WATER QUALITY MONITORING OF SURFACE RUNOFF AND TILE DRAINAGE ON DAIRY FARMS IN THE LAKE CHAMPLAIN BASIN

Bob Brower Scientific Symposium

March 6, 2021

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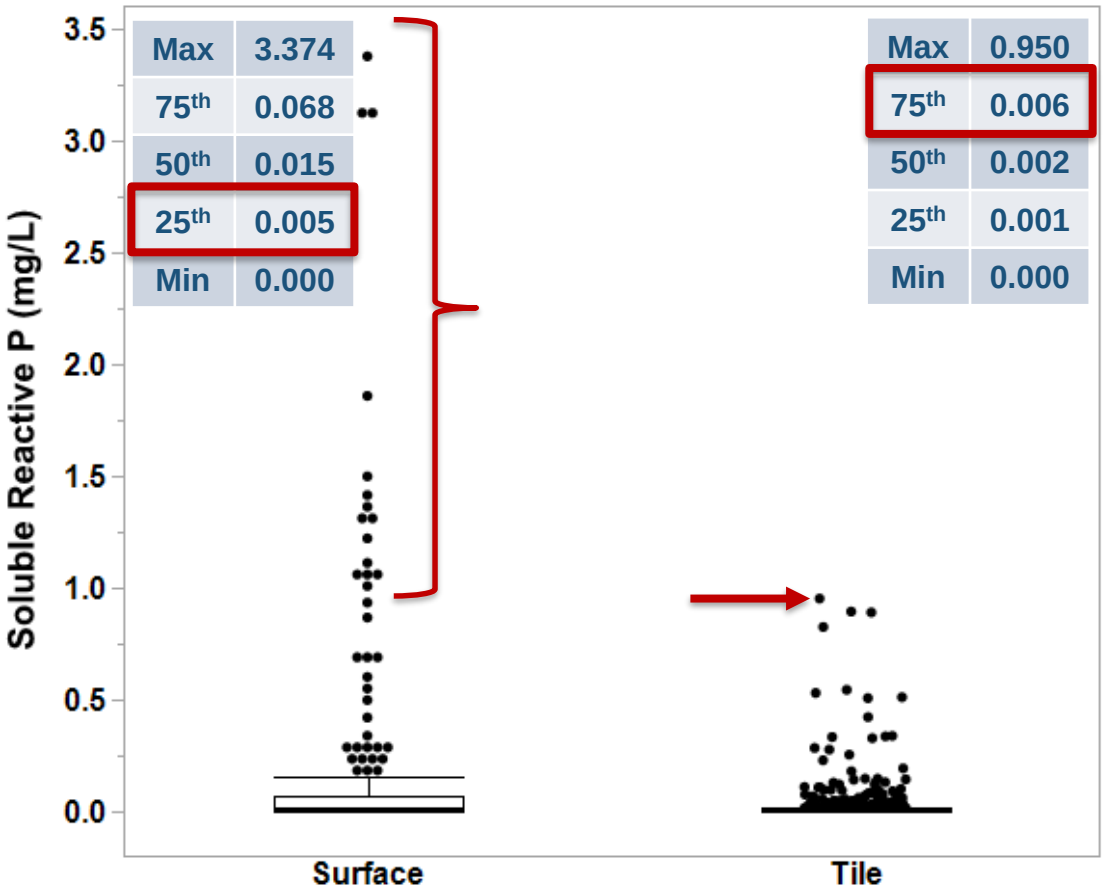
<u>Miner Institute Dairy Farm</u>

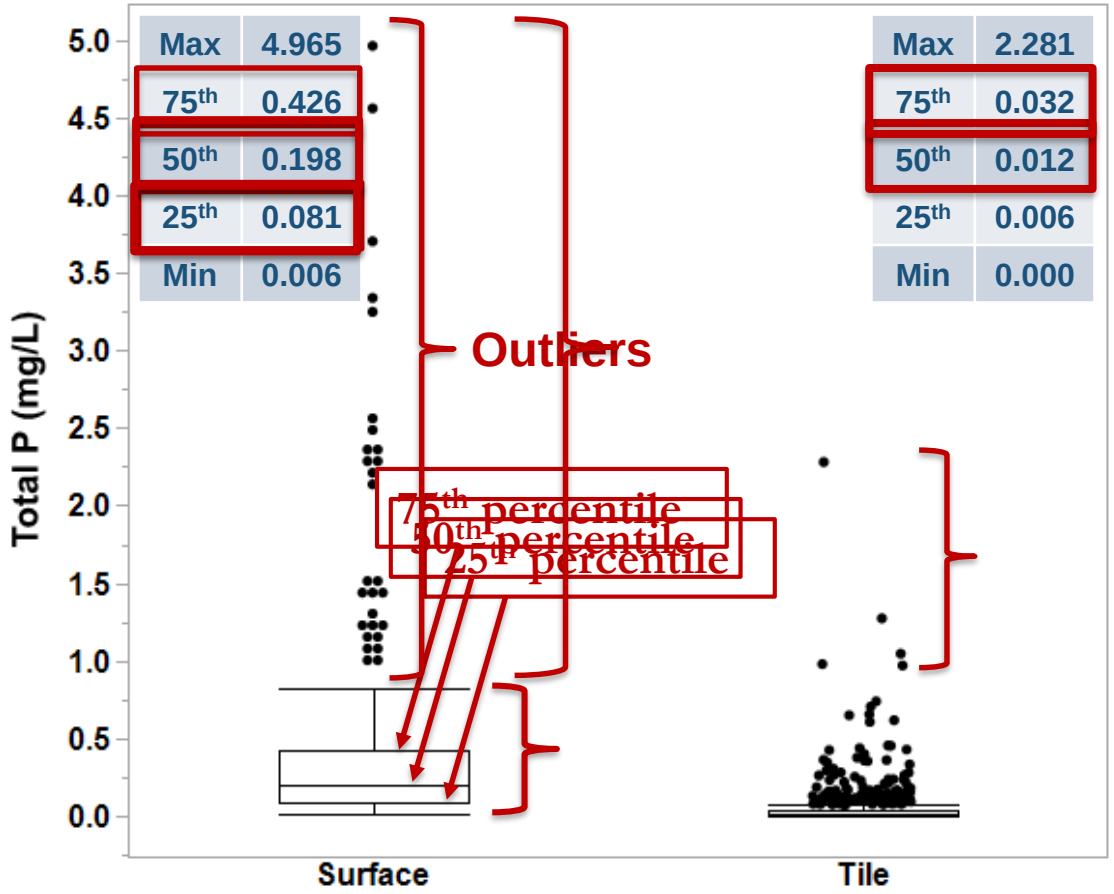
- 480 milking Holstein cows
- 1450 acres of cropland
  - ➢ alfalfa-grass/corn rotation

Sample Concentrations (composite samples) 2016-2020

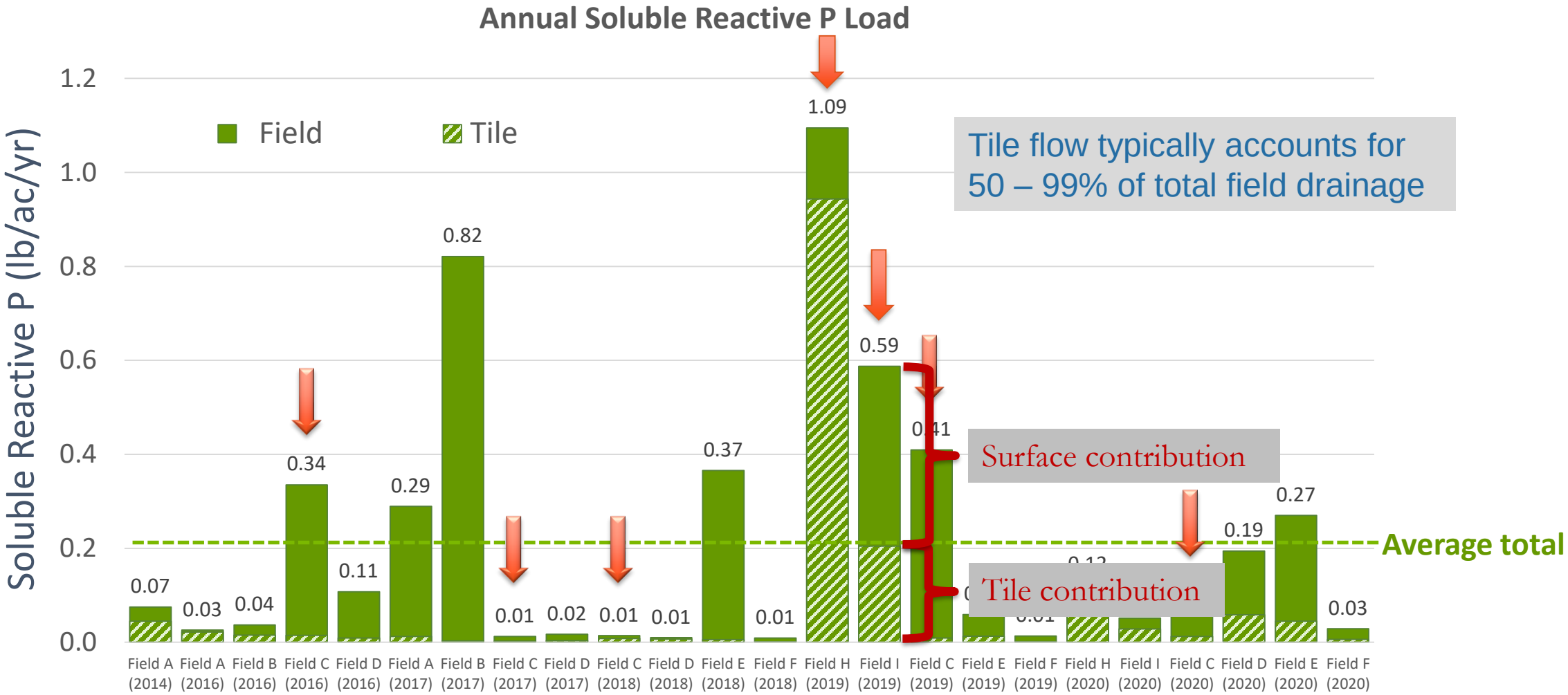
6 corn fields, annual manure applications, tillage

240 surface runoff samples & **1102** tile drainage samples



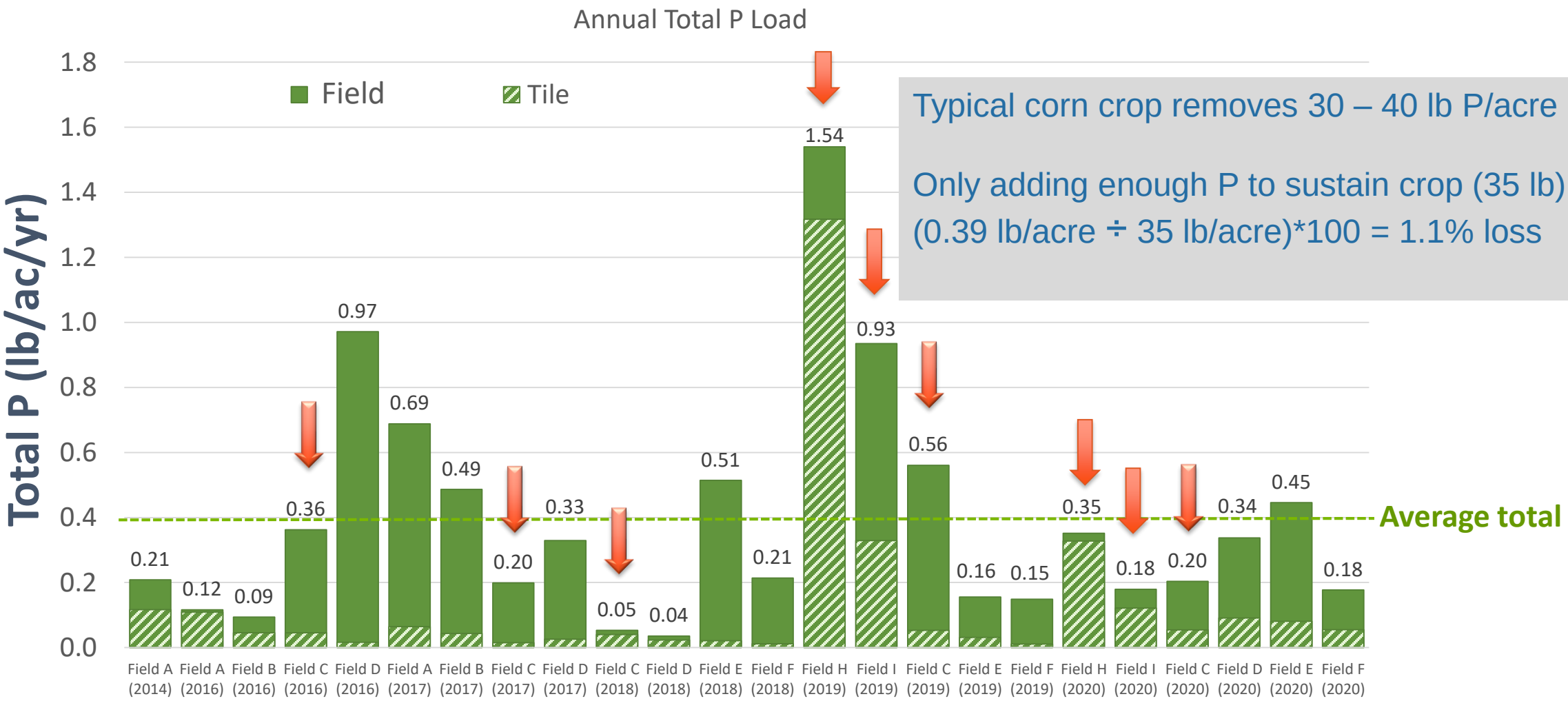


Annual P Losses by Runoff Pathway (2014-2020)



Averages (mean): Tile = 0.07; Surface = 0.14; Total = 0.21 lb/acre/yr

Annual P Losses by Runoff Pathway (2014-2020)



Typical corn crop removes 30 – 40 lb P/acre

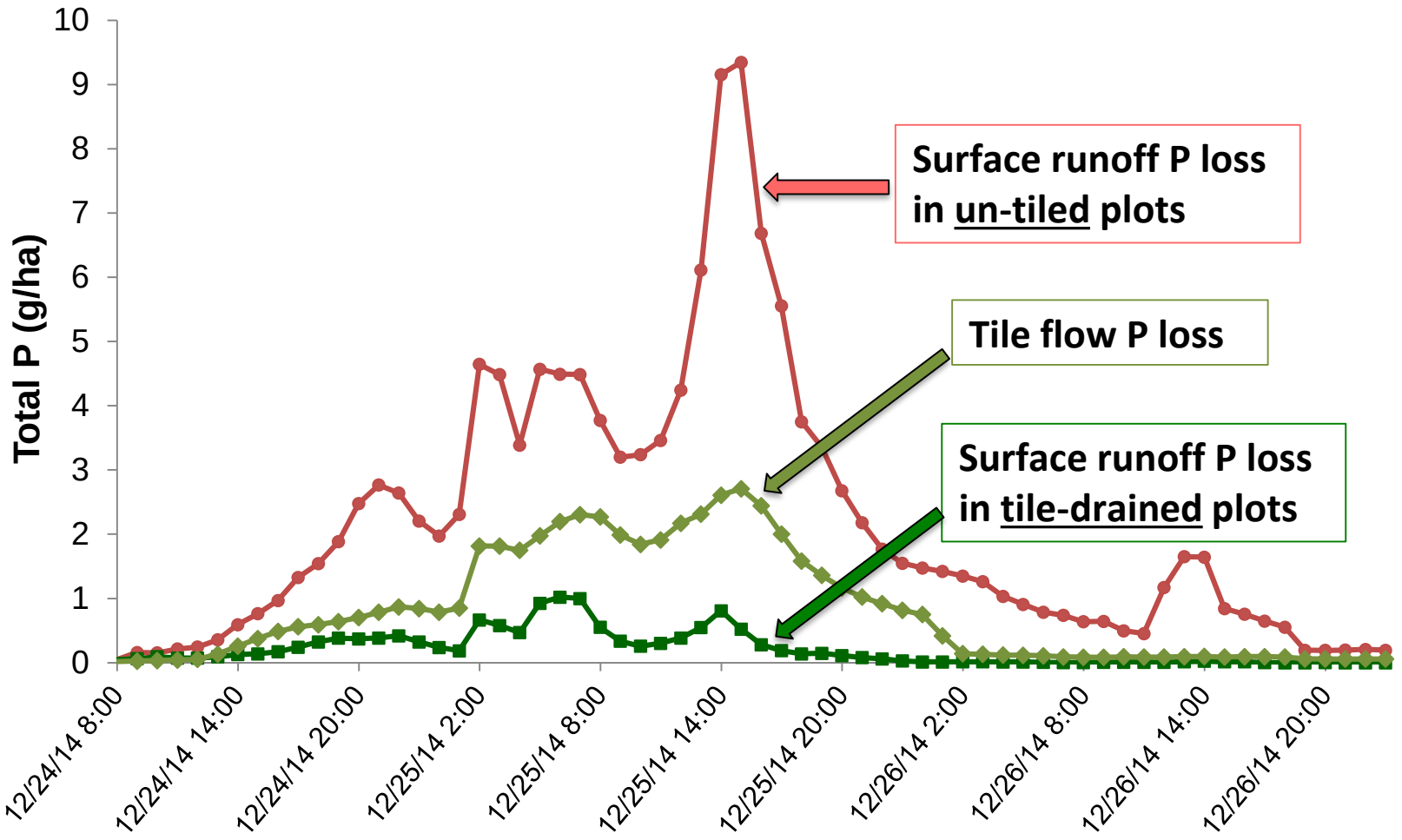
Only adding enough P to sustain crop (35 lb):
(0.39 lb/acre ÷ 35 lb/acre)*100 = 1.1% loss

Averages (mean): Tile = 0.13; Surface = 0.26; Total = 0.39 lb/acre/yr

Tiled vs. Un-tiled Plots: Snowmelt Runoff Event

- 0.25-acre research corn plots
- 2 tile-drained, 2 un-tiled
- Surface runoff sampled from all, tile flows sampled in drained plots
- Hourly samples
- Manure applied 1 month prior

- 86% decrease in surface runoff in tiled plots
- 67% more total flow from tiled plots (tile was 91% of flow)
- Tiled plot loss = **0.06 lb/acre**
- Un-tiled plot loss = **0.12 lb/acre**



Take-home Messages

- Majority of P loss occurring in surface runoff
- No evidence (so far) of tile drainage increasing P losses, may decrease in certain conditions (erosion reduction; snowmelt events).
- Losses represent very small fraction of applied P
- Majority of P loss occurs during a very short window of time (often during snowmelt)
- Risk factors (surface runoff & tile drainage):
  - Surface-applied manure w/ no incorporation
  - Manure application timing relative to weather events
  - High concentration of P in the soil (legacy P)
  - *Tiles only:* Macropores (heavier clay soils, no-till)

Questions?

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Acknowledgments:
Eric Young, Steve Kramer, Casey Corrigan, Keegan Griffith, Mark Haney, Leanna Thalmann, Ashton Nelson, Miner Institute Crops Crew, and Adirondack Farms

Thank you to our funding sources:

Northern New York Agricultural Development Program
Farmer-Driven Research • Real-World Results

USDA NRCS
United States Department of Agriculture
Natural Resources Conservation Service

Lake Champlain Basin Program

Surface Runoff Sampling and Analysis

- Earthen berms around perimeter of field
- Surrounded by ditches to exclude outside water
- All surface runoff routed to single outlet at field edge

Pre-calibrated fiberglass H-flume
Water height = flow rate

- Flow-proportional composite sampling: 5 acre field = sample/3,200 gal of flow (640 gal for every acre)
- Miner Institute laboratory analysis: Soluble reactive P (SRP), total P, nitrate, ammonium, total N, total suspended solids (TSS; aka sediment)

Surface Runoff Sampling and Analysis

Sample intake line

Autosampler

16-L sample container

Flow module (data interface, storage)

Ultrasonic water level sensor

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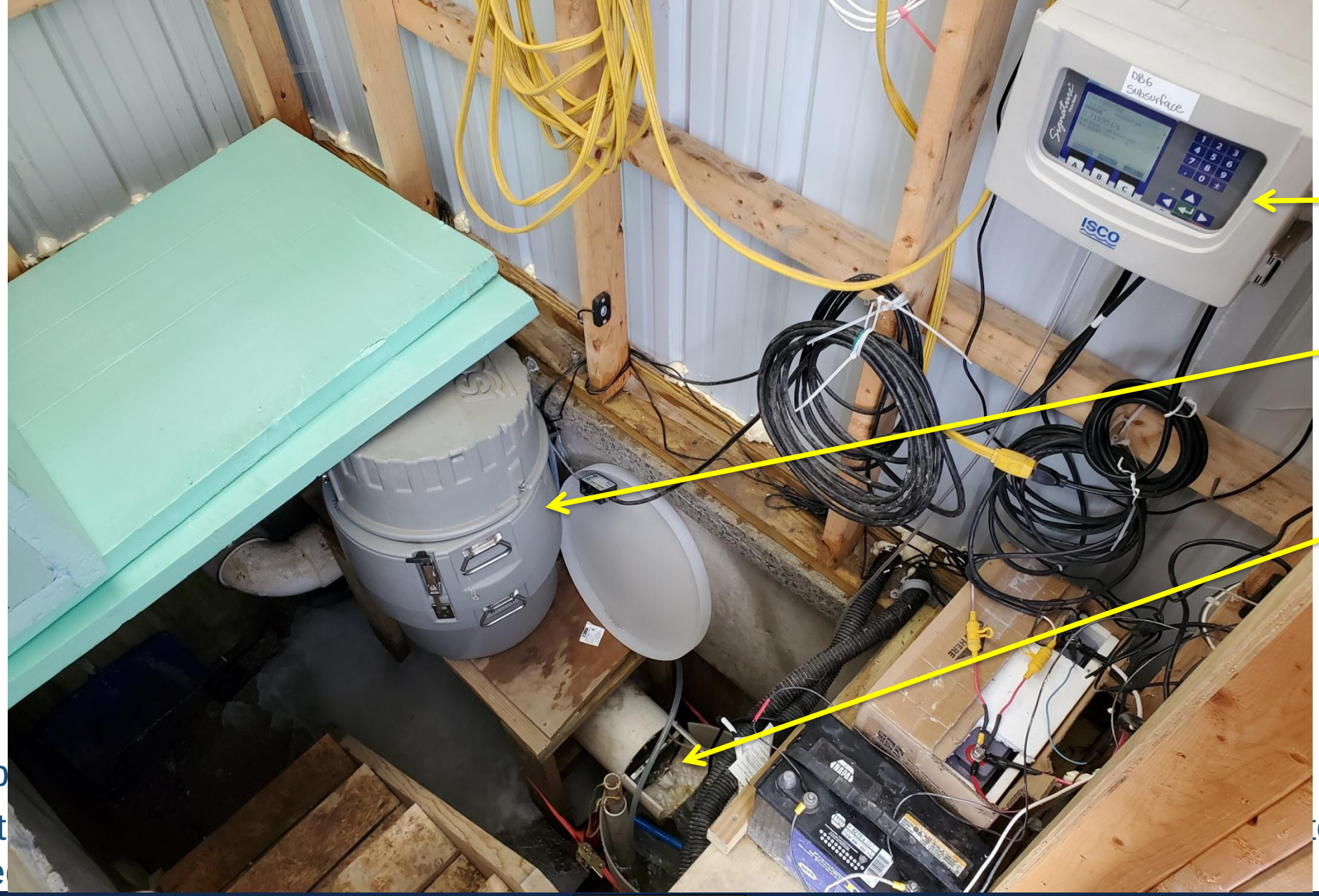

- Flow-prop
- Miner Inst … total N, total suspende

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Bubbler tube:
Resistance = flow

Thel-Mar Weir

Flow meter (data interface, storage)

Autosampler

Why Install Tile Drainage?

- Drains *excess* water from poorly drained fields
- Can improve soil health (↓compaction, ↑aeration)
- Reduces risk of surface runoff
- Lengthens growing season
  - ❖Higher crop yield and quality
  - ❖Reduces need for imported feed (nutrients)
  - ❖Cover crops, timing of manure applications