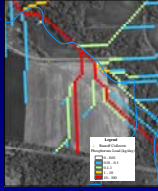
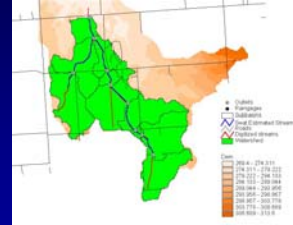


**Predicting Non Point Source Pollution Paths  
For Locating Best Management Practices ?**



by  
**Paul L. Richards**  
Department of Earth Sciences  
SUNY College at Brockport

Glacial-depressional environments comprise large portions of the developed Great lakes region. These environments pose a challenge for P and sediment TMDL modeling because of the complex nature of surface flow paths.



**SWAT MODEL OF A MILL CREEK TRIBUTARY**

**WOULDN'T IT BE NICE TO BUFFER  
ONLY THOSE STREAM SEGMENTS THAT  
ACTUALLY RECEIVE PHOSPHOROUS ?**



Bren (1998, 2000) theoretically showed through flowpath considerations that loads per unit stream length are highly variable.

- Higher order stream segments receive less
- Tributary junctions are sensitive to loads

**MODELS THAT INCORPORATE TOPOGRAPHIC INFORMATION**

**Weighted Flow Accumulation**  
Richards and Campbell (2002)

**Topmodel**

Beven and Kirkby (1979)

**Topmodel – Loading coefficients**

Endreny and Wood (2003)

**Ansfor**

Thomas and Beasley (1986)



**OBJECTIVES**

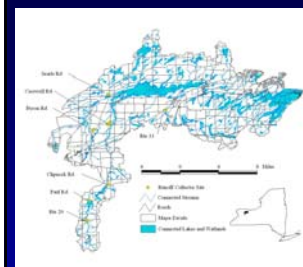


- 1) Run the weighted phosphorous accumulation Model (Richards and Campbell, 2002) for Black Creek to identify phosphorous transport paths capable of reaching Black Creek
- 2) Evaluate the accuracy of the model in locating significant streamlines and tributary junctions
- 3) Collect field data on some of these overland P flowpaths to determine the following:

Was the transport path present ?

Do model rankings between P transport paths agree with field data. ?

**STUDY AREA**



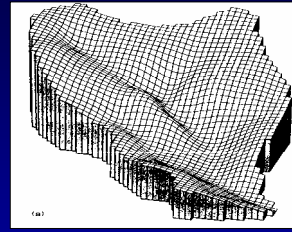
**Agricultural in the west**

**Urbanizing in the east**

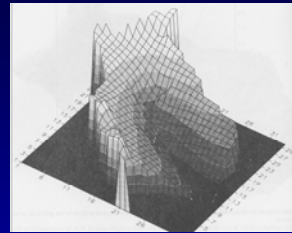
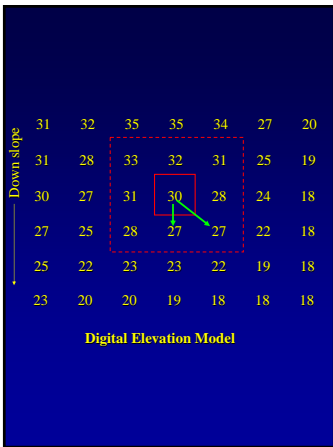
Long history of settlement



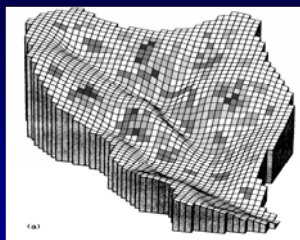
THE MODEL



Digital Elevation Model



FLOW ACCUMULATION GRID



FLOW ACCUMULATION GRID WEIGHTED BY TOTAL PHOSPHOROUS LOAD FROM EACH CELL

CALCULATING PHOSPHOROUS LOAD

$$FLUX = CONC * RUNOFF$$

FLUX, phosphorous load (g/day)

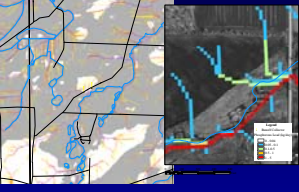
CONC, Event mean conc (g/vol)

RUNOFF, runoff (vol/day)



### MODEL OUTPUT

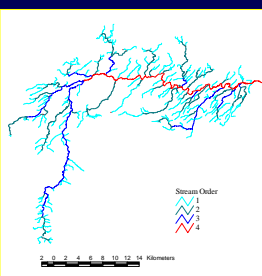
1) Identify transport paths on the hill slope by colorcoding only those cells that receive large phosphorous fluxes.



2) Identify channel segments by classifying cells with high threshold flow accumulation values. Different values are iteratively run to obtain the modeled stream network that is closest to the true length of stream network that is closest to the true length of stream network and has the same structure.

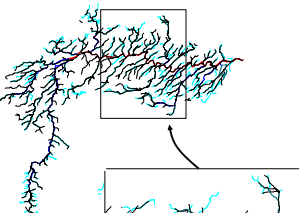
### MODEL VERIFICATION

Objective 2 Evaluate the accuracy of the model for locating flow center lines.



1:24,000 hydrography for verification

### RESULTS



Optimal threshold  
2.2

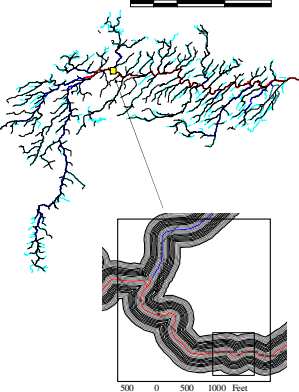
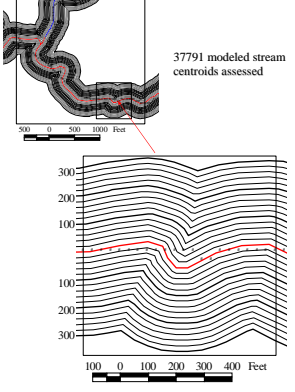
Stream length  
99.2% of actual

87.5% of 1<sup>st</sup> order  
Streams represented

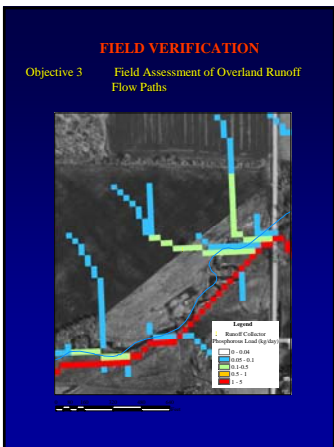
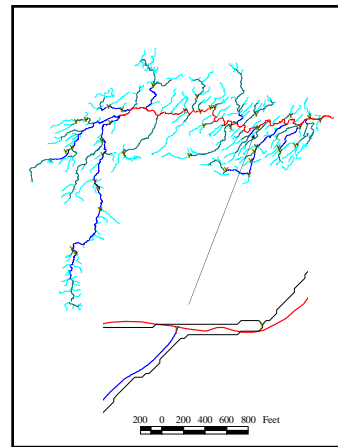
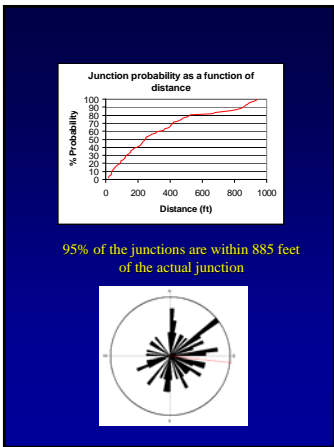
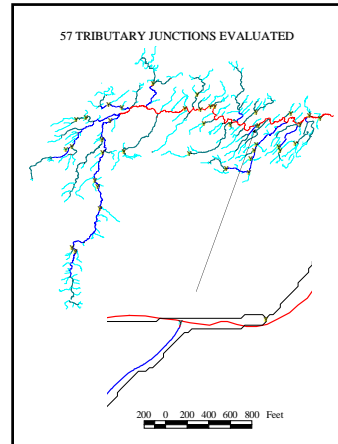
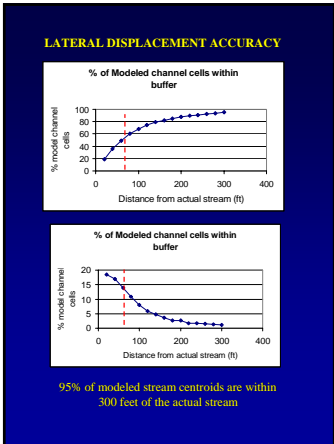
100% of 2<sup>nd</sup>, 3<sup>rd</sup> and  
4<sup>th</sup> order streams

### Types of errors:

- 1) Missing (whole) stream segments
- 2) Whole stream segments present in the model but not in nature.
- 3) Extension errors
- 4) Lateral displacement of stream segments

37791 modeled stream  
centroids assessed





Overland Runoff qualitatively measured in three Categories:

- 1) Runoff less than 3.8 liters (accurate).
- 2) Runoff greater than 3.8 liters, but not flowing when the collector was sampled. Volume estimated to be equivalent to the volume of the runoff collector plus the volume of the hole.
- 3) Runoff greater than 3.8 liters and still flowing. Runoff estimated to be the measured flow integrated over a 24 hour period.

\*Except for the first category these are all underestimates

### Runoff Metrics Evaluated

Approximate volume of overland flow and total phosphorous

Mean concentration of phosphorous

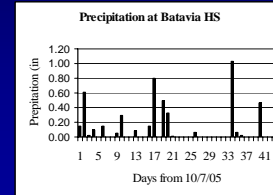
Frequency of active overland flow

Catchment area associated with the runoff collector

Depression Storage

Soil moisture changes after the event

Duration of ponding after the event



### FIELD RESULTS

The model predicted the presence of the larger overland flow paths reasonably, however it was inaccurate on:

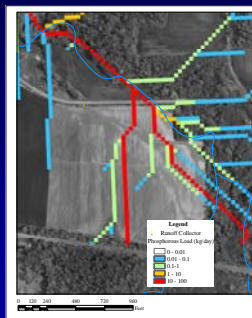
- The precise location

- Whether the flowpath was hydrologically connected to the Black Creek

IN FACT, more was learned by what the model DID NOT predict.



BYRON ROAD SITES



PAUL RD. SITE



RTE 20 SITES

### FIELD RESULTS

Site Name	Log Phosphorous flux		RANKS	
	Field g/day	Modelled g/day	Field	Model
Paul Rd	1.5	-1.4	1	5.5
Rte 20 N	0	-2.4	2	9
Casswell NW	-0.7	-0.3	3	1
Byron East	-1.1	-1.7	4	6
Clipcock Rd	-1.2	-2	5	8.5
Casswell S	-2.1	-2	6	8.5
Byron West	-2.4	-3.5	7	3
Rte 33	-2.6	-1.4	8	5.5
Casswell SW	-2.8	-0.4	9	2
Scarth	-4.1	-0.7	10	4
Rte 20 S	No Load	-2.7	11.5	10
Casswell N	No Load	-1.9	11.5	7

### CONCLUSIONS

While the P transport model was very useful in the field for identifying sites of enhanced overland runoff, it does not always identify the right location and whether the runoff is hydrologically connected.

Technical issues that still need to be overcome before these models can really be used for onsite BMP Decisions:

*Resolution of the DEM (still too large)*

*Historic changes to topography made by humans (road berms, stream re-routing) that are not reflected in the DEM*

*Location and extent of TILE drains which can modify or exaggerate surface flow paths*

*Model Accuracy for identifying overland flow Paths : 300 feet*

*Model Accuracy for identifying stream junctions: 885 feet (downstream bias)*

### ACKNOWLEDGEMENTS

Funding for this research was supported by a grant from the NYS Water Resources Institute



The authors wish to thank David Cannon and Ryan Grimm for assistance in the field and for processing some of the GIS data. We would also like to thank Erin Magee for her assistance in chemically analyzing the water samples. George Squires of the Genesee County NRCS provided valuable input and advice for the project. We appreciate his assistance and help in the field.