



United States Department of Agriculture



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Ephemeral Gully Erosion: What is it and how do we treat it?

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Why do we need to address EG Erosion?

512.0 Conservation System Requirement

C. Conservation System Requirements

(1) A conservation system must provide for a substantial reduction in soil erosion from the “pre- plan” level (the condition that existed before conservation measures were applied). [7 CFR Section 12.2(a)]

(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**

NFSAM Part 512
Subpart A
512.0



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Why do we need to address EG Erosion?

512.10 Requirements of an HEL Conservation Plan

E. Contents of a Conservation Plan

The HEL conservation plan document will contain at a minimum the following:

(i) Statements documenting the USDA participant's decisions regarding erosion reduction treatment for all forms of erosion identified on the HEL fields, including treatments described in Section III of the FOTG.

(ii) Documentation of required treatment that will result in substantial reduction in the following types of erosion and meet FOTG requirements:

- Sheet and Rill
- Wind
- Ephemeral Gully

(iii) Maps and other information to meet the requirements of the NPPH and this manual.

NFSAM Part 512
Subpart B
512.10



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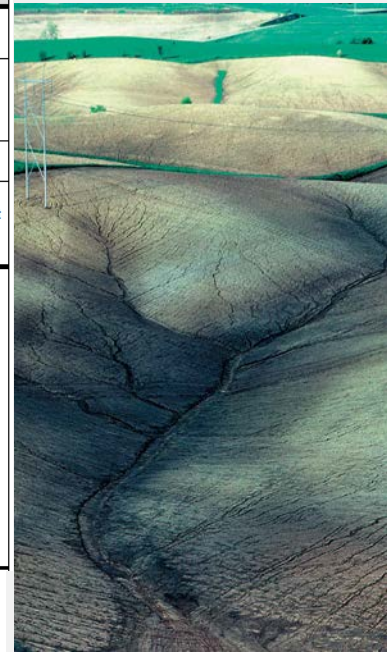
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Why do we need to address EG Erosion?

National and State Resource Concerns and Planning Criteria
10/1/2013

NRCS Resource Concerns List



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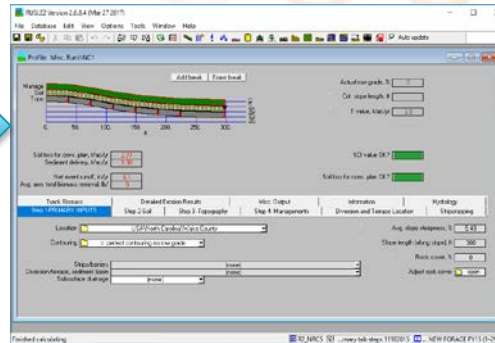
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SOIL	Description	Land Use	Component	Screening	Assessment Level	Assessment Tools
SOIL EROSION - Sheet, rill, & wind erosion	Detachment and transportation of soil particles caused by rainfall runoff/splash, irrigation runoff or wind that degrades soil quality.	<ul style="list-style-type: none"> • Crop* • Developed Land* • Farmsteads* • Associated Ag Land* • Designated Protected Area* • Other Rural Land* • Pasture* 	Sheet & Rill	Permanent ground cover > 90% and slope < 10%	Water erosion rate \leq T	RUSLE2
			Wind		Wind erosion rate \leq T	WEPS
		• Forest*	Sheet & Rill	Soil surface organic residue cover > 80%	Site is stable and without visible signs of erosion	Visual Inspection
		• Range*	Sheet & Rill	State established criteria.	RHA - soil site stability - slight to moderate or less OR Rangeland Planned Trend is positive	RHA - Rangeland Health Assessment
Wind	Rangeland Trend Worksheet					
SOIL EROSION - Concentrated flow erosion	Untreated classic gullies may enlarge progressively by head cutting and/or lateral widening. Ephemeral gullies occur in the same flow area and are obscured by tillage. This includes concentrated flow erosion caused by runoff from rainfall, snowmelt or irrigation water.	• Crop*	Ephemeral gullies	Ephemeral gullies are not occurring	Conservation practices and managements are in place to prevent or control ephemeral gullies	Field measurements / observations
			Classic gullies	Classic gullies are not present	Classic gully management is adequate to stop the progression of head cutting and widening and offsite impacts are minimized by vegetation and/or structures	
		• Forest*	Classic gullies	Classic gullies are not present	Classic gully management is adequate to stop the progression of head cutting and widening and offsite impacts are minimized by vegetation and/or structures	
		<ul style="list-style-type: none"> • Farmsteads* • Pasture* • Range* • Developed Land* • Associated Ag Land* • Designated Protected Area* • Other Rural Land* 				

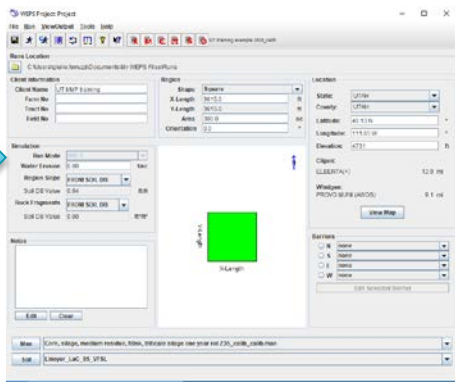


What tools do we have to estimate Erosion?

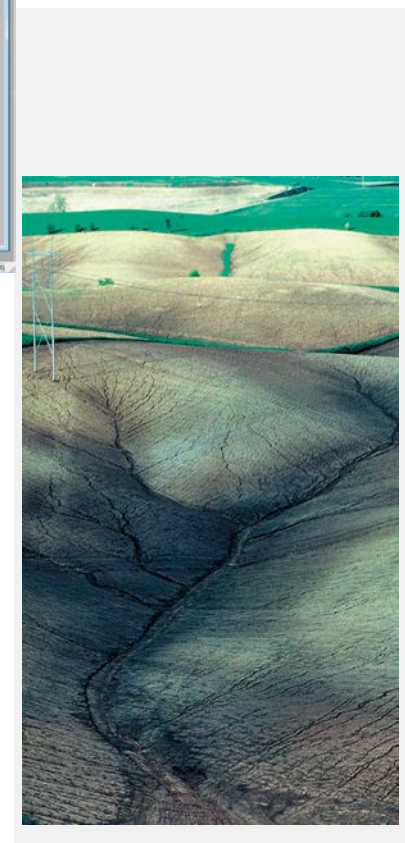
- Sheet and Rill → **RUSLE2**



- Wind → **WEPS**



- Ephemeral Gully → 



Gully Definitions

Classical Gullies

Classical gullies are an advanced stage of channel erosion. They are formed when channel development has progressed to the point where the gully is too wide and too deep to be tilled across. These channels carry large amounts of water after rains and deposit eroded material at the foot of the gully. They disfigure landscapes and make land unfit for growing crops.

Ephemeral Gullies

Ephemeral gullies can be plowed in and tilled across depending upon their depth and width. They are somewhat transitory rather than permanent like classical gullies. Ephemeral gullies will reform in the same location in a field where flow from upslope regions concentrates. Creation of a grass waterway where an ephemeral gully forms can often control this type of erosion.

The National Soil Erosion Research Laboratory, West Lafayette, IN.



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Gully Definitions

Classical Gullies

Classical gullies are channels resulting from erosion and caused by the concentrated but intermittent flow of water usually during and immediately following heavy rains. Deep enough (usually >0.5 m) to interfere with, and not to be obliterated by, normal tillage operations.

Ephemeral Gullies

Ephemeral Gullies are small channels eroded by concentrated flow that can be easily filled by normal tillage, only to reform again in the same location by additional runoff events.

Soil Science Society
of America (2001)



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Rill Definitions



Rills may be any size, but are usually less than 4 inches deep. Rills have one or more of the following characteristics:

1. They are generally parallel on a slope, but may converge
2. They are generally of uniform spacing and dimension
3. Flow pattern develops many small, disconnected parallel channels.
4. They are obliterated by tillage and generally appear at different locations on the landscape from year to year
5. They generally occur on side slopes above drainageways
6. They are generally shorter than ephemeral cropland gullies
7. They usually end at a concentrated flow channel, a terrace, or an area where the slope flattens and deposition occurs
8. They are on the same portion of the slope that is used to determine the length of slope factor (L) for RUSLE

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Is this an ephemeral gully?

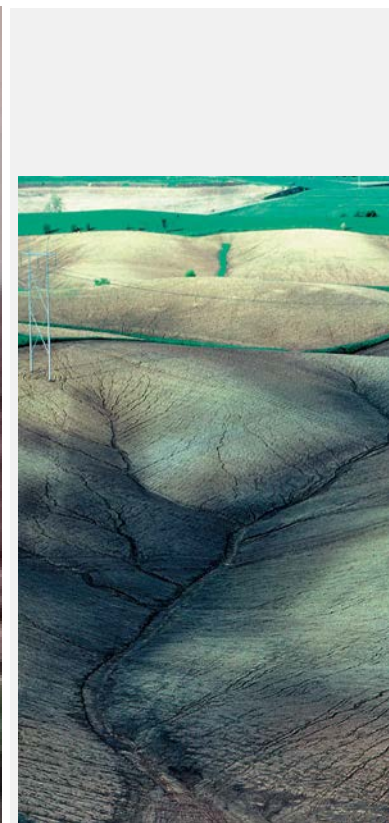


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Is this an ephemeral gully?



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Is this an ephemeral gully?

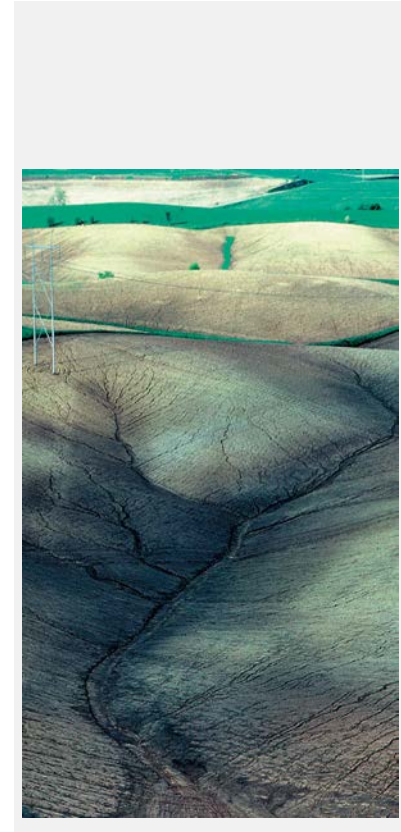


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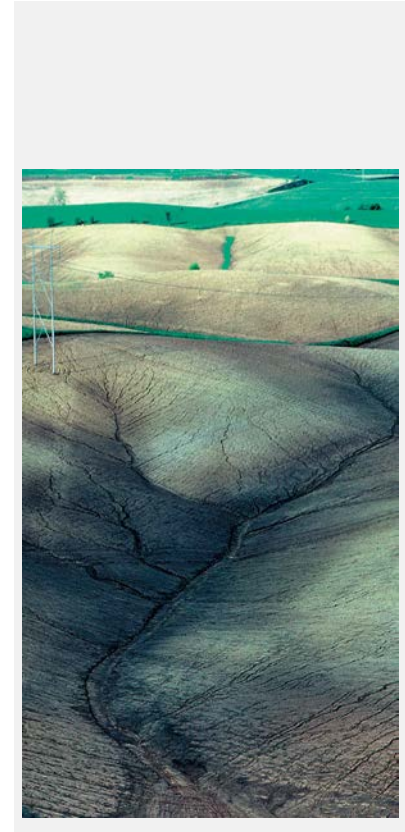


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Is this an ephemeral gully?



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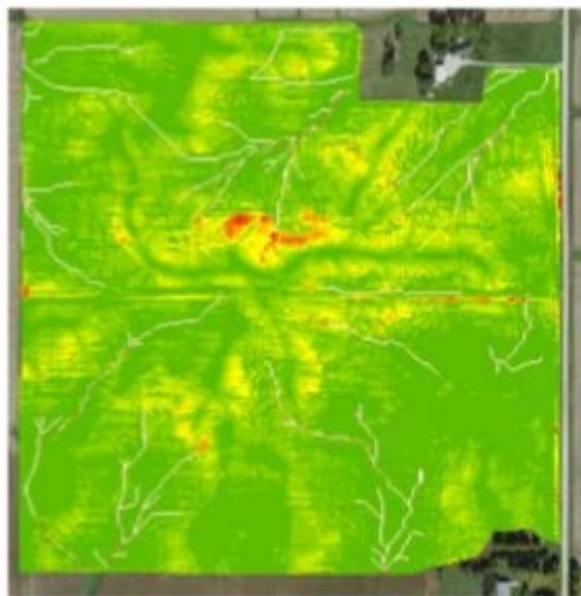
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How significant is EG erosion?



Sheet & Rill Erosion: 403 tons
Ephemeral Erosion: 538 tons
Total: 941 tons



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What causes EG erosion?

When the shear velocity of the main concentrated flow exceeds the soil threshold value, a channel incision occurs.

This is the beginning of the rill that can become an ephemeral gully and eventually a classic gully if left untreated.



For peat's sake,
hold yourself
together!

A. Capra, 2013
NSERL



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How do we treat EG erosion?

“An ounce of prevention is worth a pound of cure.”

So, let's first focus on prevention of the causes before we discuss treatment of the ephemeral gully!

Benjamin Franklin



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How do we prevent EG erosion?

We must ensure that the shear velocity of the main concentrated flow does not exceed the soil threshold value.

- **Make the concentrated flow pathways less erodible.**
- **Reduce the amount of water that is flowing into the concentrated flow pathways.**
- **Retard the flow of water into the concentrated flow pathways.**



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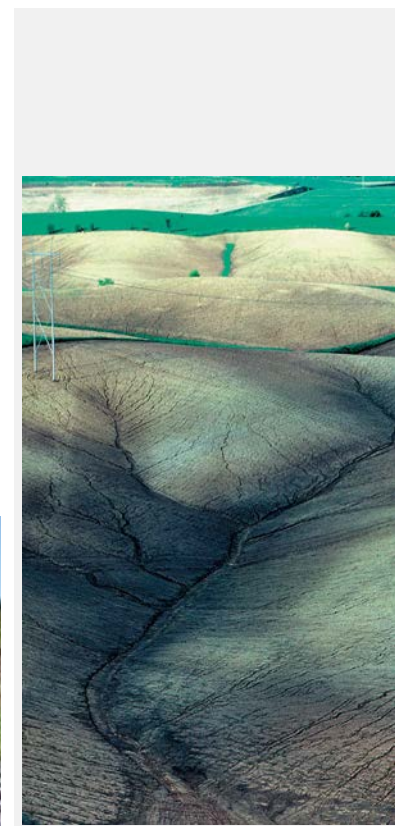
Making the concentrated flow pathways less erodible



Grassed Waterway, CPS 412



Lined Waterway or Outlet, CPS 468



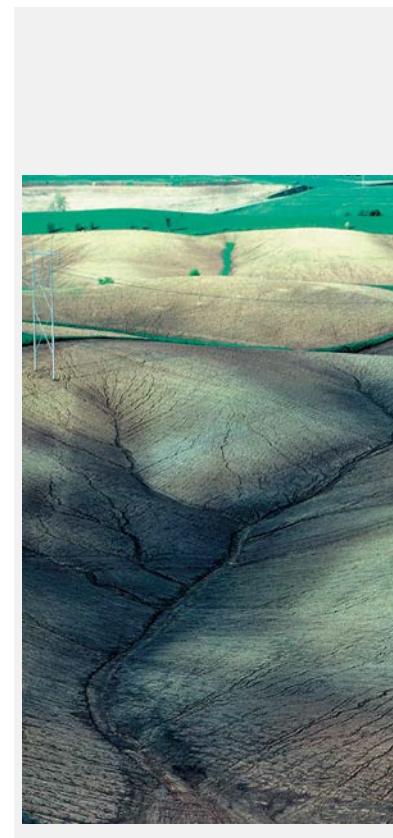
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Reduce the amount of water that is flowing into the concentrated flow pathways

- ***Increase infiltration*** in the field outside of the growing season with Cover Crops (CPS 340).
- ***Increase infiltration*** in the field during the growing season with crops that produce lots of active roots Conservation Crop Rotation (CPS 328).
- **Prevent soil crusting and shield soil from raindrop impact to *maintain or increase infiltration* rate with Residue and Tillage Management (CPS 329 & 345).**



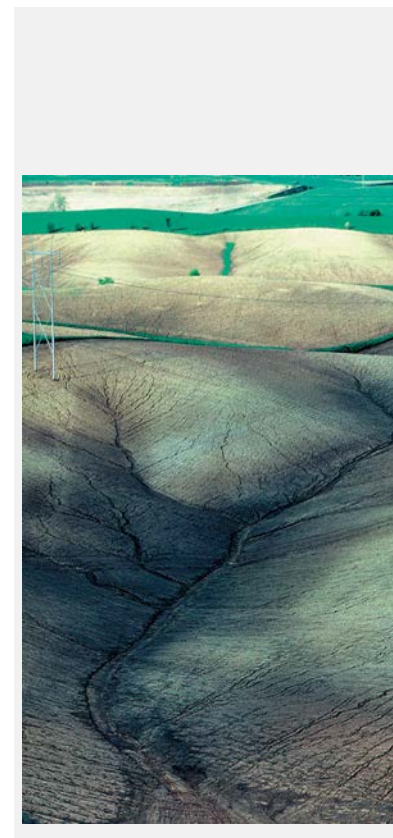
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Reduce the amount of water that is flowing into the concentrated flow pathways

- *Maintain infiltration rates in the field by controlling the compaction due to wheel traffic with Controlled Traffic Farming (CPS 334).*
- *Reduce the total amount of water being delivered to the concentrated flow pathway by diverting it to a stable outlet with Diversions (CPS 362), Hillside ditches (CPS 423) or Terraces (CPS 600).*



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Retard the flow of water into the concentrated flow pathways

Slow down the water that is flowing into the concentrated flow pathway with an adjacent vegetative practice:

- **Field Border (CPS 386)**
- **Filter Strip (CPS393)**



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Retard the flow of water into the concentrated flow pathways

Slow down the water that is flowing along the planning slope with practices such as:

- **Contour Farming (CPS 330),**
- **Contour Orchard and Other Perennial Crops (CPS 331)**
- **Contour Buffer Strips (CPS 332)**
- **Stripcropping (CPS 585)**
- **Vegetative Barriers (CPS 601)**



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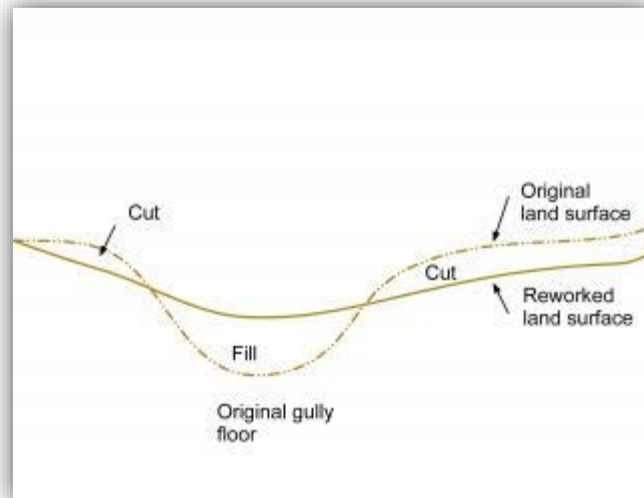
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How do we treat EG erosion?

With the same techniques that we have discussed!

However, there may be a need for some minor or, in some cases, significant earthwork to repair the area affected prior to establishing the aforementioned practices to stabilize the area.



www.agric.wa.gov.au



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How can we determine if a field will be susceptible to gully erosion?

NRCS is currently evaluating a promising tool that may assist in:

- locating the potential sites of ephemeral gullies in the field,
- estimating the amount of soil loss within the gullies and,
- reporting the amount of sediment delivered out of the field (both from sheet/rill and gully contributions).

Dalmo Vieira, ARS



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EphGEE – Ephemeral Gully Erosion Estimator

Extension of RUSLE2 erosion modeling technology to account for ephemeral gully erosion

- **Physically-based channel hydraulics and sediment transport model**
- **Calculates annual soil loss due to gully development**
- **Calculates deposition of sediment in gully channels**
- **Calculates soil actually leaving fields (sediment yield)**

Dalmo Vieira, ARS

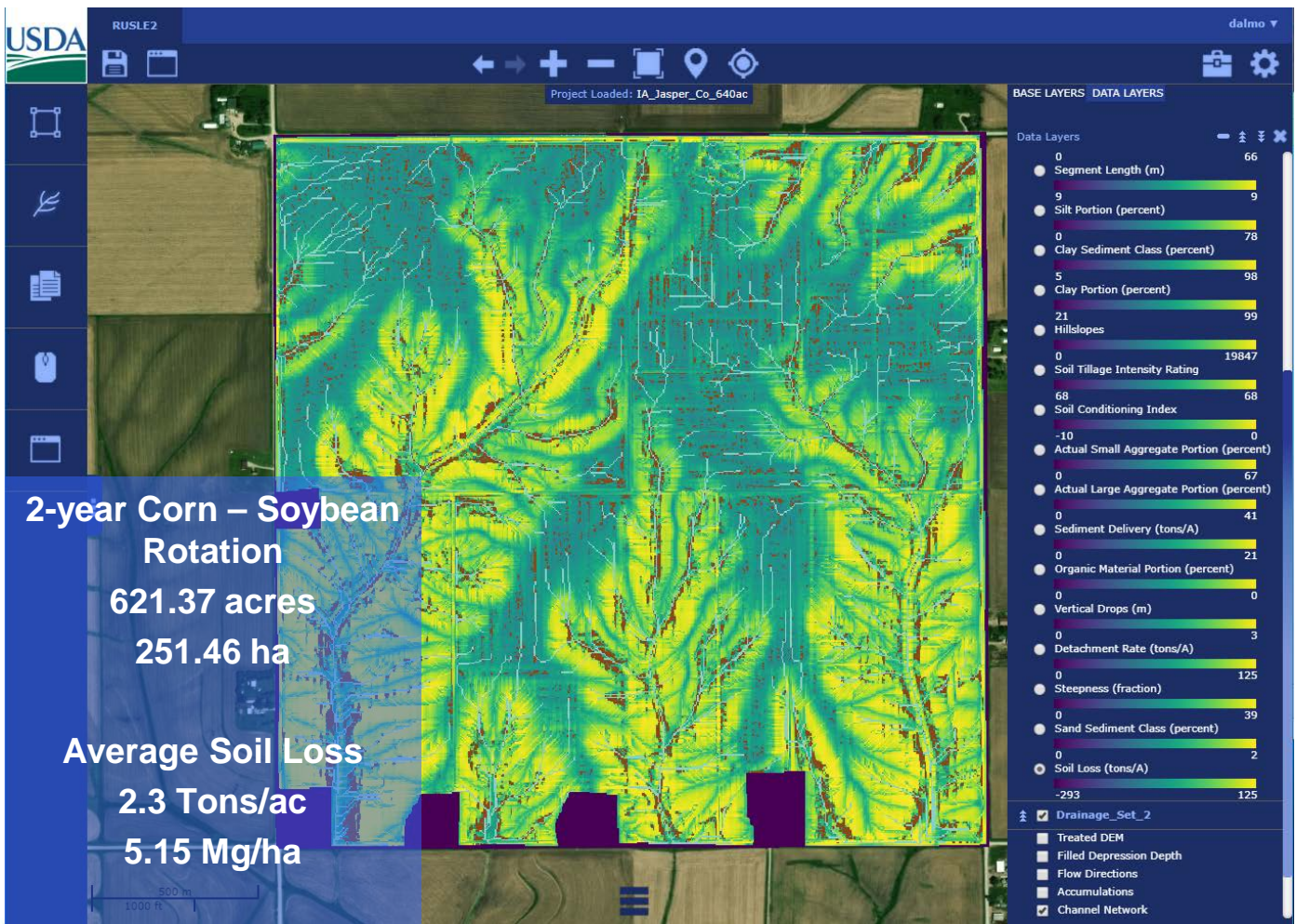


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RUSLER-EphGEE - Sheet and Rill Erosion

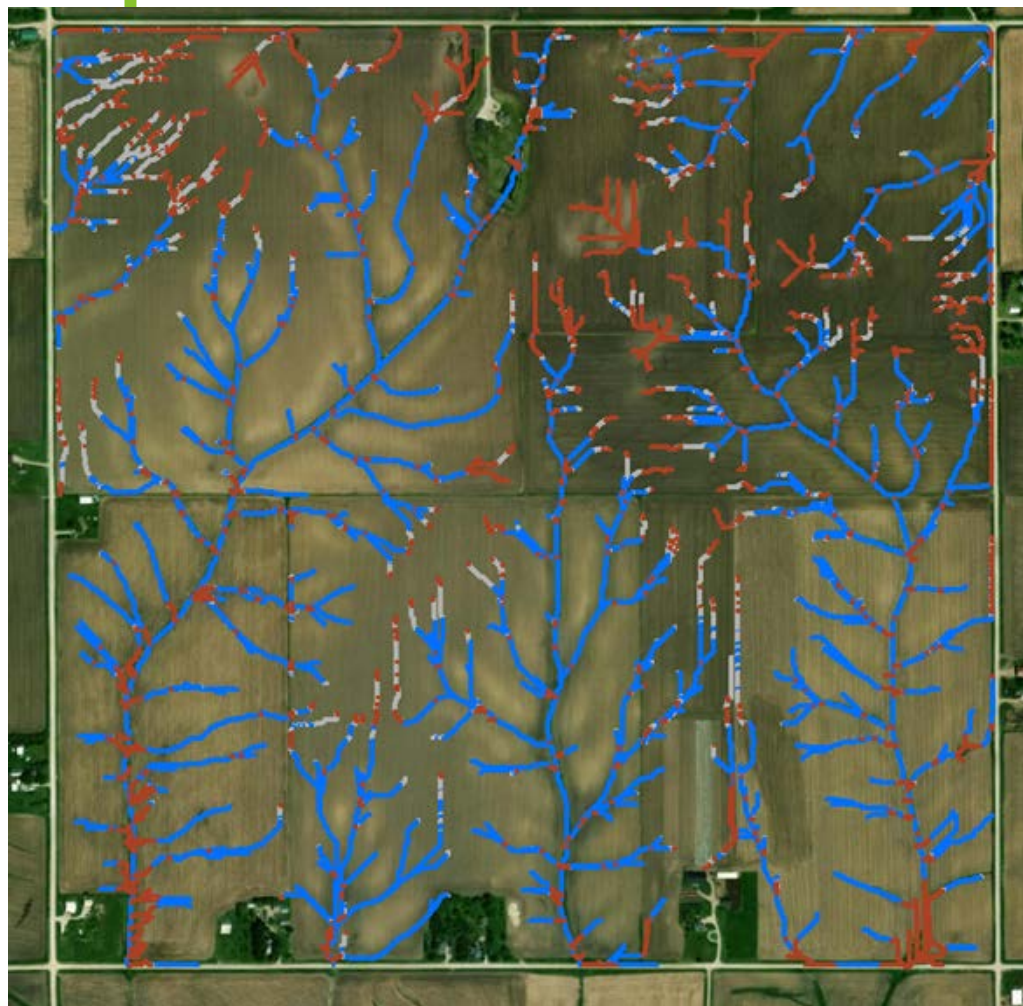


Dalmo Vieira, ARS



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RUSLER-EphGEE – Gully Erosion & Deposition



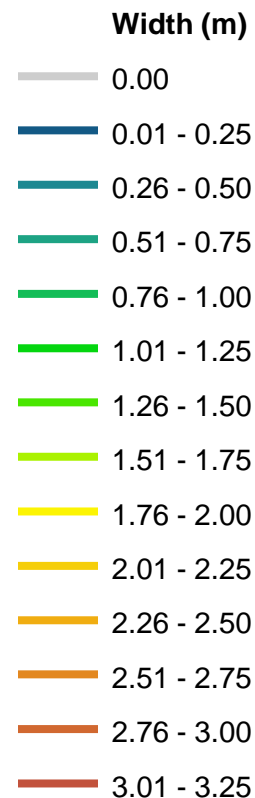
- No change
- Erosion
- Deposition



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RUSLER-EphGEE – Gully Widths



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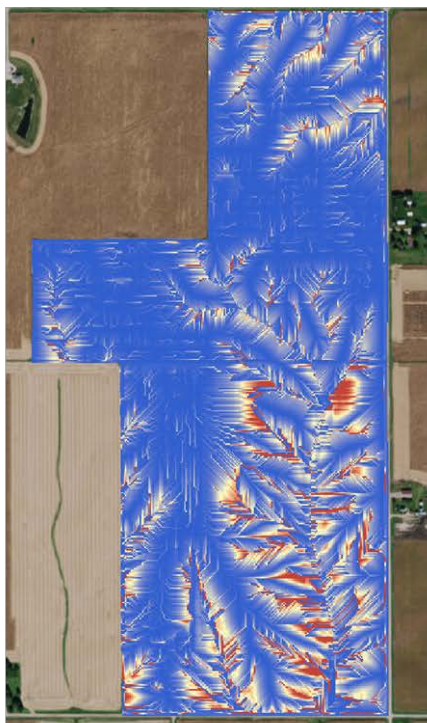


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RUSLER-EphGEE



RUSLER
sheet-and-rill erosion

Map resolution: 3 m
92 ha = 227.5 acres



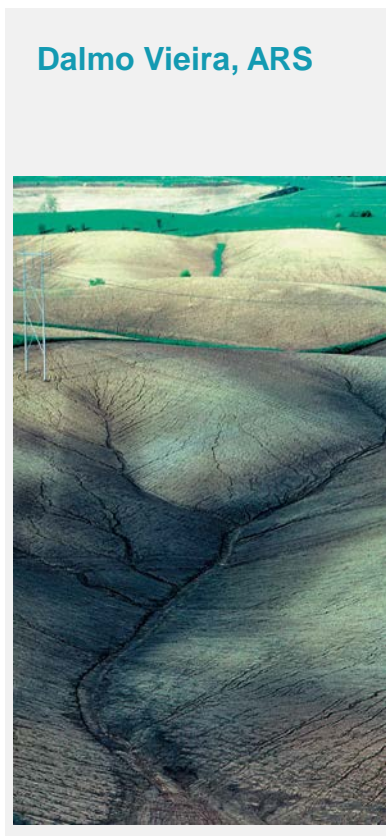
EphGEE
ephemeral gully erosion

5784 channel cells (3 m)
9196 Rusle2 hillslopes



EphGEE
deposition in gully channels

Execution time: 34 min
Single core: 8h:17min



Dalmo Vieira, ARS

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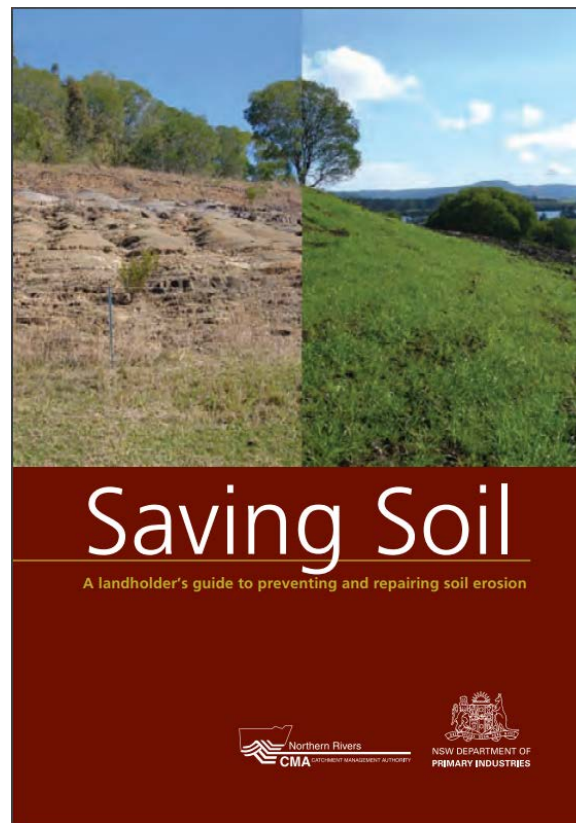
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Good references



<https://www.agric.wa.gov.au/water-erosion/repairing-gully-erosion>



www.dpi.nsw.gov.au



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Questions?



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