flooded	1.3	2.8%						
8	30085 Grundy silt loam, 2 to 5 percent slopes	8.7	18.9%						
9	30167 Pershing silt loam, 2 to 5 percent slopes	14.5	31.6%						
10	36087 Nodaway silt loam, 1 to 3 percent slopes, frequently flooded	0.0	0.0%						
11	60093 Gara-Armstrong complex, 5 to 9 percent slopes	1.8	4.0%						
12	60155 Lindley-Keswick complex, 9 to 14 percent slopes	0.9	2.0%						
13	60165 Menfro silt loam, 2 to 5 percent slopes	1.0	2.1%						
14									
15	<b>2</b>								
16	13626 Nodaway silt loam, 1 to 3 percent slopes, occasionally flooded	0.0	6.0%						
17	30085 Grundy silt loam, 2 to 5 percent slopes	0.6	94.0%						
18									
19	<b>3</b>								
20	10120 Sharpsburg silt loam, 2 to 5 percent slopes	0.1	19.4%						
21	13626 Nodaway silt loam, 1 to 3 percent slopes, occasionally flooded	0.2	66.7%						
22	30085 Grundy silt loam, 2 to 5 percent slopes	0.1	13.9%						
23									
24	<b>4</b>								
25	10132 Sibley silt loam, 2 to 5 percent slopes	0.1	100.0%						
26									

Map unit used for K and T

Table Of Contents

- Layers
  - t1689\_contours
  - howardclussandsoils
  - t1689
  - 089-1689.tif**
    - RGB
      - Red: Band\_1
      - Green: Band\_2
      - Blue: Band\_3
  - NAIP\MO
    - RGB
      - Red: Band\_1
      - Green: Band\_2
      - Blue: Band\_3
  - t1689hs.img
    - Value
      - High : 254
      - Low : 0
  - t1689slope.img
    - Value
      - High : 72.5662
      - Low : 0

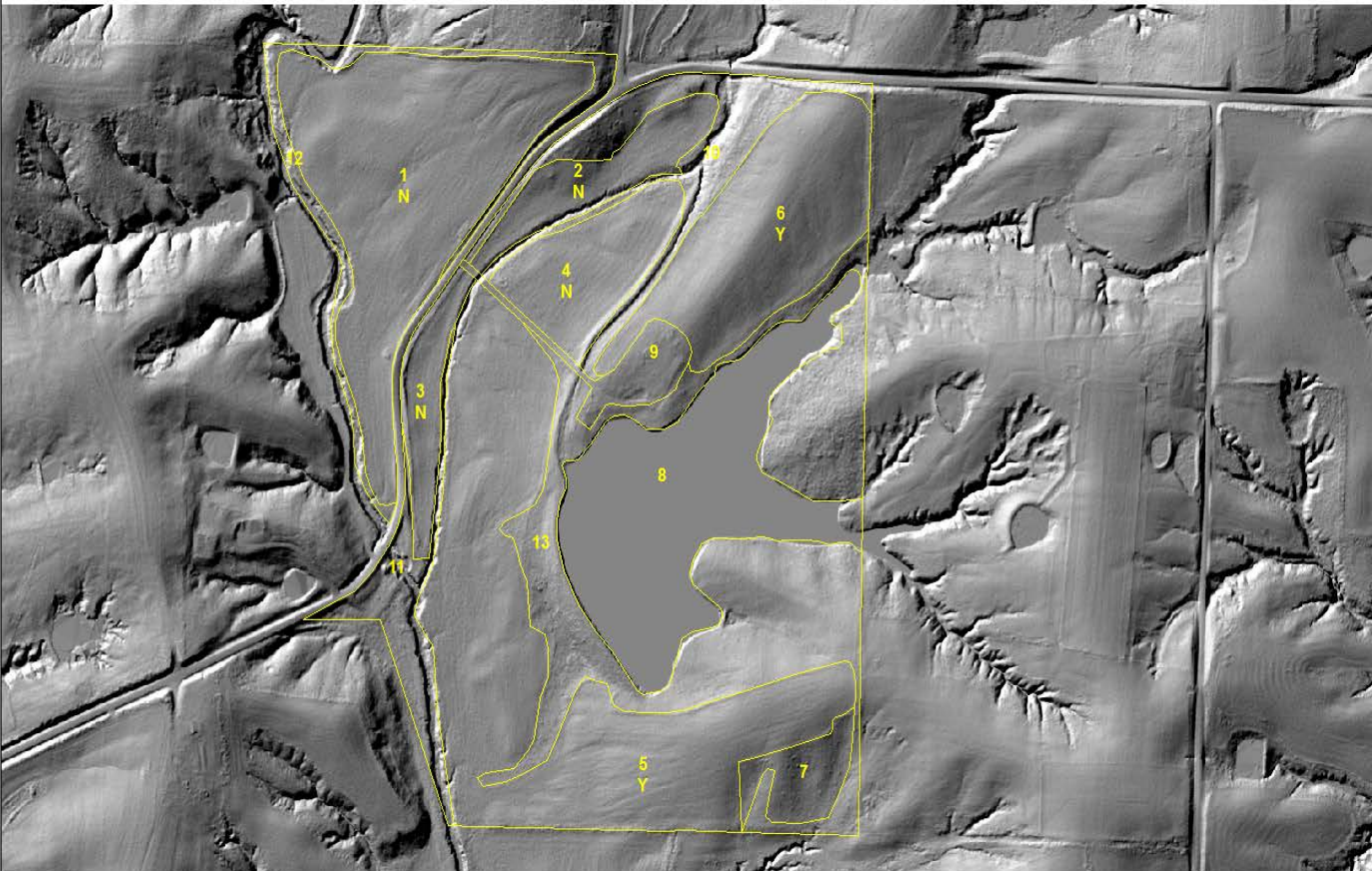


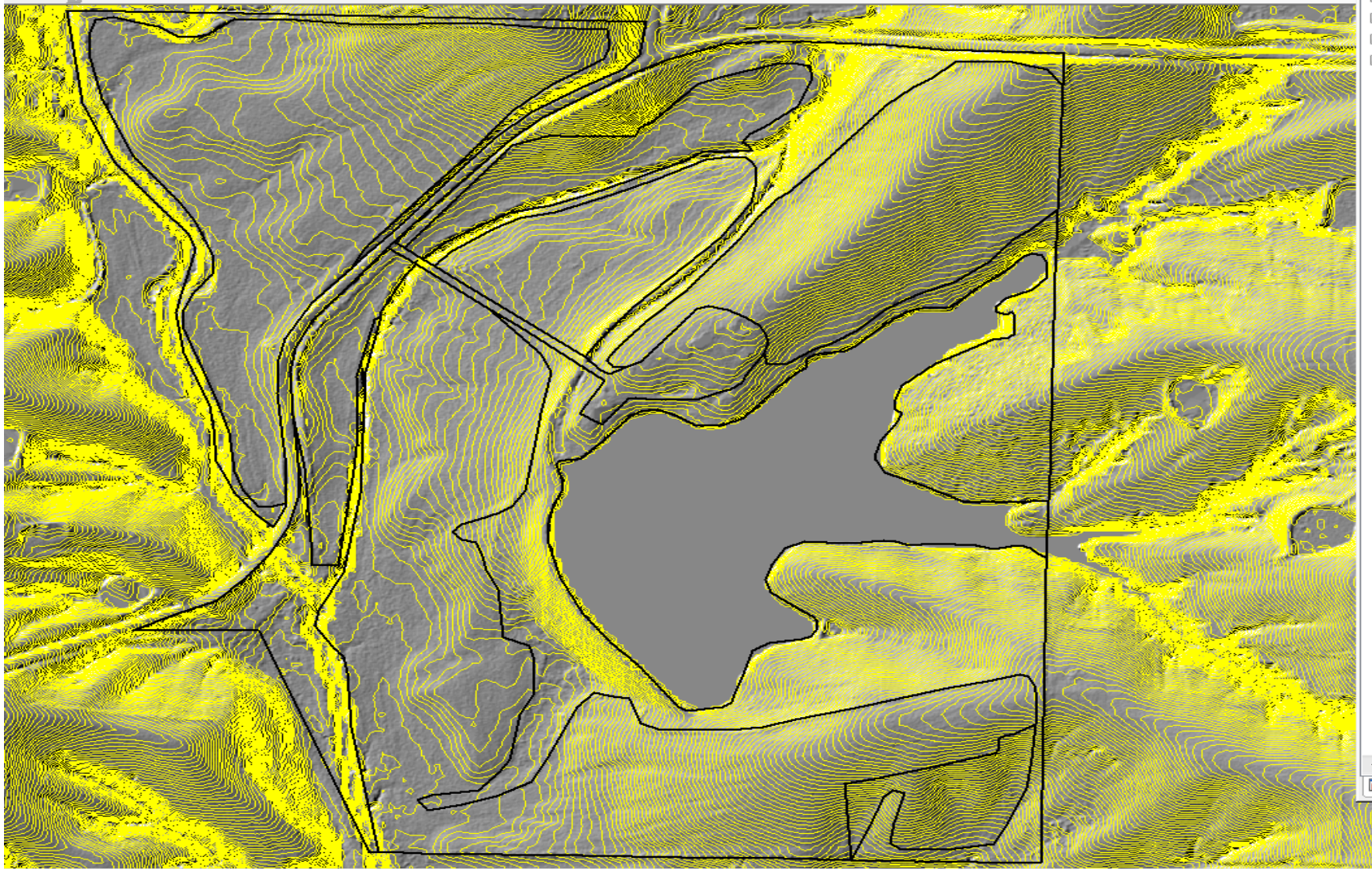
# Shapefiles

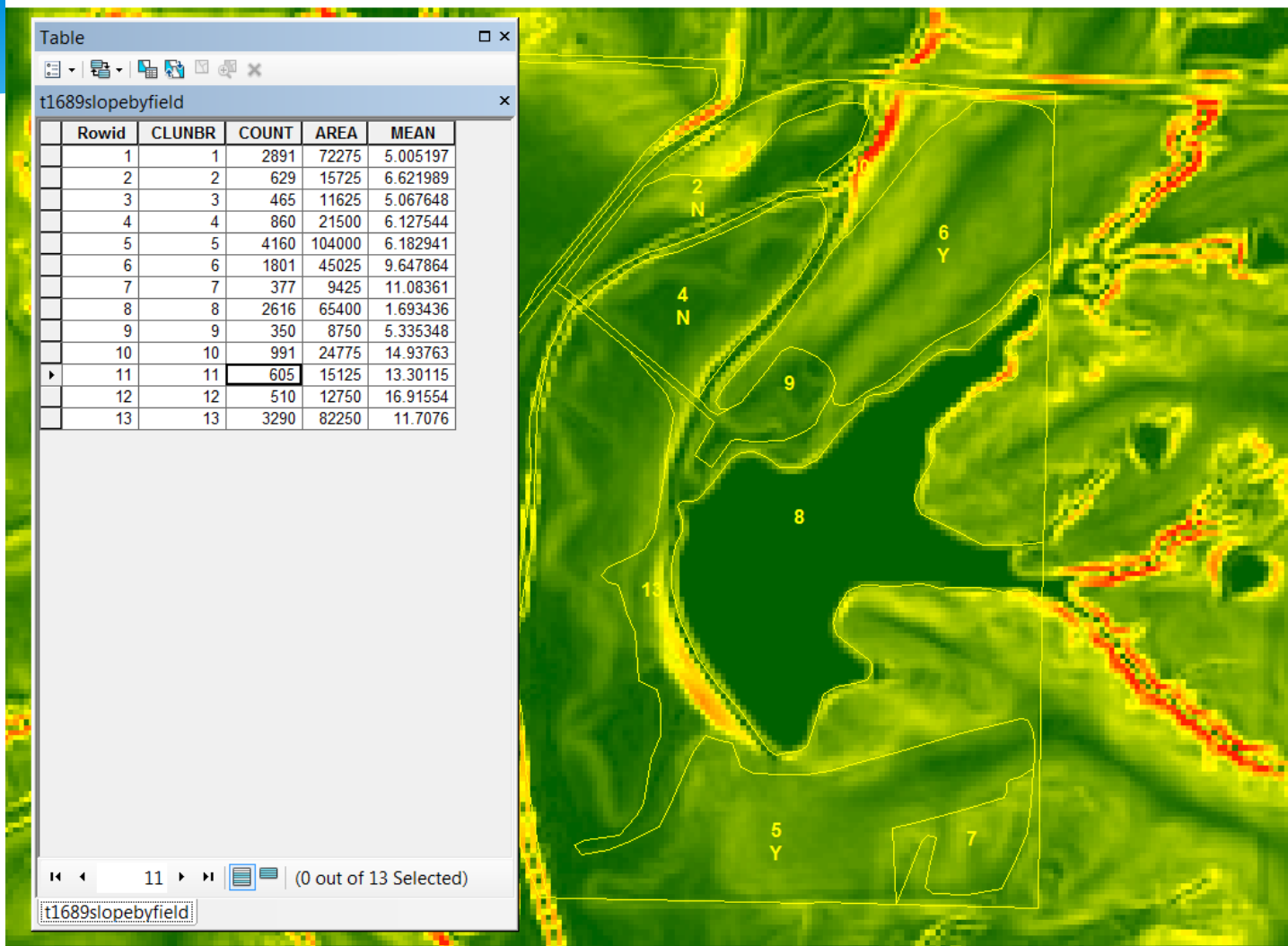
- \* Fields 5 and 6 are HEL (Y) and appear (in the NAIP aerial photography) to be cropped.
- \* Hillshade is to give you an overview “lay of the land” and contours can also assist with measuring slope length

Table Of Contents

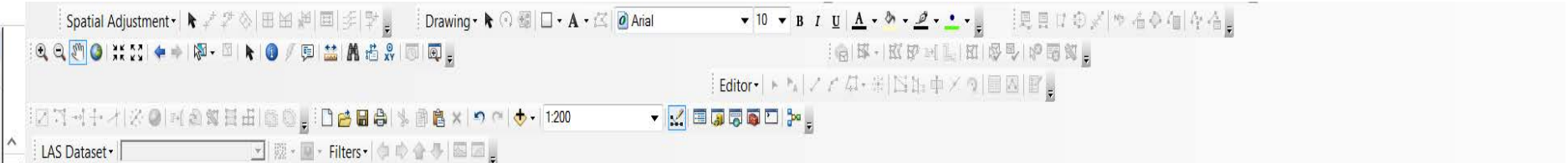
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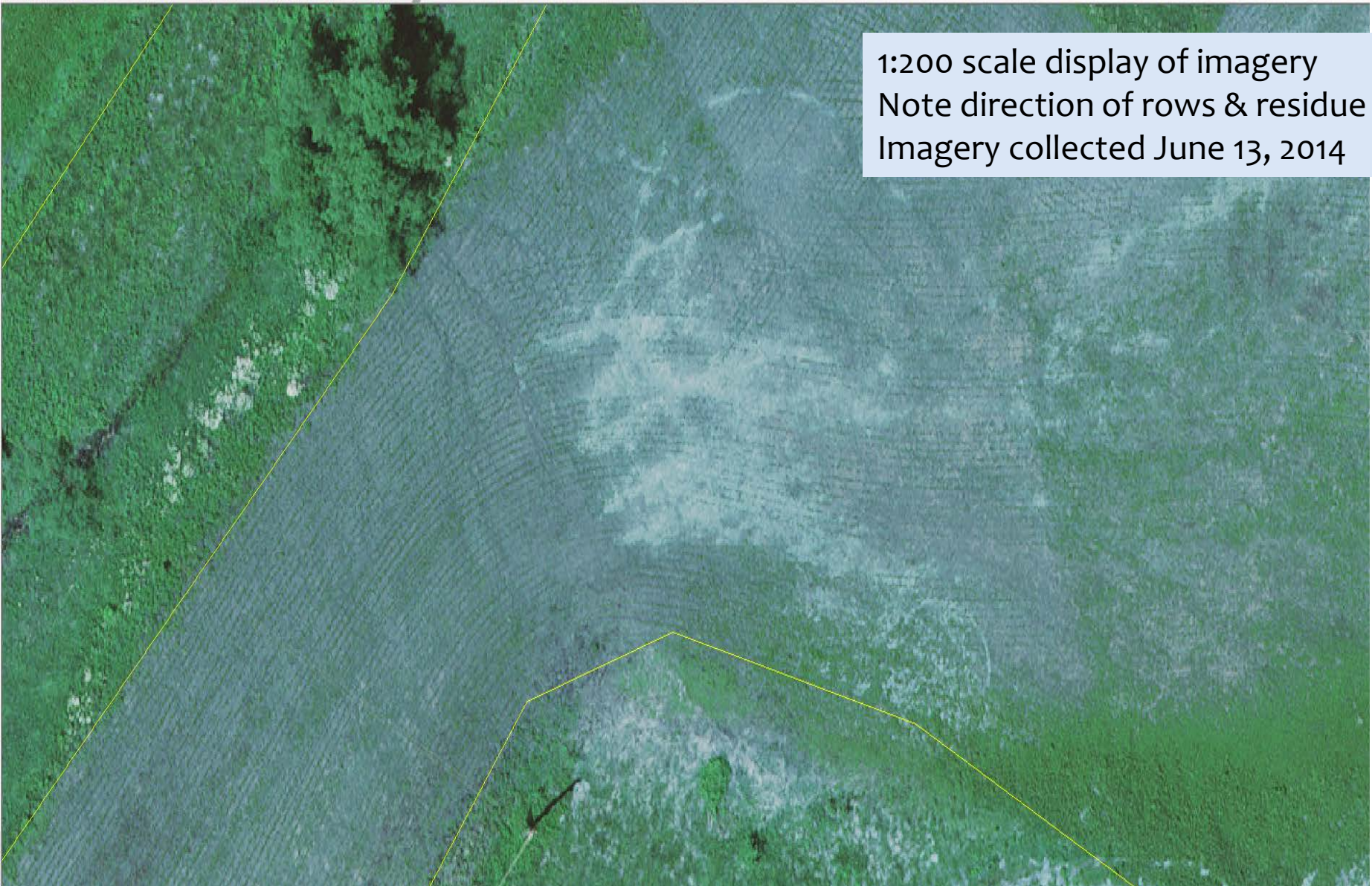




Slope has been summarized by field.  
Use CLUNBR for field number and MEAN for average slope.



1:200 scale display of imagery  
Note direction of rows & residue  
Imagery collected June 13, 2014



# Completing Sheet & Rill Portion

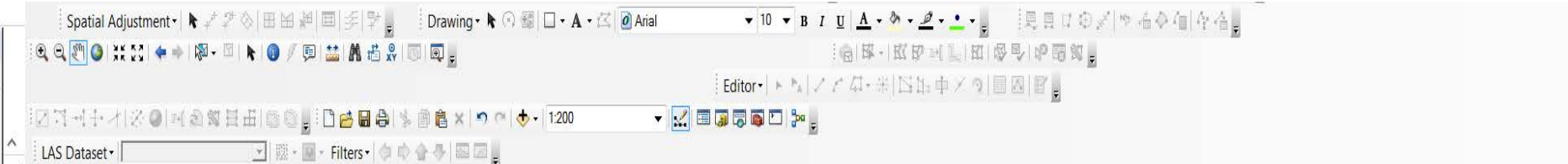
- \* Reviewed all digital data and case file data to determine inputs to RUSLE2
- \* Ran RUSLE2 for compliance call

# Ephemeral Erosion

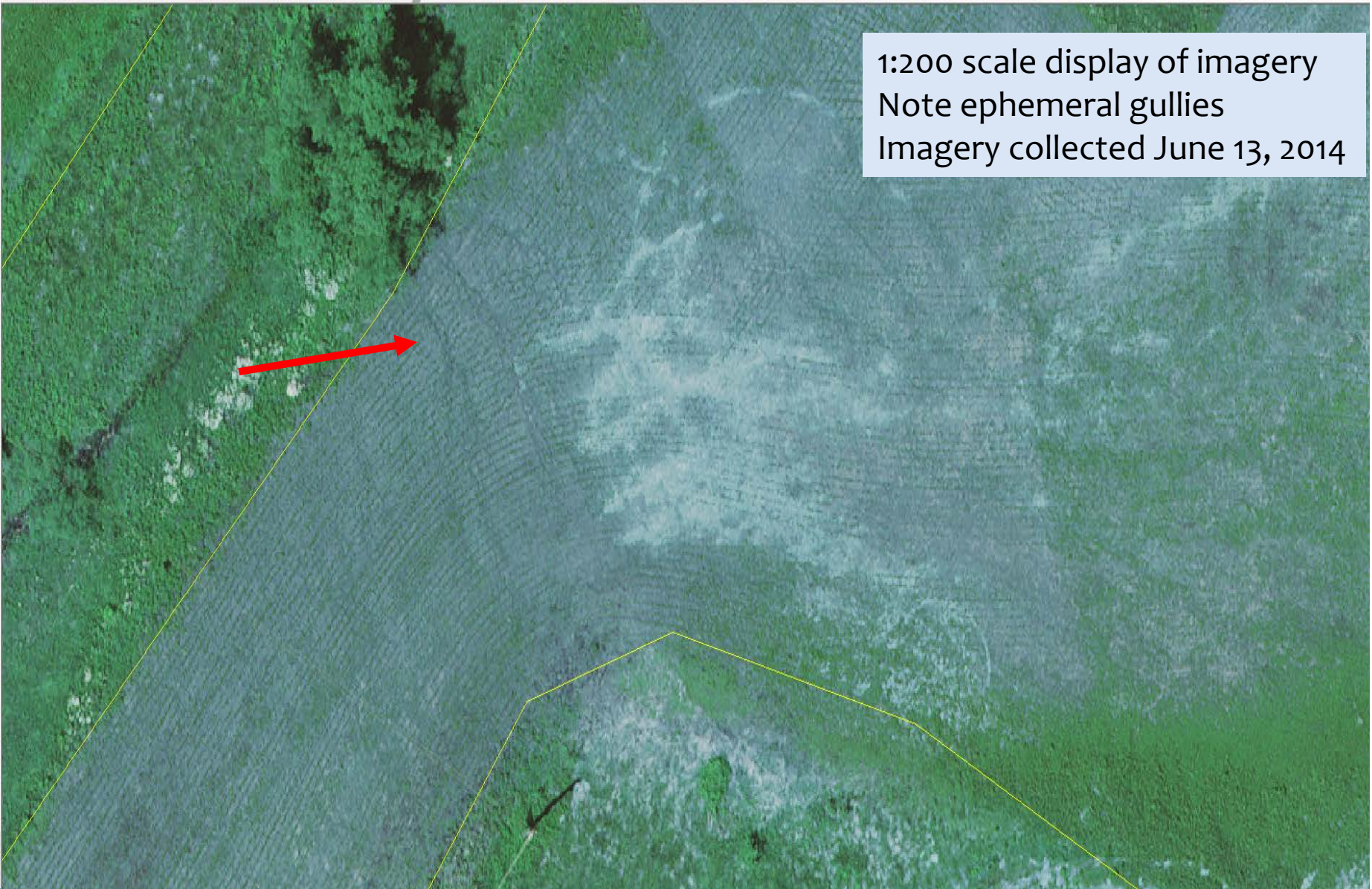
## National Agronomy Manual

Ephemeral gullies are concentrated flow channels formed when rills converge to form shallow channels. They can easily be filled with soil by typical tillage operations and re-formed in the same general location by subsequent runoff events.





1:200 scale display of imagery  
Note ephemeral gullies  
Imagery collected June 13, 2014



# HEL Determination Model

## Step 1:

- \* V1 SSURGO digital data, from the time period of the “frozen soils” for HEL determination, were attributed HEL, PHEL, NHEL
- \* An ArcMap Toolbox tool was written to intersect a selected CLU tract with these attributed, frozen soils and produce a summary report

# HEL Determination Model

## Example of Access HEL Summary report by tract Number

[CPA-026E.pdf](#)

### HEL SUMMARY BY TRACK NUMBER

*Monday, July 22, 2013*

FARMNBR: 5037

TRACTNBR: 303

<b>CLUNBR: 1</b>		<b>Field acres =</b>		<b>9.3</b>		
<b>STATUS HEL</b>	<b>Acres MUSYM</b>	<b>Acres =</b>	<b>0.0</b>	<b>Percent of field:</b>	<b>0.35%</b>	
	0.0 73569					
<b>STATUS NHEL</b>	<b>Acres MUSYM</b>	<b>Acres =</b>	<b>9.3</b>	<b>Percent of field:</b>	<b>99.65%</b>	
	4.2 66014					
	5.1 66054					
<b>CLUNBR: 2</b>		<b>Field acres =</b>		<b>8.7</b>		
<b>STATUS NHEL</b>	<b>Acres MUSYM</b>	<b>Acres =</b>	<b>8.7</b>	<b>Percent of field:</b>	<b>100.00%</b>	
	4.1 66014					
	4.6 66054					

This report shows the number of acres and percentage of the field by HEL status

# HEL Determination Model

## Step 2:

- \* If the CLU field is undetermined due to PHEL map units, EI is calculated for map units using LiDAR-derived digital elevation models
- \* The algorithms used for EI are from the RUSLE manual and a few juried articles on determining HEL
- \* PHEL units are assessed as HEL or NHEL based on  $EI >$  or  $EI < 8$ .
- \* Similar report is generated by the ArcToolbox tool with the PHEL units now determined to be HEL or NHEL

# HEL Determination Model

## Algorithms used for the calculation

Calculate S factor using LIDAR dataset

$$[0.065 + 0.0456 (\text{slope}) + 0.006541(\text{slope})^2]$$

Calculate L factor using LIDAR dataset

$$[\text{flow length} / 72.5]^{MN}$$

<1 % slopes MN=0.2; 1-3 % slopes MN=0.3; 3-5 % slopes MN=0.4; >5 % slopes MN=0.5

LS factor = L factor \* S factor

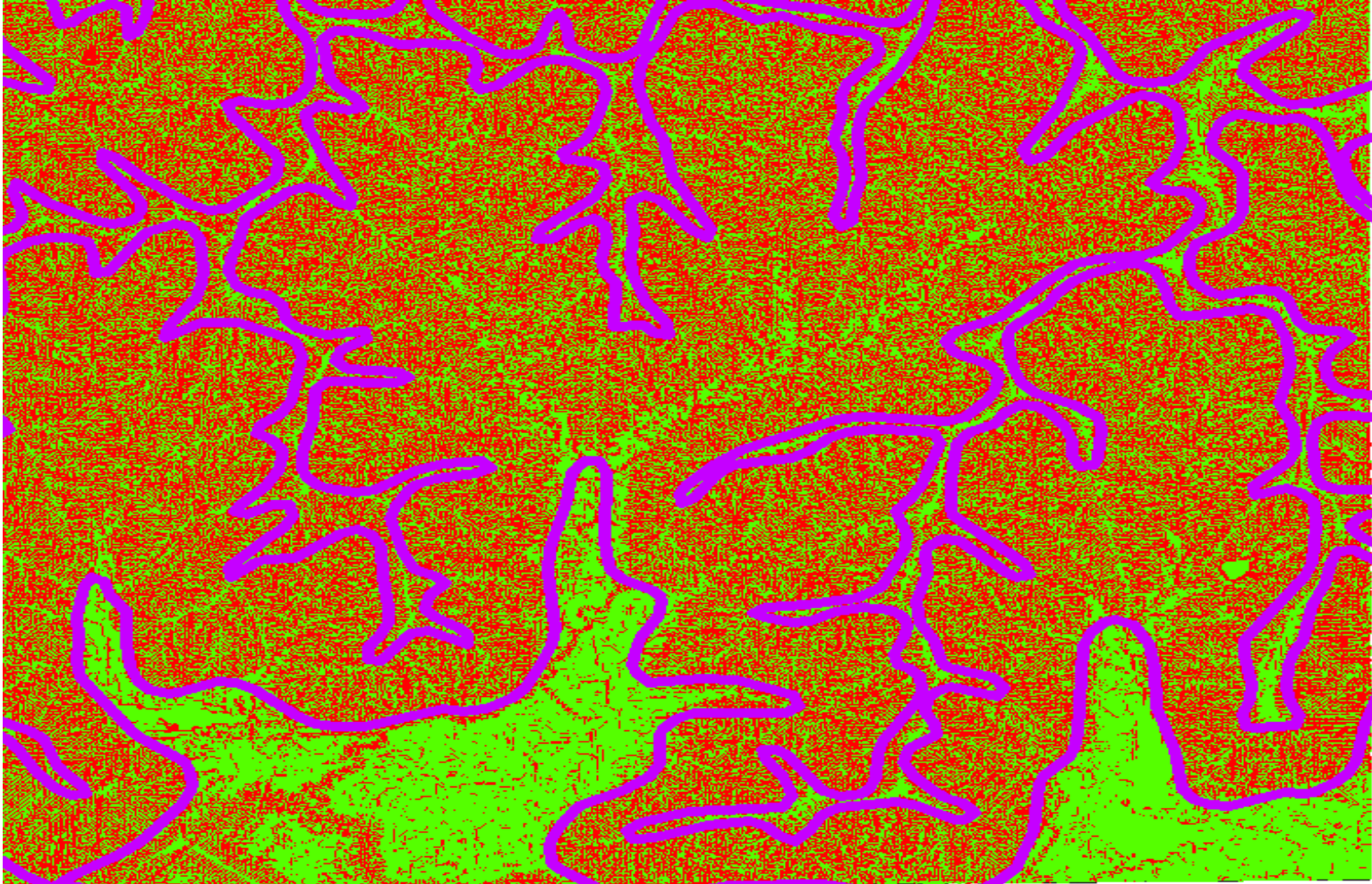
Determine the T and Kw factors from the fixed HEL soil map

Determine the Rainfall for the county by GIS layer

Erosion Index = Rainfall factor \* kfactor \* lsfactor / Tfactor

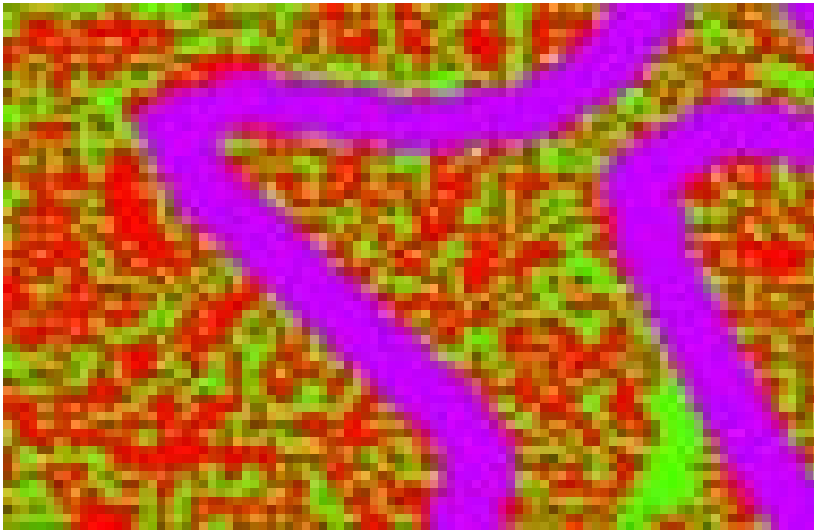
# HEL Determination Model

Example output of EI <8 in Green and >8 in Red.

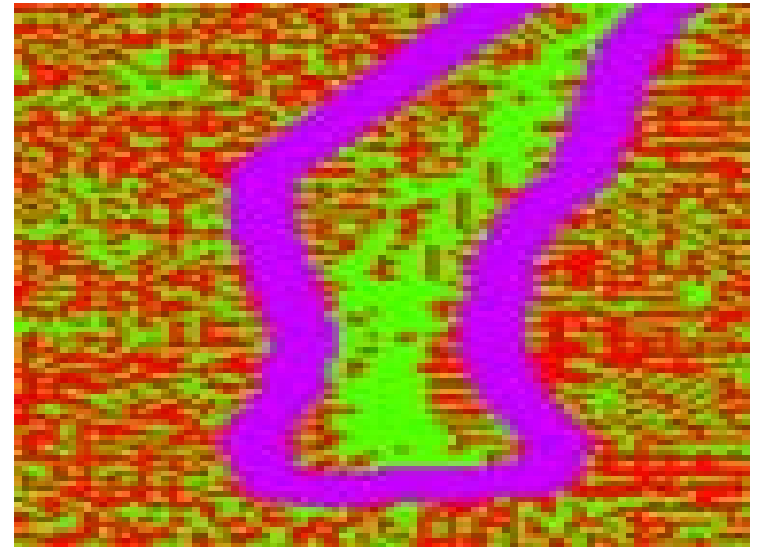


# HEL Determination Model

## Close up of PHEL map unit in two areas



IF the field was in this area it would be HEL because the area is mostly red



IF the field was in this area it would be NHEL because The area is mostly NHEL

# Wetland Determinations

