Update on USDA-NRCS Edge-of-Field Runoff Water Quality Study

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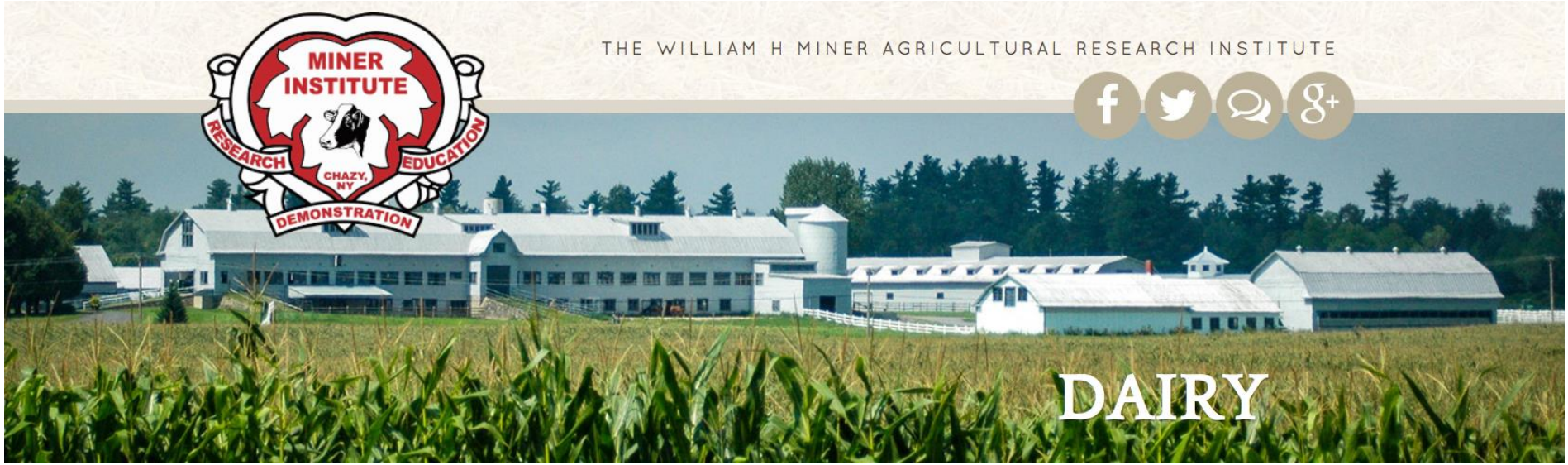
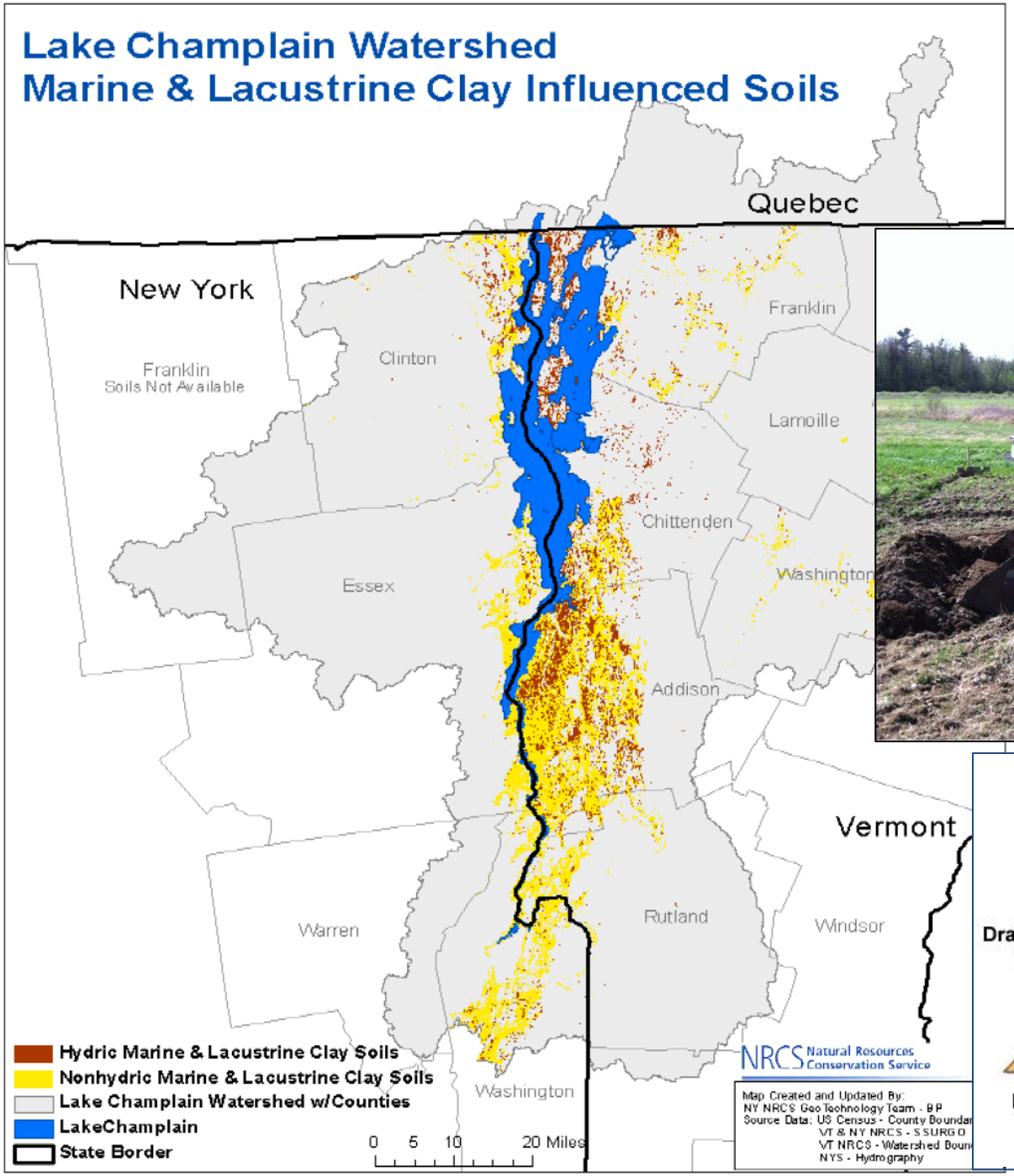
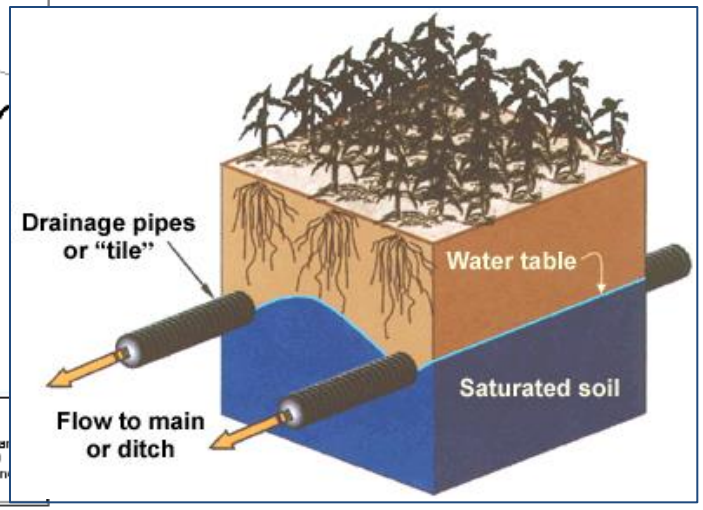


Lake Champlain Watershed
Marine & Lacustrine Clay Influenced Soils





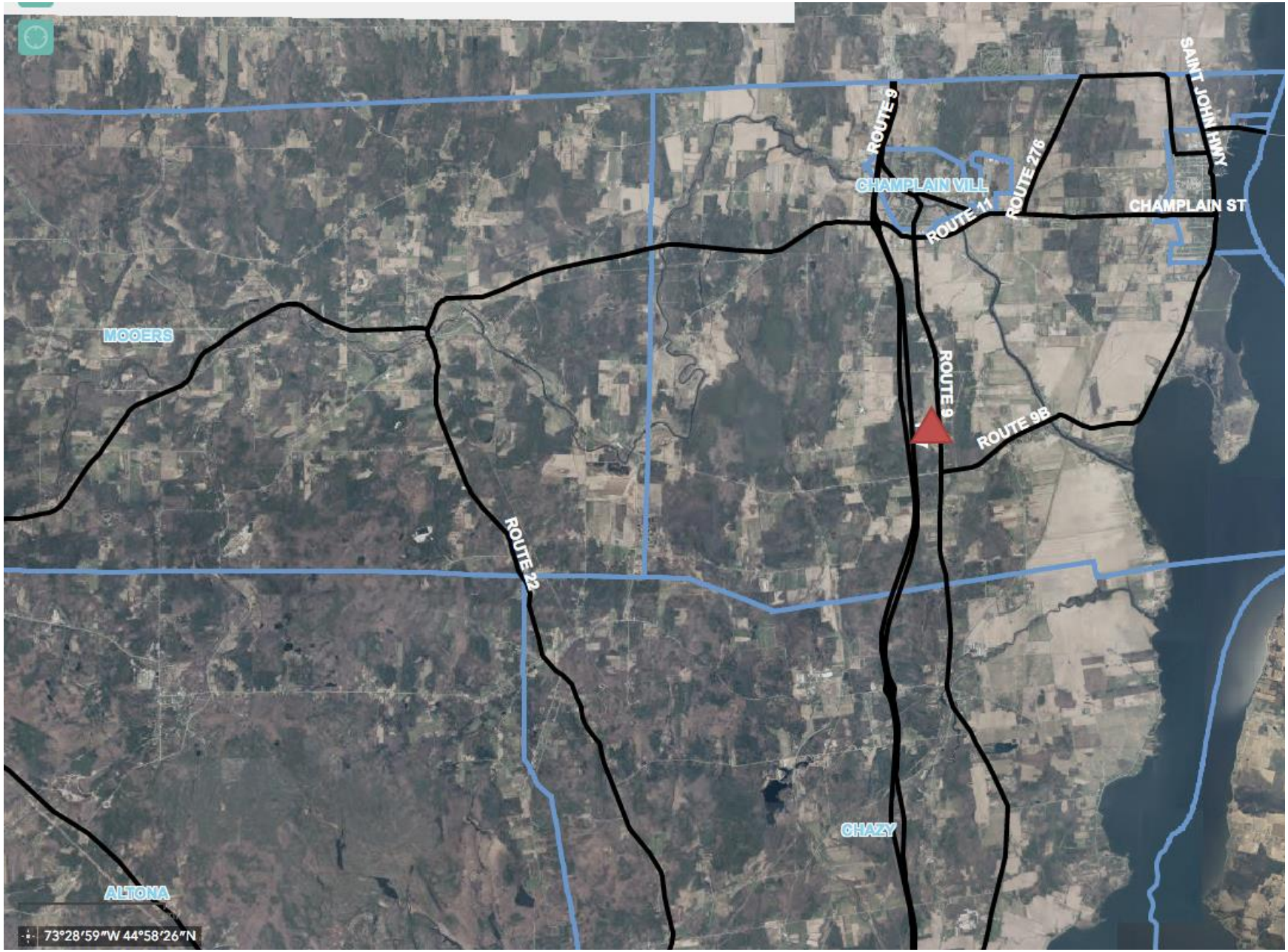
Clays and *macropore* flow

http://soilandwater.bee.cornell.edu/Research/pfweb/educators/intro/macroflow.htm

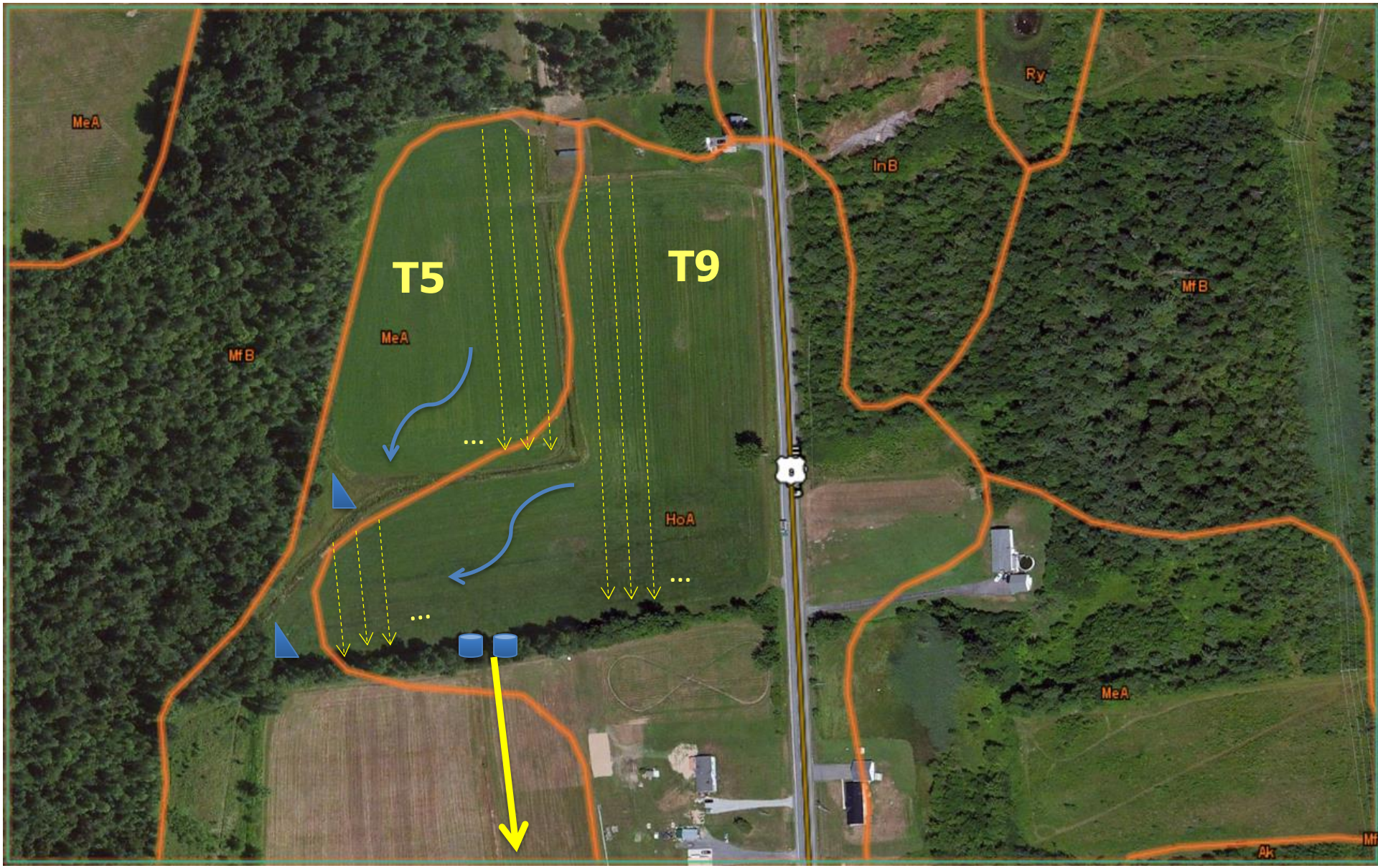
USDA Edge-of-Field Monitoring

- Small paired watersheds (5 and 9 acres)
- 2-year baseline, 4-year treatment period
- Controlled vs. free subsurface drainage
- Sediment, N, & P losses
- Crop yields, nutrient budgets, economics

Site Location

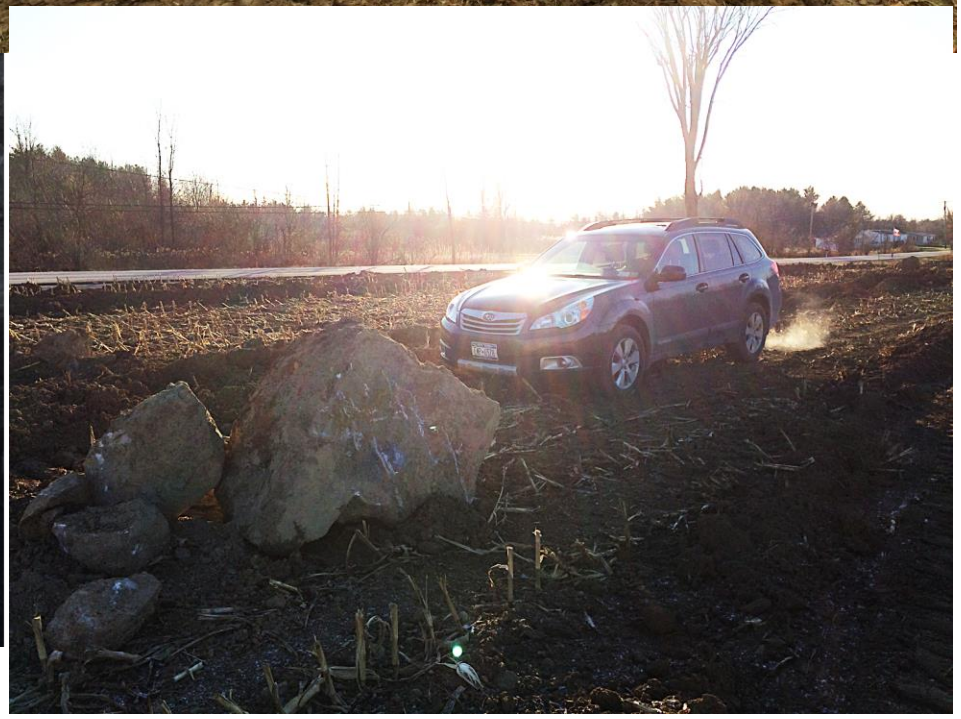


Soils and Drainage



Timeline of Activities

- **2013**
  - Fields selected for NRCS contract
  - Wetland determination…
- **2014**
  - Tile drains installed
  - Subsurface manholes
  - Surface water flumes
- **2015**
  - Flow and sampling instruments
  - Full monitoring October 2015




OESO

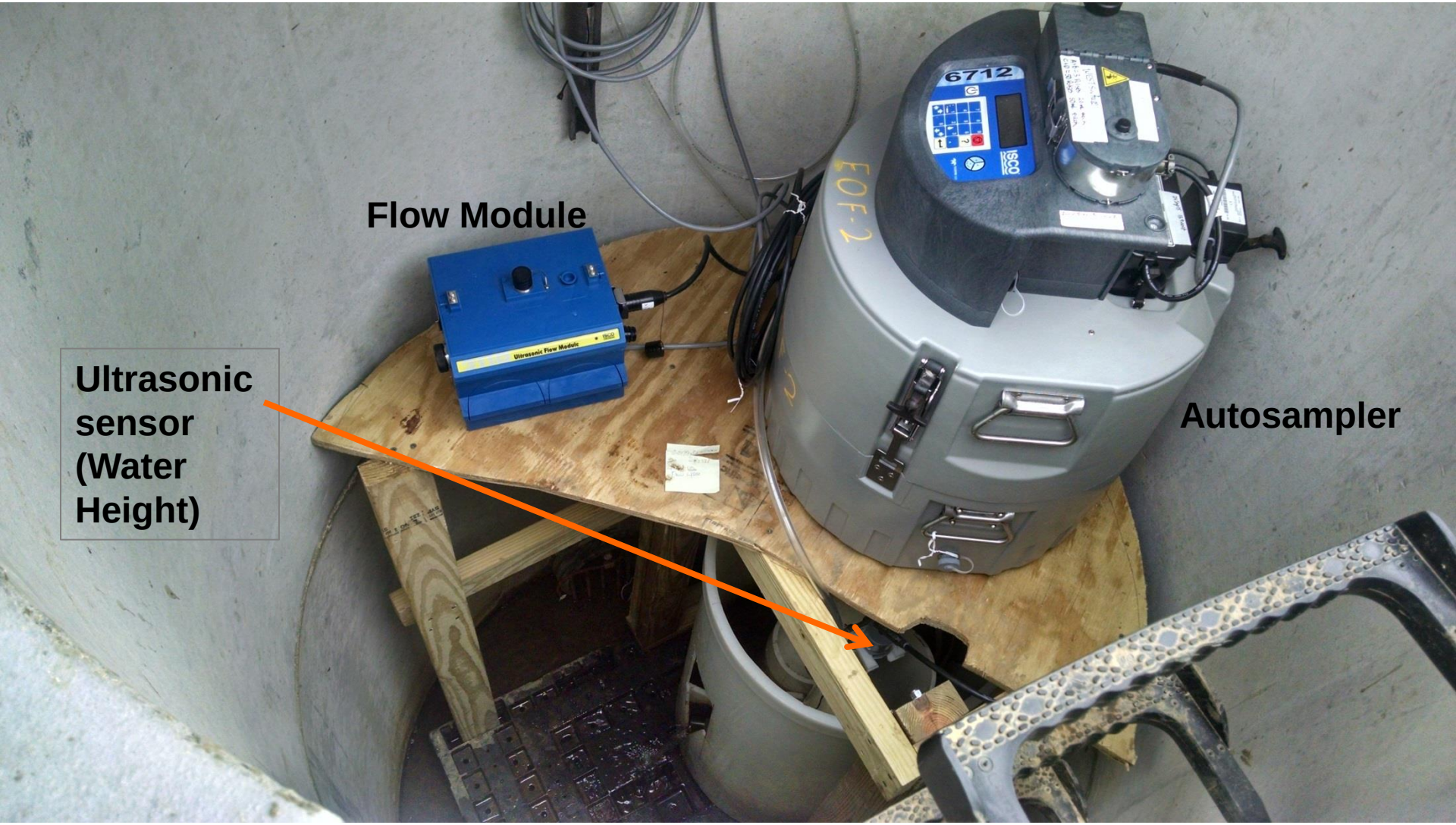
Surface Water Instruments

- 200 mL sample taken/0.70 mm of runoff
- Total suspended solids, total N, nitrate-N, ammonium-N, total P, and soluble reactive P

Subsurface Tile Drain Setup

55 Ga plastic drum with 5 in. V notch weir

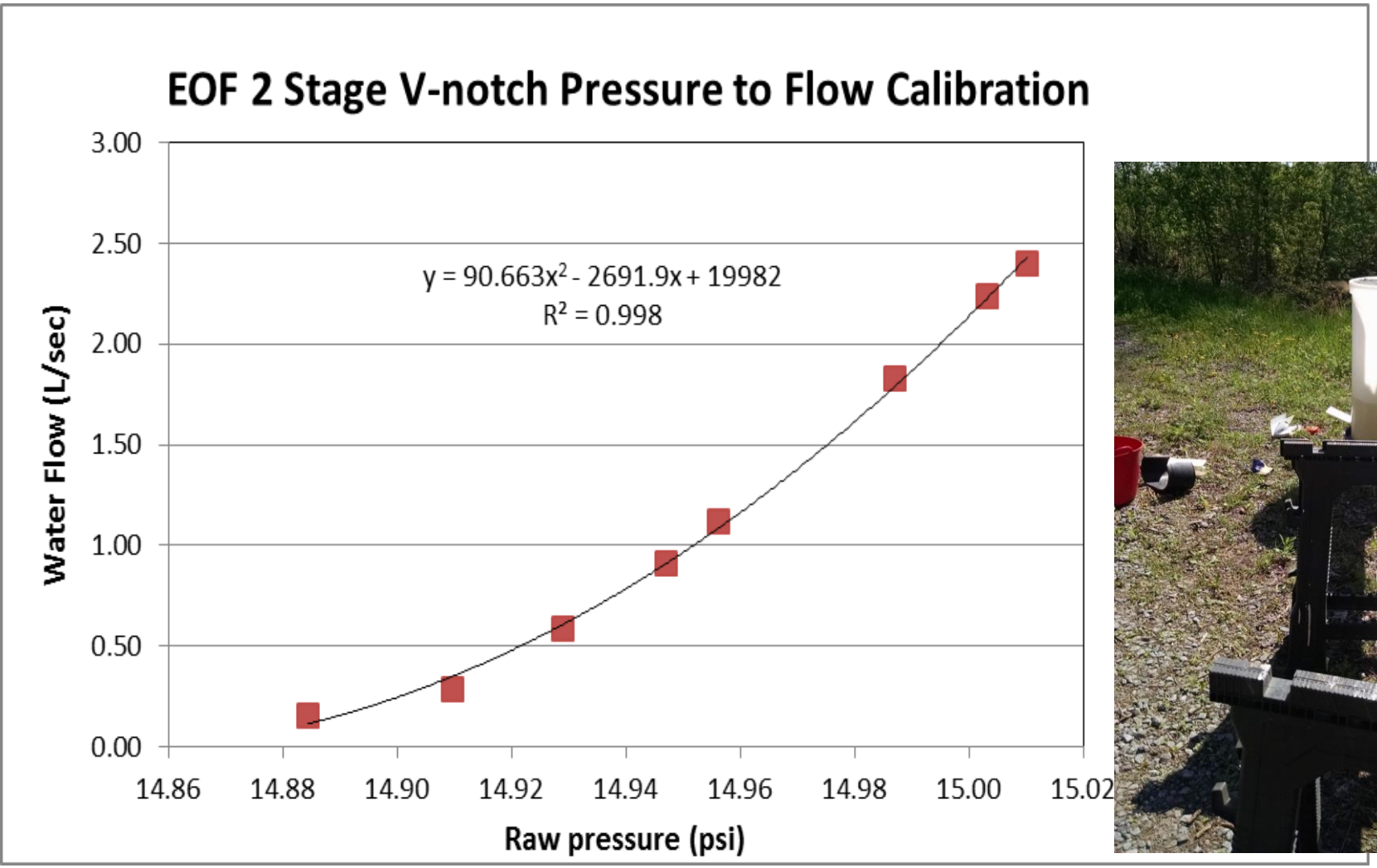
ISCO Autosampler, Flow Module and Ultrasonic sensor



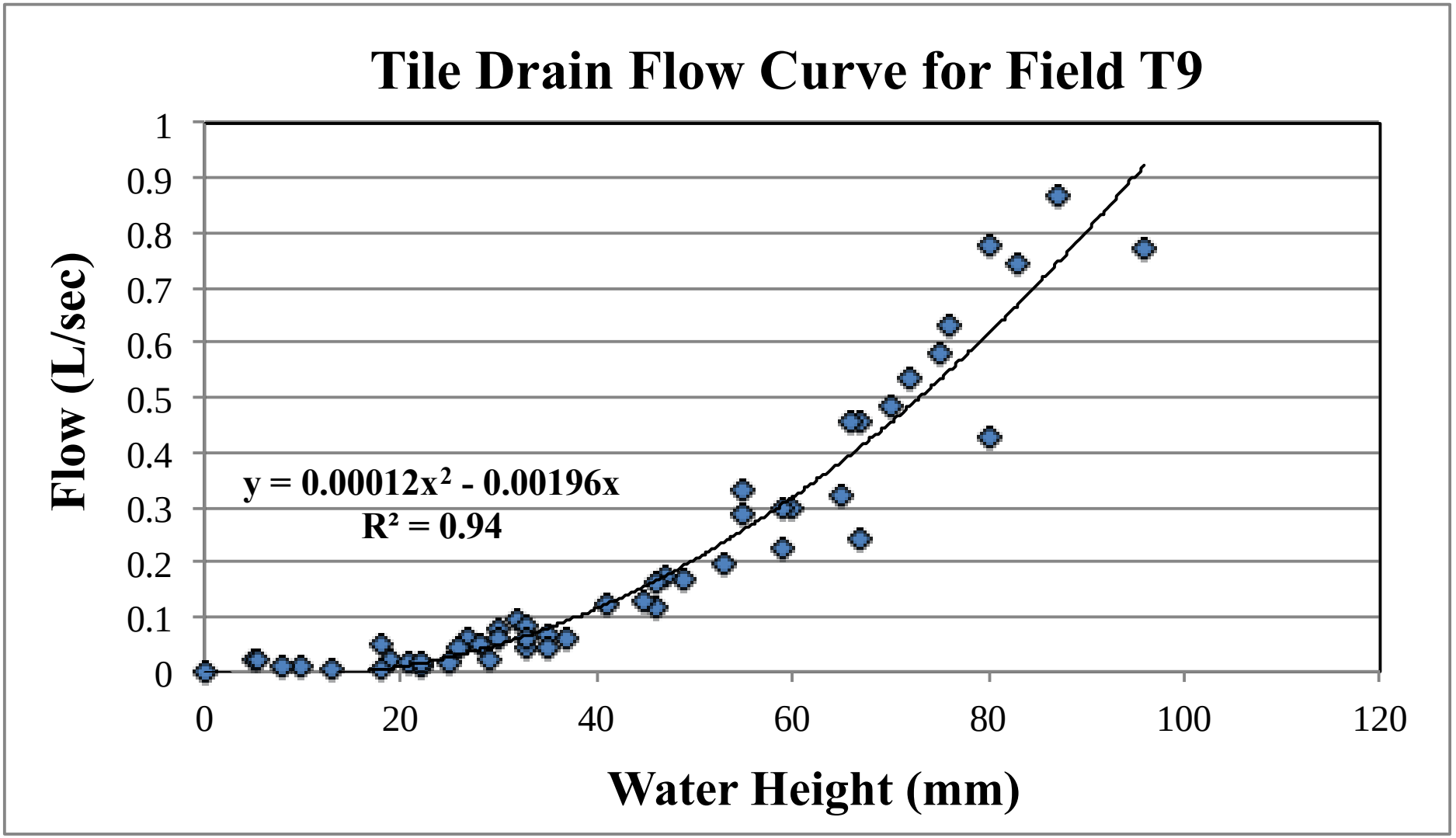
Tile Drain Flow Measurement

Water height/pressure via Ultrasonic sensor -> flow module

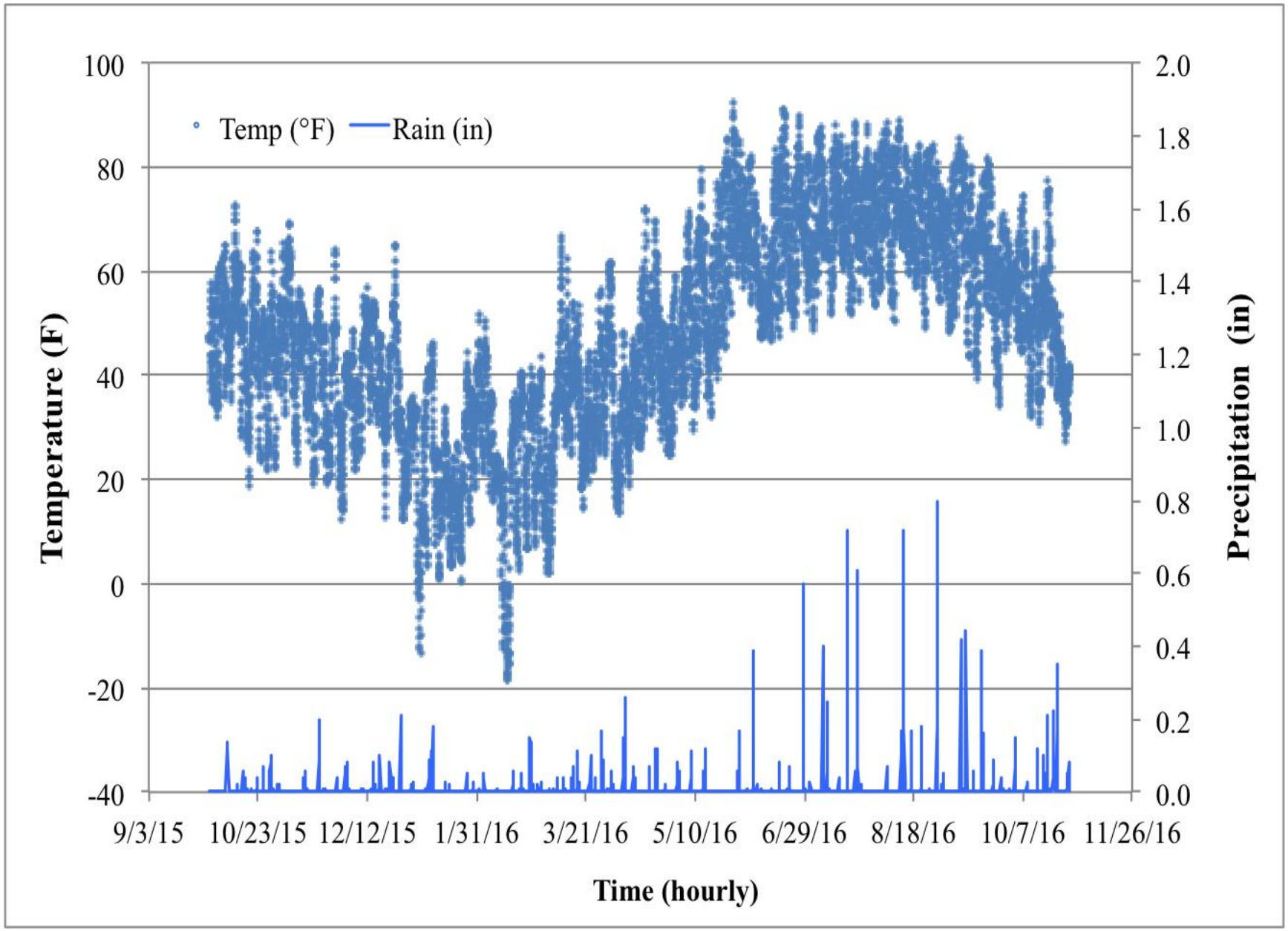
Proof of Concept



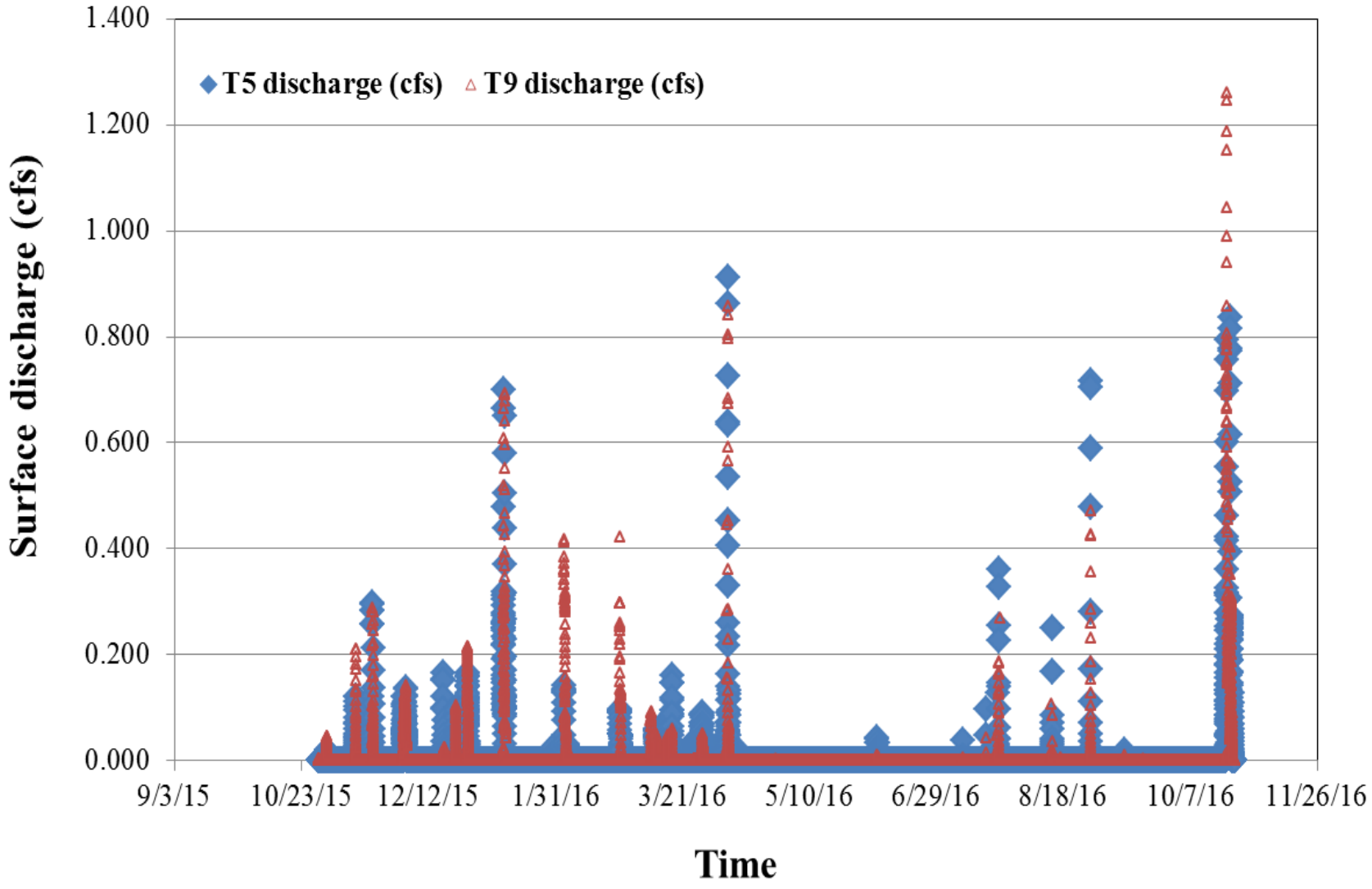
Field Tile Drain Flow Curve



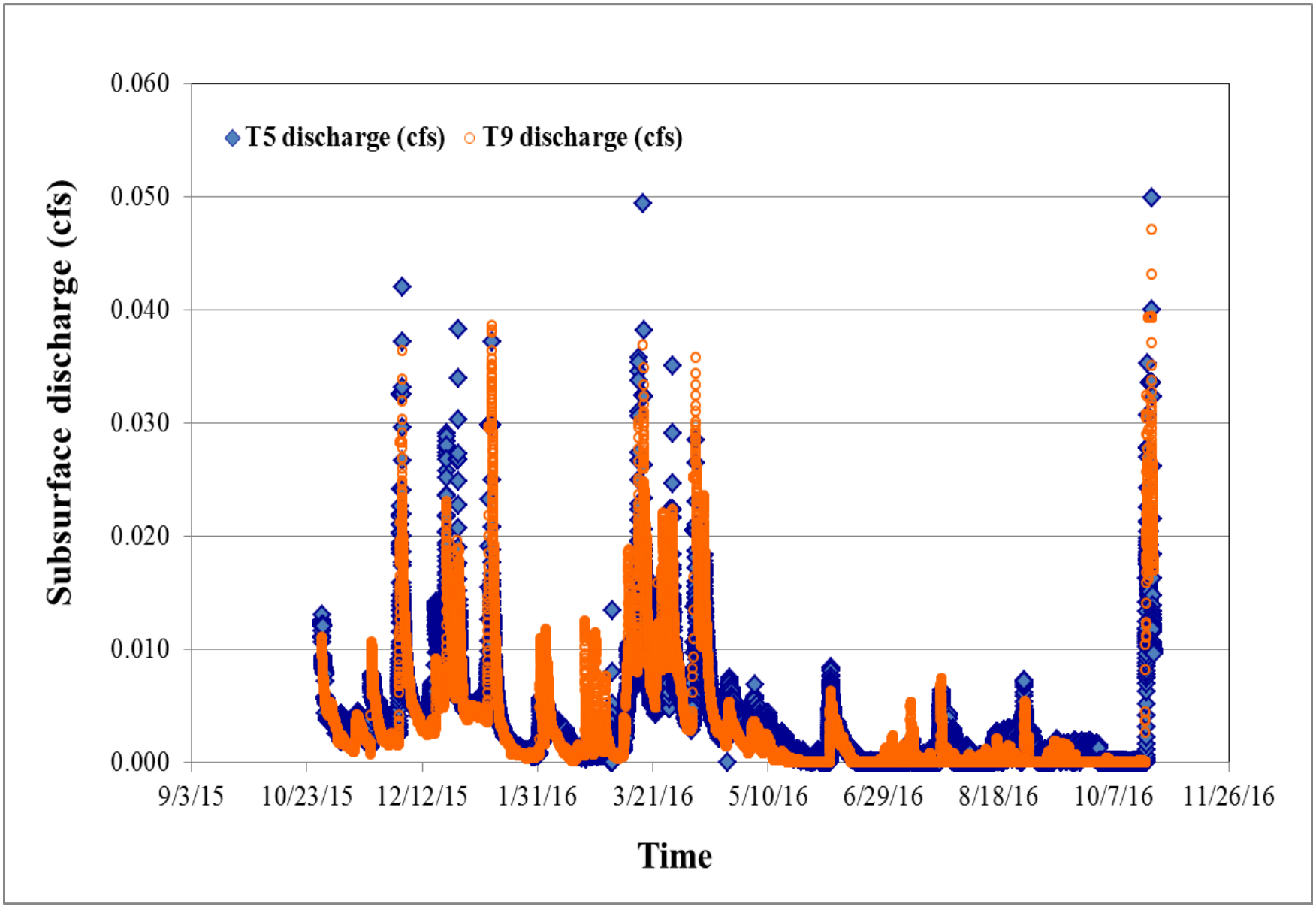
Weather


Temp (°F)
Rain (in)
Temperature (F)
Precipitation (in)
100
80
60
40
20
0
-20
-40
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
9/3/15
10/23/15
12/12/15
1/31/16
3/21/16
5/10/16
6/29/16
8/18/16
10/7/16
11/26/16
Time (hourly)

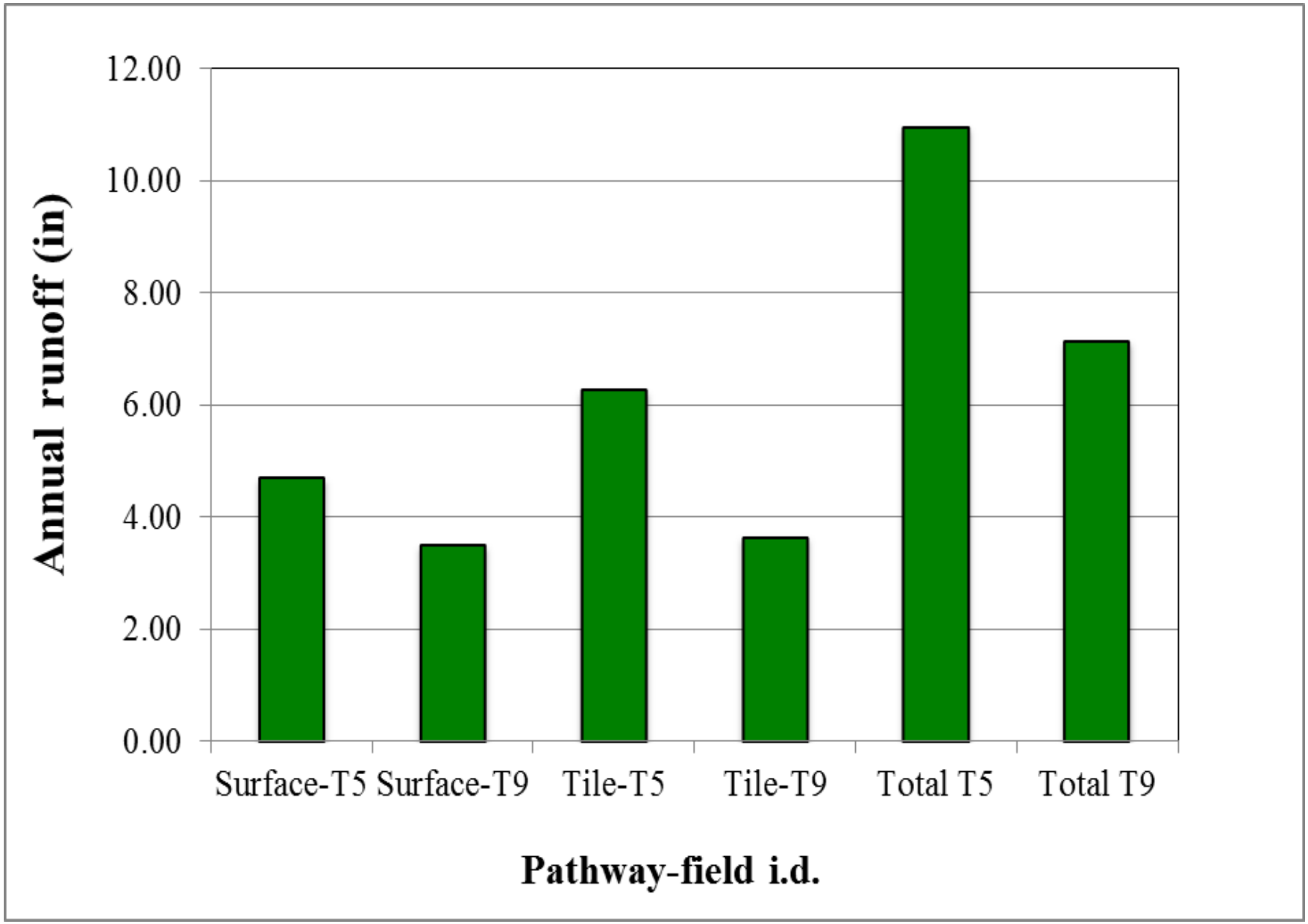
Surface Runoff Events



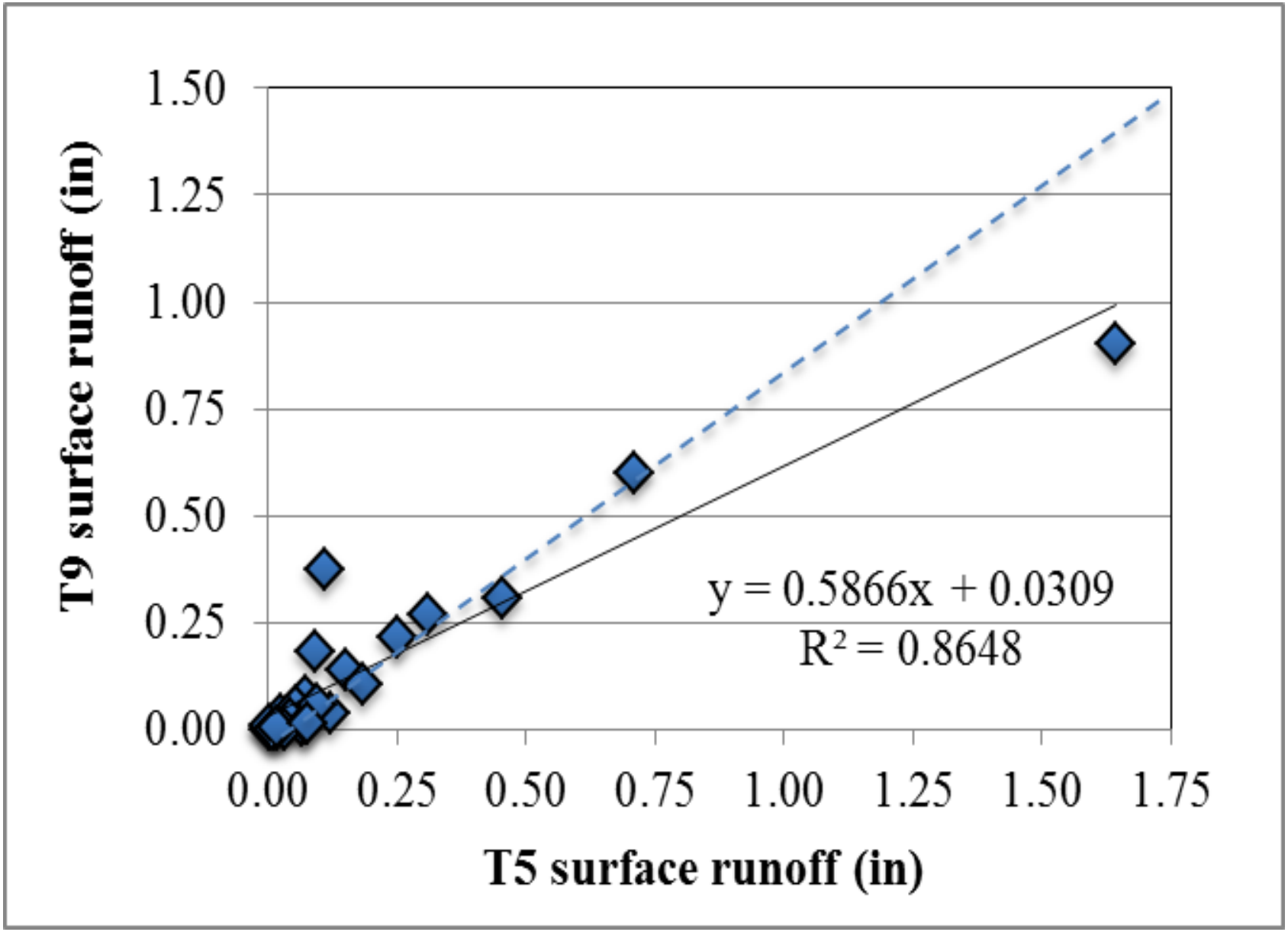
Tile Drain Runoff Events



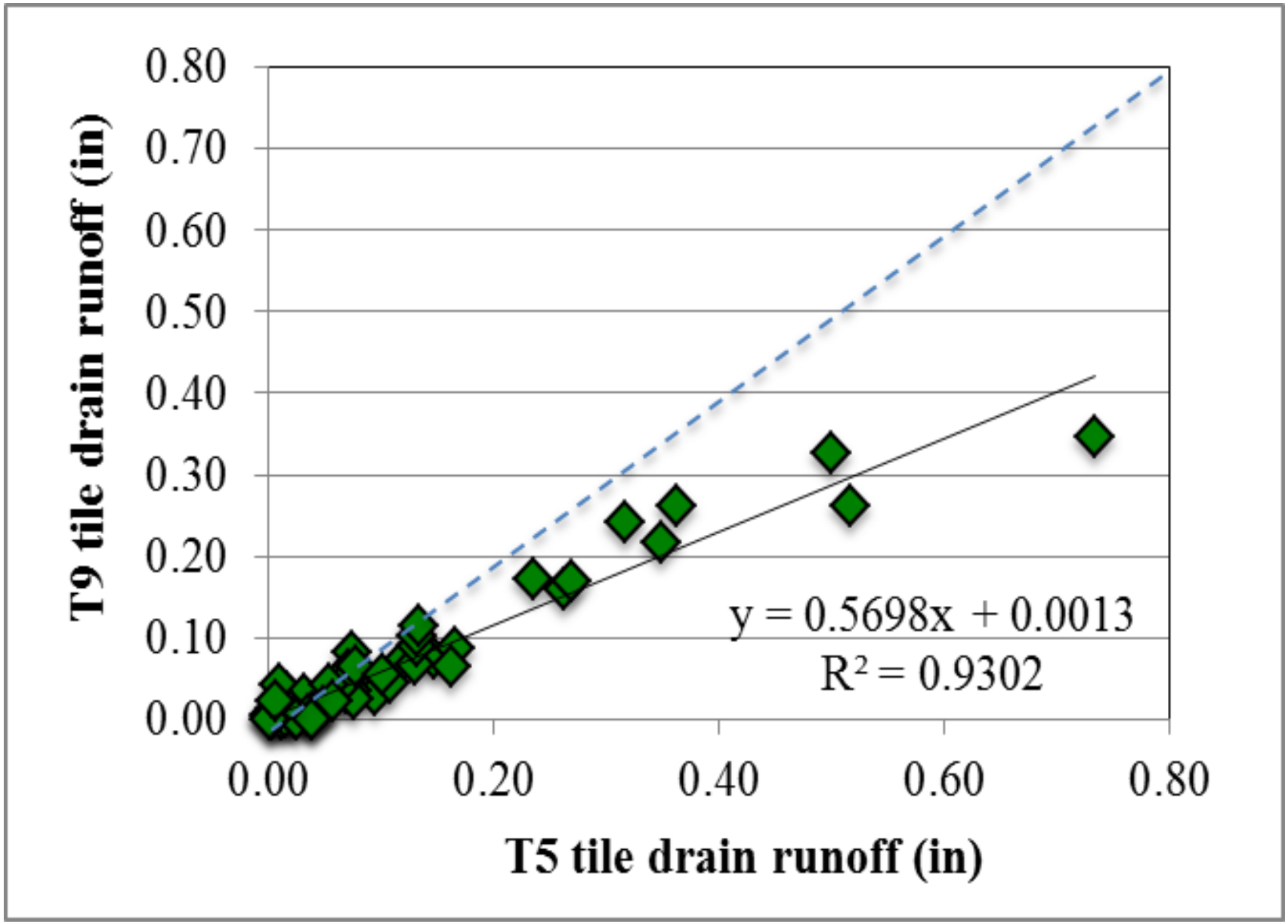
Annual Runoff



Surface Runoff Calibration



Tile Runoff Calibration

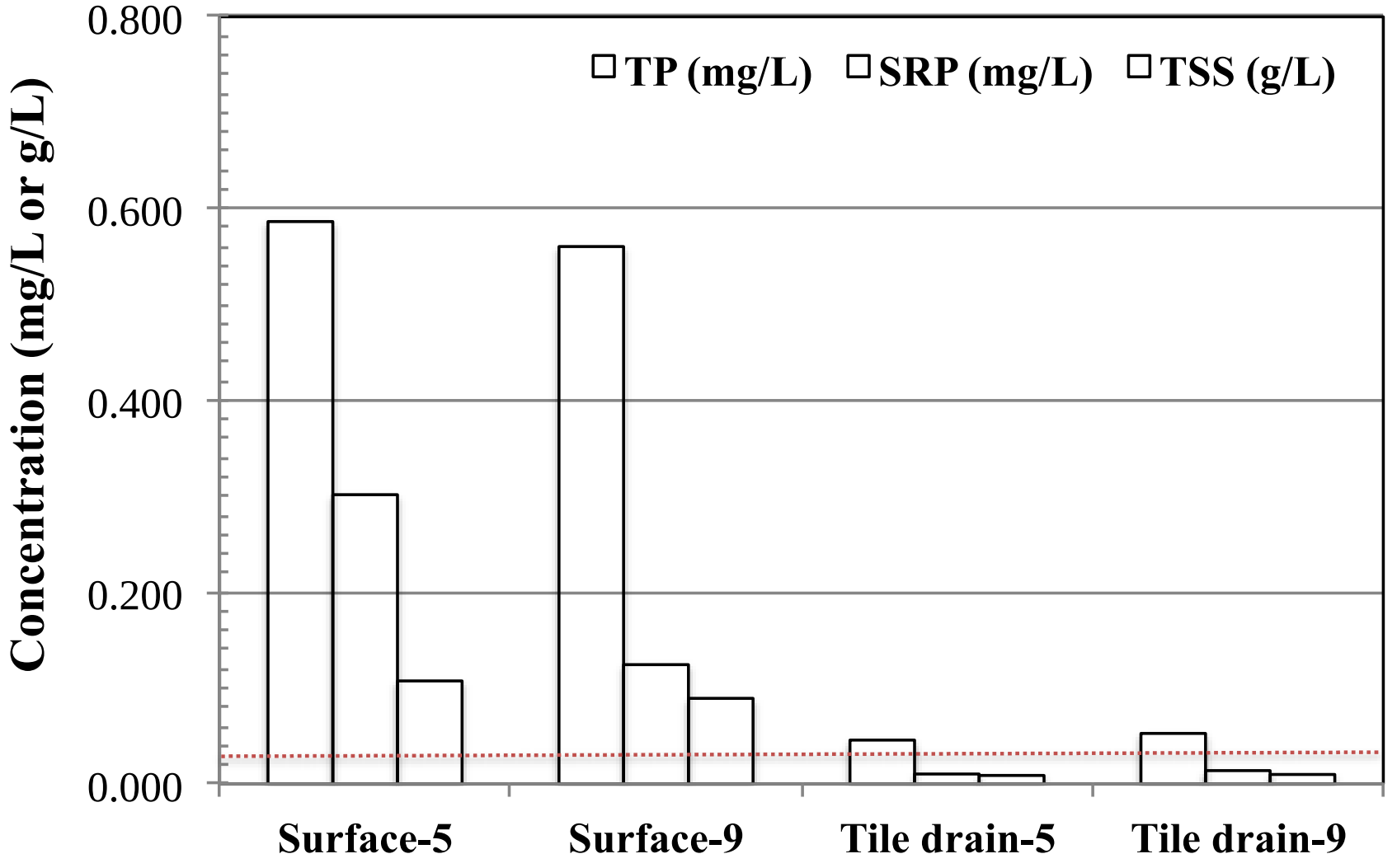


Annual Nutrient Loads

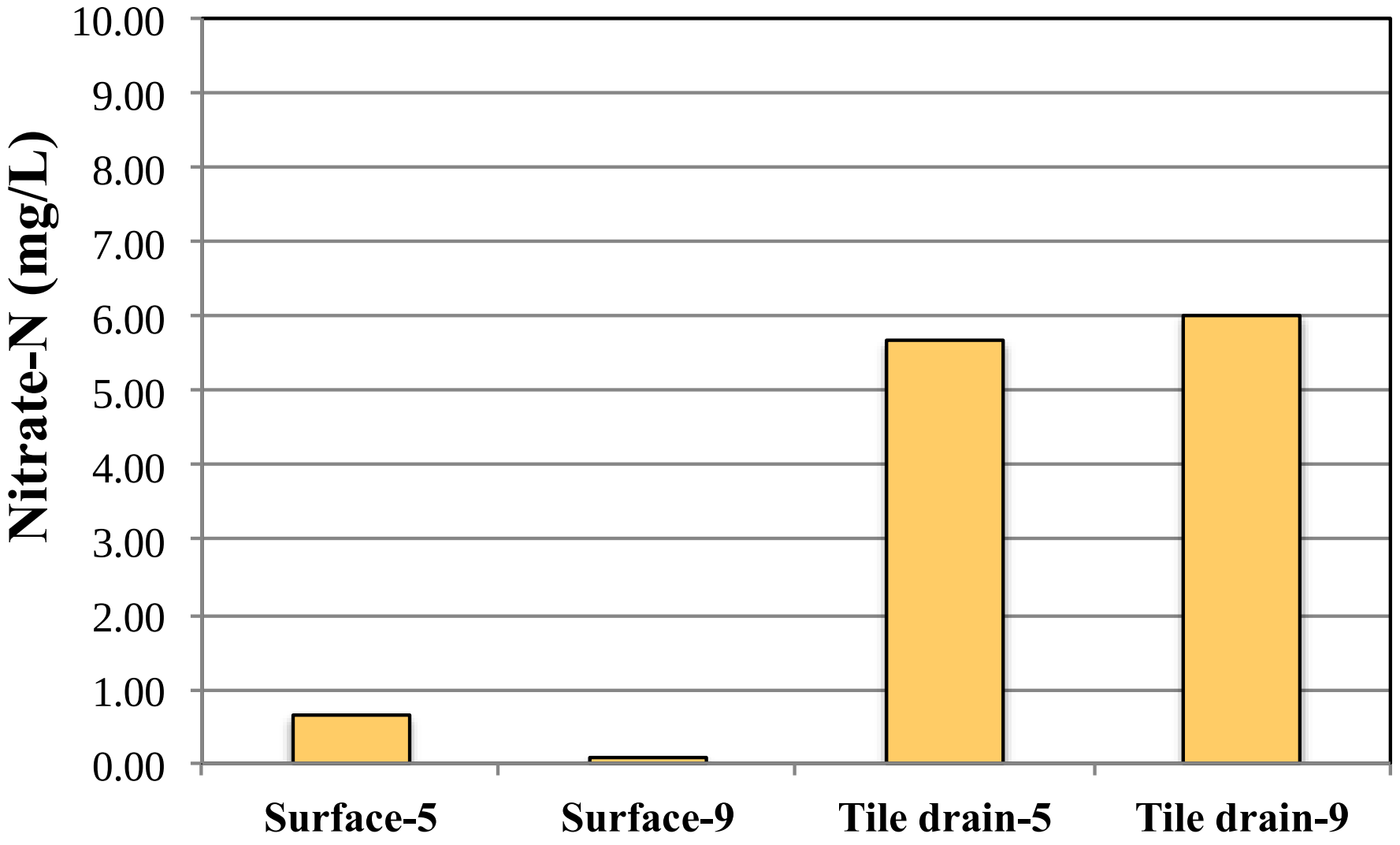
Pathway-Field	SRP load (lb/ac/yr)	TP load (lb/ac/yr)	TSS load (lb/ac/yr)	Nitrate-N load (lb/ac/yr)	TN load (lb/ac/yr)	Amm-N load (lb/ac/yr)
Surface-T5	0.32	0.62	115	0.69	2.02	0.07
Surface-T9	0.10	0.44	71	0.24	1.70	0.06
Tile-T5	0.01	0.06	13	8.04	10.52	0.05
Tile-T9	0.01	0.04	8	4.97	6.48	0.05
Total T5	0.34	0.69	127	8.7	12.5	0.12
Total T9	0.11	0.48	79	5.2	8.2	0.11
T5 % Tile	**4.4**	**9.4**	**10**	**92.1**	**83.9**	**38.9**
T5 % Surface	**95.6**	**90.6**	**90**	**7.9**	**16.1**	**61.1**
T9 % Tile	**10.4**	**9.0**	**10.3**	**95.4**	**79.2**	**47.3**
T9 % Surface	**89.6**	**91.0**	**89.7**	**4.6**	**20.8**	**52.7**

- 90 to 96% of TP loss = surface runoff
- 91% of SRP loss = surface runoff
- 90% of sediment loss = surface runoff
- 79 to 84% of nitrate-N loss = tile drainage

Flow weighted mean concentrations



FWM Nitrate-N concentrations



N and P Efficiency

Field	100 lb/ac 23-12-18	80 lb/ac sidedress N	Total N input (lb/ac/yr)	Total P input (lb/ac/yr)	Total K input (lb/ac/yr)
T5	YES	YES	114.5	7.9	22.0
T9	YES	YES	114.5	7.9	22.0

Field	% N efficiency	% P efficiency
T5	89.1	91.3
T9	92.5	93.2

Summary

- ≥ 90% of total and soluble P loss from surface runoff
- 90% of sediment loss from surface runoff/erosion
- Majority of N loss from tile flow
- Importance of field hydrology
- Nutrient management critical


Thank You!
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NRCS Natural Resources Conservation Service