Introduction and Overview of Wetbud

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http://www.landrehab.org/WETBUD

Who's doing what?

Zach Agioutantis, Univ. of Kentucky -- Programmer & MODFLOW

W. Lee Daniels, Virginia Tech -- Program coordinator & gadfly

Ben Hiza, Old Dominion University – Julie Metz models / groundwater

Stephen Stone, Old Dominion University – Huntley Meadows models

Tess Thompson, Virginia Tech – Surface water & ET estimators

Rich Whittecar, Old Dominion University – Groundwater & MODFLOW

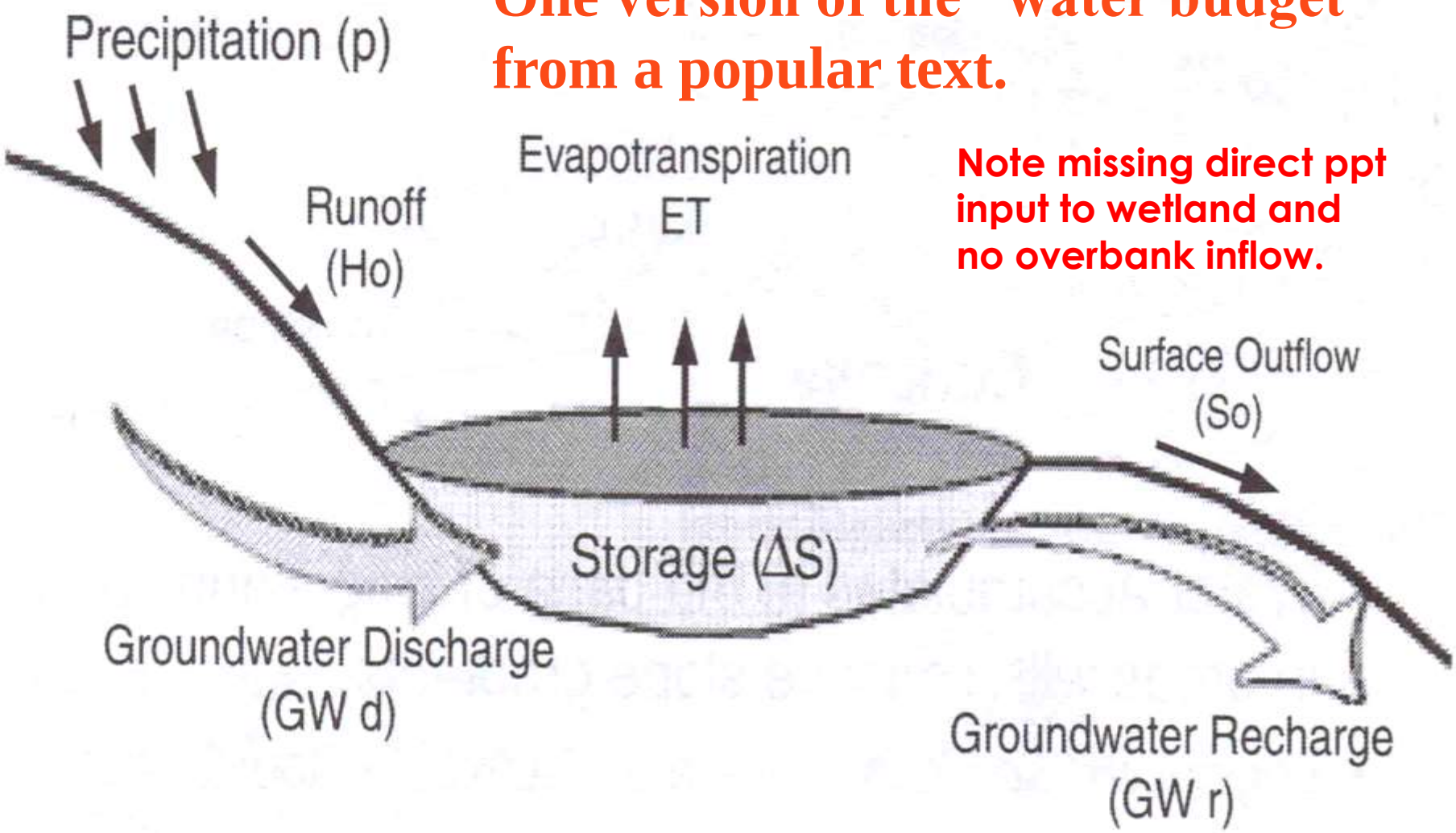
Previous Graduate Students: Kerby Dobbs, Matt Gloe, John McCleod, Eric Neuhaus, O. Waverly Parks, Candice Piercy, Tracy Thornton, Cal Smith

Research Associates/Specialists: Dan Evans, Katie Haering, Sara Klopf and Laura Lehman.

INPUTS = OUTPUTS + / - STORAGE

$$P + Ho + GWd = Gwr + So + ET + \Delta Storage$$

One version of the "water budget" from a popular text.



Note missing direct ppt input to wetland and no overbank inflow.

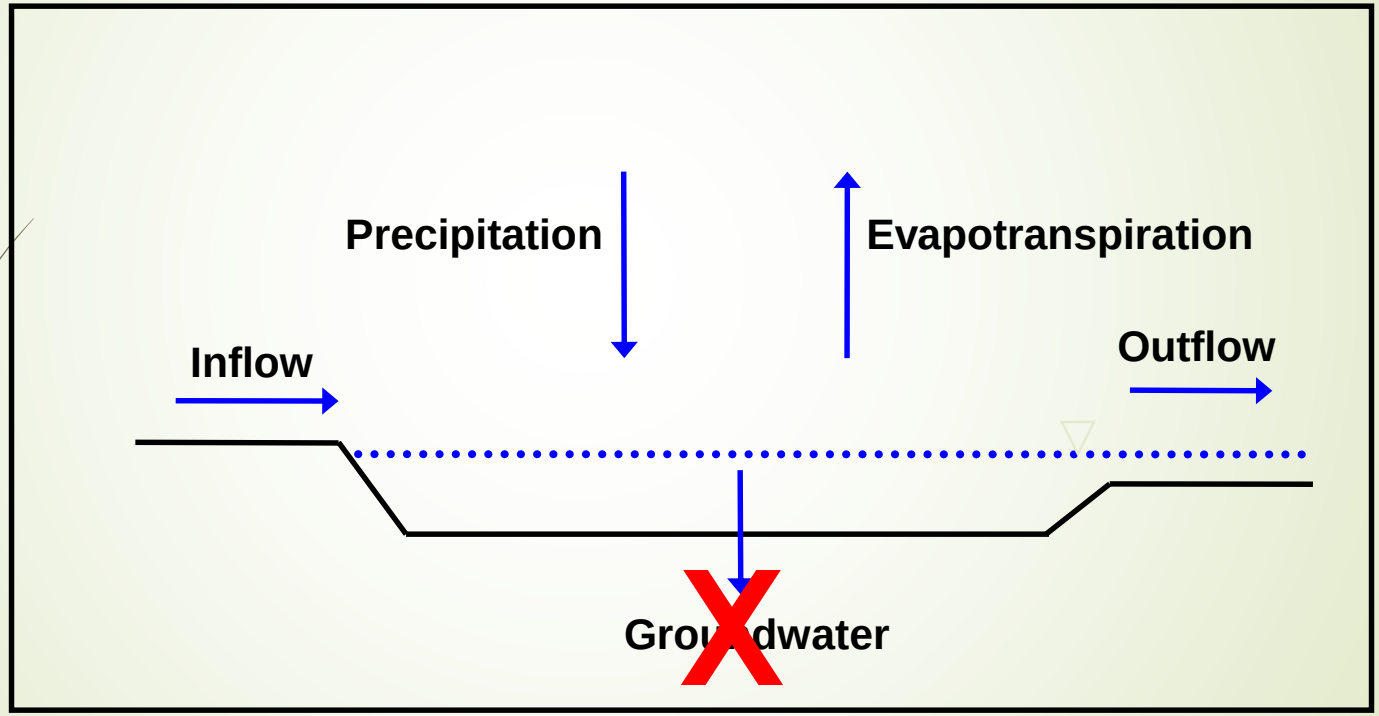
Created Wetland Water Budgeting

- **Wide variation in water budgeting approaches among agencies and consultants.**

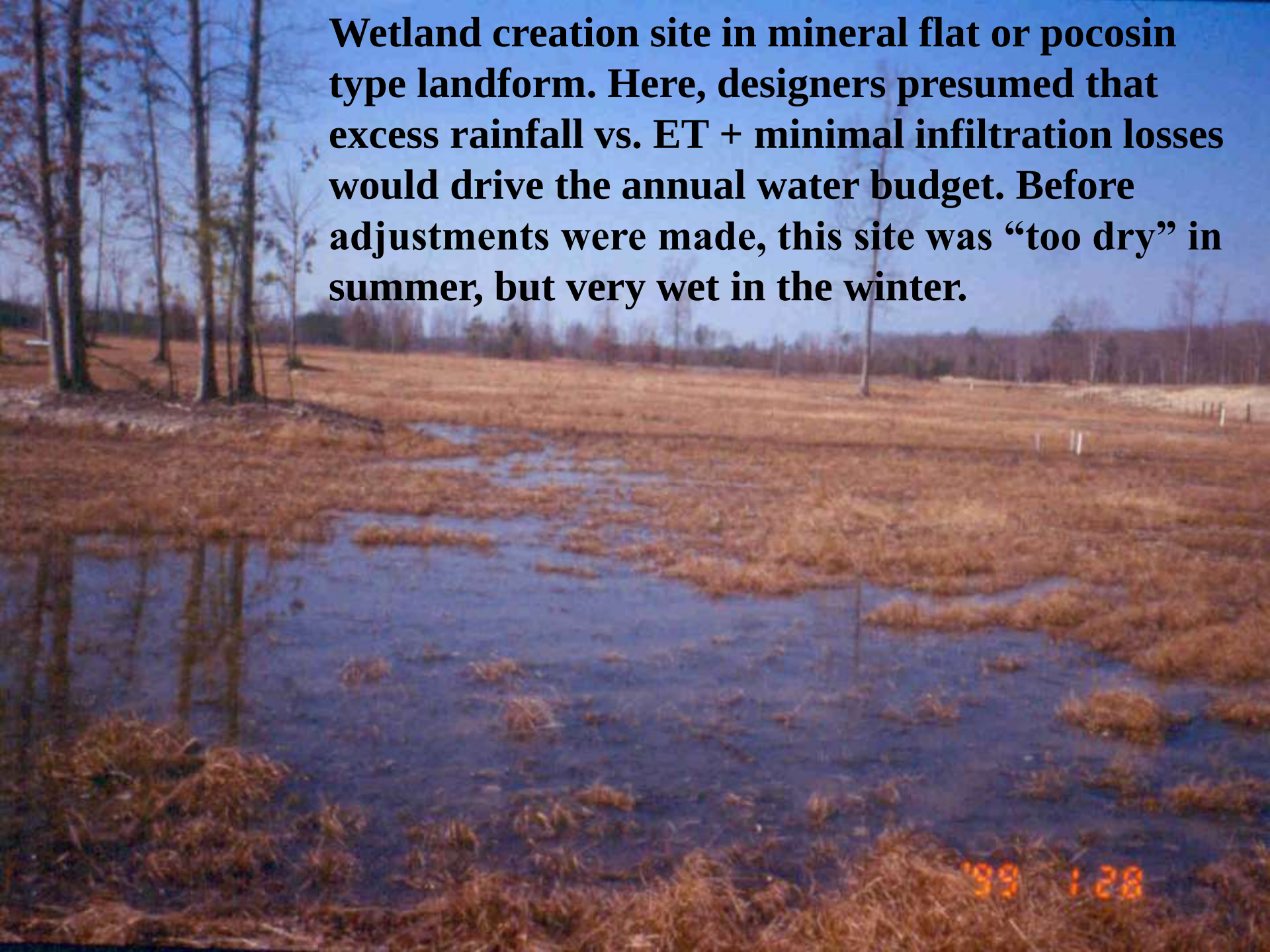
- **Many agencies follow and/or recommend variations of the "Pierce Approach" whereby ground water flux is presumed minimal, ET is estimated via Thornthwaite, runoff additions are estimated via SCS/NRCS Runoff Curve Number Method, water is presumed to be detained over the site via a berm, and water level is controlled via an outlet, etc.**

A “simple” way to create a mitigation wetland is to create a perched system

Can work on hilltops with low permeability compacted subsoils



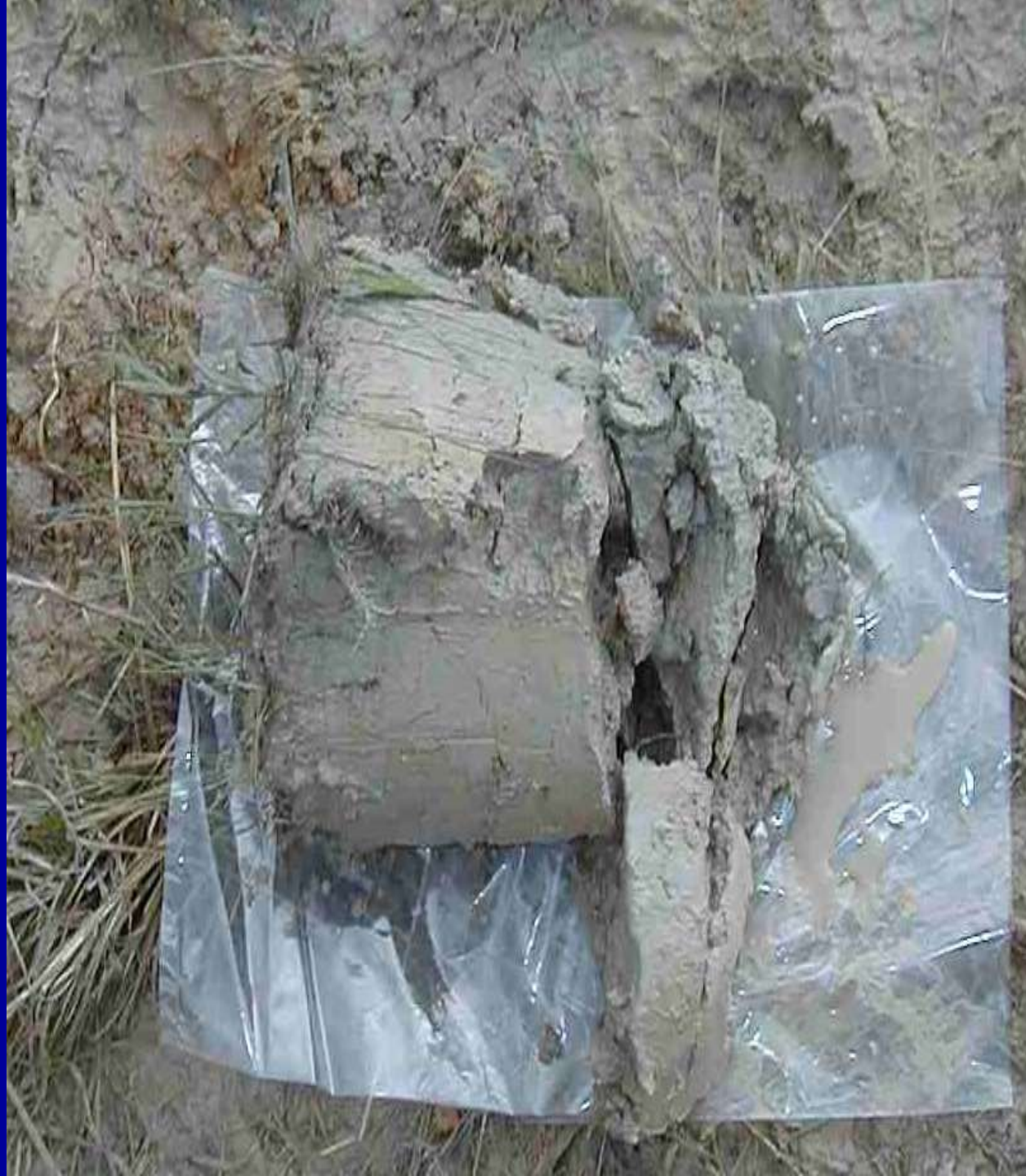
assume negligible



Wetland creation site in mineral flat or pocosin type landform. Here, designers presumed that excess rainfall vs. ET + minimal infiltration losses would drive the annual water budget. Before adjustments were made, this site was “too dry” in summer, but very wet in the winter.

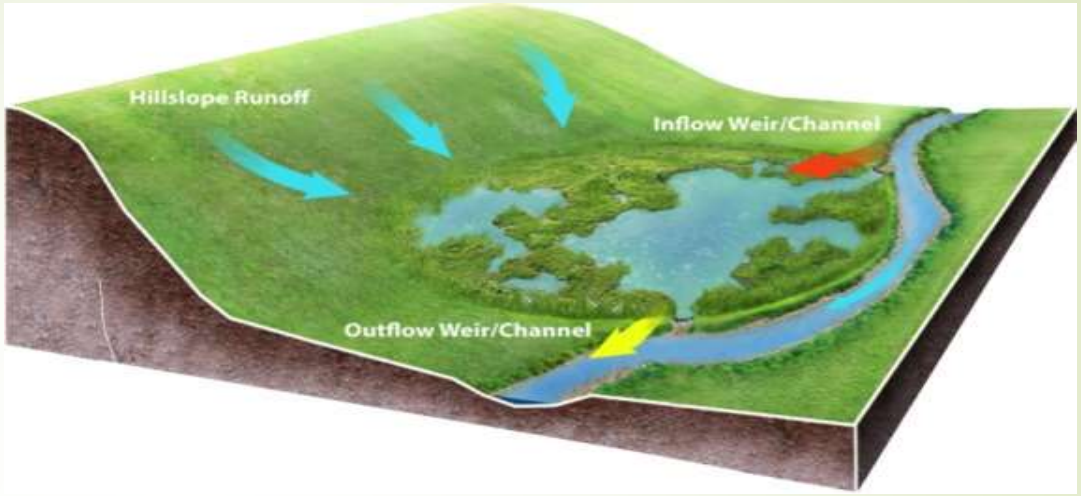
Surface soil from the same wetland.

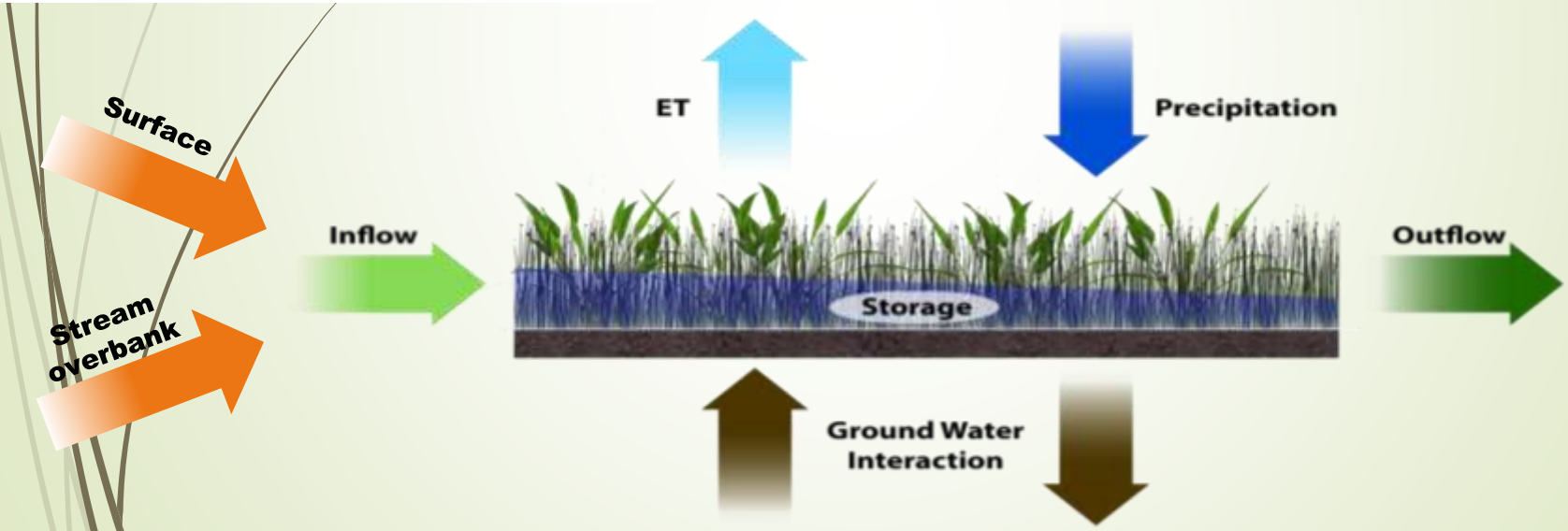
Note massive structure in surface breaking to firm plates at about 20 cm. This is the “traffic pan” that was designed to perch the water table, but also led to extremely dry summer conditions.



Water Budget Model Issues

- "Bath Tub" vs. Sloped Systems
- Vegetative Flow Resistance
- Groundwater Inputs vs. data?
- Overbank Flow Contribution
- Which Precipitation Data?
- Variations in ET Estimators
- Complex topography





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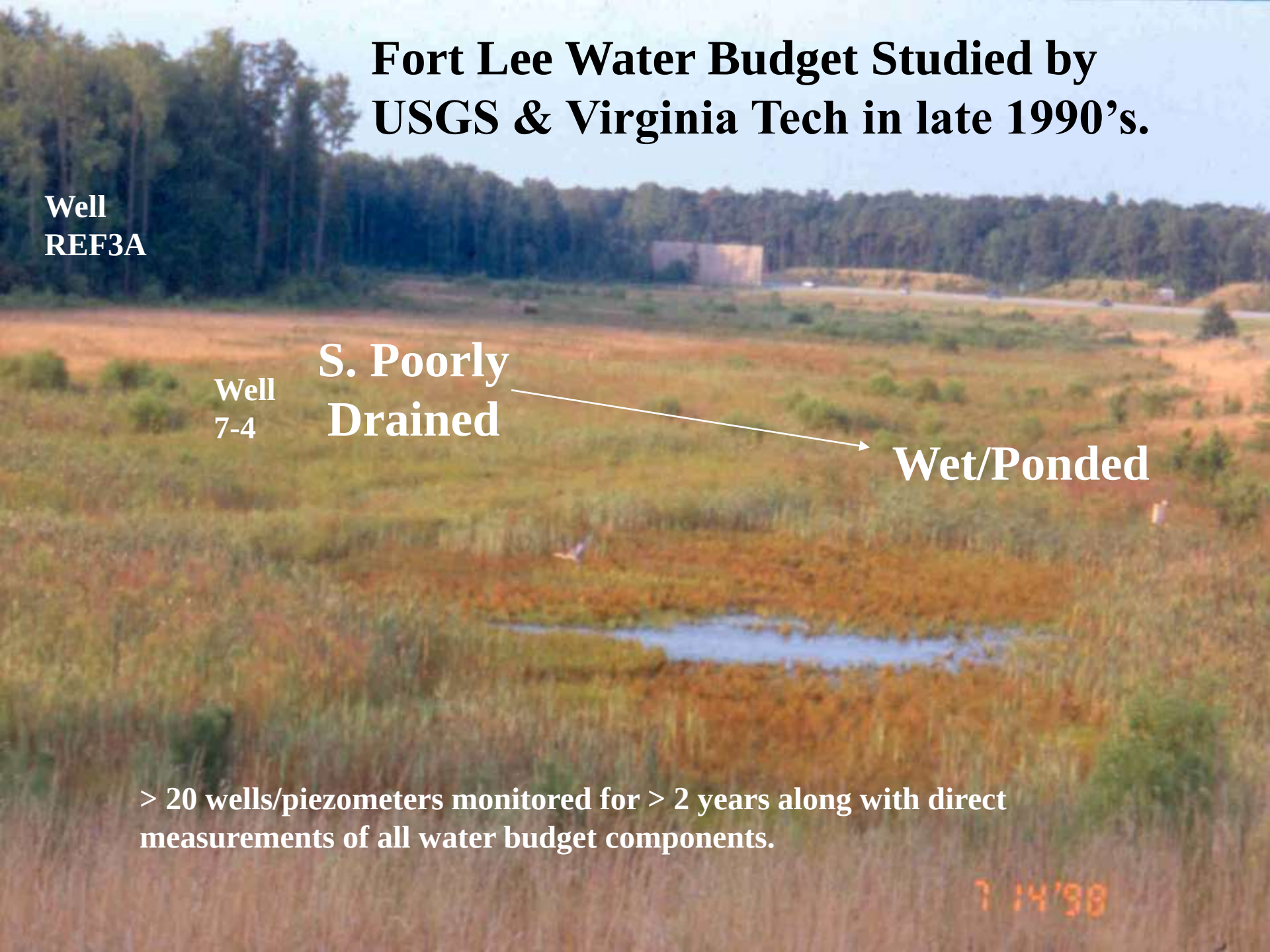
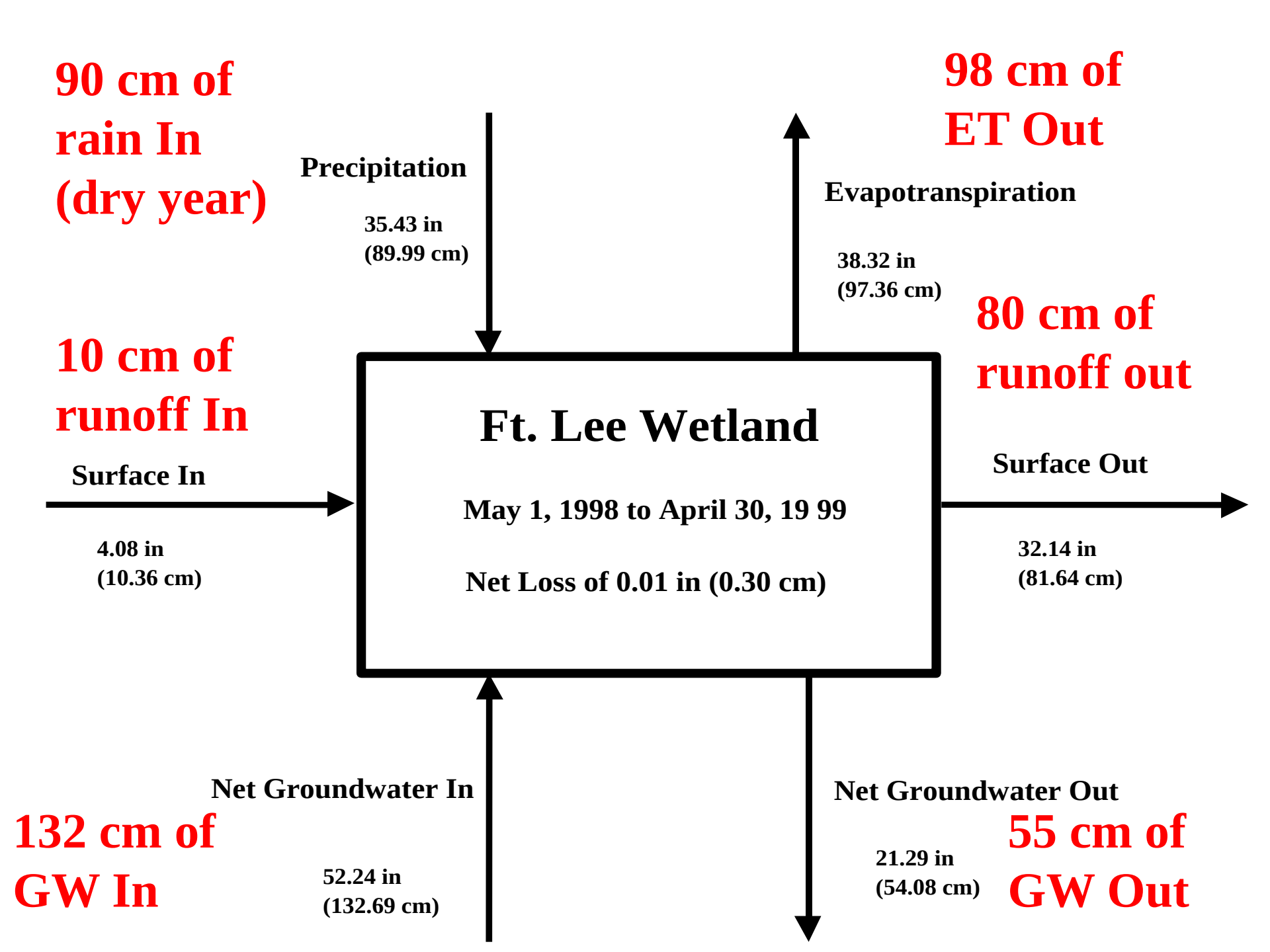
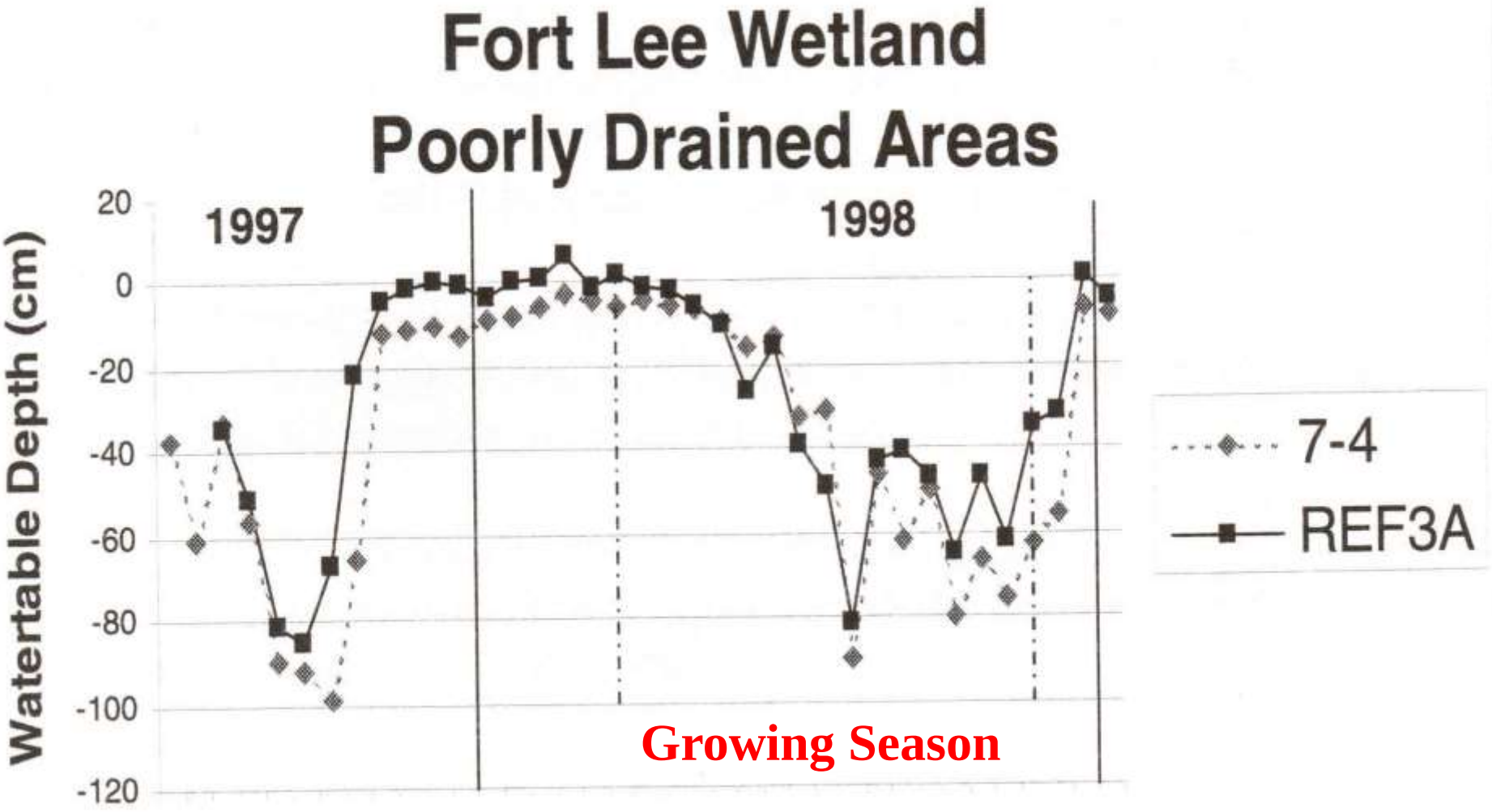

Fort Lee Water Budget Studied by USGS & Virginia Tech in late 1990's.
Well REF3A
Well 7-4
S. Poorly Drained
Wet/Ponded
> 20 wells/piezometers monitored for > 2 years along with direct measurements of all water budget components.
7 :4'98

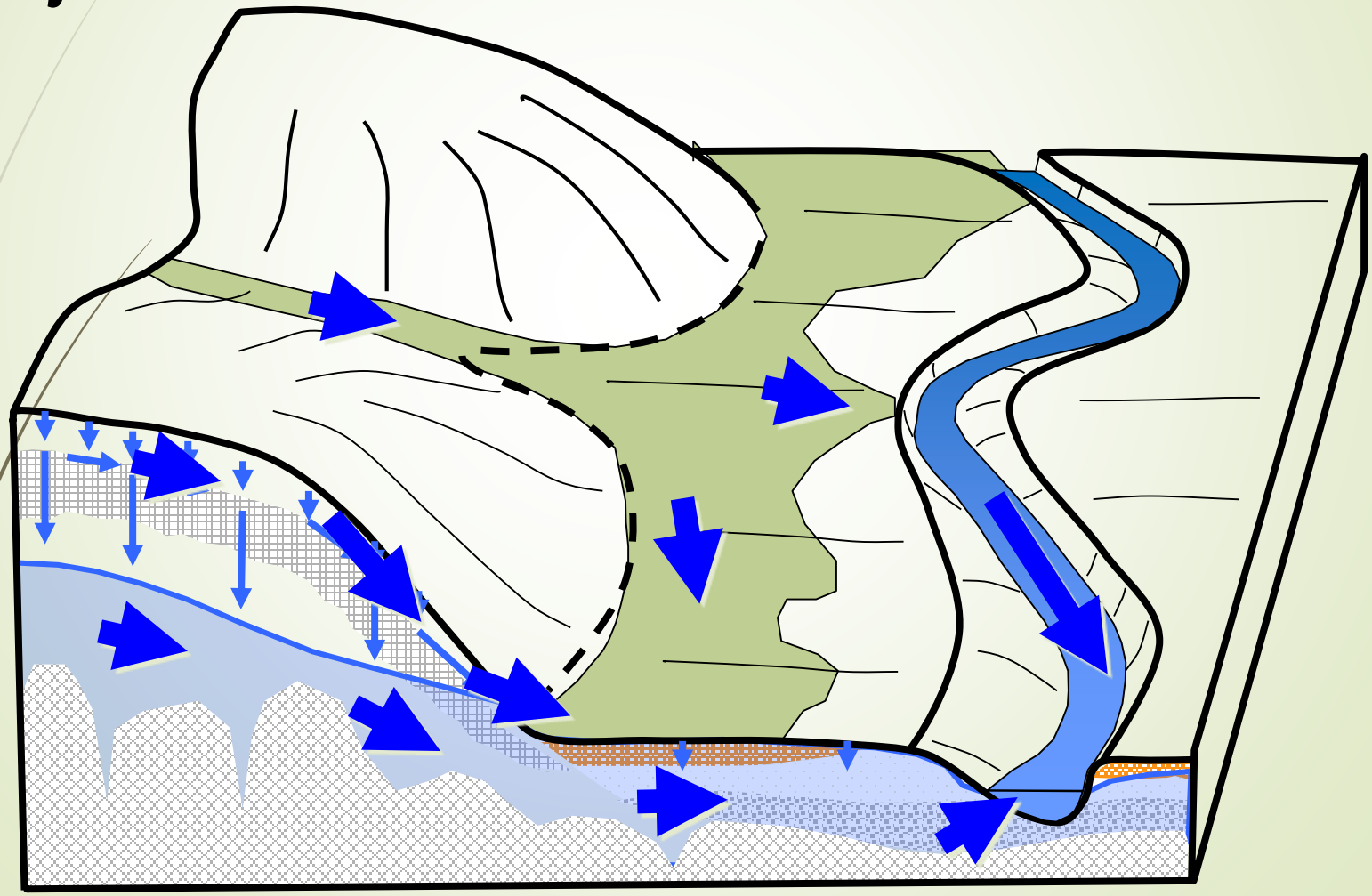

90 cm of rain In (dry year)
Precipitation
35.43 in (89.99 cm)
98 cm of ET Out
Evapotranspiration
38.32 in (97.36 cm)
80 cm of runoff out
10 cm of runoff In
Surface In
4.08 in (10.36 cm)
Ft. Lee Wetland
May 1, 1998 to April 30, 19 99
Net Loss of 0.01 in (0.30 cm)
Surface Out
32.14 in (81.64 cm)
Net Groundwater In
132 cm of GW In
52.24 in (132.69 cm)
Net Groundwater Out
21.29 in (54.08 cm)
55 cm of GW Out



Hydroperiod for one zone in Fort Lee wetland (7-4) vs. adjacent natural wetland (REF3A). How do we pick a design target? Here it was just lucky.

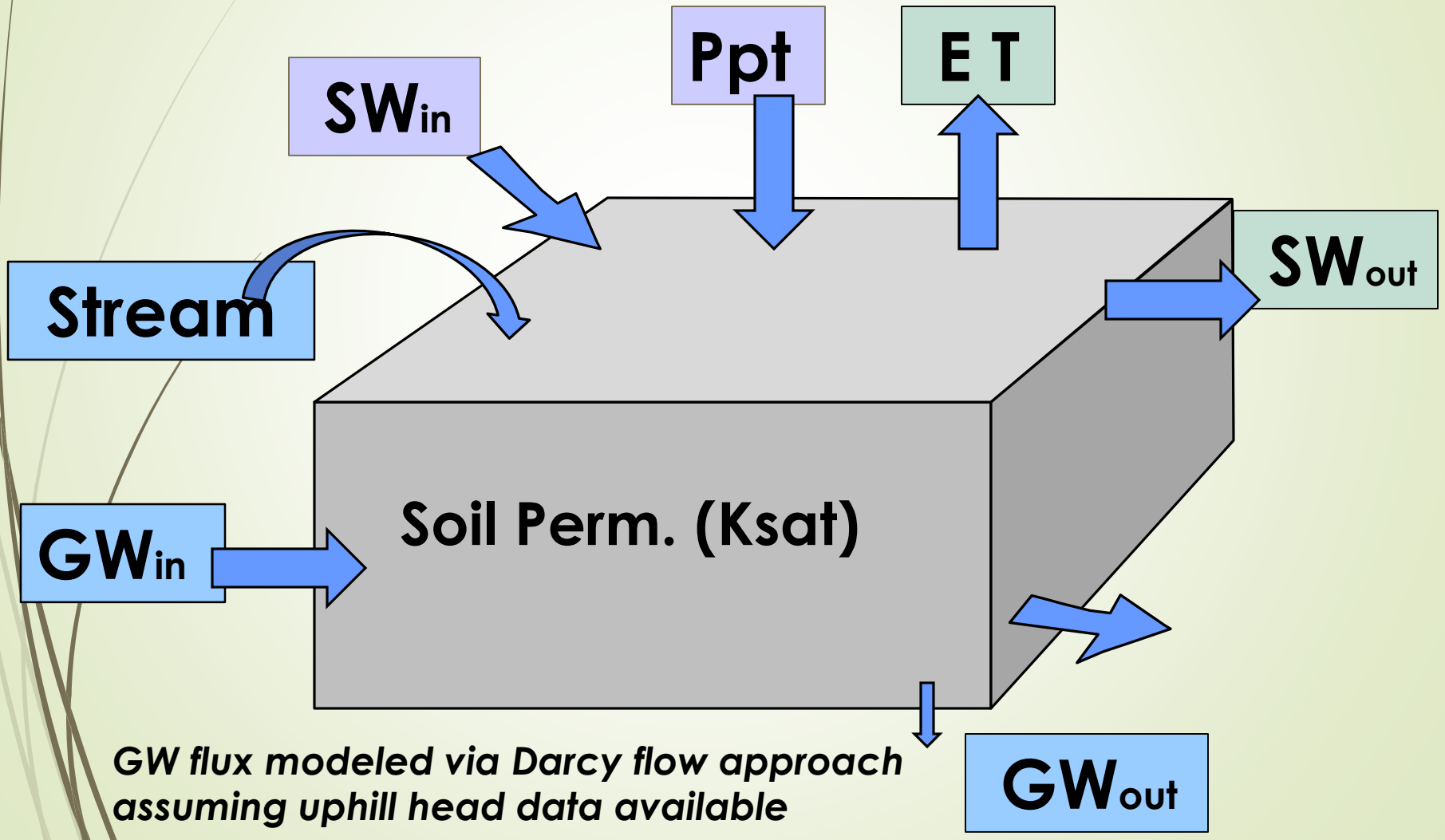
Less than 20% of this site exhibited a hydroperiod similar to well 7-4. Around 40% was much drier and the rest was much, much wetter.

<u>Piedmont Wetlands</u>: the interface between uplands, groundwater, and surface water. Primary original focus of research funds; *Wetbud works just fine for the Coastal Plain!*



Wetbud Basic Version

Wetbud is a design tool for wetland creation

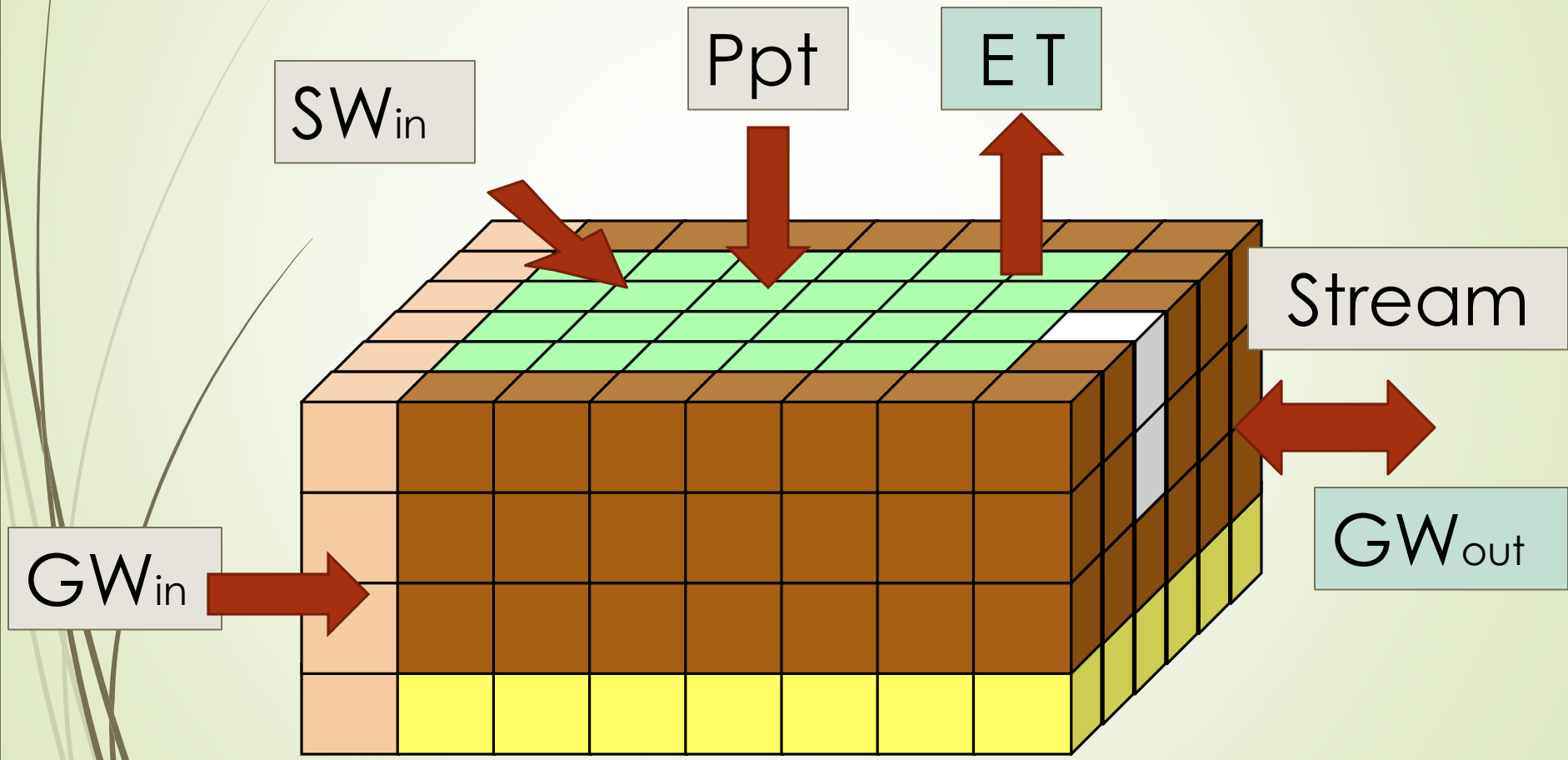


Wetbud Advanced Version

Allows for 3-D modeling including multiple water/soil/substrate layers, slopes, variable wetland topography, etc.

Incorporates more rigorous groundwater flux modeling via MODFLOW (basic model uses a simplified Darcy approach)

WetBud – Advanced Version



Model and Component Validation & Calibration

Huntley Meadows – Fairfax
(detailed ET x 4 and GW studies)

Northfork Bank – Haymarket
(basic model + overbank flow)

Cedar Run 3 – W. of Quantico

Others at Julie Metz, Bender Farms, Pocahontas, etc.

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Design Standards Development

Precipitation

- Statistically based analysis for wet, normal, and dry rainfall years
- Recommended weather stations for VA/MD
- Tools for auto download of any USA station

Evapotranspiration

- Calculates both Penman and Thornthwaite
- For W-N-D years selected by precipitation
- Options for input of pan data, Bowen Ratio, etc.

Groundwater

- Measurement protocol recommendations
- Wem: Projection of long term hydroperiod
- Soils data import for Ksat for all VA map units

Hydroperiod "Library"

- Developing VA and MD Regional Collection of "typical hydroperiods"
- What is targeted design Hydroperiod for PFO, PSS, PEM?

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