

GeoWEPP ArcGIS 10.1

Development Team

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LESAM Lab Team

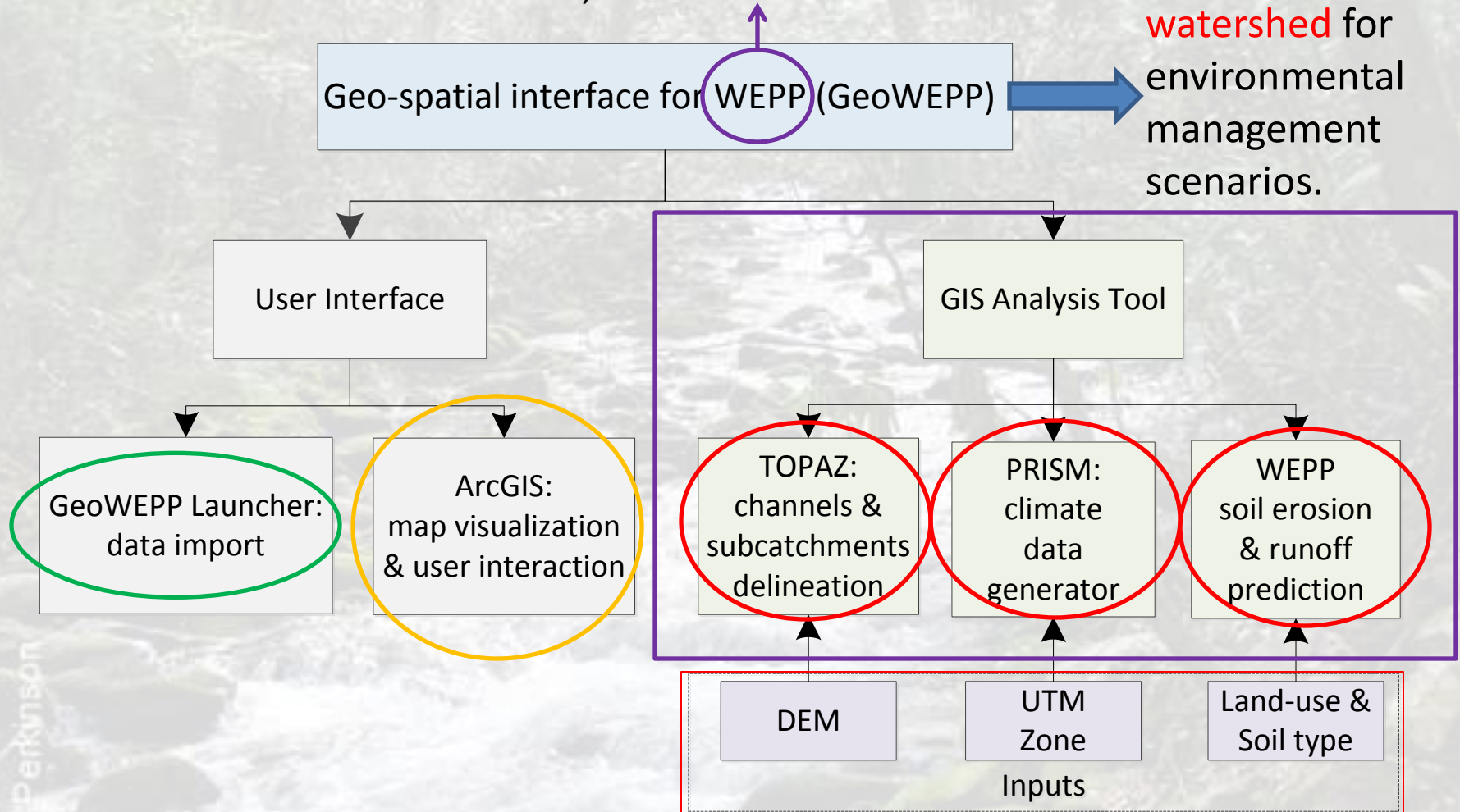
Contents

- 1. GeoWEPP introduction
- 2. GeoWEPP for non-structural management
 - Vegetation Buffer Strip (Strip Cropping), Reforestration
- 3. GeoWEPP for structural management
 - Culvert (Impoundment), Terrace (Road, parking lot)

Introduction

A process based soil erosion model for federal agencies involved in water & soil conservation, initiated in 1985

Predict soil erosion & runoff in a small watershed for environmental management scenarios.

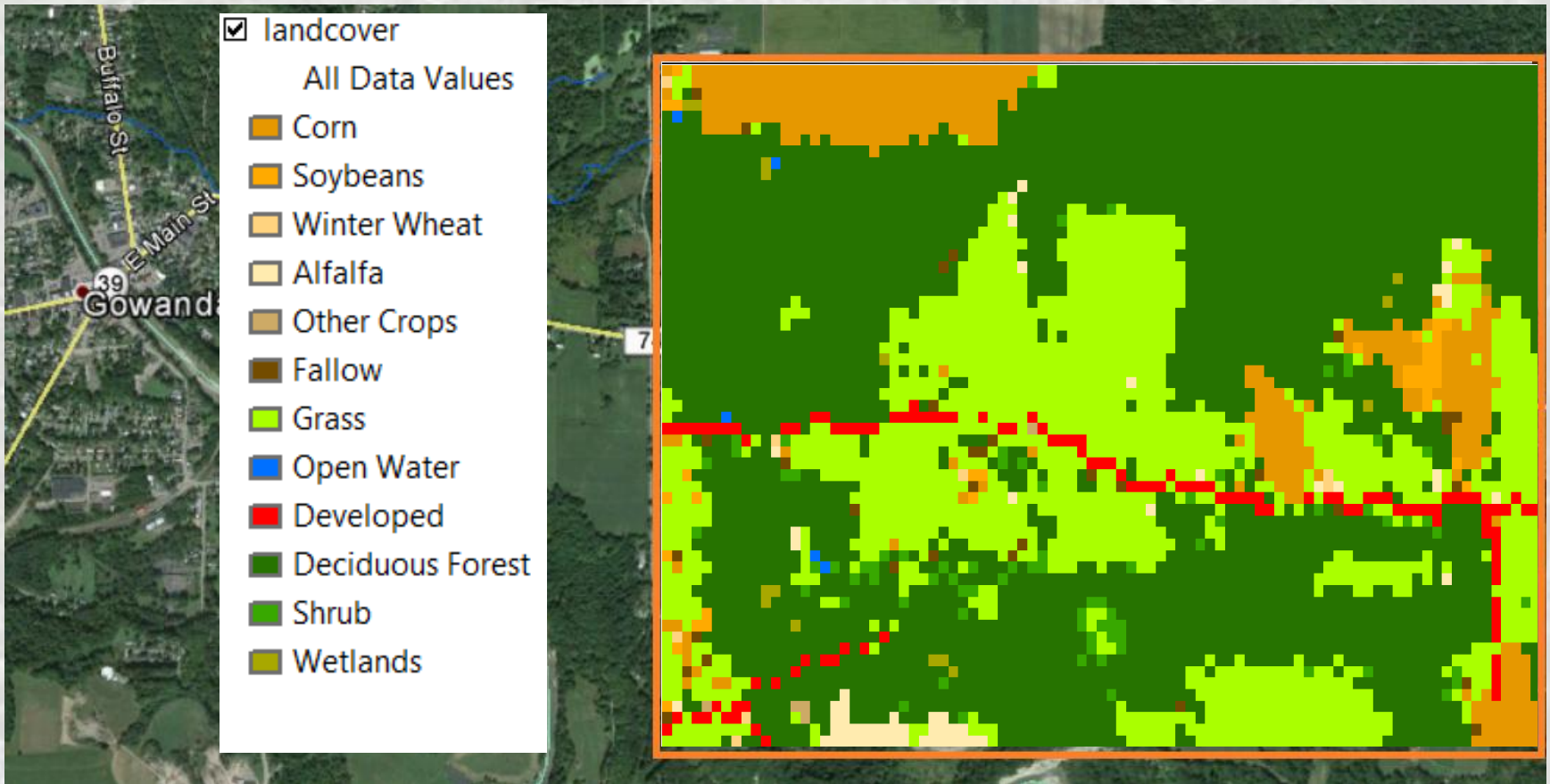


GeoWEPP Toolbar



- 1. Delineate channels
- 2. Delineate subcatchments
- 3. Generate climate data for WEPP input
- 4. Generate erosion pattern by accepting watershed
- 5. Show reports from WEPP
- 6. Save project
- 7. Remap with different tolerable value
- 8. Get Hillslope Info
- 9. Change associated land use and soil in a hillslope
- 10. Rerun WEPP to get new erosion pattern
- 11. Load a single hillslope to WEPP
- 12. Go to WEPP to load watershed project
- 13. Save project and exit

Example site



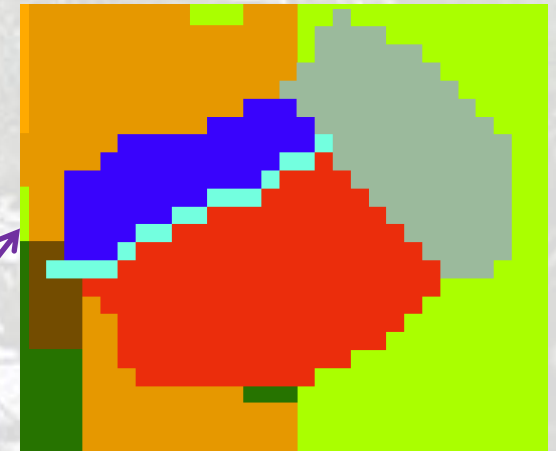
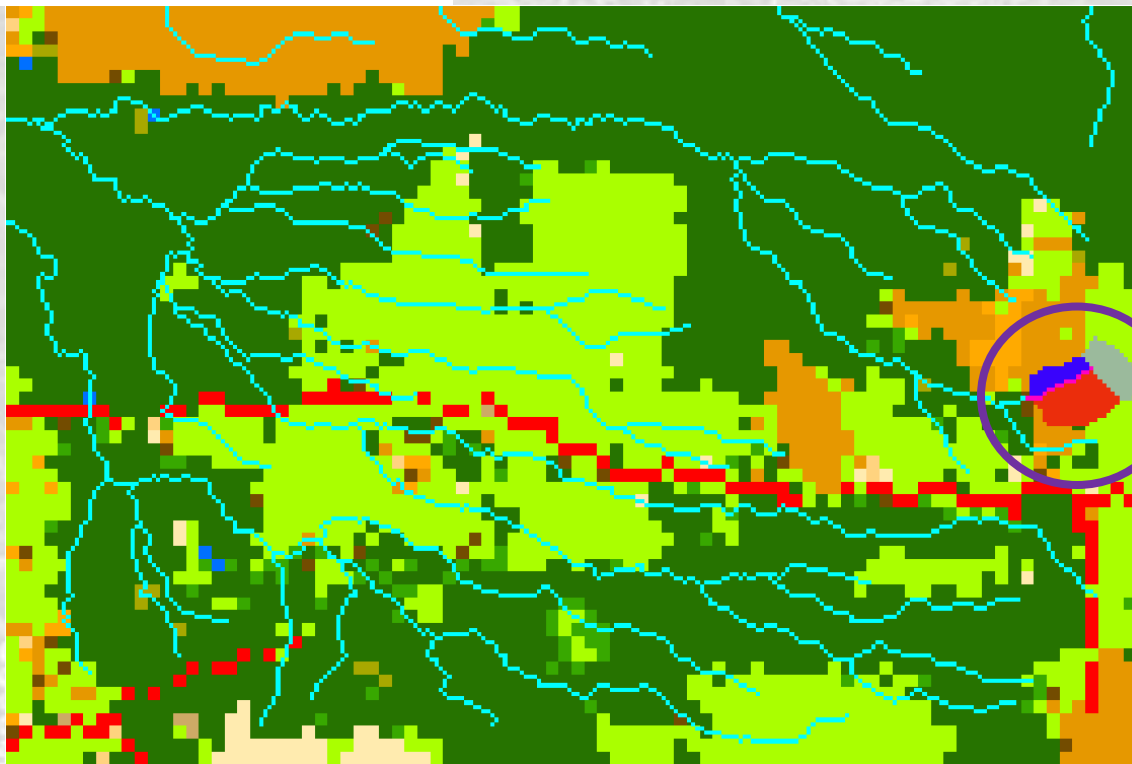
East of Gowanda, NY

Data are from USDA

Channels & Subcatchment delineation - TOPAZ

Network.tif

Channel



Subcatchments.tif

21 - Source subcatchment

22 - Right subcatchment

23 - Left subcatchment

24 - Channel

1 Critical Source Area &
1 Select outlet point from channel
1 Minimum Source Channel Length

Generating climate for WEPP- PRISM

Climate Selector

Closest Climate Station to Outlet P

GOWANDA ST HOSPITAL NY

Climate Modification

Climate Parameters for **GOWANDA ST**

Modified Climate Name: **Mod GOWANDA ST**

42.48 °W 78.93 °N

860 feet elevation

PRISM

PRISM Modification Window

For modifying CLIMATE at 42.48 N 78.93 W and 860 ft elevation

PRISM Location: 42.48 N 78.9 W and 1,266 ft elevation

Select a value in the annual precipitation or elevation tables to move north, south, east, or west in the PRISM 2.5 minute (approximately 2.5 mi) grid of values. The value in the center is your current location.

Station Mean Precipitation (in)	Month	PRISM Mean Precipitation (in)
2.60	January	2.73
2.05	February	2.37
2.58	March	2.88
2.75	April	3.28
3.04	May	3.35
3.34	June	4.03
3.63	July	3.63
3.31	August	3.93
3.70	September	4.30
3.02	October	3.48
3.48	November	4.07
2.83	December	3.84
36.33	Annual	42.04

Annual Precipitation (in)		
37.97	39.37	42.13
38.61	42.04	41.39
40.94	42.74	42.95

Elevation (ft)		
892	1,053	1,243
971	1,266	1,197
1,178	1,414	1,446

Month	Mean Maximum Temperature (°F)	Mean Minimum Temperature (°F)	Mean Precipitation (in)	Number of Wet Days
January	32.79	18.50	2.60	15.30
February	34.83	18.94	2.05	11.41
March	43.99	25.73	2.58	11.73
April	57.33	36.10	2.75	11.45
May	68.92	45.90	3.04	11.27
June	77.43	55.38	3.34	9.29
July	81.31	59.87	3.63	9.30
August	79.34	58.32	3.31	9.73
September	72.61	51.95	3.70	9.74
October	62.01	42.34	3.02	11.19
November	48.85	33.56	3.48	13.37
December	37.10	23.57	2.83	14.88
Annual	Clear All Changes	36.33	138.66	
Enter 0 to reset) >>		0.00	0.00	0.0%

Adjust temperature for elevation by lapse rate

Accept Values

Return with no Changes

Help

Exit

Accept watershed to predict erosion

WEPP/TOPAZ Translator

File View Help

WEPP Watershed Settings

Change Soil Associations Change Channel Associations

Change Management Associations

Watershed has 3 Hillslopes and 1 Channel.

Climate: New York\GOWANDA ST HOSPITAL NY.cli

Number of Years: 2

Simulation Method: Watershed and Flowpaths

Name	Management	Soil	% of Area
Hill_21	grass.rot	ny\DANLEY(SIL).sol	32.5%
Hill_22	agriculture\com-fall mo...	ny\DANLEY(SIL).sol	18.8%
Hill_23	agriculture\com-fall mo...	ny\DANLEY(SIL).sol	48.6%

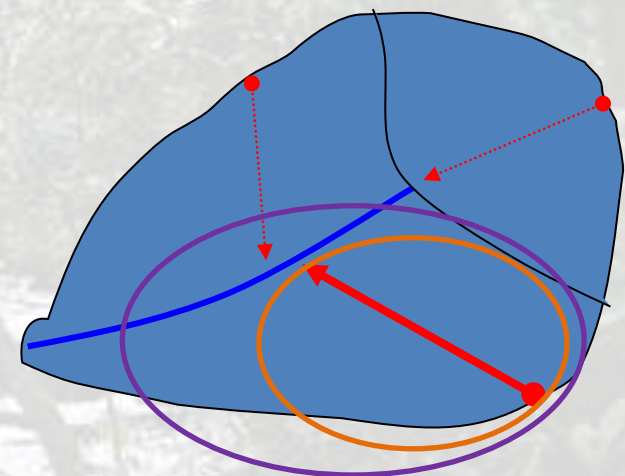
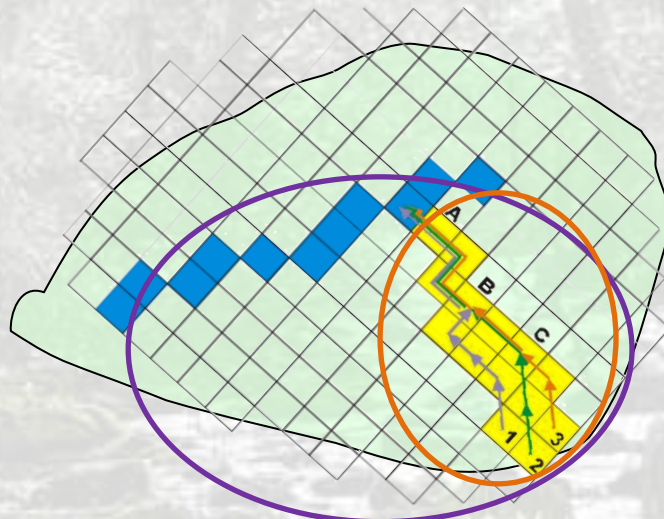
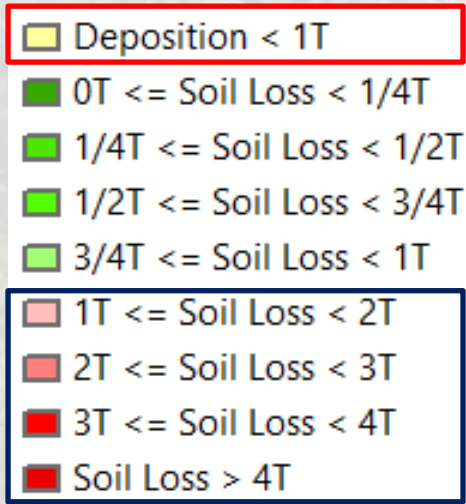
Subcatchments.tif

- 21 - Source subcatchment
- 22 - Right subcatchment
- 23 - Left subcatchment
- 24 - Channel

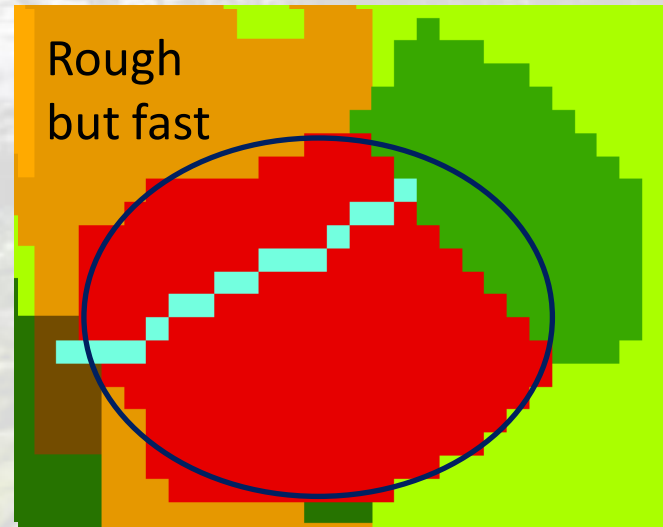
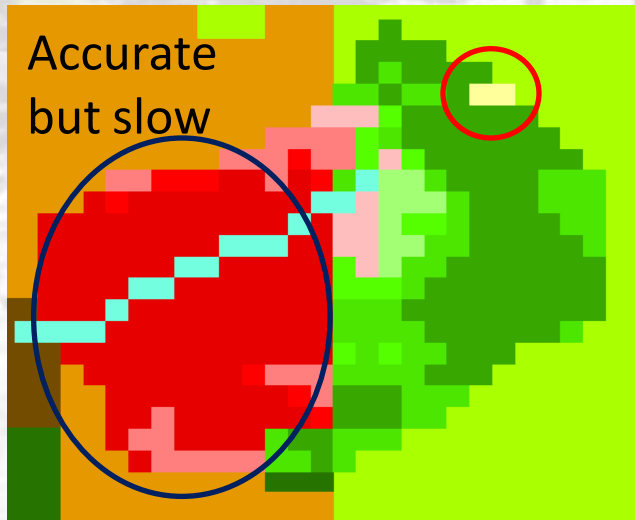
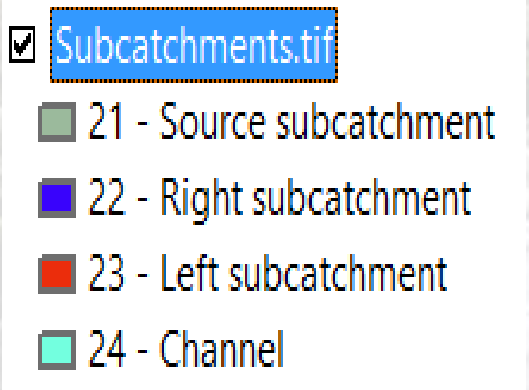
Soil erosion prediction - WEPP

Flowpath Method

Watershed Method



1T = 1 ton/hectare/year



GeoWEPP Reports

Watershed Method

Hillslopes		Runoff Volume (m ³ /yr)	Soil Loss (tonne/yr)	Sediment Yield (tonne/yr)	Soil Loss (tonne/ha/yr)	*Mapped Sediment Yield (tonne/ha/yr)
WEPP	TOPAZ					
1	21	847.3	0.1	0.1	0.1	0.1
2	22	604.9	2.9	2.9	4.6	4.6
3	23	1682.4	14.6	14.6	9.1	9.1

Flowpath Method

Channels	Discharge Volume (m ³ /yr)	Soil Loss (tonne/yr)	Sediment Yield (tonne/yr)	Length (m)
NUM WEPP TOPAZ				
1 1 24	3152.9	n.a.	14.3	189.0

Hillslopes		Runoff Volume (m ³ /yr)	Soil Loss (tonne/yr)	Sediment Yield (tonne/yr)	Soil Loss (tonne/ha/yr)	*Mapped Sediment Yield (tonne/ha/yr)
WEPP	TOPAZ					
1	21	944.5	0.4	n.a.	0.3	n.a.
2	22	586.0	10.3	n.a.	16.7	n.a.
3	23	1064.5	13.0	n.a.	8.1	n.a.



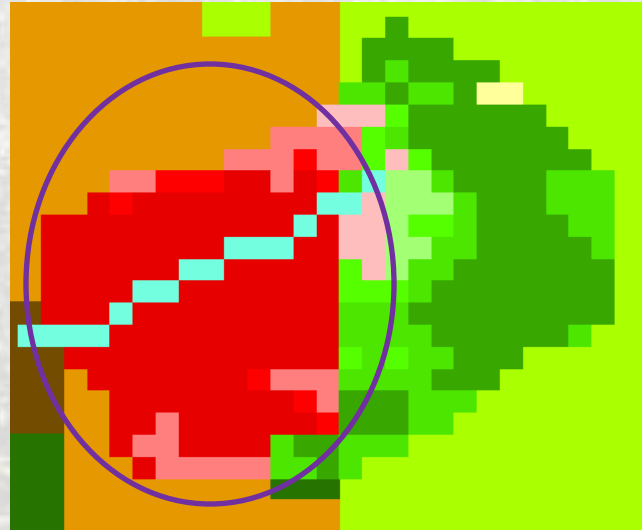
GeoWEPP for Nonstructural Management

Vegetation Buffer Strip

Flowpath

All Data Values

- Deposition < 1T
- 0T <= Soil Loss < 1/4T
- 1/4T <= Soil Loss < 1/2T
- 1/2T <= Soil Loss < 3/4T
- 3/4T <= Soil Loss < 1T
- 1T <= Soil Loss < 2T
- 2T <= Soil Loss < 3T
- 3T <= Soil Loss < 4T
- Soil Loss > 4T



landcover

All Data Values

- Corn
- Soybeans

Area	GIS Landuse	WEPP Management
3.5%	Fallow	fallow.rot
42.6%	Grass	grass.rot
47.0%	Corn	agriculture\com-fall moldboard plow.rot
7.0%	Deciduous Forest	GeoWEPP\Forest Perennial.rot










Wetlands

How much run-off will vegetation Buffer Strip reduce?





Vegetation Buffer Strip – Flowpath method

Flowpath

All Data Values

-  Deposition < 1T
-  0T <= Soil Loss < 1/4T
-  1/4T <= Soil Loss < 1/2T
-  1/2T <= Soil Loss < 3/4T
-  3/4T <= Soil Loss < 1T
-  1T <= Soil Loss < 2T
-  2T <= Soil Loss < 3T
-  3T <= Soil Loss < 4T
-  Soil Loss > 4T

Subcatchments.tif

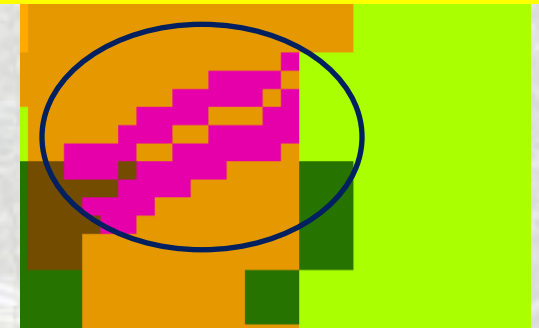
-  21 - Source subcatchment
-  22 - Right subcatchment
-  23 - Left subcatchment
-  24 - Channel

Original



With Vegetation Buffer Strip

Same idea for Strip Cropping



Run off: $2595 \text{ m}^3 / \text{yr}$ $\xrightarrow{- 457 \text{ m}^3 / \text{yr}}$ $2138 \text{ m}^3 / \text{yr}$

Soil Loss: $23.7 \text{ ton} / \text{yr}$ $\xrightarrow{- 13.2 \text{ ton} / \text{yr}}$ $10.5 \text{ ton} / \text{yr}$

Return Period Analysis - Extreme Event

Load a single hillslope to WEPP

GOWANDA ST HOSPITAL NY

Manager
Slope
Soil

Return Periods

Return Period (years)	Daily Runoff Volume (mm)	Daily Sediment Leaving (t/ha)	Daily Peak Rate (mm/hr)	Daily Precipitation (mm)
2	35.7	5.7	83.3	49.3
5	54.1	9.9	107.7	58.9
10	65.2	12.4	123.7	78.2
20	72.4	14.5	133.1	94.8
25	78.5	14.5	140.5	101.9
50	101.2	16.0	142.8	111.1

In a year, there is 2% probability for an extreme event causing 16.0 tons/ha soil loss

Simulate for 100 years

Return Periods: English Units

Graph:

100 Year Simulation

Value	Units
36.60	in
4.56	in
5.202	ton/A
5.202	ton/A

0.0

107.6

Feet

Vegetation Buffer Strip – Return Period Analysis

Return Period (years)	Daily Runoff Volume (mm)	Daily Sediment Leaving (t/ha)	Daily Peak Rate (mm/hr)	Daily Precipitation (mm)
2	35.7	5.7	83.3	49.3
5	54.1	9.9	107.7	58.9
10	65.2	12.4	123.7	78.2
20	72.4	14.5	133.1	94.8
25	78.5	14.5	140.5	101.9
50	101.2	16.0	142.8	111.1

100 Year Simulation	Value	Units
Average Annual Precipitation	36.60	in
Average Annual Runoff	4.06	in
Average Annual Soil Loss	3.315	ton/A
Average Annual Sediment Yield	1.332	ton/A

1 Original

Return Period (years)	Daily Runoff Volume (mm)	Daily Sediment Leaving (t/ha)	Daily Peak Rate (mm/hr)	Daily Precipitation (mm)
2	36.0	1.6	64.0	49.3
5	51.5	2.8	92.3	59.5
10	66.6	4.0	107.6	78.2
20	81.1	4.6	118.4	94.8
25	87.4	5.3	119.3	101.9
50	101.1	7.4	127.6	111.1

With Vegetation Buffer Strip

Reforestation

landcover

All Data Values

- Corn
- Soybeans

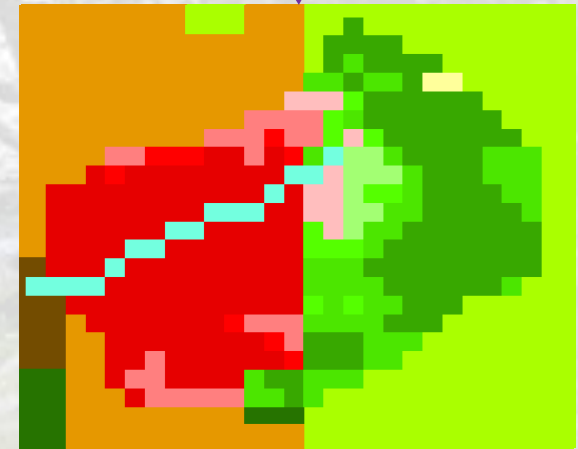
Flowpath

All Data Values

- Deposition < 1T
- 0T <= Soil Loss < 1/4T
- 1/4T <= Soil Loss < 1/2T
- 1/2T <= Soil Loss < 3/4T
- 3/4T <= Soil Loss < 1T
- 1T <= Soil Loss < 2T
- 2T <= Soil Loss < 3T
- 3T <= Soil Loss < 4T
- Soil Loss > 4T
- 23 - Left subcatchment
- 24 - Channel

Post-Fire

Pre-Fire

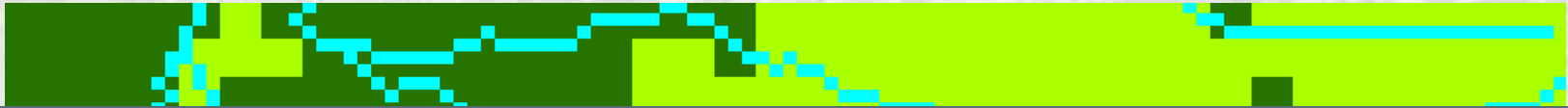


Run off: $3442.5 \text{ m}^3/\text{yr}$ $\xrightarrow{-847.5 \text{ m}^3/\text{yr}}$ $2595 \text{ m}^3/\text{yr}$

Soil Loss: $31.0 \text{ ton}/\text{yr}$ $\xrightarrow{-7.3 \text{ ton}/\text{yr}}$ $23.7 \text{ ton}/\text{yr}$

GeoWEPP for structural management

Impoundment & culvert – Return period analysis



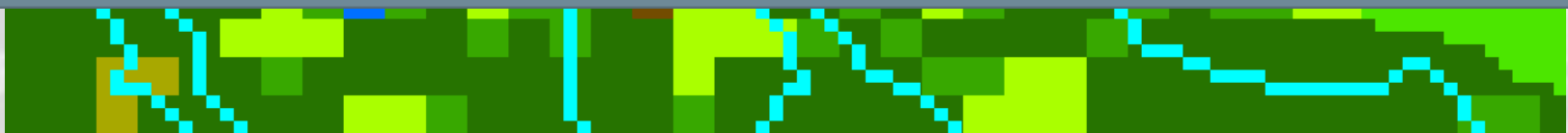
return_periods.txt - Notepad

File Edit Format View Help

Return Period Analysis

Return Period (years)	Runoff Volume (m ³)	Sediment Leaving (t)	Peak Runoff Rate (m ³ /sec)	Daily Precipitation (mm)
1	10039.2	15.4	3.0	43.9
2	16162.3	24.9	4.7	49.8
3	18805.4	32.8	5.4	54.1
5	27867.9	52.6	7.6	59.6
6	30922.9	53.5	8.3	69.9
10	36539.9	89.2	9.7	109.5
15	50342.6	89.4	12.9	111.1

Tells how much sediment goes into culvert or impoundment.
Use WEPP to simulate a single storm event as climate input for GeoWEPP to identify whether the culvert will be destroyed by the flood



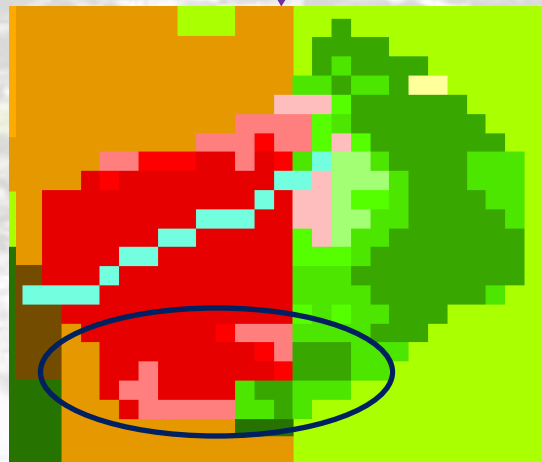
Read return period report from GeoWEPP for the watershed

Terraces / Roads / Parking lot

- landcover
 - All Data Values
 - Corn
 - Soybeans
 - Winter Wheat
- Onsite.tif
 - All Data Values
 - Deposition < 1T
 - 0T <= Soil Loss < 1/4T
 - 1/4T <= Soil Loss < 1/2T
 - 1/2T <= Soil Loss < 3/4T
 - 3/4T <= Soil Loss < 1T
 - 1T <= Soil Loss < 2T
 - 2T <= Soil Loss < 3T
 - 3T <= Soil Loss < 4T
 - Soil Loss > 4T
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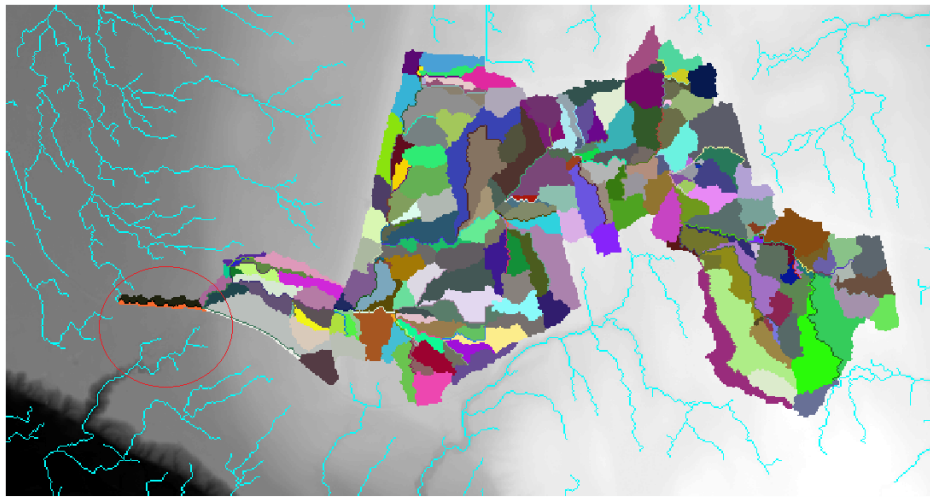
Original

Terraces

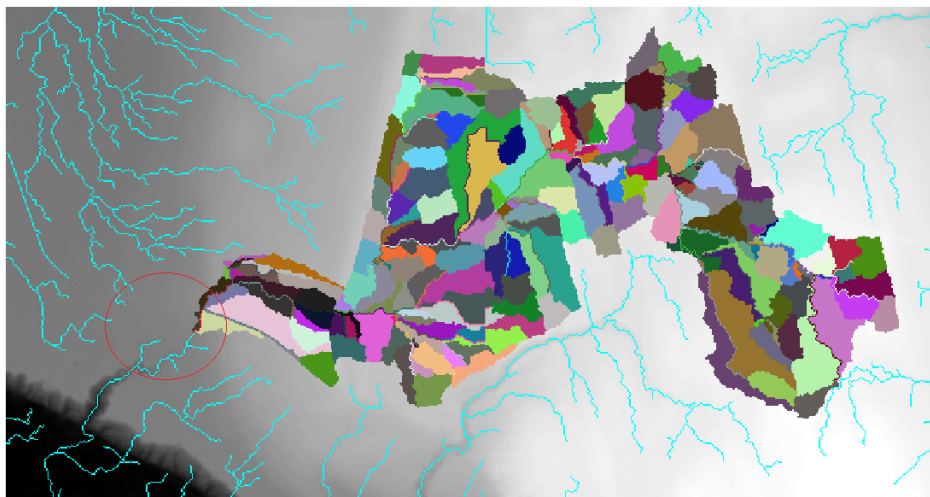


Run off: $2595 \text{ m}^3 / \text{yr}$ $\xrightarrow{+ 528.3 \text{ m}^3 / \text{yr}}$ $3123.3 \text{ m}^3 / \text{yr}$
Soil Loss: $23.7 \text{ ton} / \text{yr}$ $\xrightarrow{+ 6.1 \text{ ton} / \text{yr}}$ $29.8 \text{ ton} / \text{yr}$

Culvert Tool for flow direction



Original



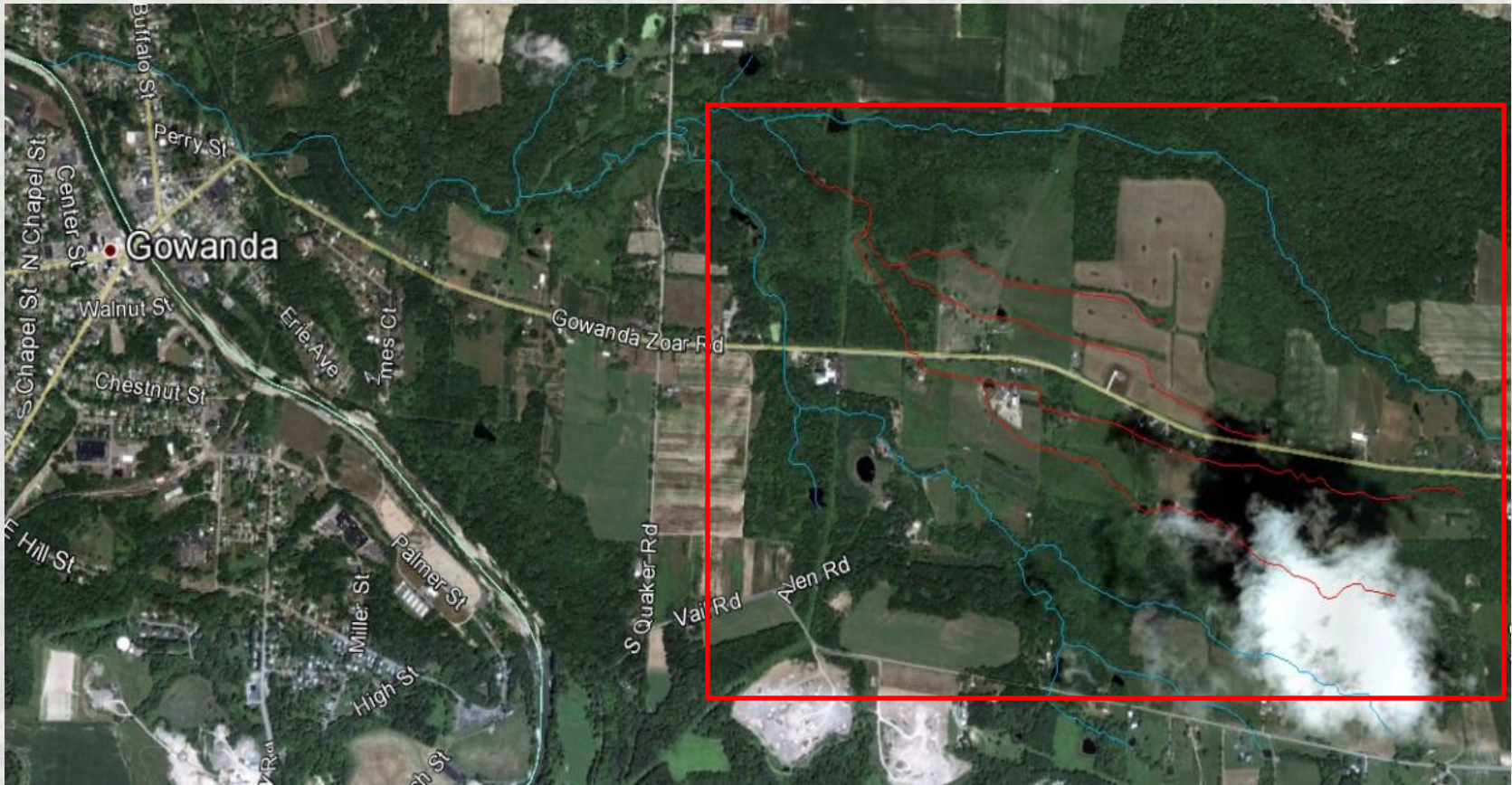
Culvert

Since culvert under road change the flow direction, DEM may record elevation of the road, which is above culvert and leads to incorrect flow direction.

Noted that DEM resolution may greatly influence flow direction

5m DEM for another study site
Developed by Brian Clarkson

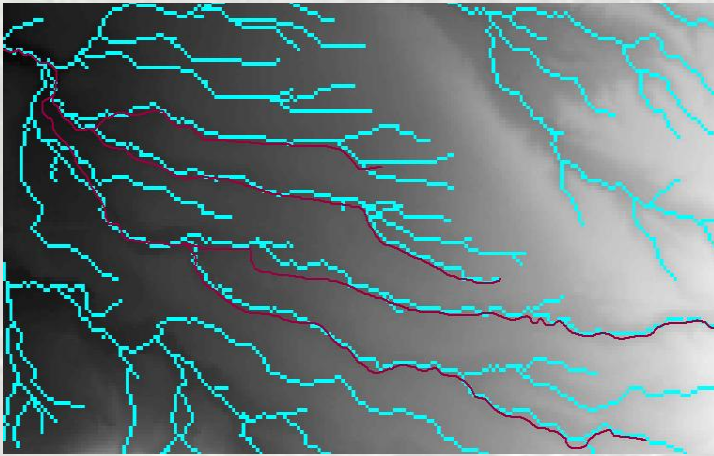
Stream Customization – GeoWEPP Extension



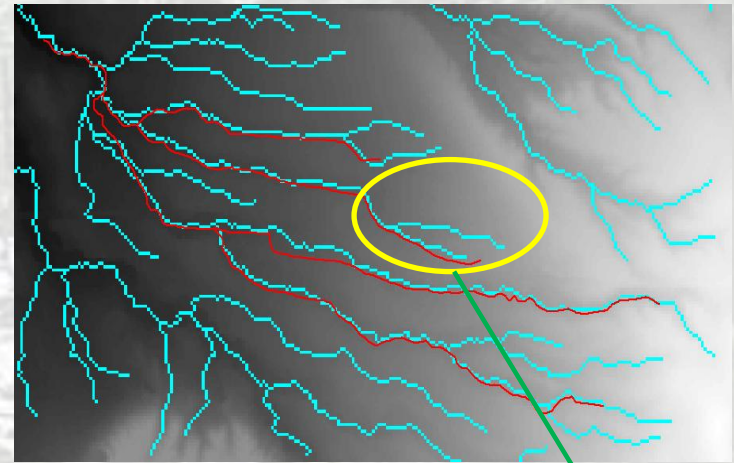
Select a point in channel to specify where the channel start
Make sure that hydrology in model is correct for further process.

Stream Customization – GeoWEPP Extension

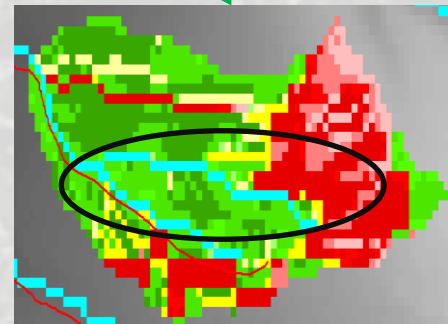
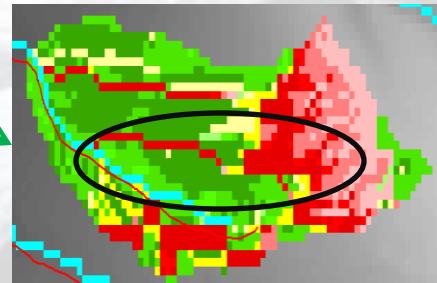
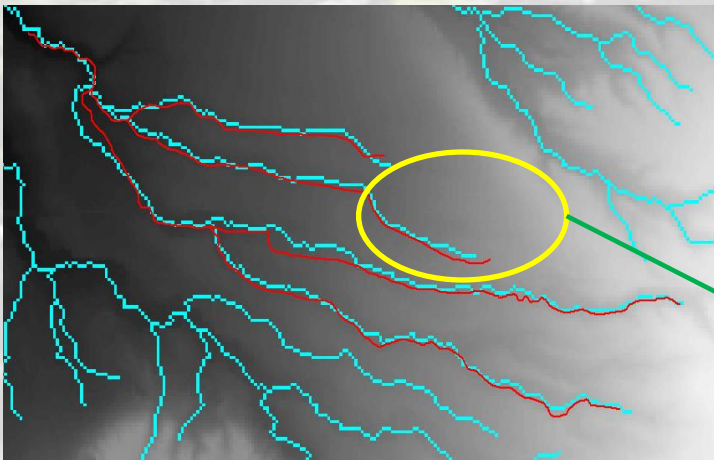
ArcMap Hydrology Tools



GeoWEPP without customization



GeoWEPP with Customization



<http://geowepp.geog.buffalo.edu/>

08/15/2010
GeoWEPP for ArcGIS 10.x
release (tentative)

in GeoWEPP User Group

LESAM
Landscape-based Environmental System Analysis & Modeling

Admin

- Site Admin
- Log out
- Entries RSS

GeoWEPP

The Geo-spatial interface for the Water Erosion Prediction Project

Home About GeoWEPP People and References Versions Customized Versions Training Materials FAQ Join Mailing List Contact Us

Support and Funding

Users around the World

Awards and News

Welcome to GeoWEPP

The **Geo-spatial interface for WEPP (GeoWEPP)** (Renschler, 2003) utilizes digital geo-referenced information such as digital elevation models (DEM) and topographical maps to derive and prepare valid model input parameters and defaults to start site-specific soil and water conservation planning for a small watershed with a single soil and land use for each sub-catchment.



The **Water Erosion Prediction Project (WEPP)** (Lafren et al., 1991; Flanagan and Nearing, 1995) model is a continuous simulation, process-based model that allows simulation of small watersheds and hillslope profiles within those watersheds for assessing various soil and water conservation management options for agricultural, rangeland, and forest sites. The integration of orthophotos, soil surveys, land use maps, climate data, and precision farming data as well as multiple soil and land use within each sub-catchment is currently under development.

Go to "http://geowepp.geog.buffalo.edu/about/"

References

- **GeoWEPP:**
- Renschler, C.S. (2003) Designing geo-spatial interfaces to scale process models: The GeoWEPP approach. *Hydrological Processes* 17, p.1005-1017.
- **WEPP:**
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- **GeoWEPP Applications:**
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- Renschler, C.S., and D.C. Flanagan (2008) Site-Specific Decision-Making Based on GPS RTK Survey and Six Alternative Elevation Data Sources: Soil Erosion Prediction. *Transactions of the ASABE* 51(2):413-424.[2009 ASABE Superior Paper Award]
- Renschler, C.S., and Lee, T. (2005) Spatially distributed Assessment of Short- and Long-term Impacts of Multiple Best Management Practices in Agricultural Watersheds. *Journal of Soil and Water Conservation* 60(6):446-456.
- Renschler, C.S., Flanagan, D.C., Engel, B.A., Kramer, L.A., and Sudduth, K.A. (2002) Site-Specific Decision-Making Based on GPS RTK Survey and Six Alternative Elevation Data Sources: Watershed Topography and Delineation. *Transactions of the ASAE* 45(6):1883-1895.
- Renschler, C.S., and J. Harbor (2002) Soil erosion assessment tools from point to regional scales – The role of geomorphologists in land management research and implementation. *Geomorphology* 47, p.189-209.