Introduction and Overview of Wetbud

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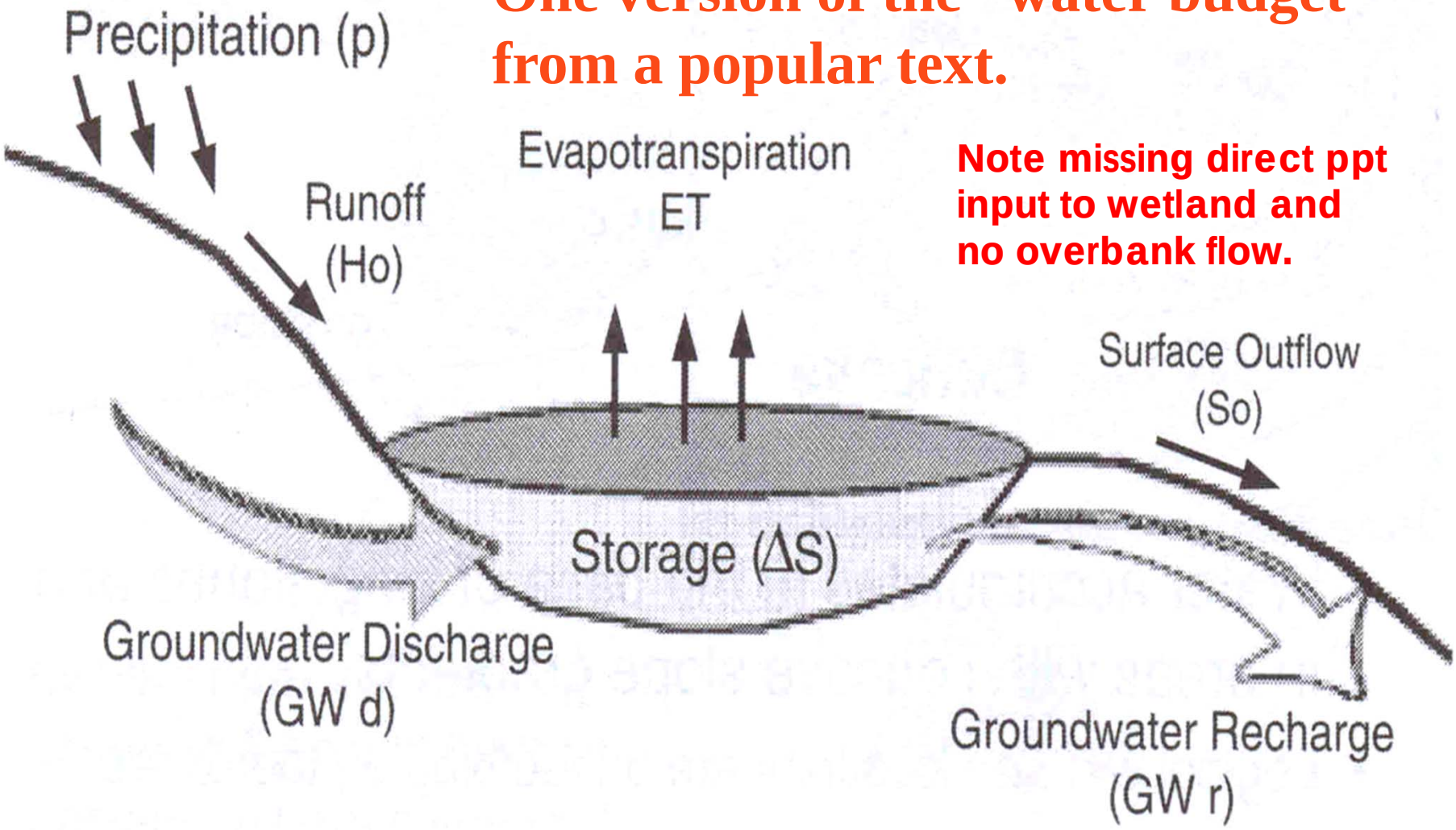
INPUTS = OUTPUTS + / - STORAGE

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

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



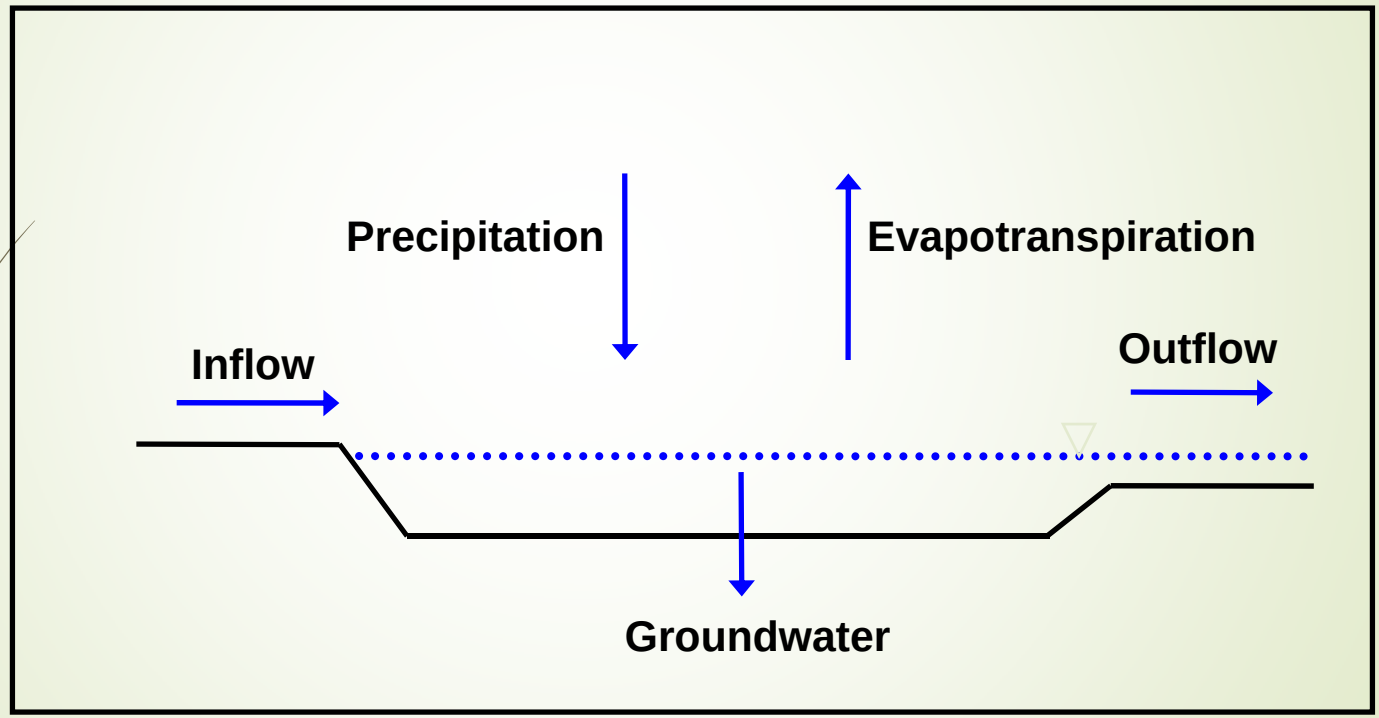
Note missing direct ppt input to wetland and no overbank flow.

Created Wetland Water Budgeting

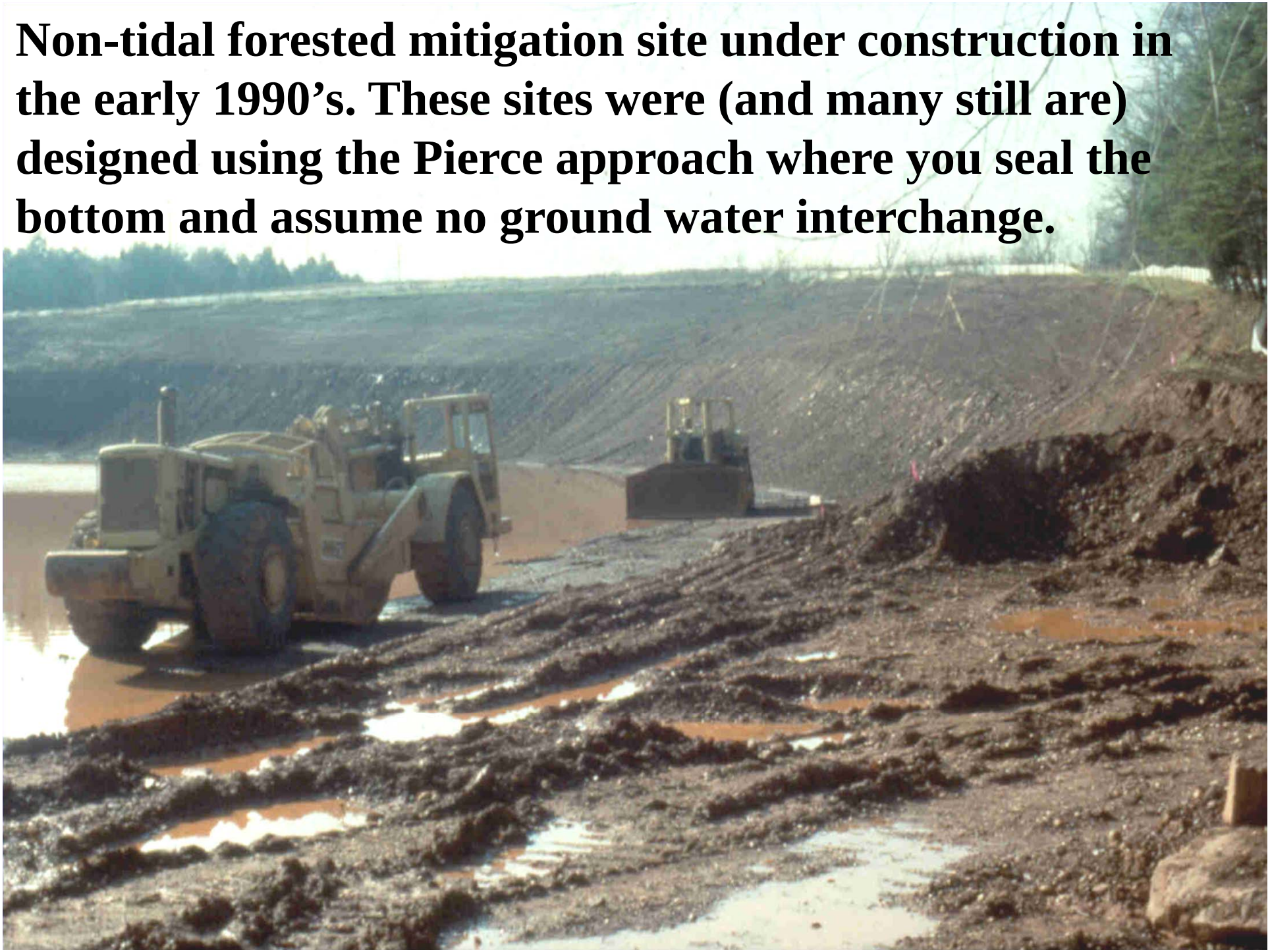
- **Wide variation in water budgeting approaches among agencies and consultants.**

- **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 Runoff Curves, and 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



Non-tidal forested mitigation site under construction in the early 1990's. These sites were (and many still are) designed using the Pierce approach where you seal the bottom and assume no ground water interchange.



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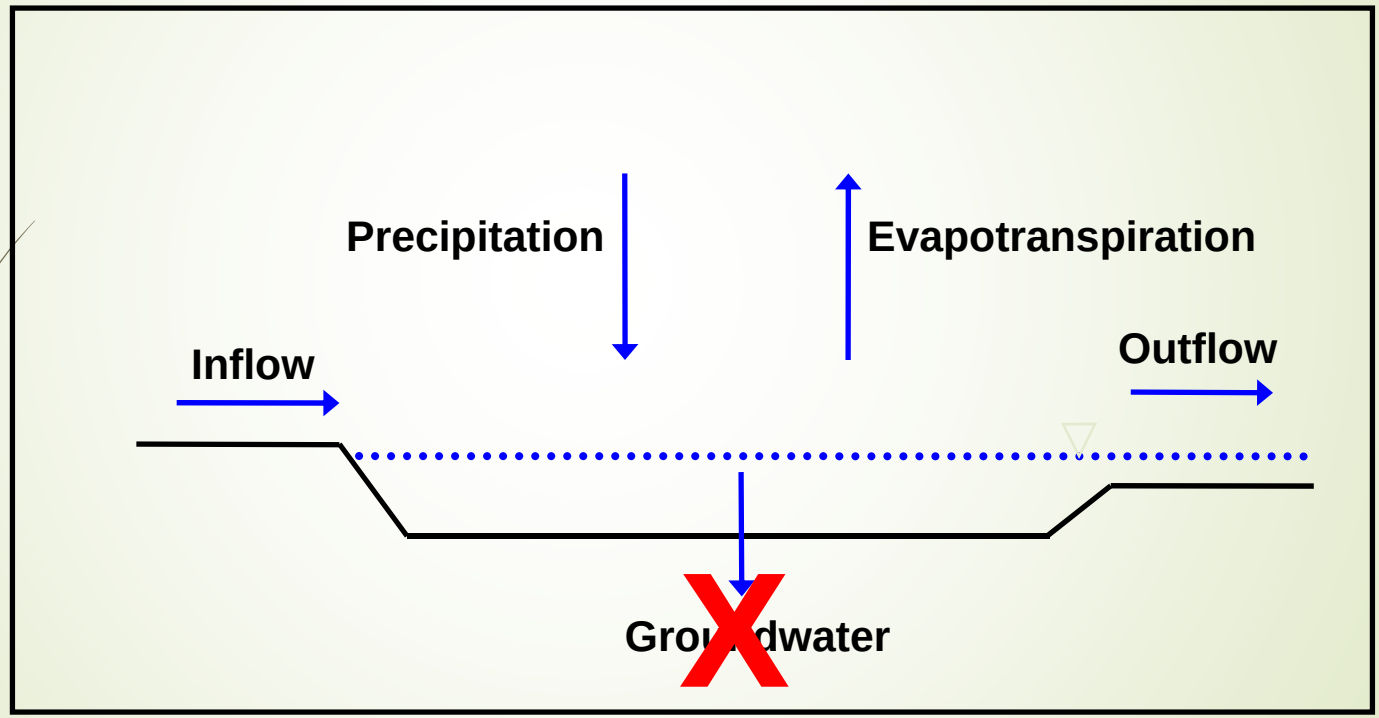
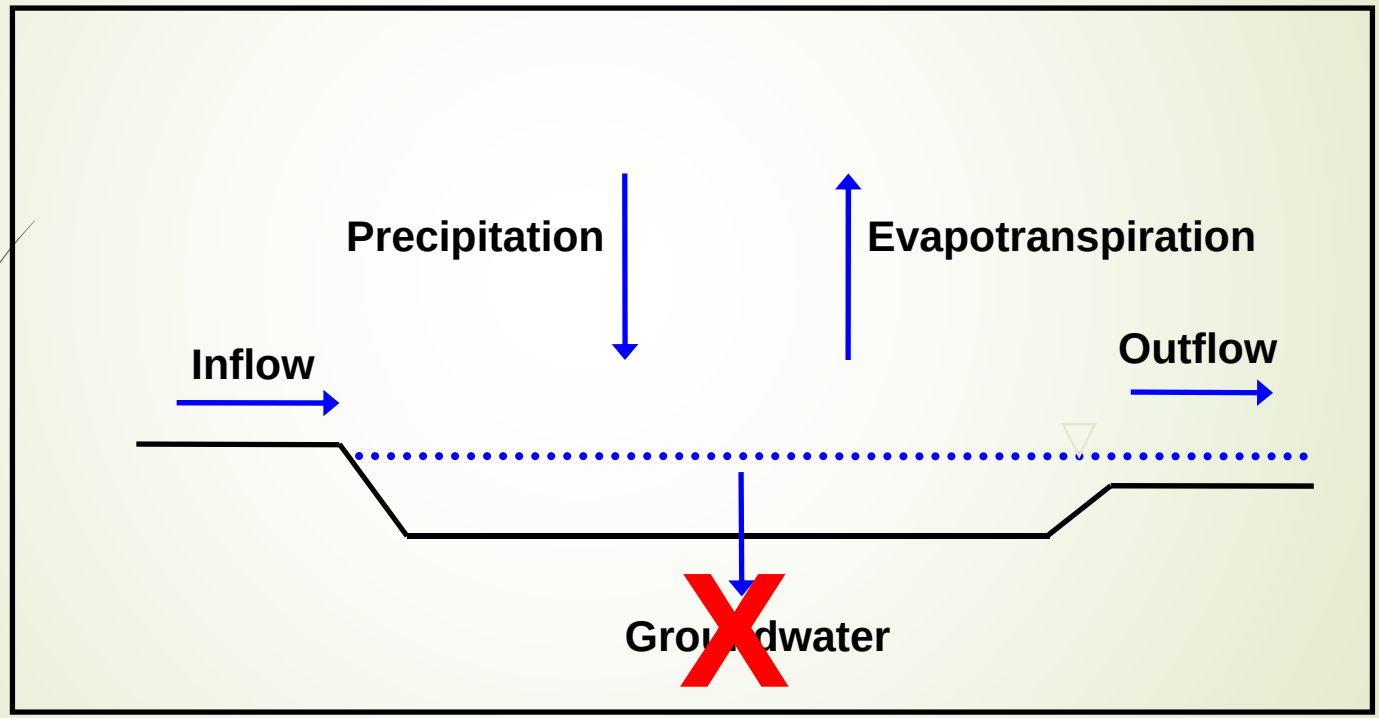


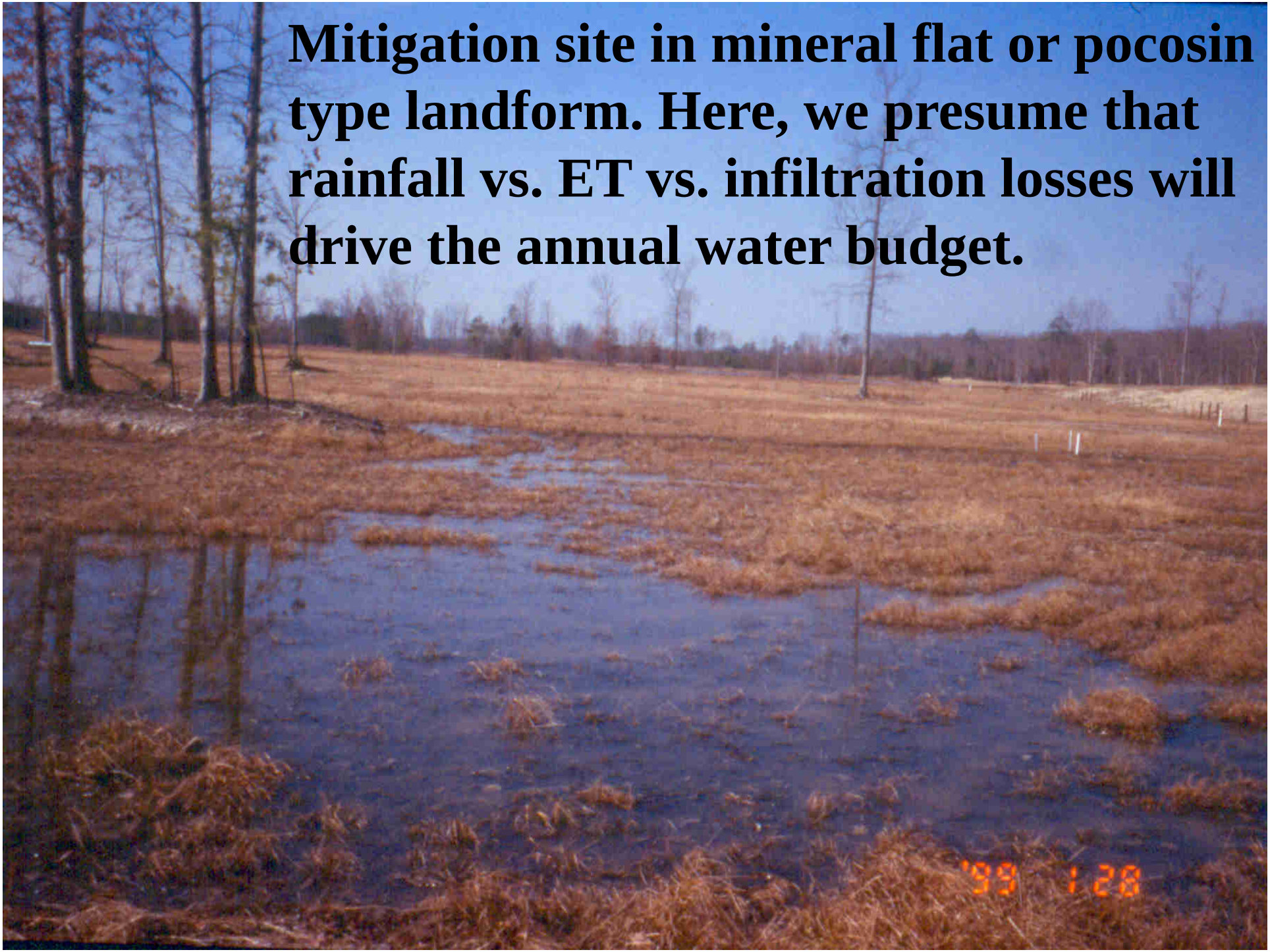
assume negligible

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

Can work on hilltops with low permeability compacted subsoils

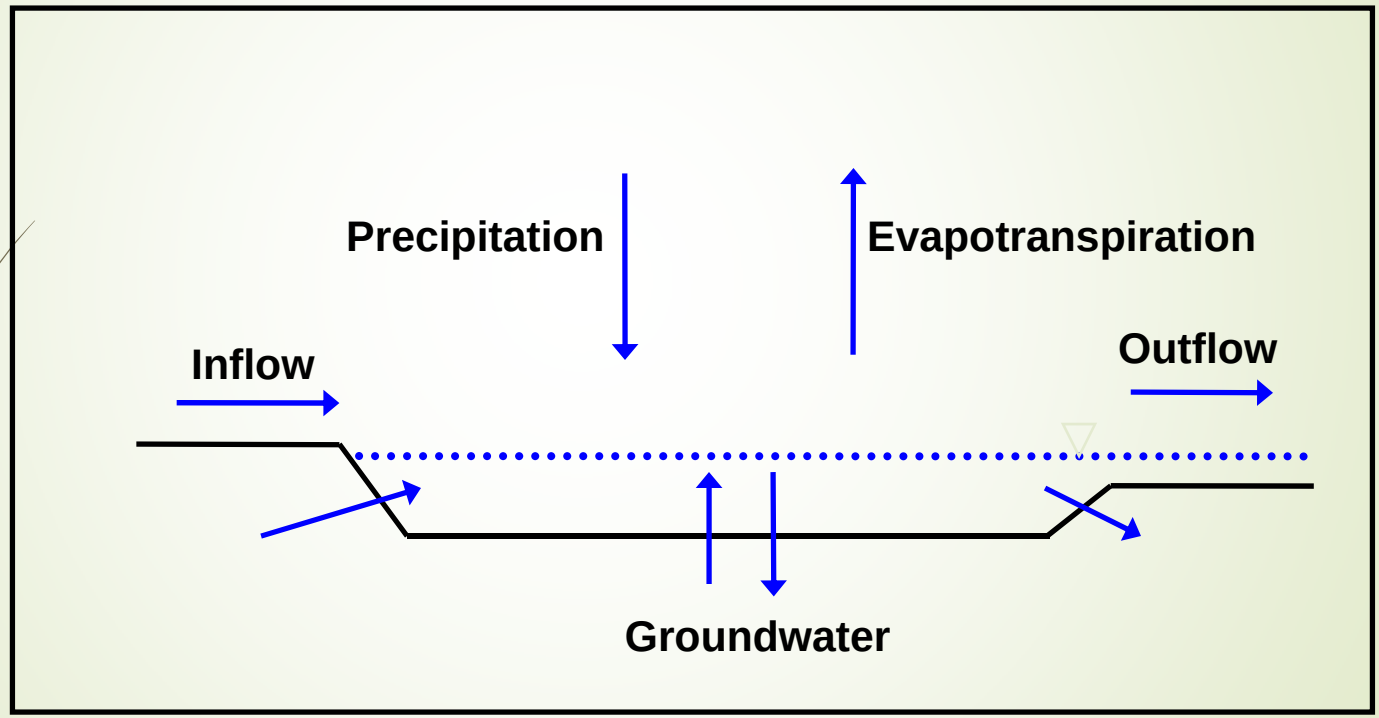


assume negligible


Mitigation site in mineral flat or pocosin type landform. Here, we presume that rainfall vs. ET vs. infiltration losses will drive the annual water budget.
'99 1 28

In most wetlands, Groundwater can seep IN and OUT many places

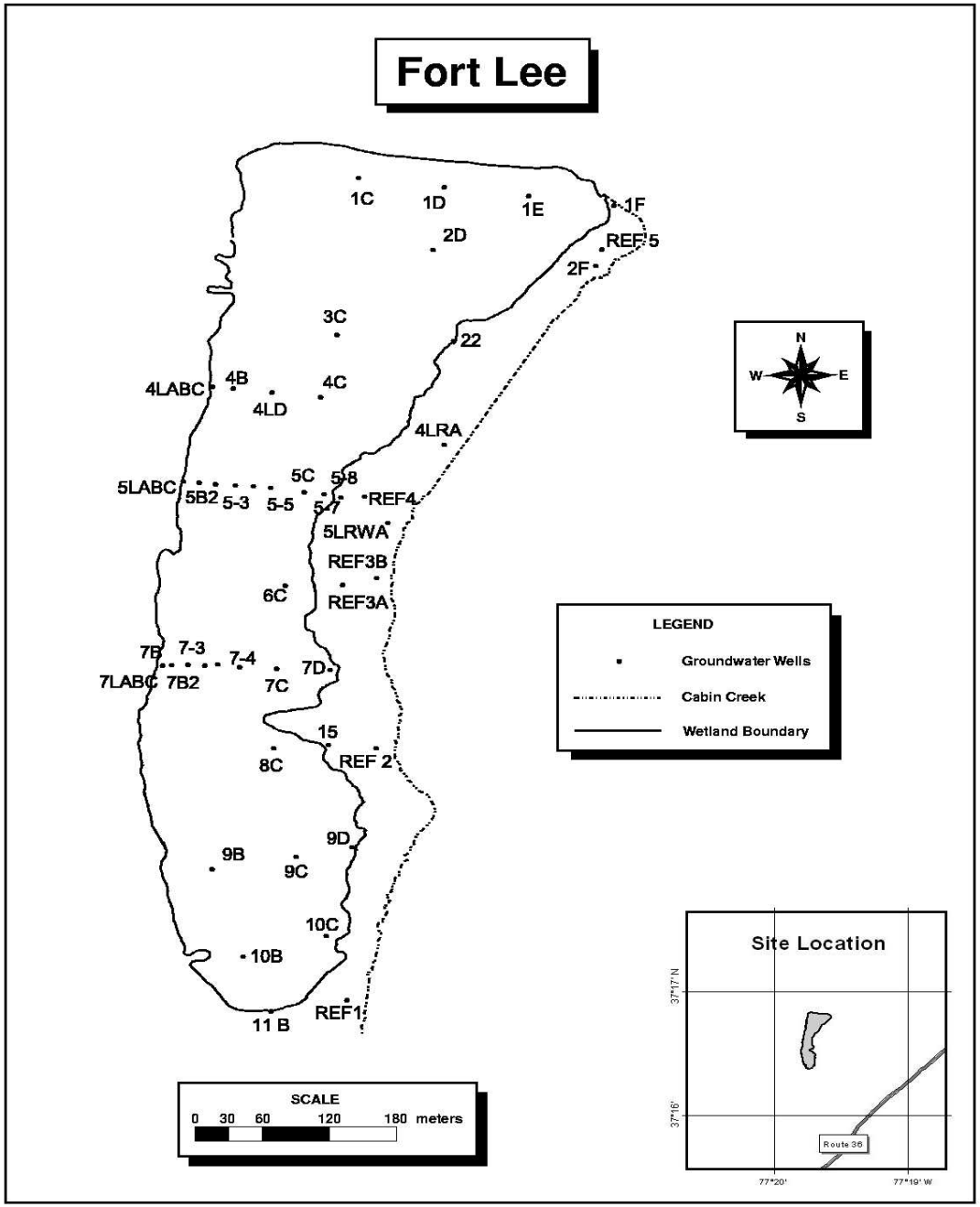
Ignore GW? the wetland can be “too wet”




Fort Lee Drainage Gradient Studied
by Cummings (a.k.a. Whitehead;1999)
S. Poorly
Drained
Wet/Ponded
7 14'98

Research Objectives

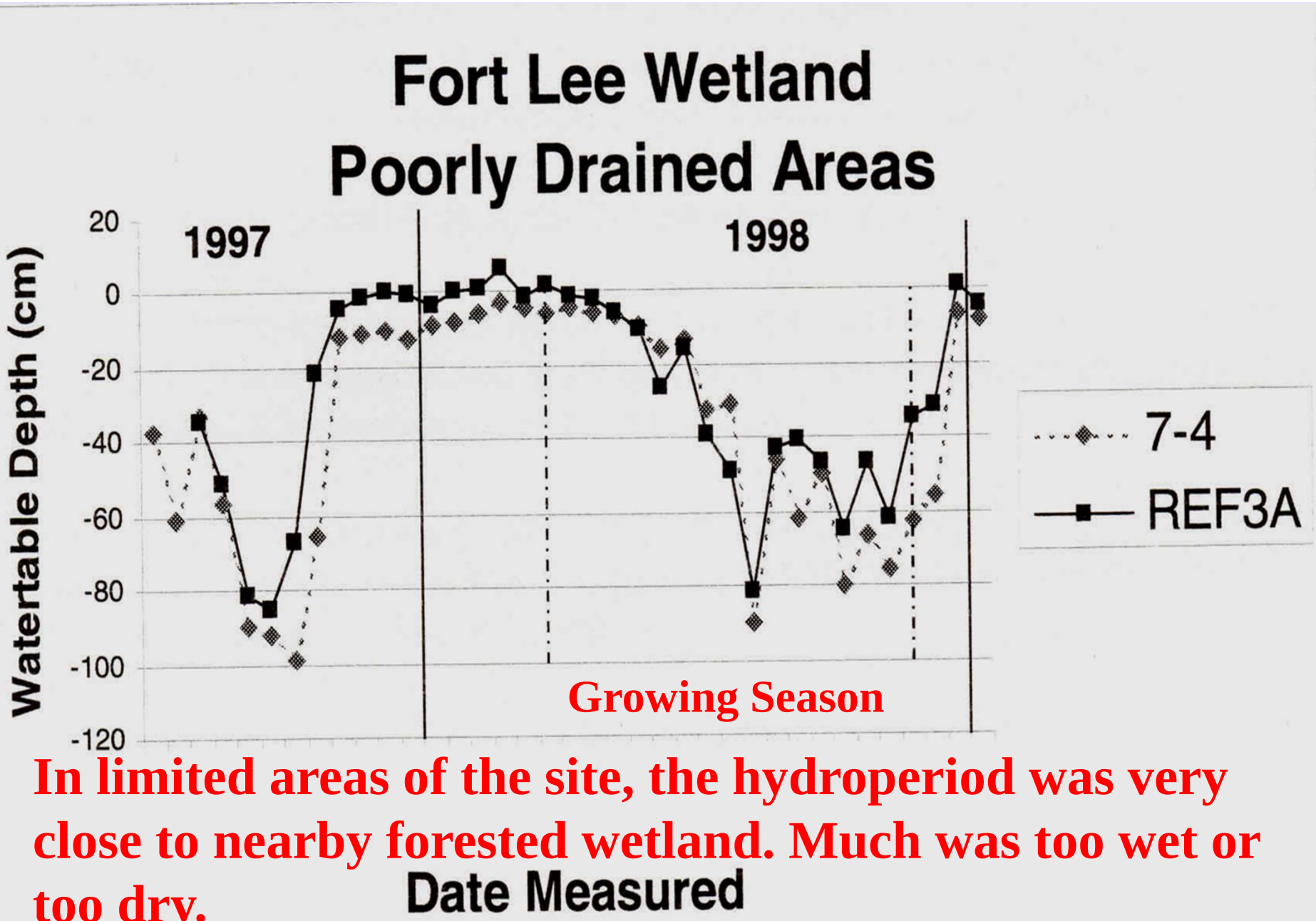
- **Determine the actual water budget for a non-tidal mitigation site in eastern Virginia (joint with USGS)**
- **Compare actual water budget data to that used conventionally by VDOT for mitigation planning**



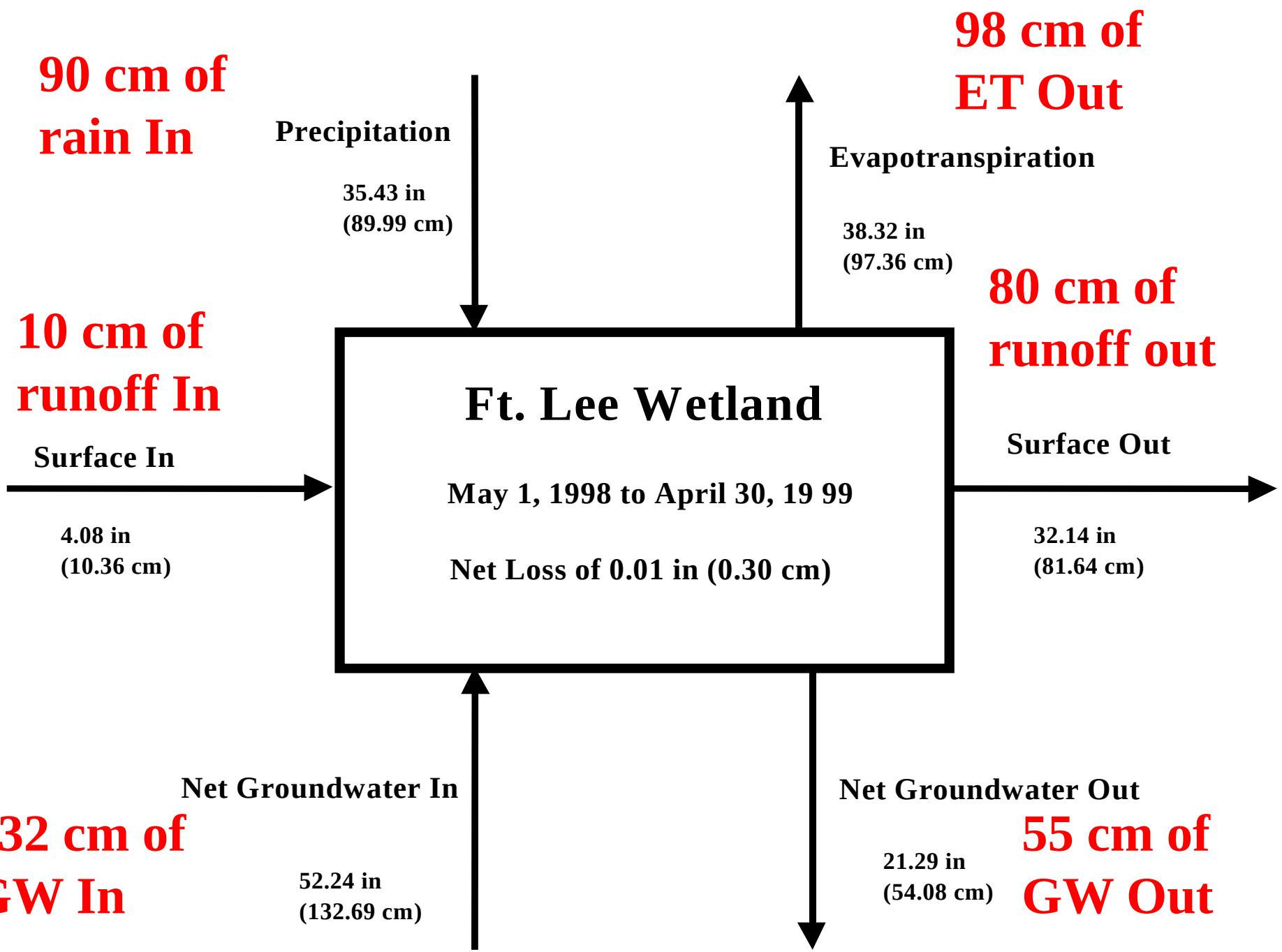
VT worked with USGS (Mike Focazio and Gary Spieran) to measure and quantify all inputs and losses. Estimated GW flux via a Darcy approach, ET via Bowen Ratio and diurnal water table flux, etc.

The site was designed (and presumed) by VDOT to be a surface water driven system.

Monitored in a ~dry year (1998/1999)



In limited areas of the site, the hydroperiod was very close to nearby forested wetland. Much was too wet or too dry.


90 cm of rain In
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

Wetbud History

Program originally funded via RFP #2 (Wetland Water Budgeting) by WSSI & Peterson Family Foundation in 2008.
<u>Original objectives</u> and tasks:

Review literature, survey regulatory and industry practices, and document all known water budget methodologies;

Interview experienced wetland scientists and engineers about existing design and construction issues related to wetland water budgets;

Find existing constructed wetlands in the Virginia Piedmont with sufficient geologic data and hydrologic instrumentation from pre- and post-construction evaluations for model evaluation;

Develop a library of historic rainfall data for all NOAA stations in Virginia and classify each year as "dry," "typical," or "wet";

Generate detailed tables with interpretative information of Piedmont soil conditions with respect to expected infiltration, permeability, and other important hydrologic and plant growth parameters;

Wetbud History

Program originally funded via RFP #2 (Wetland Water Budgeting) by WSSI & Peterson Family Foundation in 2008.
Original objectives and tasks:

Assess existing software and individual process-models (e.g. Darcy, Thornthwaite, etc.) for applicability to the Virginia Piedmont, ease-of-use, and accuracy;

Work with project collaborators to adapt existing software or to develop independent software modules and package for use in wetland hydrologic assessments;

Test the new model using data sets developed from selected test sites;

Develop an instruction manual to explain how to collect or determine groundwater data for use in this model; collect, test, or verify topsoil and subsoil data; and install and use the associated computer model; and,

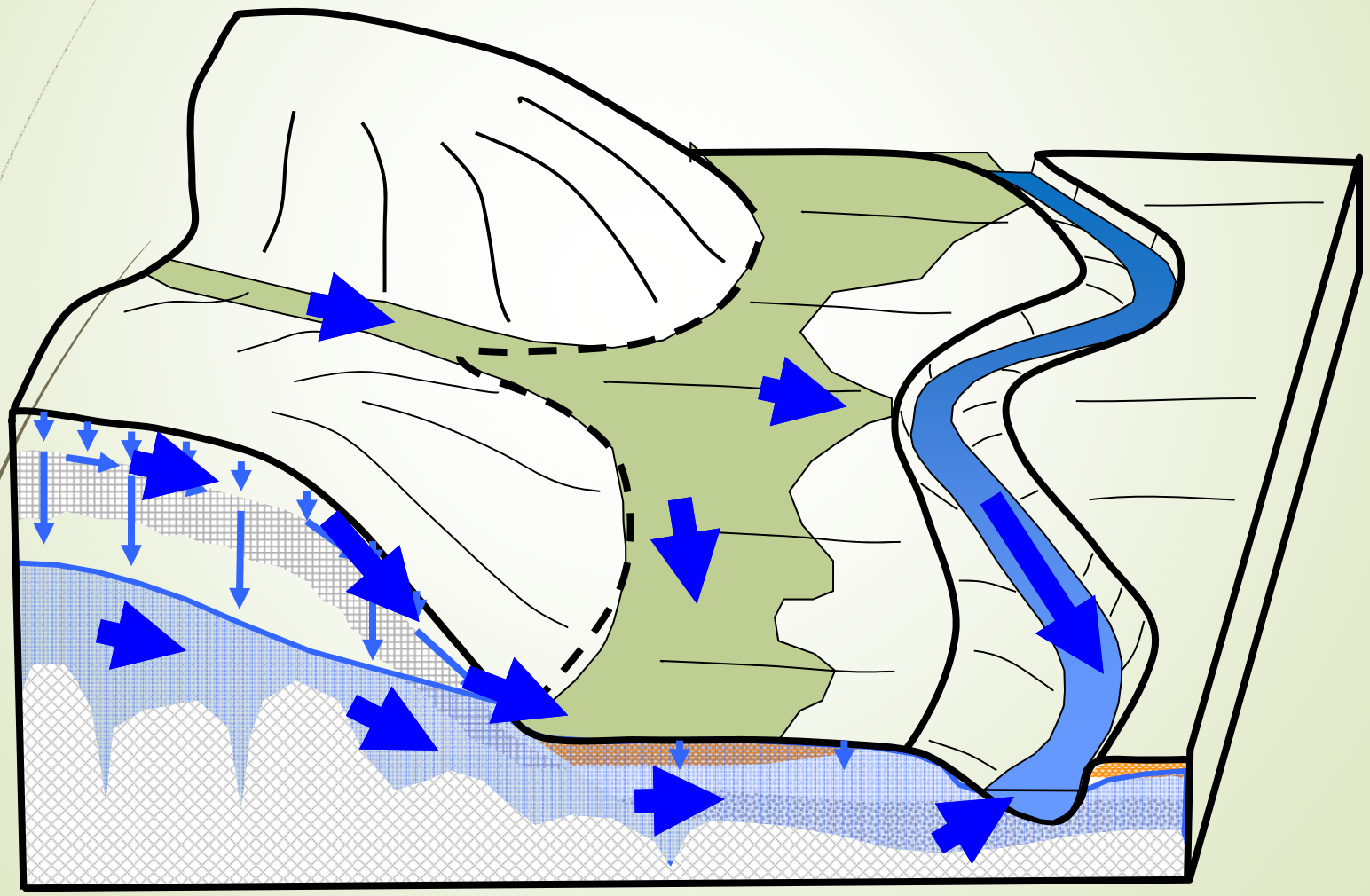
Develop training materials for use in workshops designed to teach others how to use the new software package.

Wetbud History

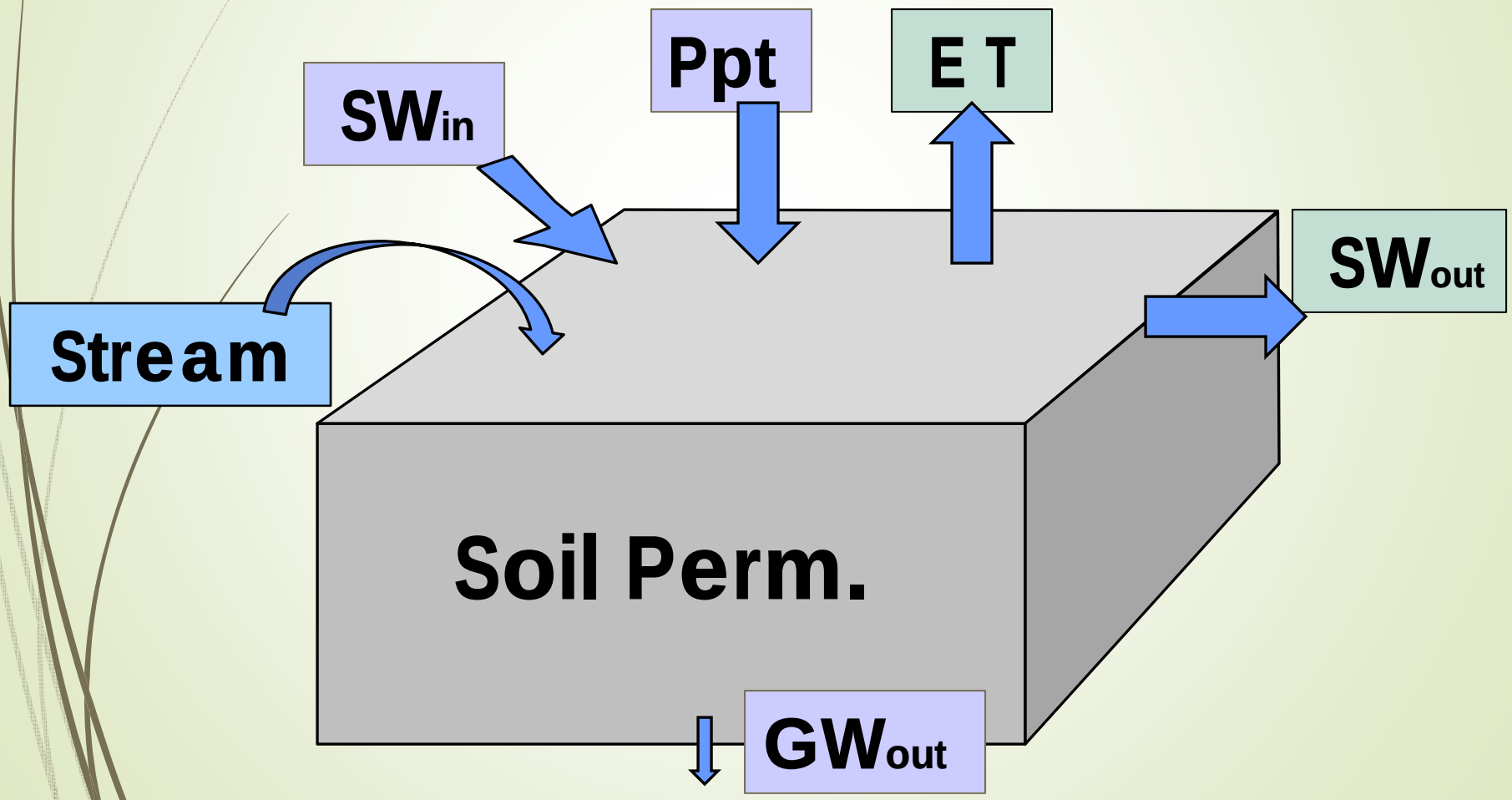
Program focused primarily on Piedmont (and Fall Zone) wetlands as research targets due to nature of funding.

Added support over time include more focus on MODFLOW and stream overbank (2011) and AET estimators (2013).

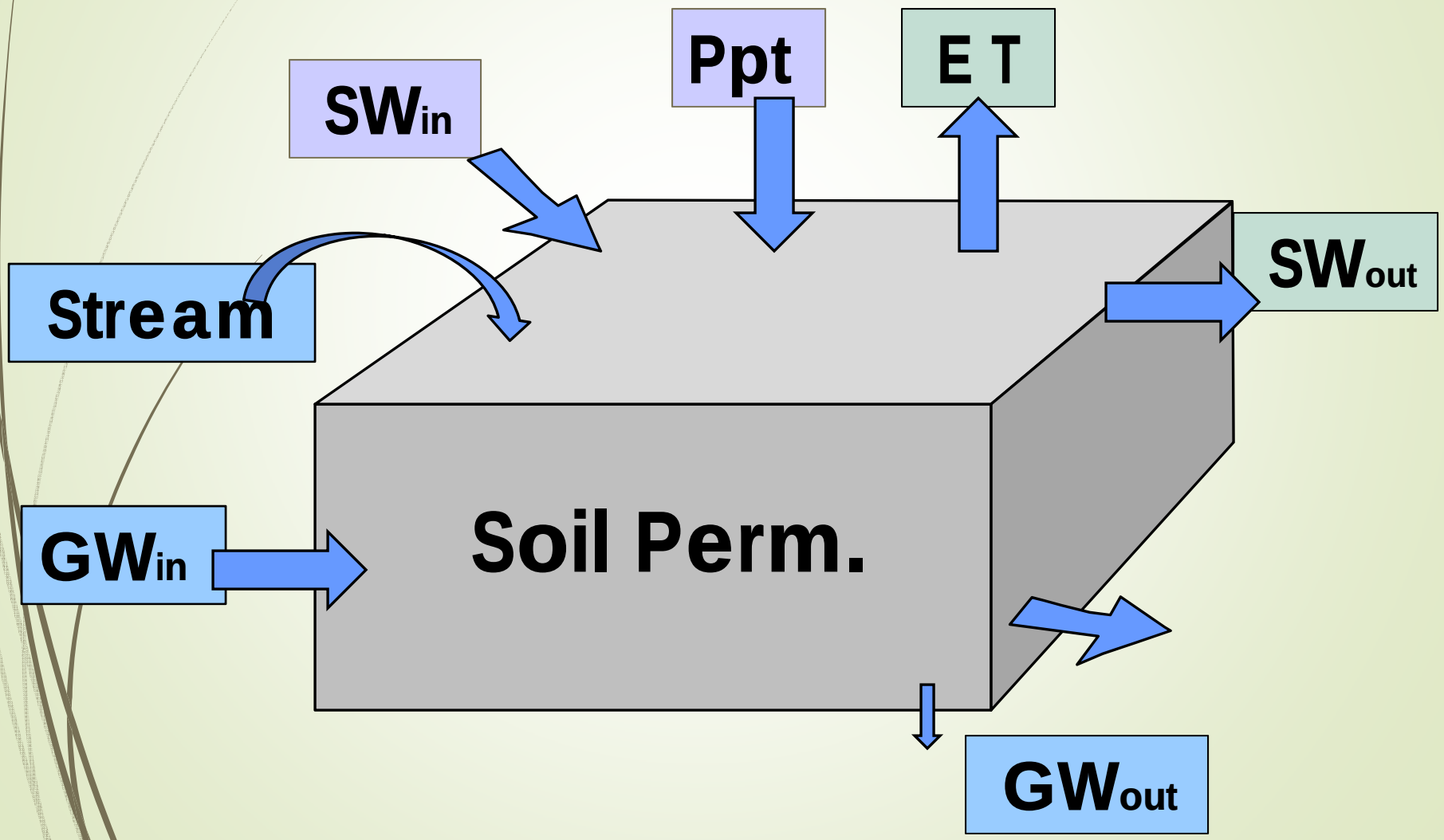
Piedmont Wetlands: the interface between uplands, groundwater, and surface water



Pierce's model for depressional wetlands



Wetbud Basic Version



Wetbud Advanced Version

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

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

Who's doing what?

Zach Agioutantis, Tech. Univ. of Crete/VT Programmer & MODFLOW

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

Kerby Dobbs, Old Dominion University -- Advanced model & manual

Tess Wynn Thompson, Virginia Tech – Surface water

Rich Whittecar, Old Dominion University -- Groundwater

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

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