

# Monitoring Tile Drainage and Conservation Drainage Practices

Dr. Jane Frankenberger  
Purdue University  
Agricultural & Biological Engineering

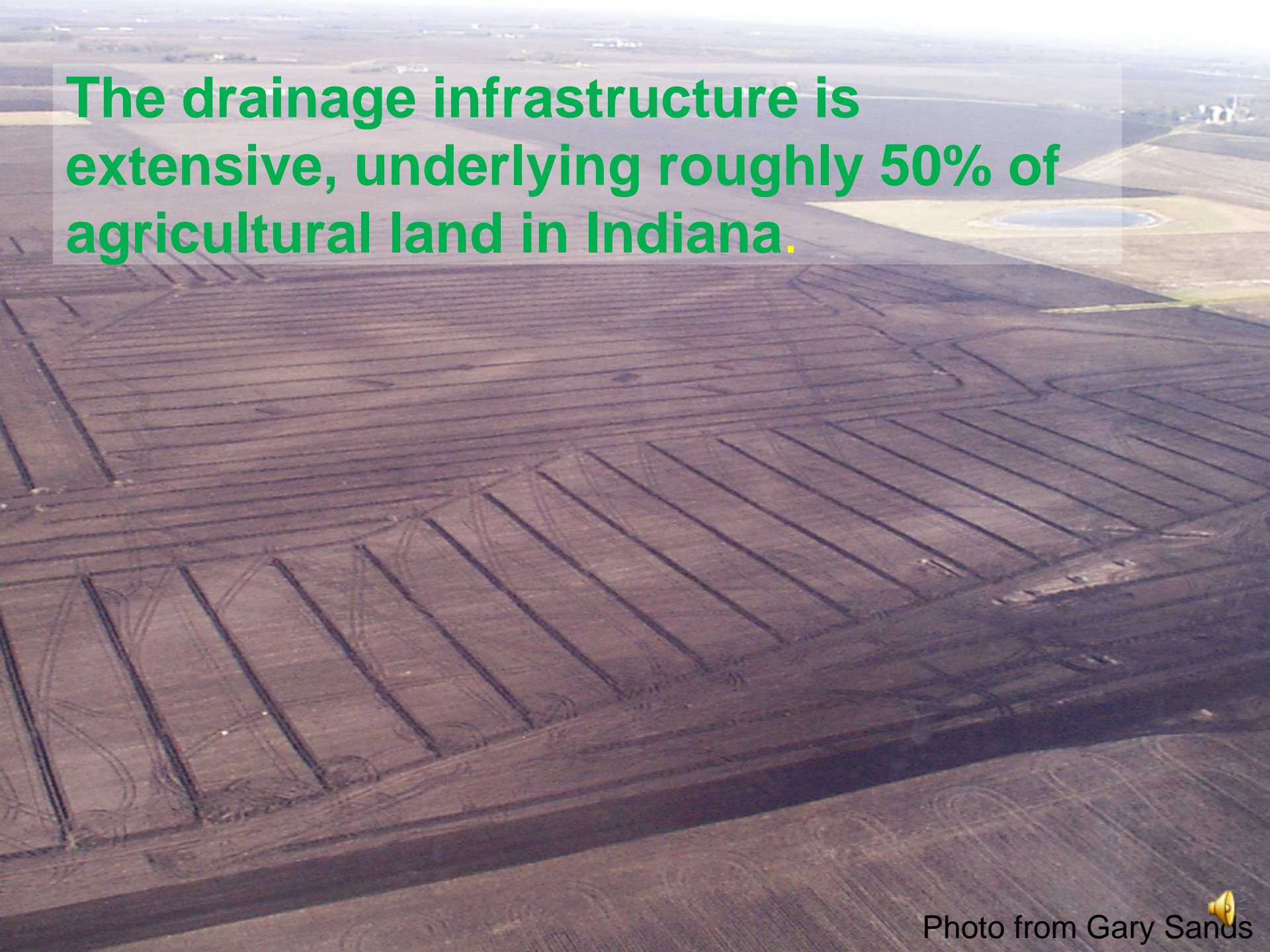
Indiana Water Monitoring Council Symposium  
December 2014

Photo: Dan Jaynes





The drainage infrastructure is extensive, underlying roughly 50% of agricultural land in Indiana.





**Drainage is still being installed, and at rates higher than ever in recent years**



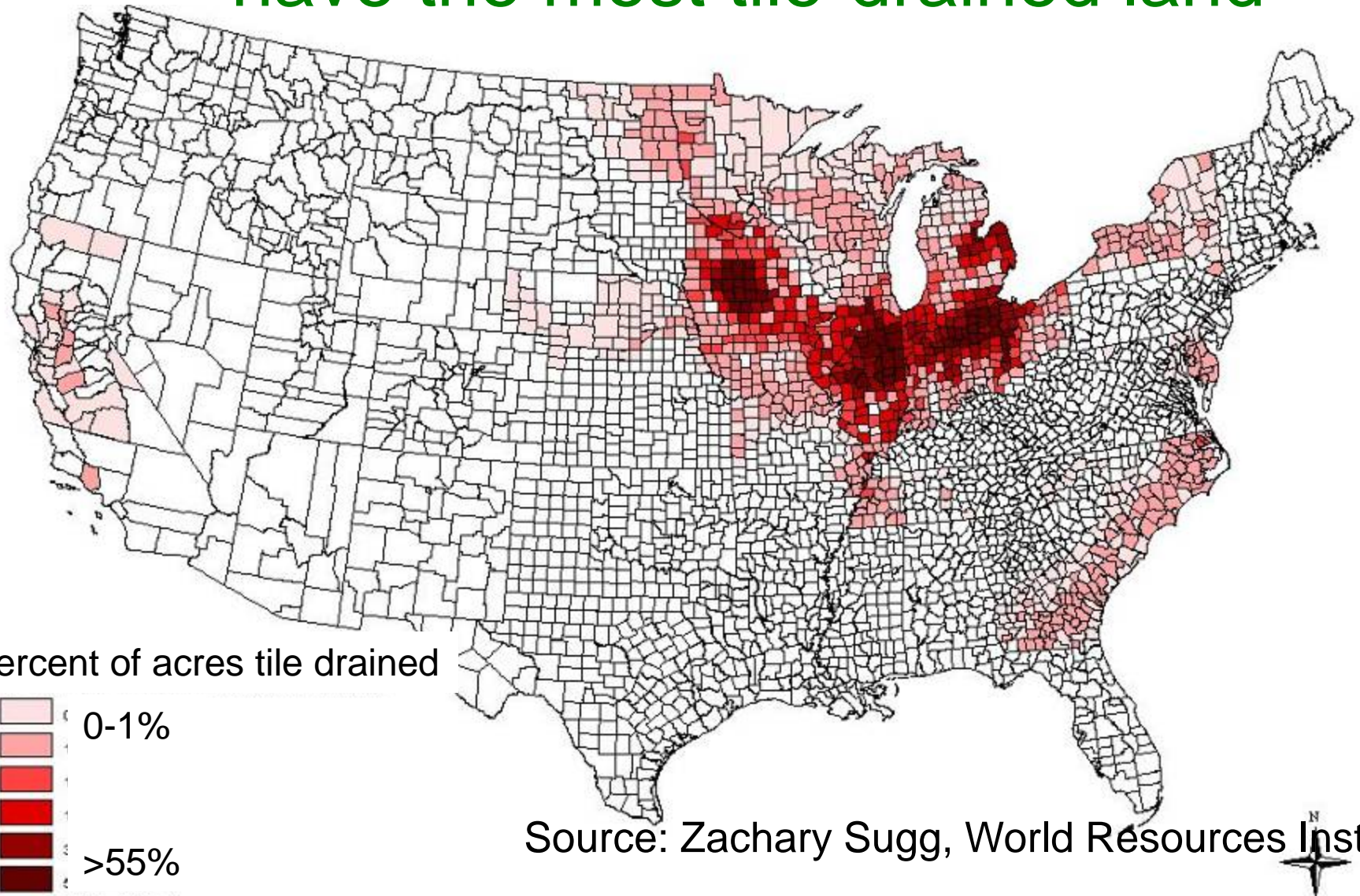


# **Drainage is still being installed, and at rates higher than ever in recent years**

- Yield monitors on combines make the effects of drainage more easily recognizable
- High crop prices made additional drainage pay



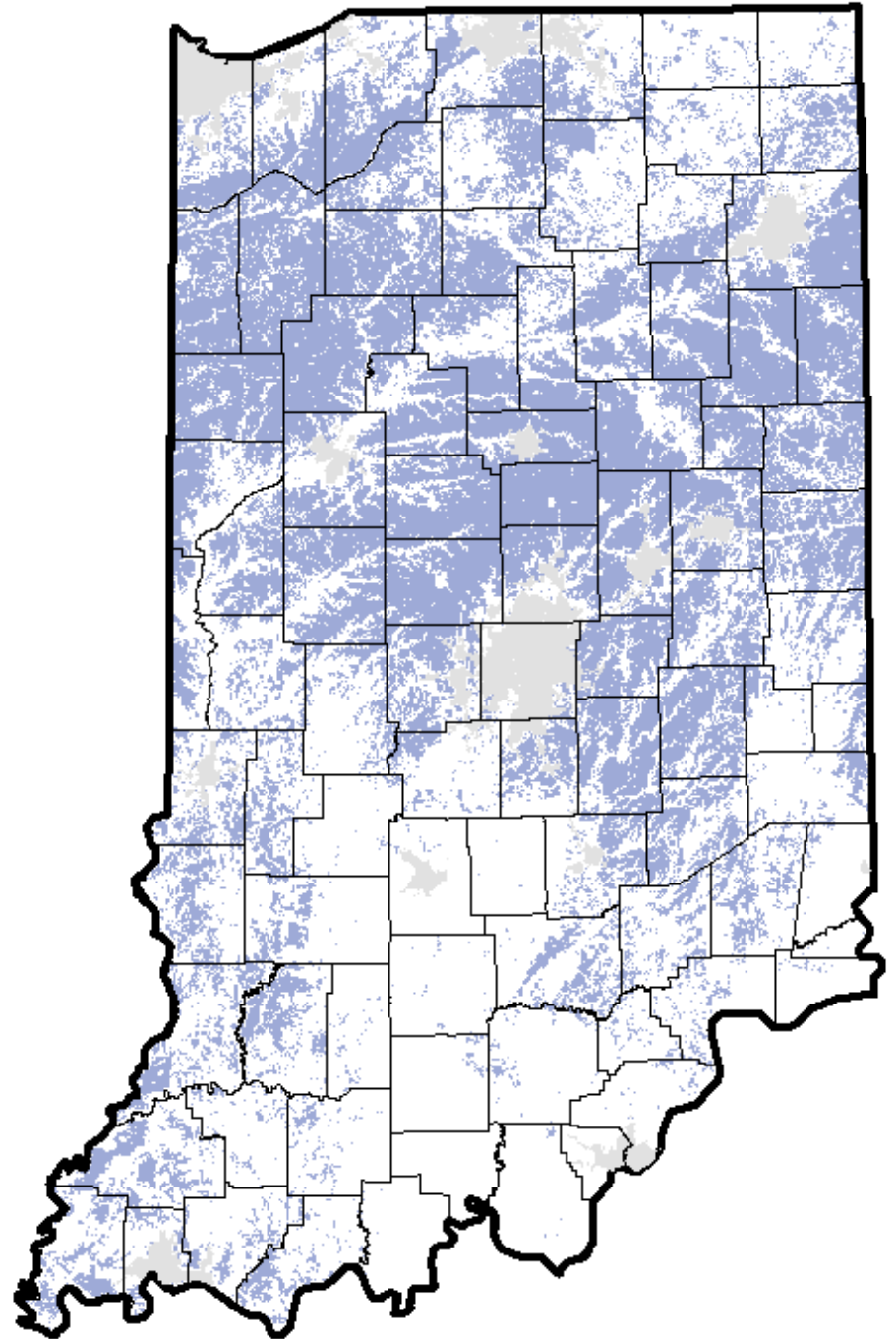
# Indiana and other “I” states (plus Ohio) have the most tile-drained land





# Estimate of tile drained land in Indiana

- Agricultural land  
(National Land Cover Dataset)
- Poorly drained soil  
(SSURGO)  
*(somewhat to very poorly drained)*



# So how do we monitor tile drains?





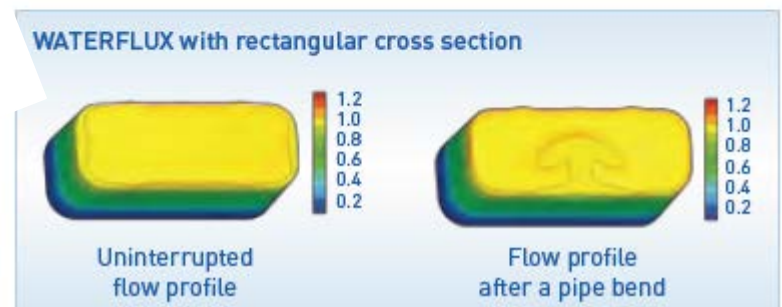
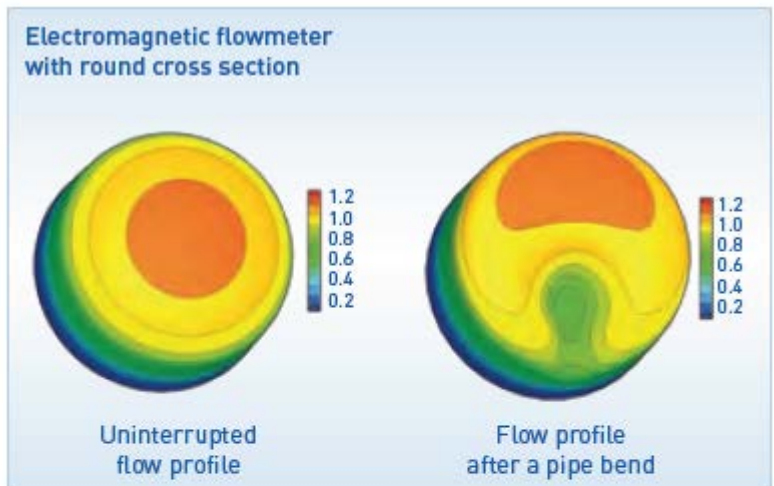
Our most recent flow meters:  
Electromagnetic





Measuring low flow is a limitation with electromagnetic flow meters.

Krohne WaterFlux can measure flow at fairly low velocities.







# Tipping bucket flow meter

(Requires free

## Weir in drain

(edge-of-field  
monitoring sites in Ohio  
(& recommended for all  
NRCS edge-of-field sites)



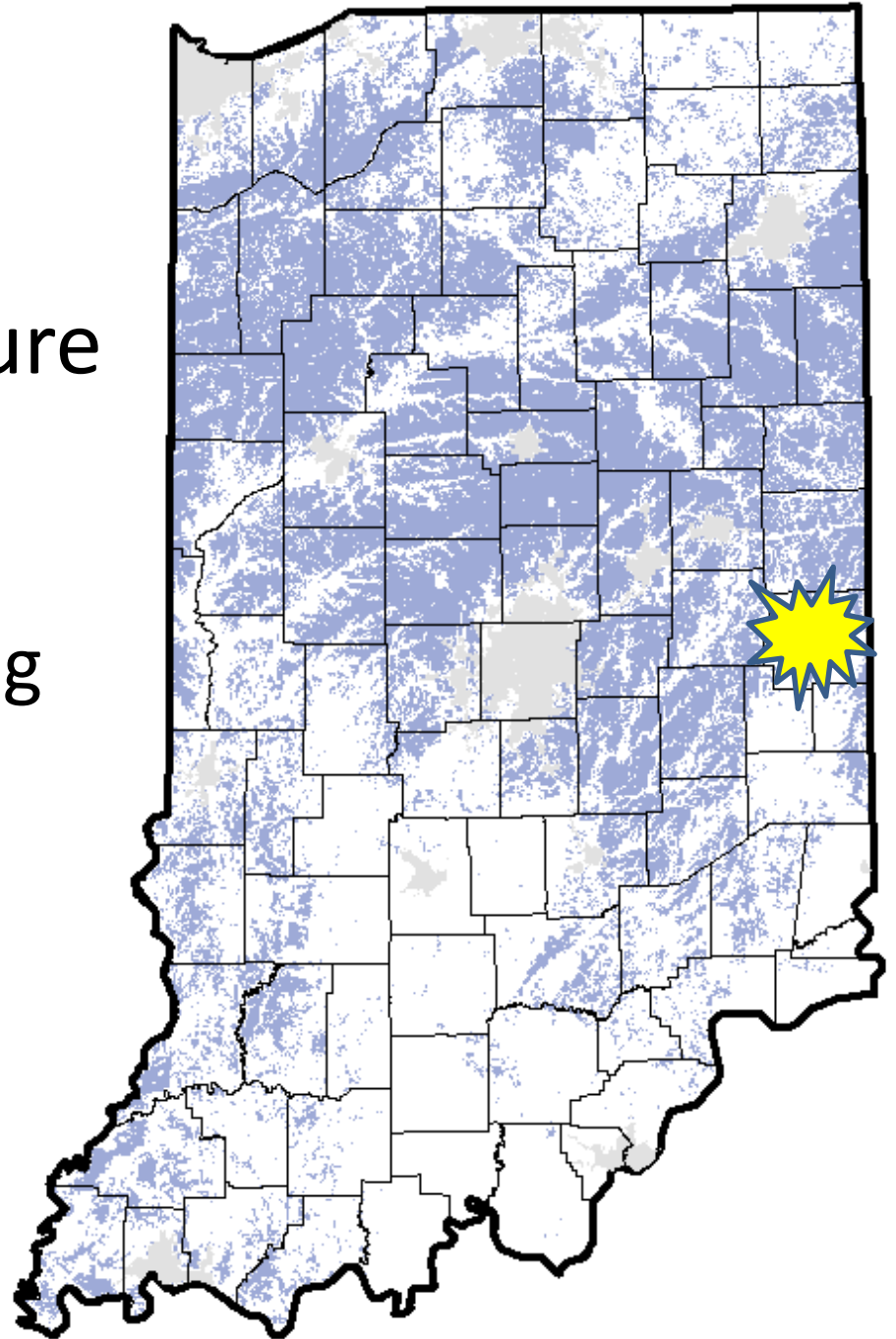


# Nitrate Concentration





Current tile drain  
monitoring:  
Davis Purdue Agriculture  
Center  
Randolph County  
(with Drs. Laura Bowling  
and Eileen Kladviko)





# Installation Field Day in 2004, with Indiana Land Improvement Contractors



24/09/2004

Photo: Steve Hawkins







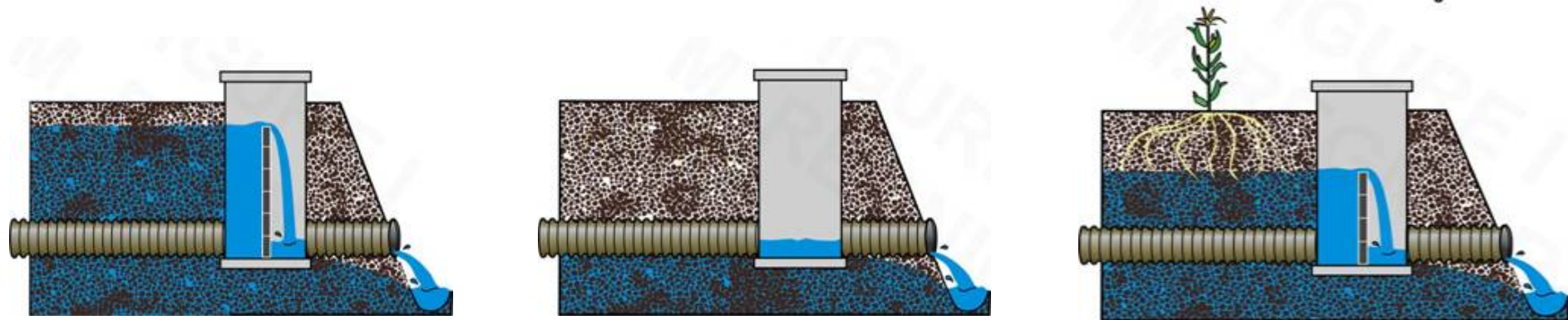
Finished product: 4 research subfields for  
determining the effects of drainage water  
management





# Drainage Water Management (a.k.a. Controlled Drainage)

A control structure is installed in a drain to raise the drainage outlet during parts of the year when a higher water table will not harm and may benefit the crop.



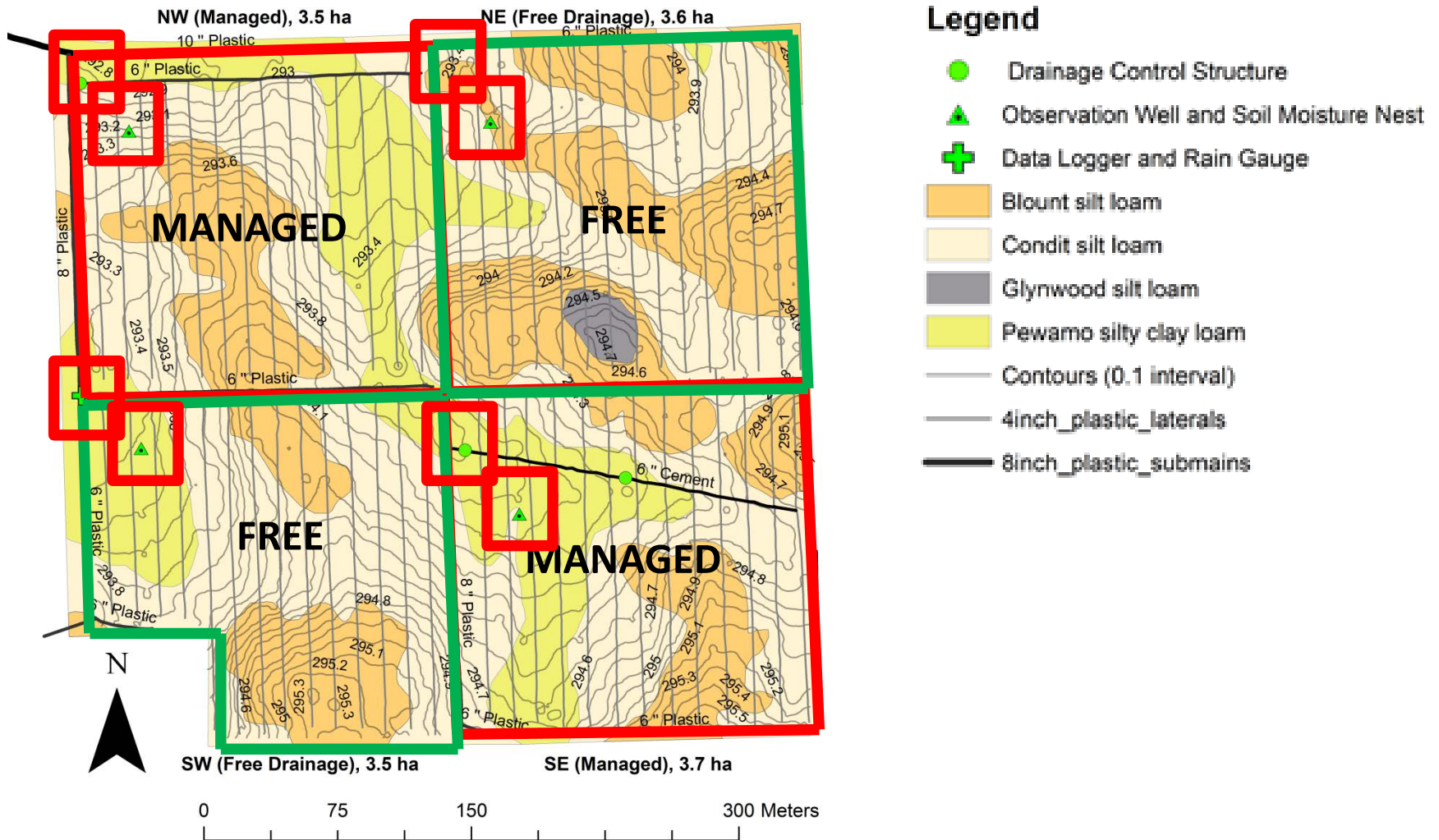
After harvest – for  
water quality

Before planting

After planting – to  
potentially store  
water for crops.

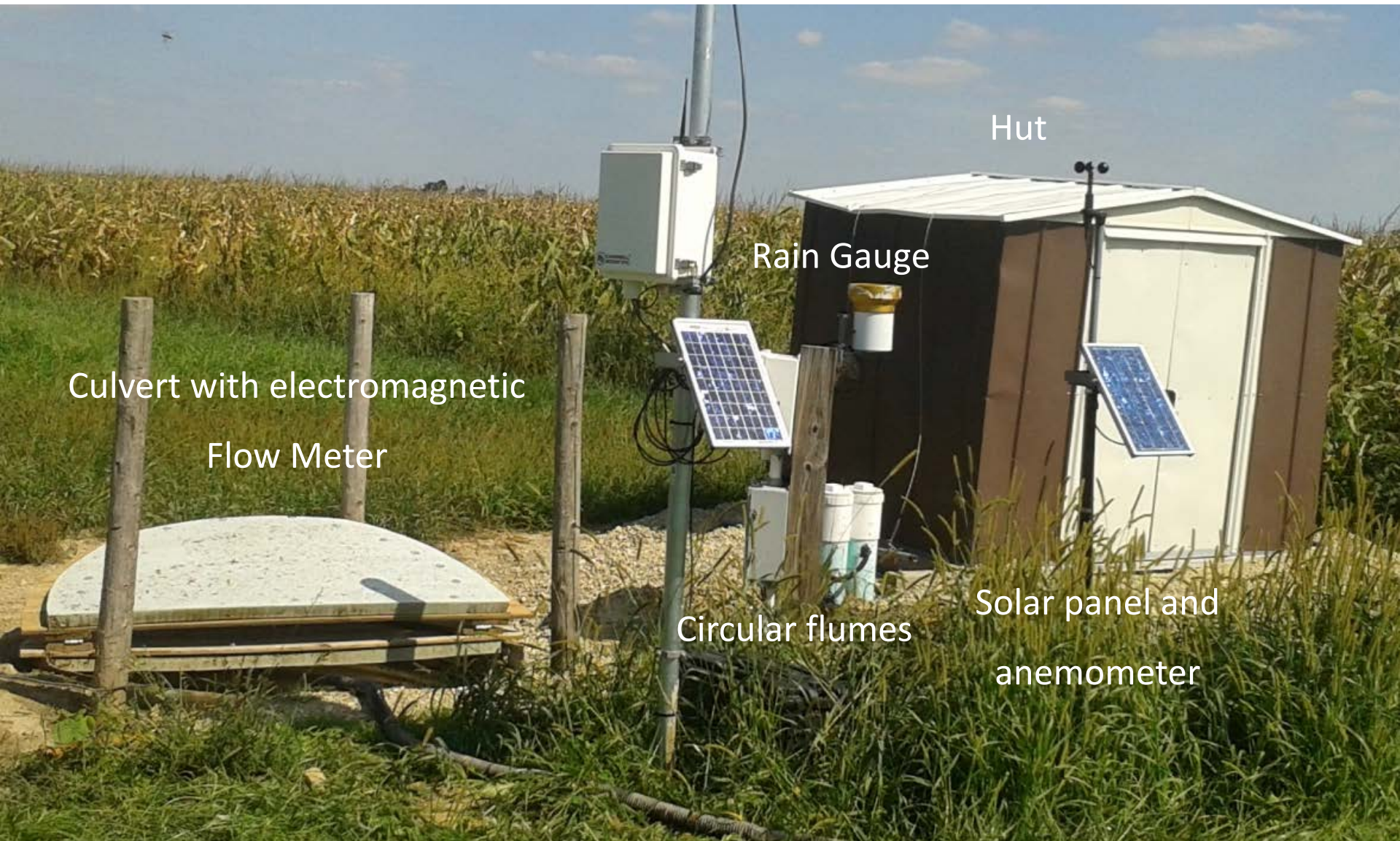


# Field W at the Davis Purdue Ag. Center





# Measurement Site



Culvert with electromagnetic  
Flow Meter

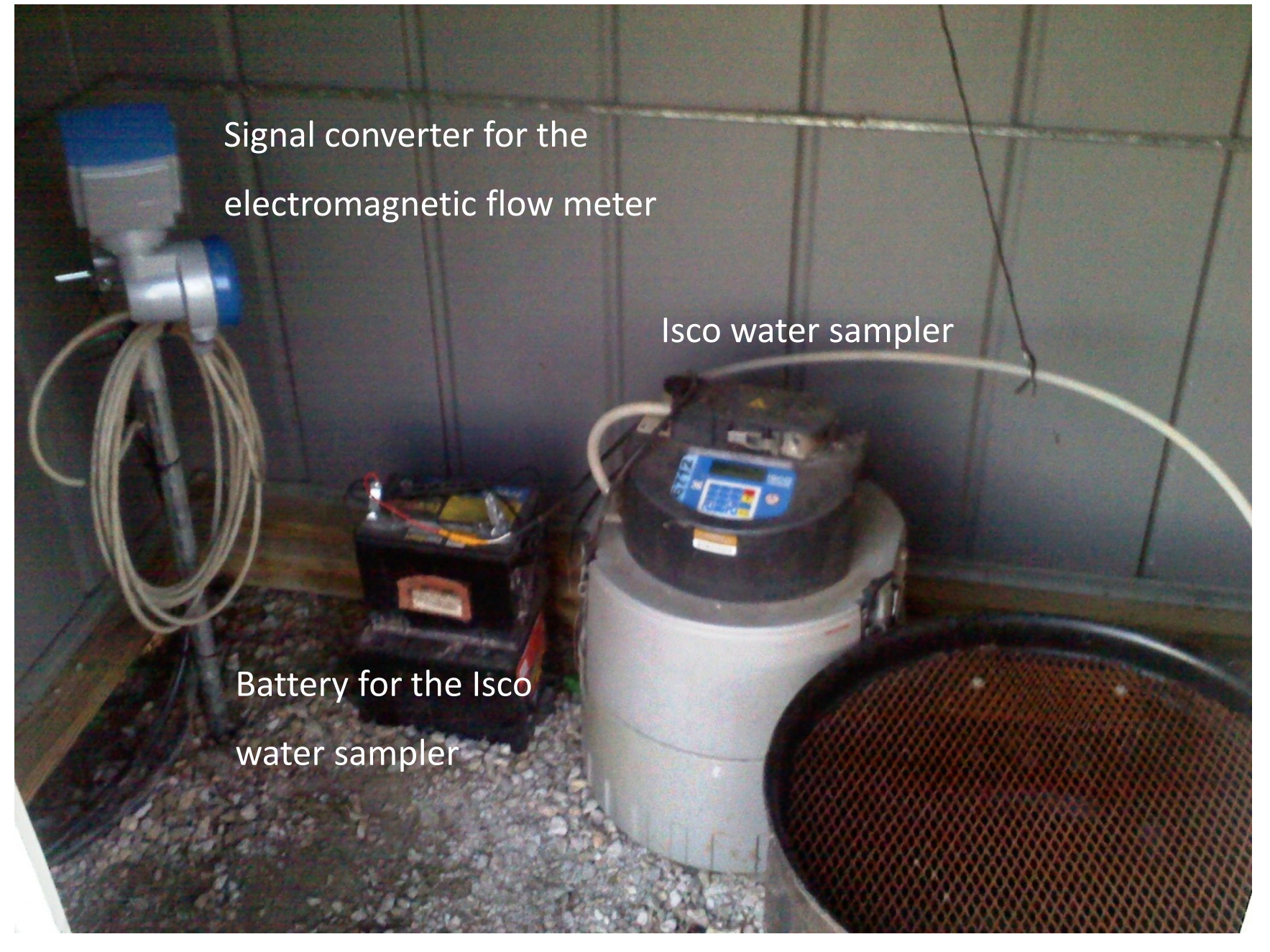
Hut

Rain Gauge

Circular flumes

Solar panel and  
anemometer





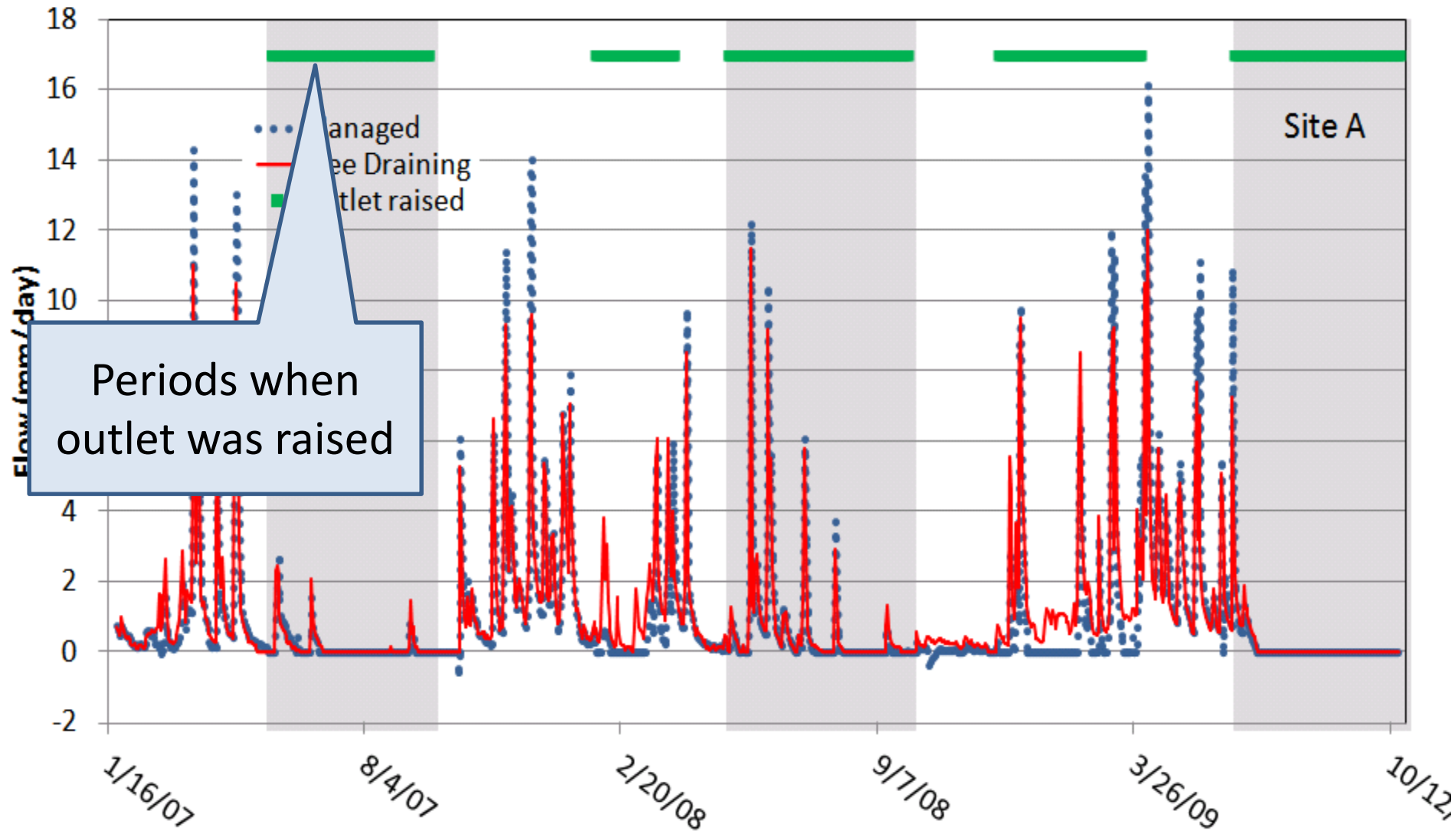
Signal converter for the  
electromagnetic flow meter

Isco water sampler

Battery for the Isco  
water sampler

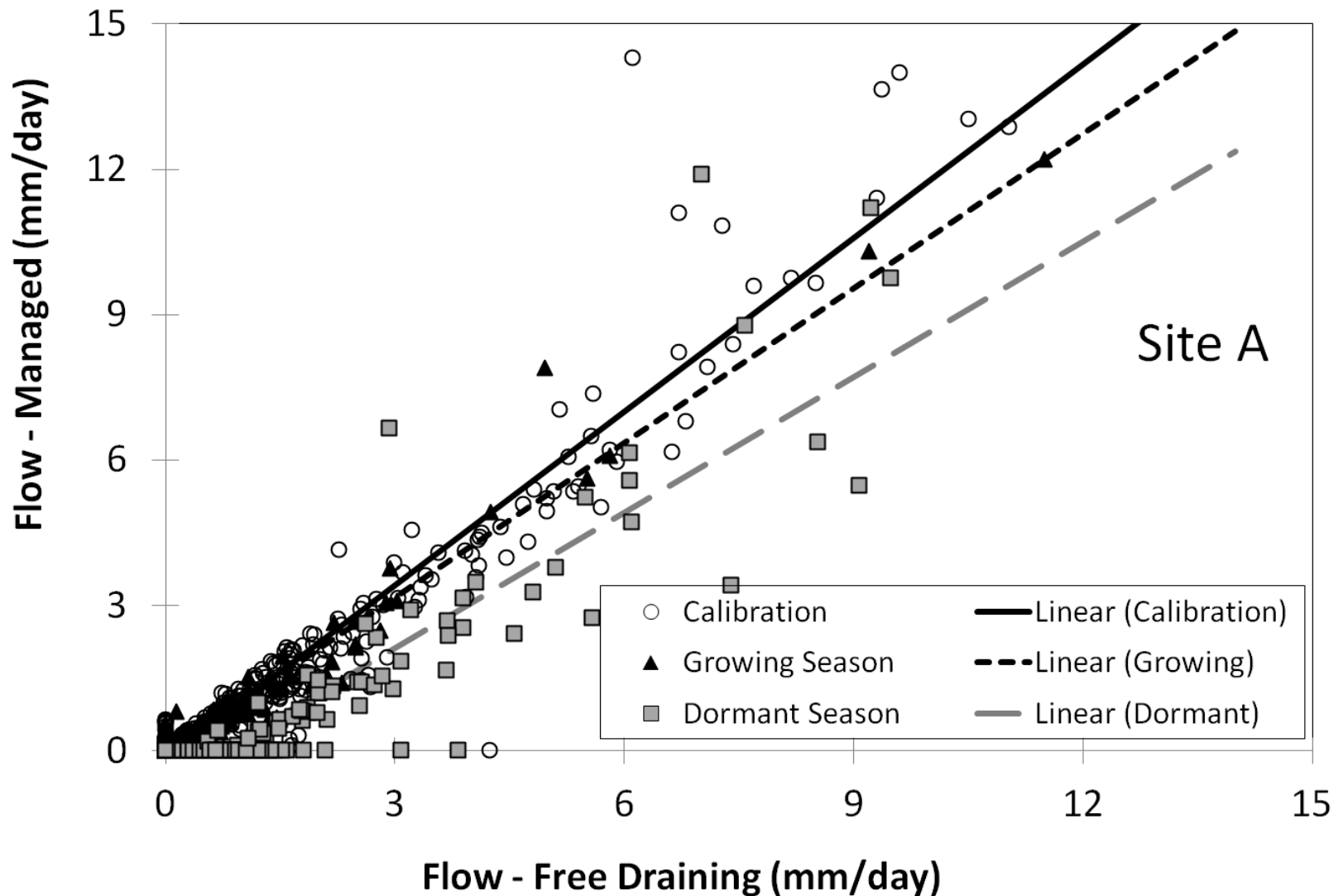


# Tile flow in free and managed paired fields





# Statistical analysis - Paired watershed approach





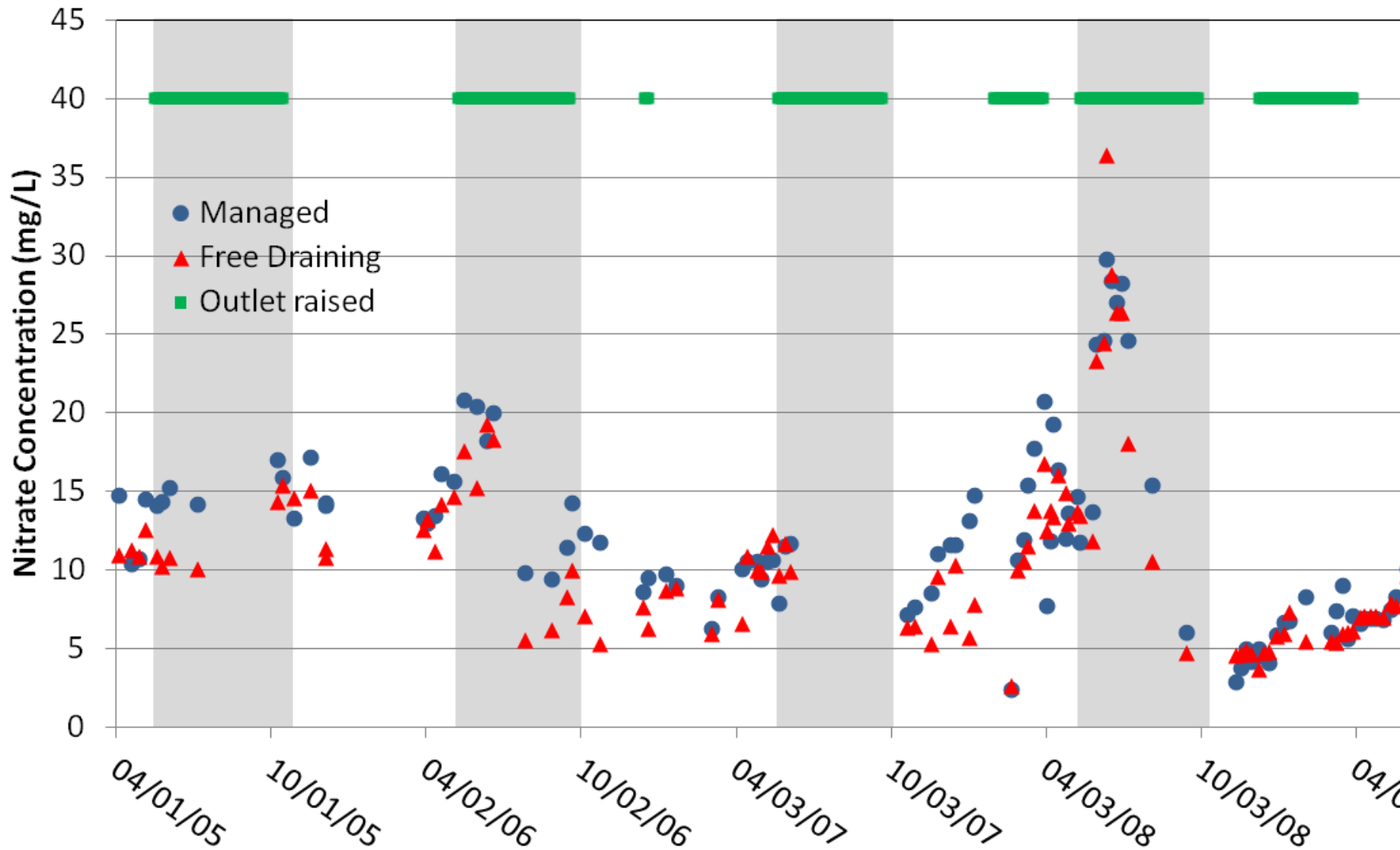
## Annual effects of drainage water management on tile flow.

		Predicted * (mm)	Observed (mm)	Reduction	
				(mm)	(%)
2000	Site A	4	405	69	14.5
			244	73	23.0
			337	104	23.6
			293	-62	-26.8
Total	Site A	915	742	173	18.9
	Site B	549	537	12	2.2

determined by applying the calibration period linear model to the observed values from the free draining field.



# Nitrate concentrations





Our published results from two private farms:

## **Annual reduction in nitrate load due to drainage water management**

	Predicted* (kg/ha)	Observed (kg/ha)	Reduction	
			(kg/ha)	(%)
Site A	112.4	86.9	<b>25.5</b>	<b>22.7</b>
Site B	79.3	65.0	<b>14.3</b>	<b>18.0</b>

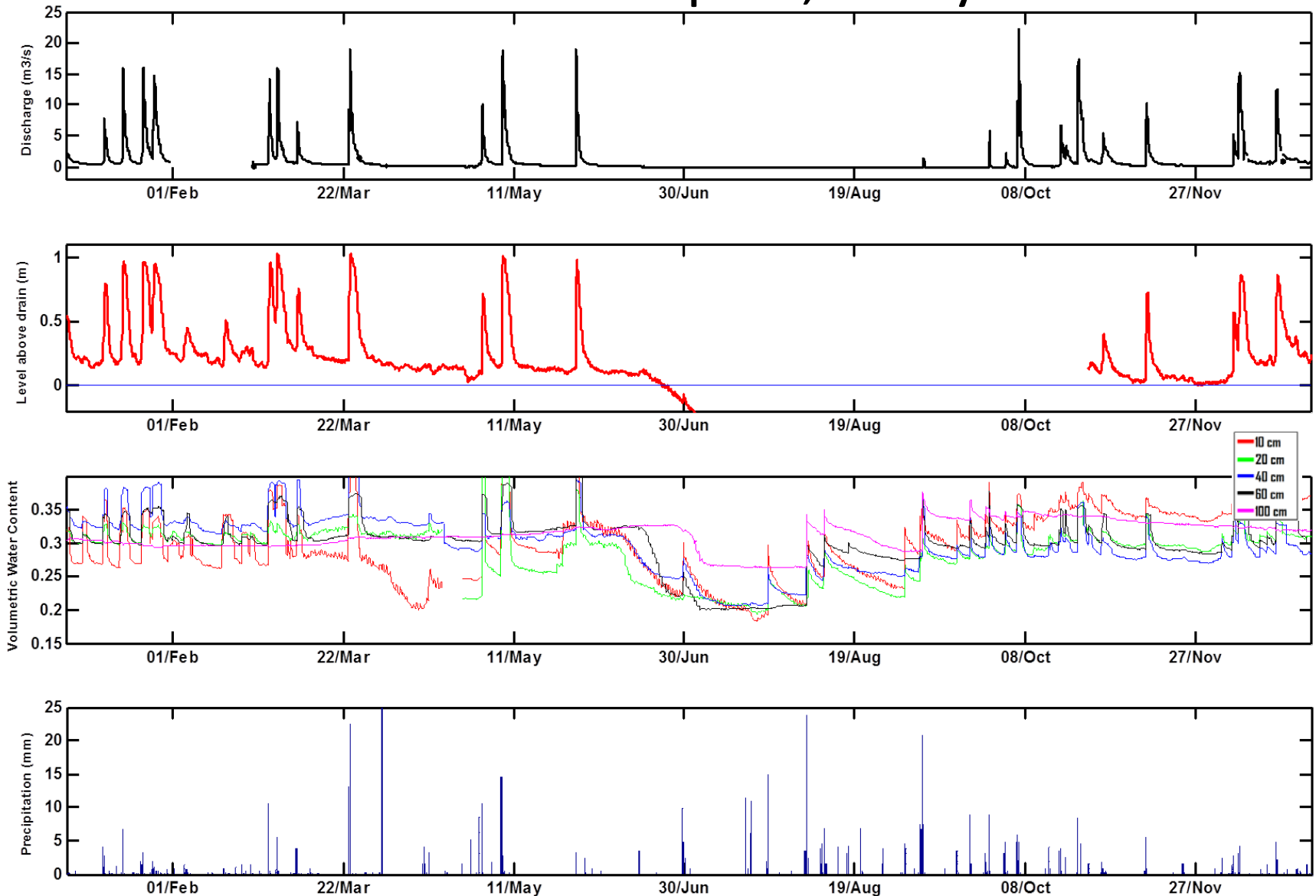


# Soil Moisture Sensors at 5 depths

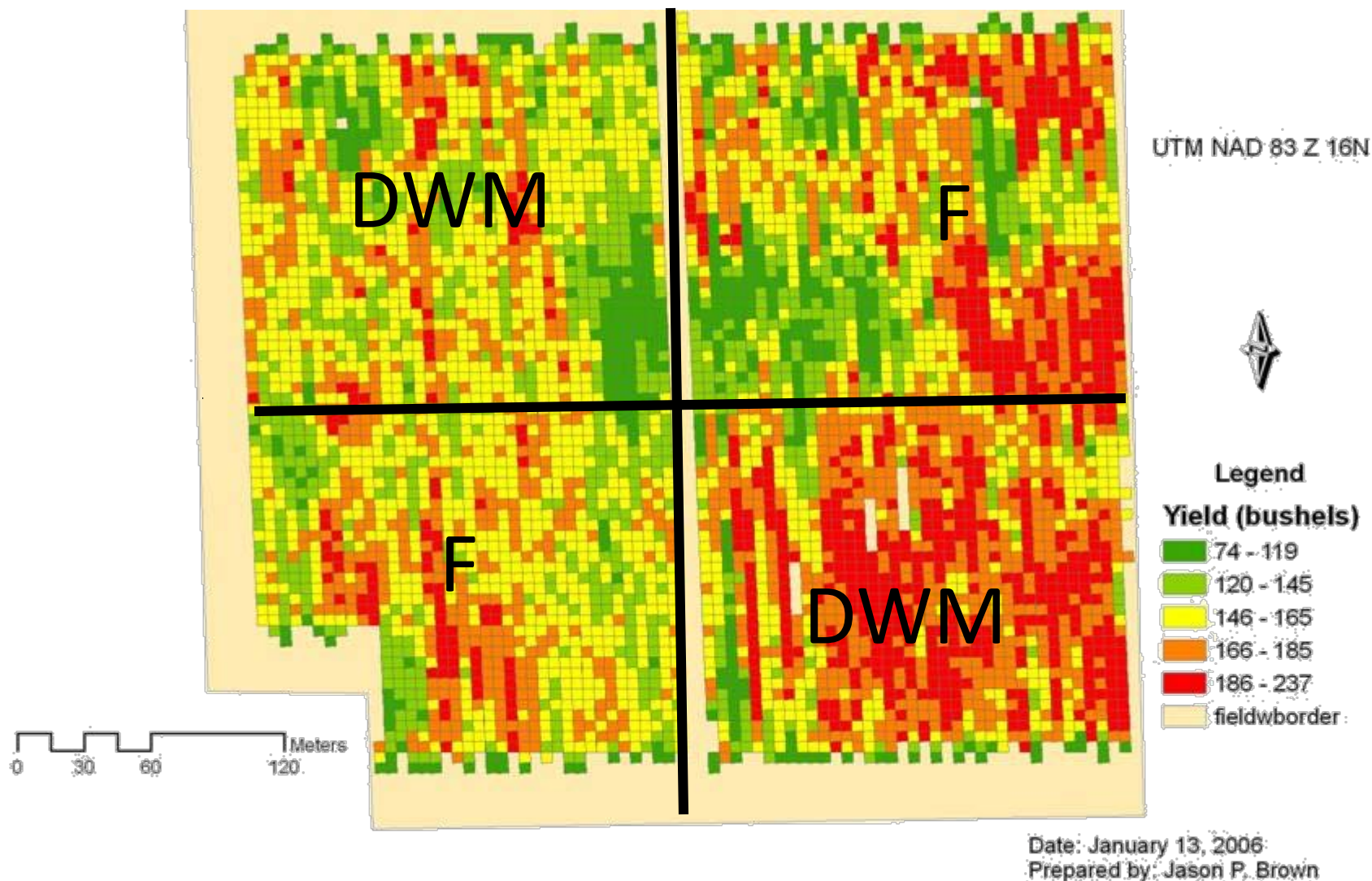




# Lots of data! Drain flow, water table, soil moisture at 5 depths, every hour



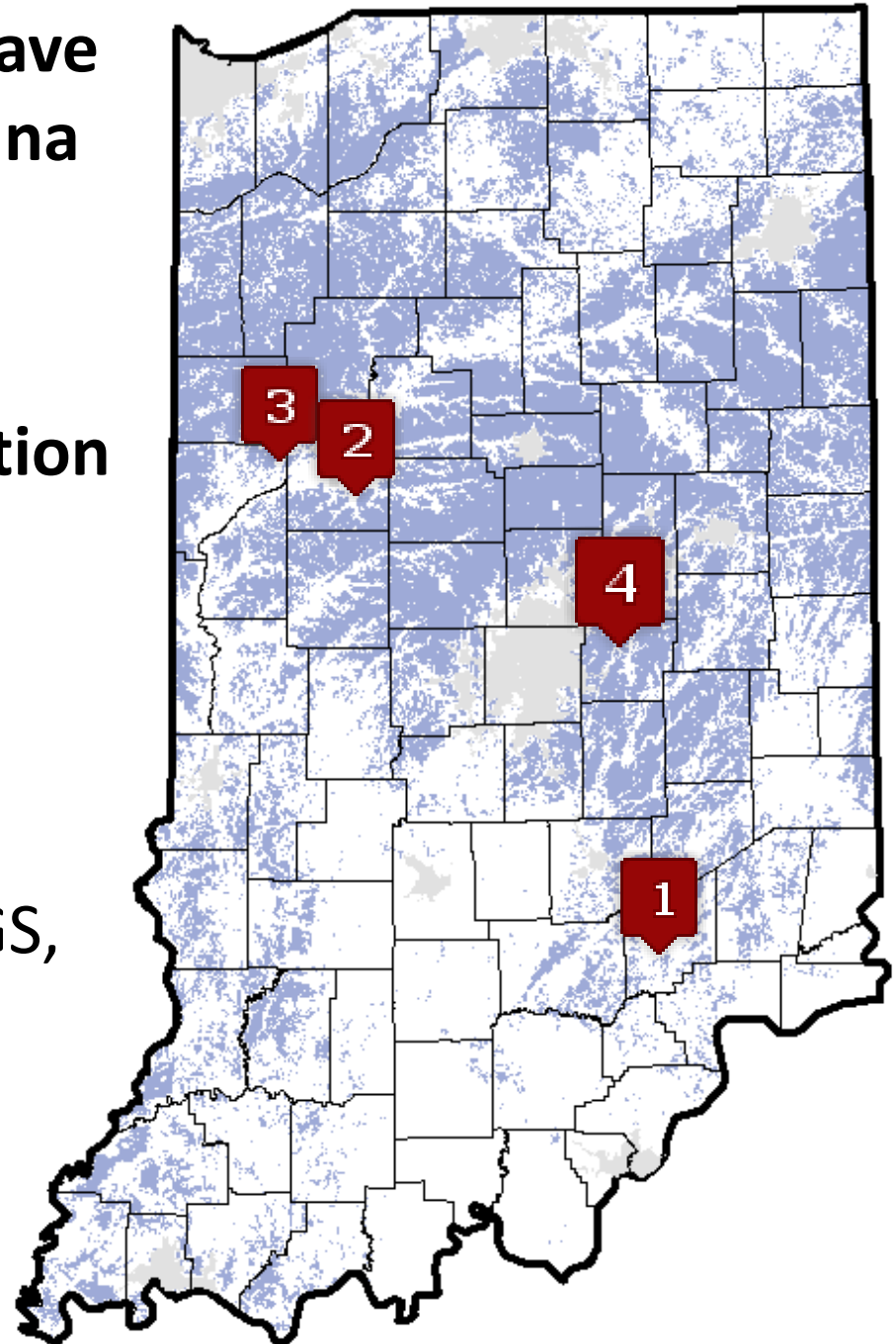
Yield has been analyzed for 9 years.  
Slight increase in most years with DWM





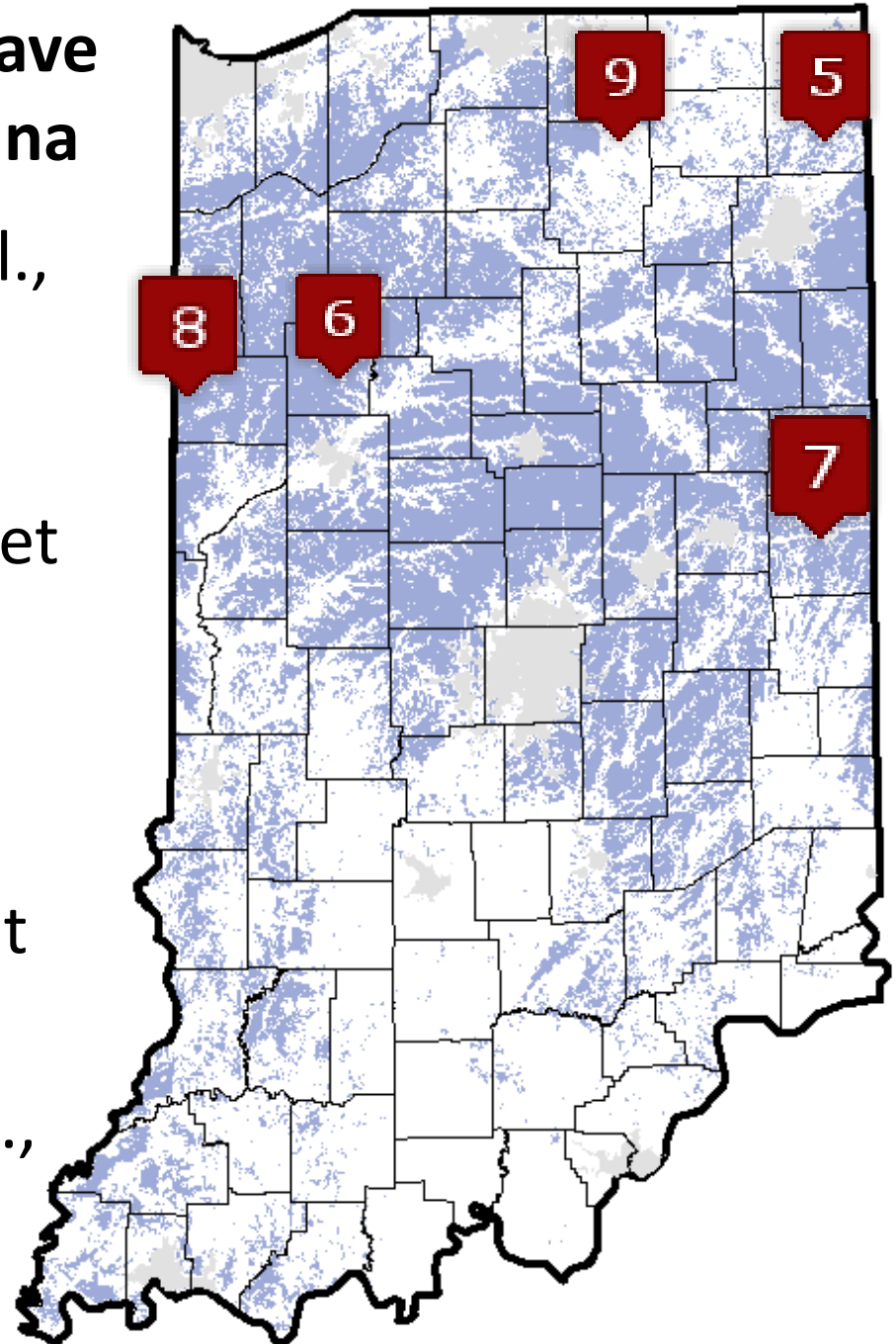
## Sites Where Tile Drains Have Been Monitored in Indiana

1. **SEPAC** (Kladvivko et al., Purdue)
2. **Water Quality Field Station** (Brouder et al., Purdue)
3. **Purdue Animal Science Farm**
4. **Sugar Creek** (including Leary-Weber Ditch) USGS, IUPUI, Royer et al



## Sites Where Tile Drains Have Been Monitored in Indiana

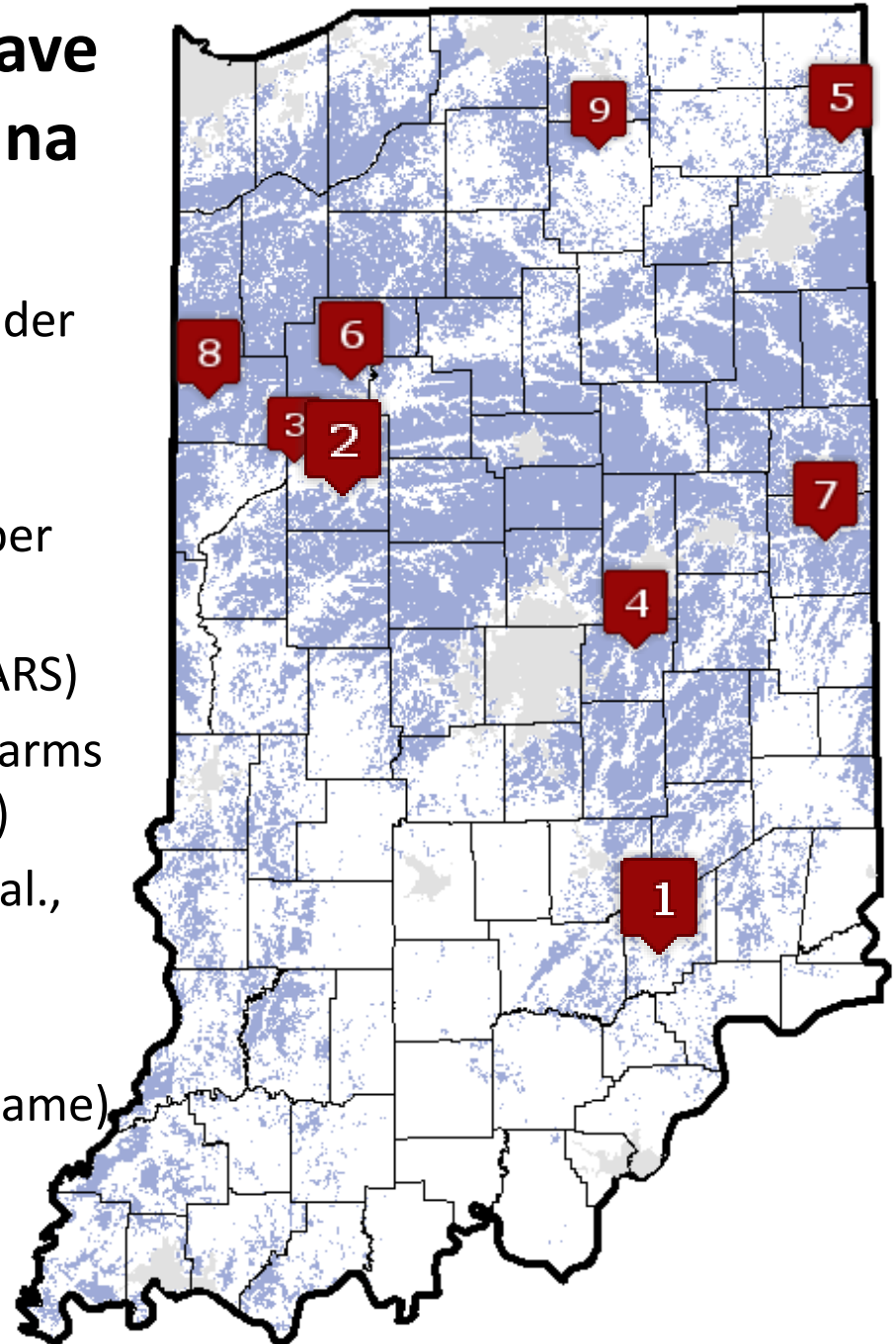
- 5. **Cedar Creek** (Smith et al., USDA-ARS)
- 6. **Hoagland/Honey Creek** (private farms - Adeuya et al., Ale et al., Purdue)
- 7. **DPAC** (Frankenberger, Bowling et al., Purdue)
- 8. **Benton County** (Royer et al., IU)
- 9. **Shatto Ditch** (Tank et al., Notre Dame)





# Sites Where Tile Drains Have Been Monitored in Indiana

1. **SEPAC** (Kladviko et al., Purdue)
2. **Water Quality Field Station** (Brouder et al., Purdue)
3. **Purdue Animal Science Farm**
4. **Sugar Creek** (including Leary-Weber Ditch) USGS, IUPUI, Royer et al
5. **Cedar Creek** (Smith et al., USDA-ARS)
6. **Hoagland/Honey Creek** (private farms - Adeuya et al., Ale et al., Purdue)
7. **DPAC** (Frankenberger, Bowling et al., Purdue)
8. **Benton County** (Royer et al., IU)
9. **Shatto Ditch** (Tank et al., Notre Dame)

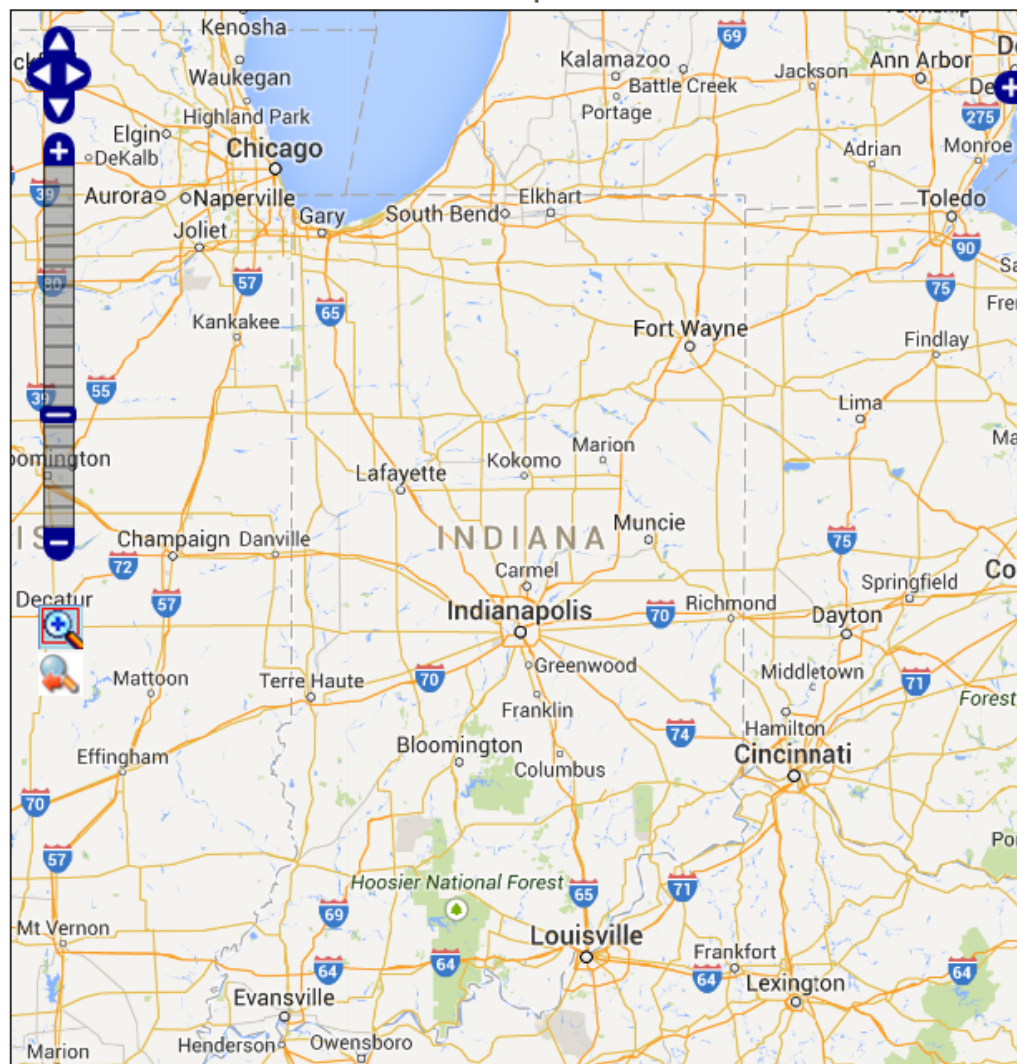




# Indiana Water Monitoring Inventory

A central hub for water monitoring locations of Indiana streams, lakes, and groundwater.

The Indiana Water Monitoring Inventory is a portal for locating water monitoring information in the state of Indiana. Many government agencies and organizations monitor Indiana's waters, and this site provides a one-stop site where you can locate monitoring sites, determine what data have been collected, and contact the data holders or their web site for more information. The actual monitoring data is not stored here -- only detailed information on the location of the monitoring site and what is being monitored or was monitored in the past.



**Map** [View Original Map](#)

Zoom in using the slider at left or hold the shift key and drag a box around the area you want.

Or search by city, state (i.e., Lafayette, IN) or zipcode

**HUC 8, 10, and 12 Layer:** ☐ **NHD Water Layer:** ☐

**All Locations:** There are currently more than 5400 locations in the database so we recommend zooming in before displaying all locations. "Download all locations" provides the location information in a spreadsheet.

[download all locations](#)

[display all locations](#)

## Legend:

- |   |   |   |
|---|---|---|
| <span style="color: red;">●</span> Federal and regional agencies              | <span style="color: purple;">●</span> Counties          | <span style="color: magenta;">●</span> Watershed organization |
| <span style="color: orange;">●</span> State agencies                          | <span style="color: darkgreen;">●</span> Private sector | <span style="color: orange;">●</span> Drinking water          |
| <span style="color: brown;">●</span> Cities and towns (except drinking water) | <span style="color: cyan;">●</span> Universities        | <span style="color: green;">●</span> Volunteers               |
| <span style="color: blue;">●</span> Non-governmental organizations            |   |   |

## Select Locations

### 1. Agency Type:

Agency: