Possible Uses of Pinelands Kirkwood/Cohansey Aquifer Study

Discussions with NJ DEP, NJBA, and PC Sub-committees (Plan Review, P & I)

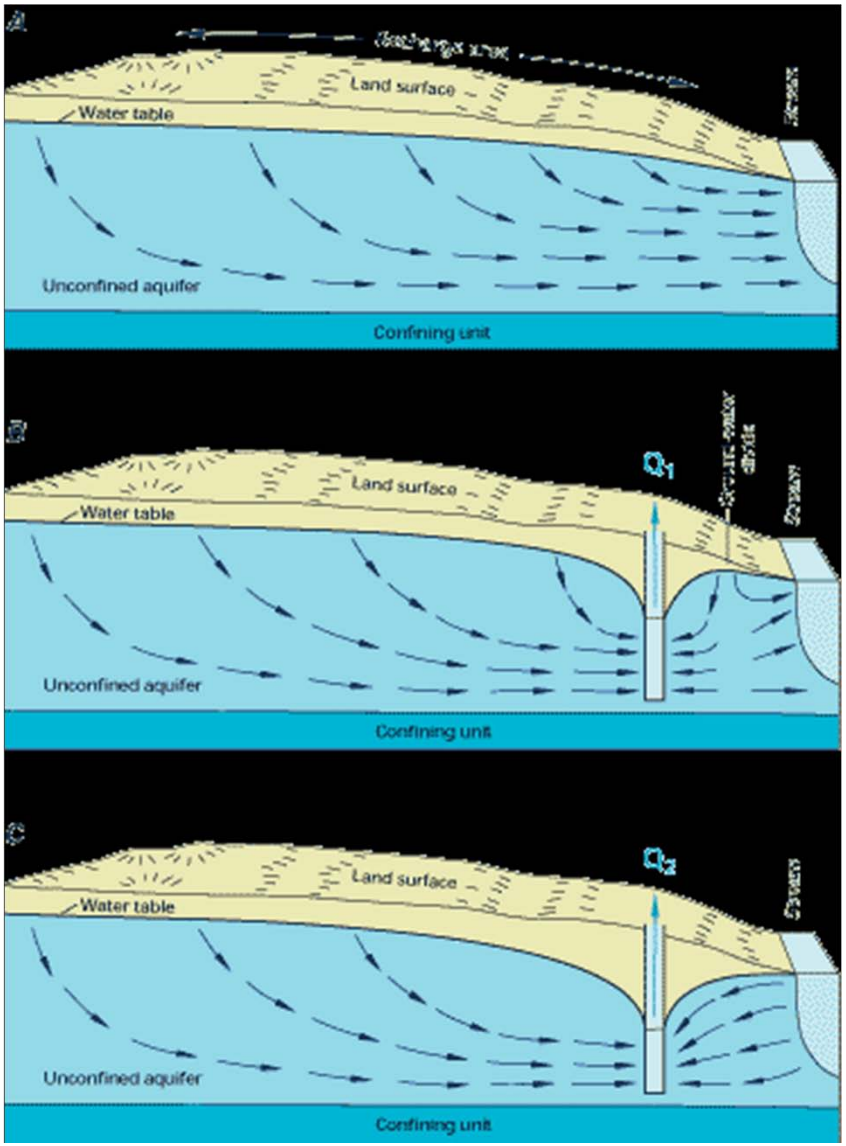
March through April, 2013

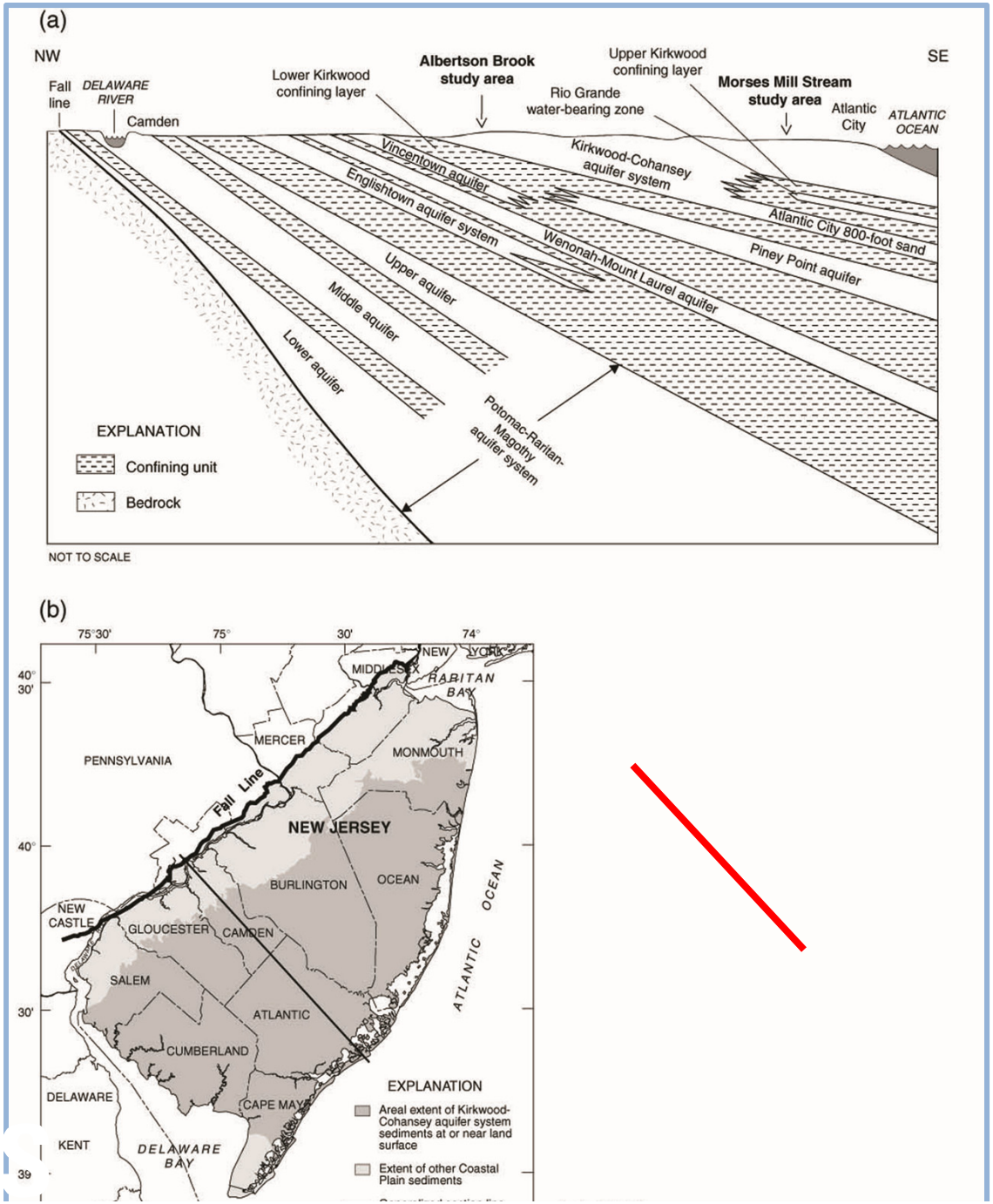
To Make Changes to Pinelands Regulations to:

1. Better Measure Regional Impacts of increased or pumping (e.g., new wells)
2. Better Measure Local Impacts of increase or new pumping near wetlands (e.g., new wells)

Hydrologic Response to Groundwater Withdrawal

- Water-level changes “nearby”
- Streamflow Reductions




(a)
NW
SE
Fall line
DELAWARE RIVER
Camden
Lower Kirkwood confining layer
Albertson Brook study area
Upper Kirkwood confining layer
Rio Grande water-bearing zone
Morses Mill Stream study area
Atlantic City
ATLANTIC OCEAN
Vincentown aquifer
Englishtown aquifer system
Kirkwood-Cohansey aquifer system
Atlantic City 800-foot sand
Piney Point aquifer
Wenonah-Mount Laurel aquifer
Upper aquifer
Middle aquifer
Lower aquifer
Potomac-Raritan-Magothy aquifer system
EXPLANATION
Confining unit
Bedrock
NOT TO SCALE
(b)
75°30'
75°
30'
74°
40° 30'
40°
30'
39
NEW YORK
MIDDLESEX
RARITAN BAY
MERCER
MONMOUTH
PENNSYLVANIA
Fall Line
NEW JERSEY
BURLINGTON
OCEAN
NEW CASTLE
GLOUCESTER
CAMDEN
SALEM
ATLANTIC
ATLANTIC OCEAN
CUMBERLAND
DELAWARE
CAPE MAY
KENT
DELAWARE BAY
EXPLANATION
Areal extent of Kirkwood-Cohansey aquifer system sediments at or near land surface
Extent of other Coastal Plain sediments

How Can We Better Assess Regional Impacts?

- What do current Pinelands regulations say?
- What new metrics can we derive from the study?
- How can we regulate these metrics?

7:50-6.86 Water management

(c) All wells and all increases in diversion from existing wells which require water allocation permits from the New Jersey Department of Environmental Protection shall be designed and located so as to minimize impacts on wetlands and surface waters. ..

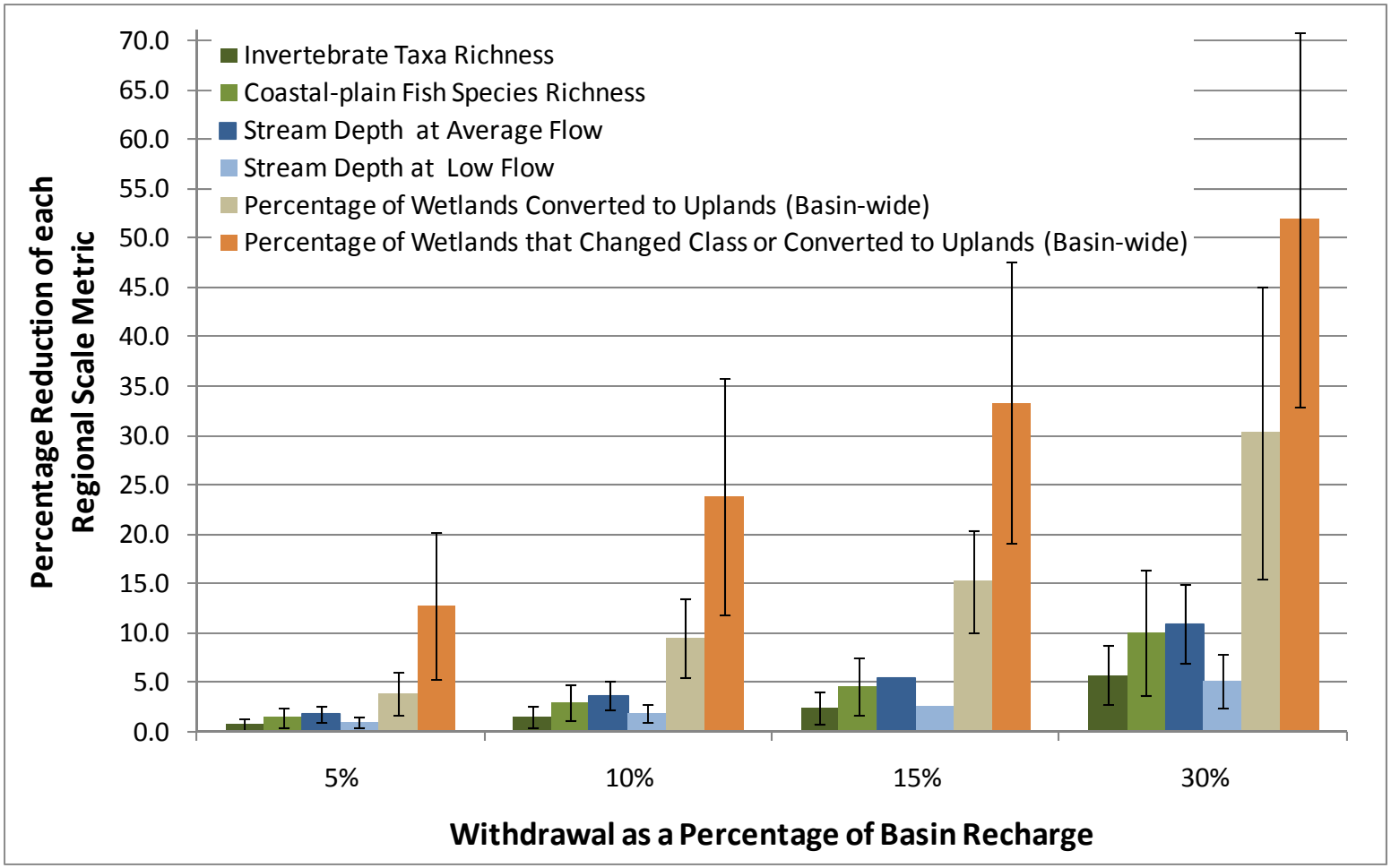
7:50-6.86 Water management (Impacts)

(e) Except for agricultural uses, all new potable and non-potable water supply diversions of more than 100,000 gallons per day that utilize the Kirkwood-Cohansey aquifer as a source of water supply and new increases in existing potable and non-potable water supply diversions of over 100,000 gallons per day that utilize the Kirkwood-Cohansey aquifer may be permitted only if it is demonstrated that:

1. No viable alternative water supply sources are available; or

2. The proposed use of the Kirkwood-Cohansey aquifer will not result in any adverse ecological impact on the Pinelands Area.

Metrics to Evaluate Regional/Watershed Scale Impact



Assumes use is 100% consumptive/depletive

Possible ways to address regional impacts

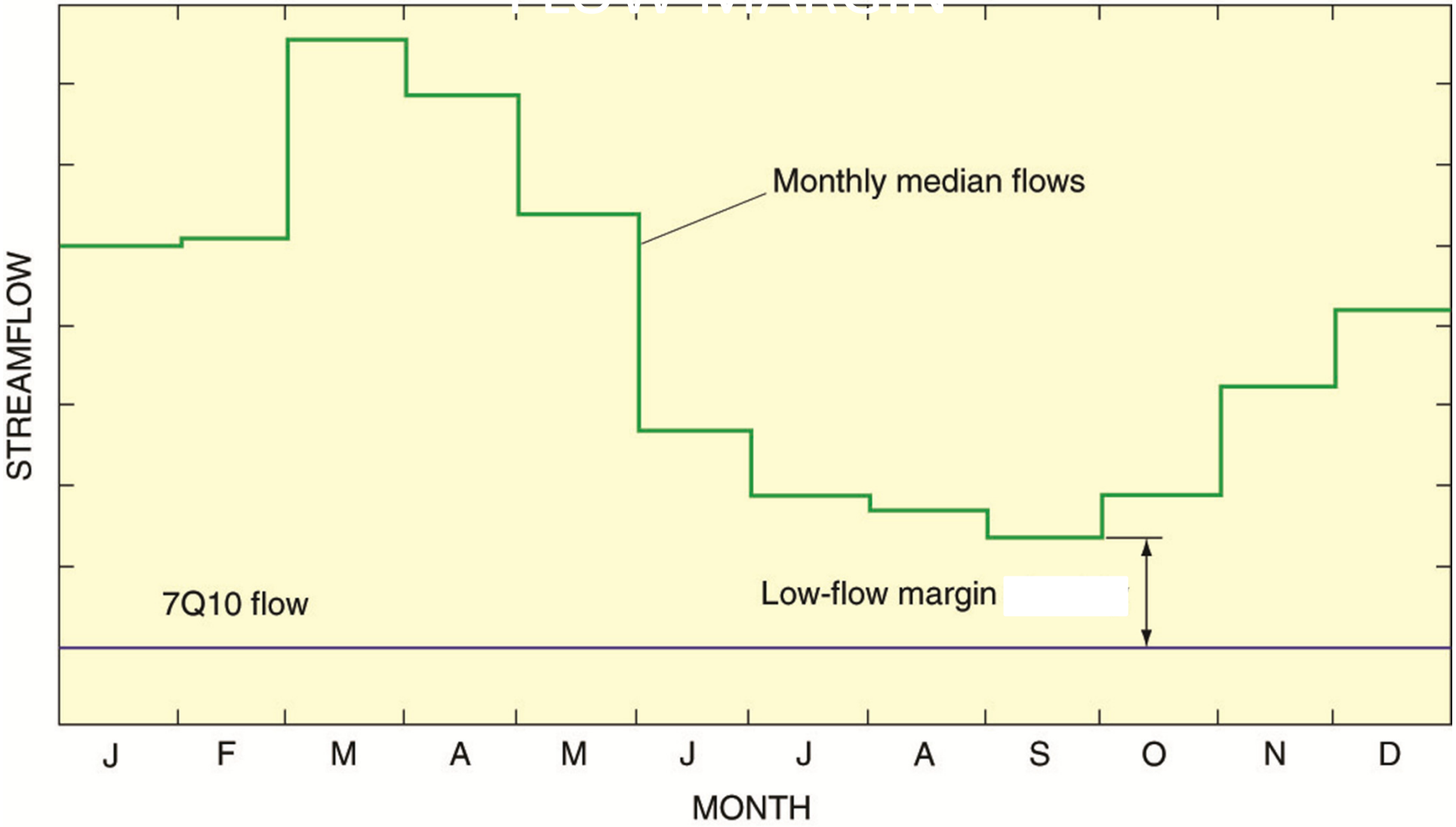
A. **Low Flow margin** (the preferred alternative)

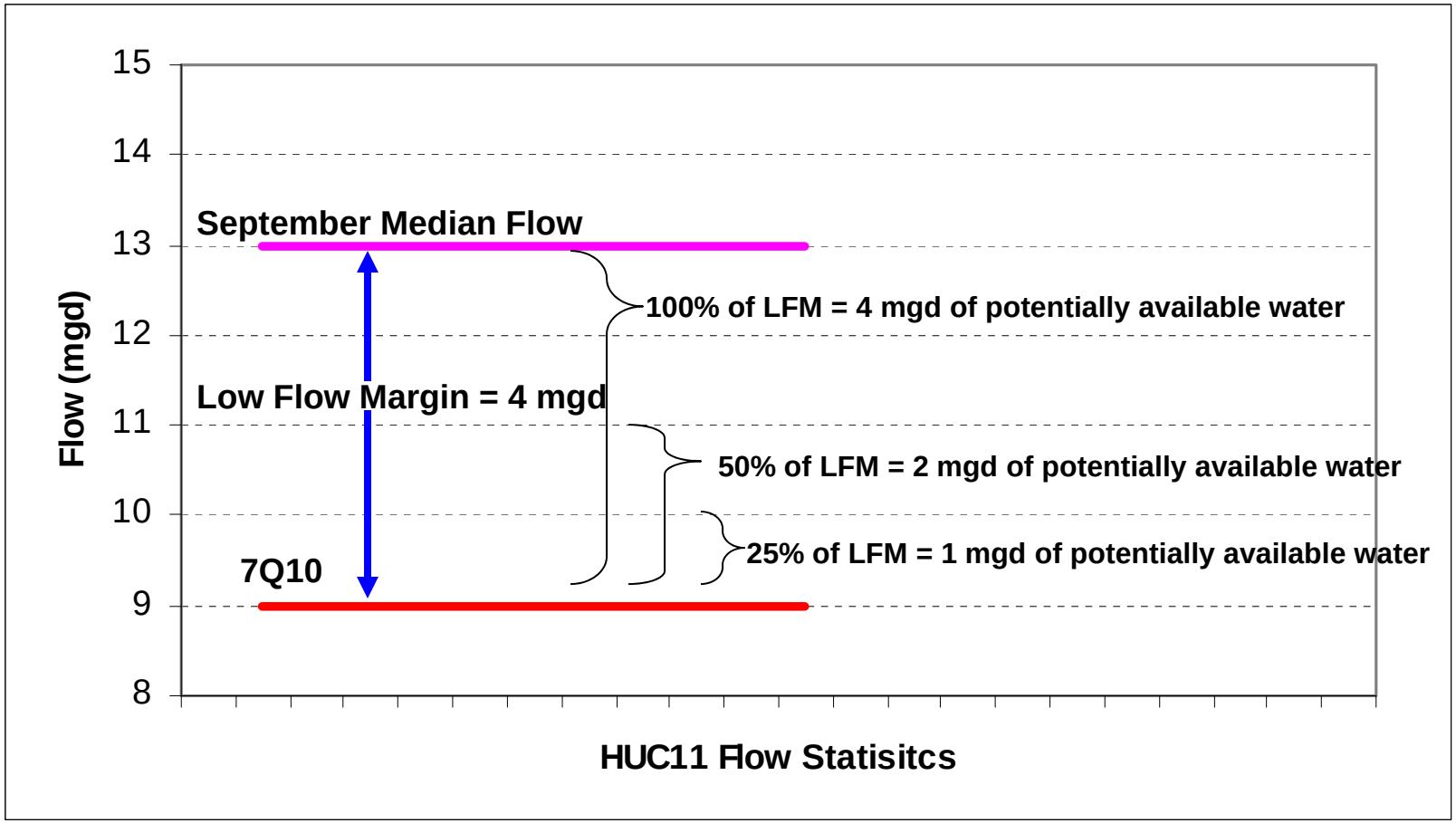
1. Define difference between an average annual low flow and a less frequent ten year low flow (e.g., the 7Q10)
2. Permit use of a percentage of that difference (e.g., 25%)

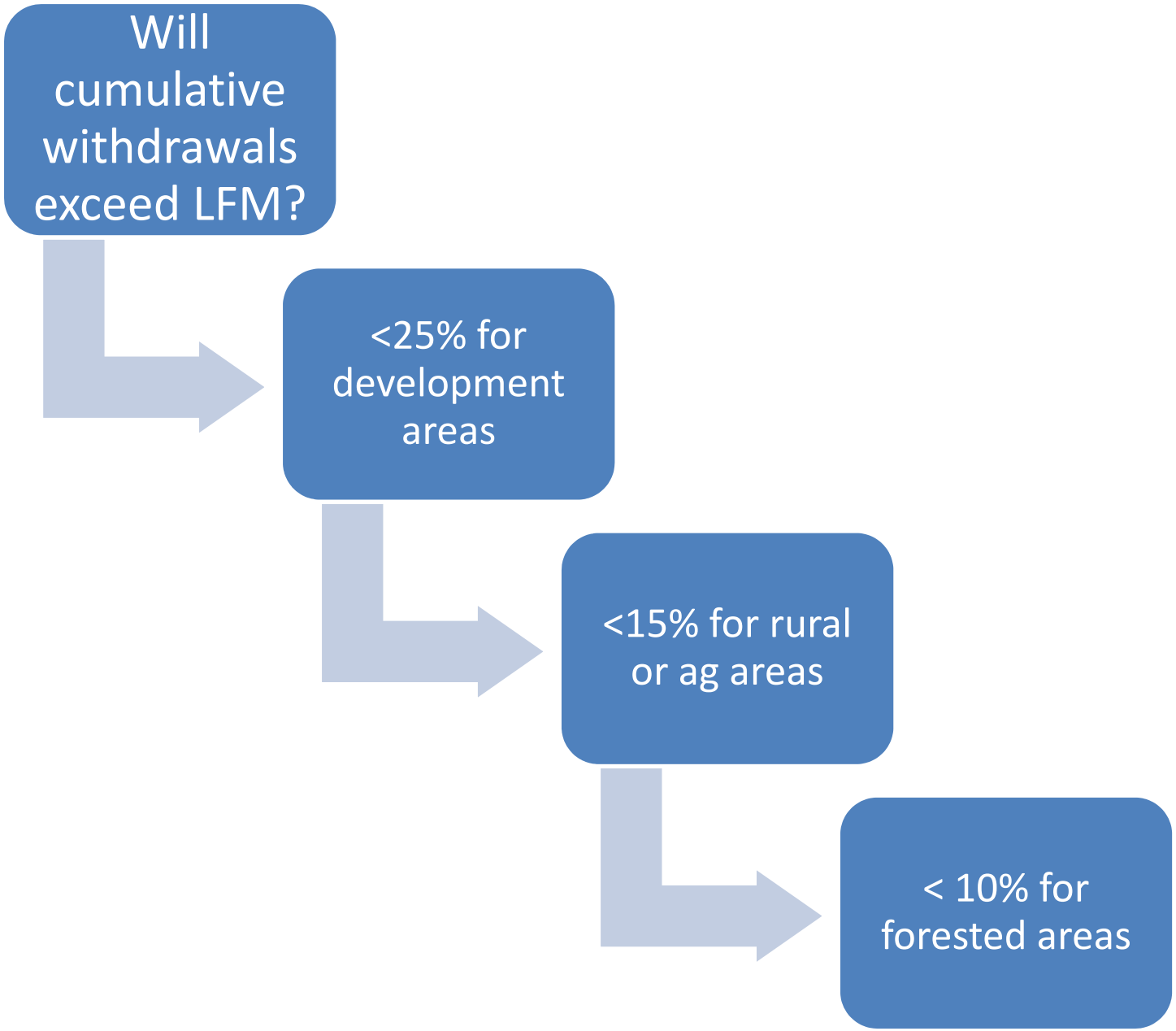
B. **Other options**:

1. USGS: Gompertz with wetland vulnerability;
2. Current staff method: % Basin Depletion – e.g., <10% recharge

Low Flow Margin Method



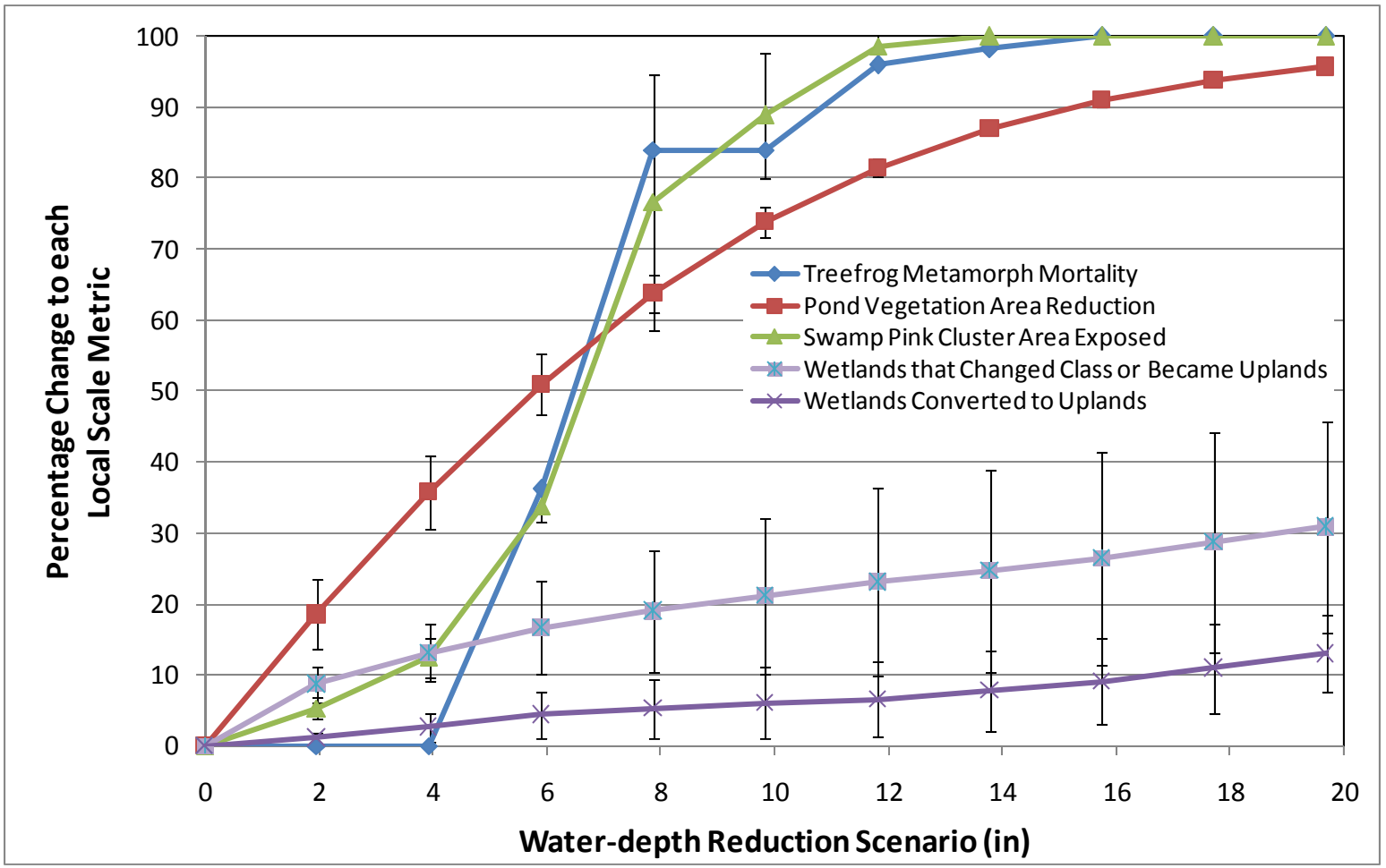

15
14
13
12
11
10
9
8
Flow (mgd)
September Median Flow
Low Flow Margin = 4 mgd
7Q10
100% of LFM = 4 mgd of potentially available water
50% of LFM = 2 mgd of potentially available water
25% of LFM = 1 mgd of potentially available water
HUC11 Flow Statisitcs


Will cumulative withdrawals exceed LFM?
<25% for development areas
<15% for rural or ag areas
< 10% for forested areas

How Can We Better Estimate Future Local Impacts?

- What do current regulations say?
- What new metrics can we derive from the study?
- How can we regulate these metrics?

Metrics to Evaluate Local Scale Impact



Assumes use is 100% consumptive/depletive

Wetlands Impacts vary by Affected Resource and Should and Will be Addressed Differently

1. Pine Barrens Tree Frog Ponds:
   a. Permit not more than 3” drawdown; or
   b. Buffer by distance; or
   c. Do not permit wells in PAD and FA
2. Other wetlands: Permit not more than 6” drawdown (using Thiem)

How Can We Better Measure drawdown to implement these metrics?

1. Mod Flow Modeling (the “gold” standard)
2. Thiem Modeling

USGS SUMMARY

- Groundwater withdrawals affect wetland water levels and streamflow in the Pinelands
- Effects can be predicted by using detailed models (where available)
- Strategic well location can reduce hydrologic effects
- Effects can also be predicted by using simpler models, with some limitations

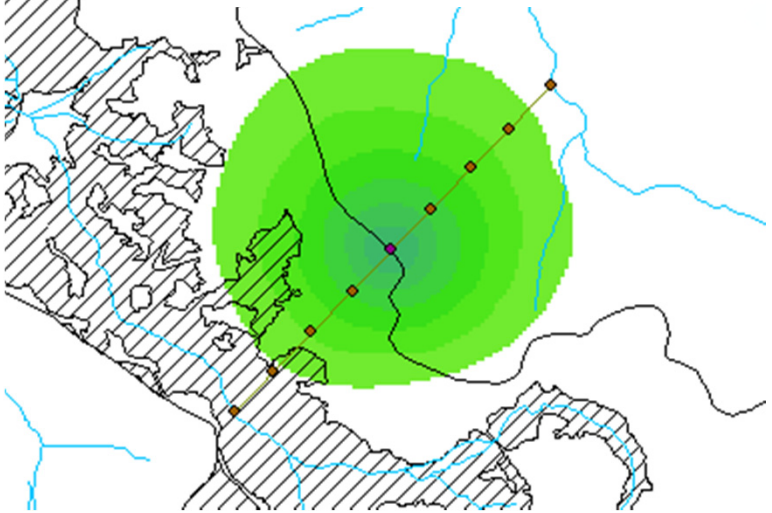
A MODEL SIMPLER (Than Full Mod Flow) CAN ALSO PREDICT HYDROLOGIC EFFECTS

- **Thiem** Can be applied
- anywhere in the Pinelands

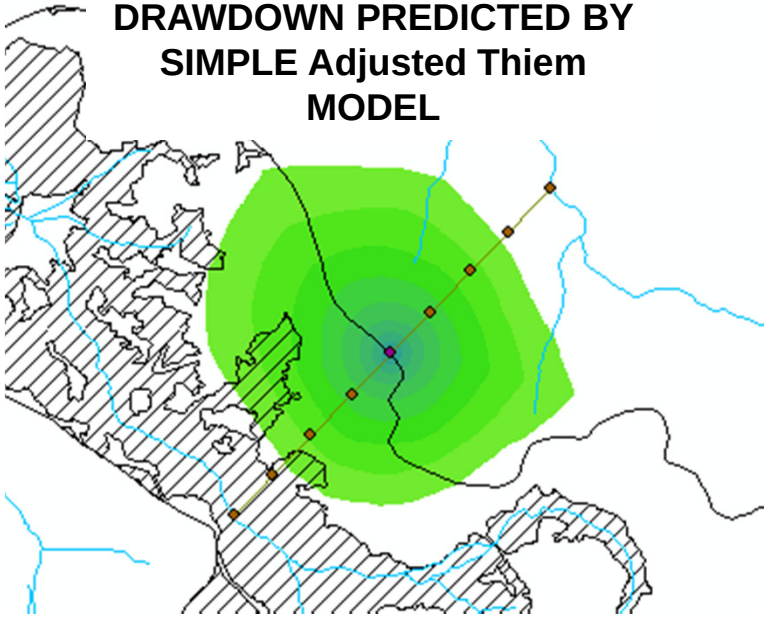
- Important limitation (less confidence when estimating less than 6" drawdown)

McDonalds Branch

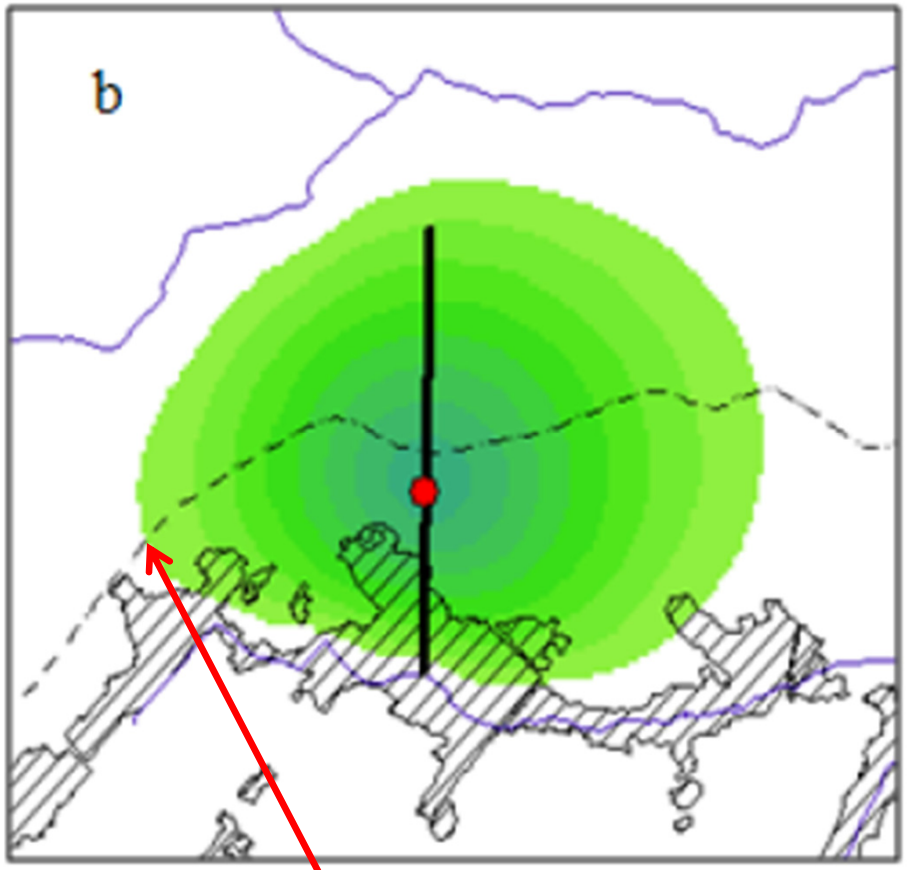
DRAWDOWN PREDICTED BY DETAILED Mod Flow MODEL



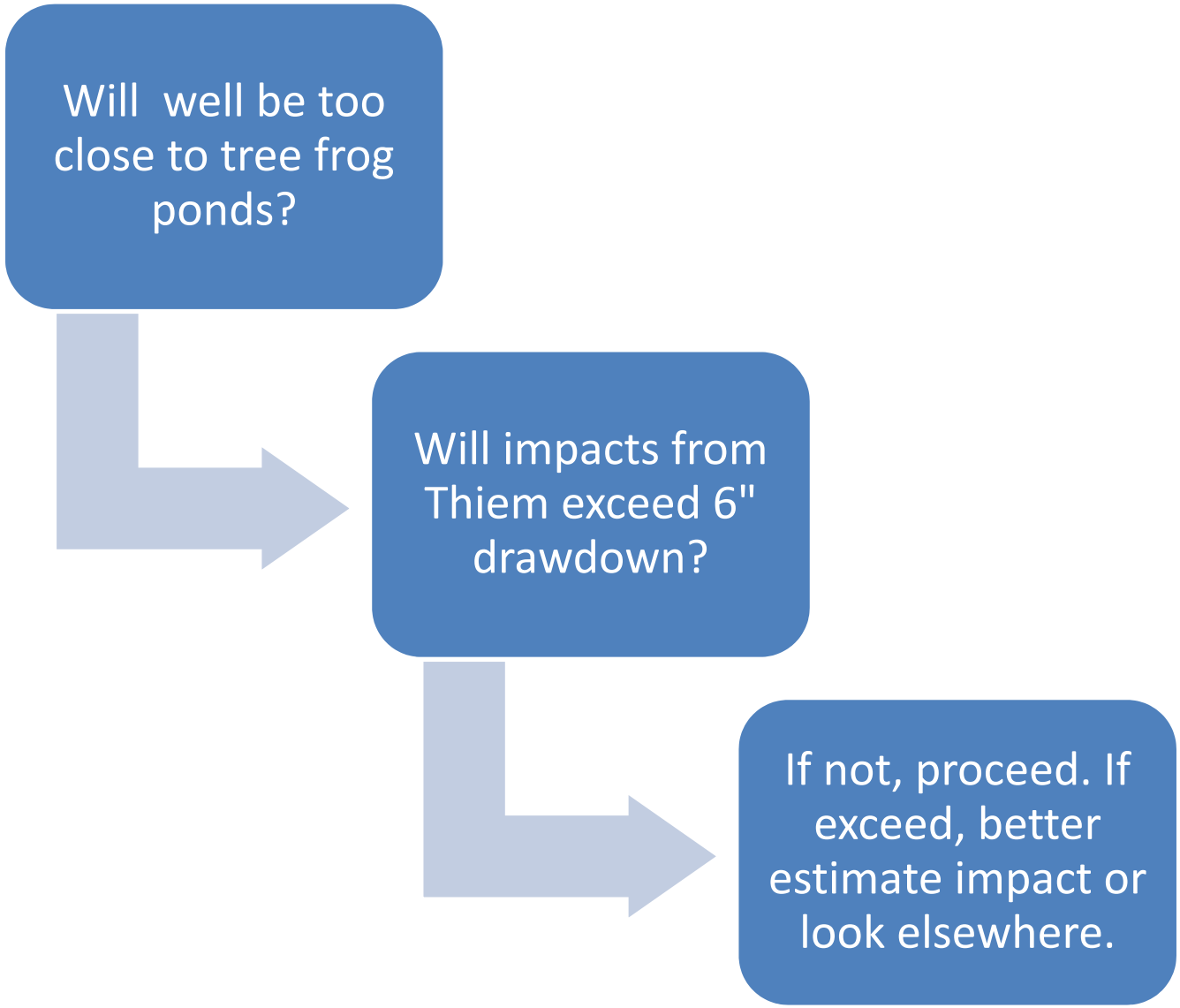
DRAWDOWN PREDICTED BY SIMPLE Adjusted Thiem MODEL



Local Scale Impact



Drawdown distribution simulated using detailed MODFLOW model (courtesy of USGS)


Will well be too close to tree frog ponds?
Will impacts from Thiem exceed 6" drawdown?
If not, proceed. If exceed, better estimate impact or look elsewhere.

How can the study's results be used for planning?

- Predict future water supply well needs
- Assess whether surficial K/C can meet the well needs
- Guide purveyors to best areas to locate wells and, as necessary, look for other solutions

Case Study: Barnegat 2012 Buildout Estimates

Buildout Scenario	Future Growth (Nonresidential)	Future Growth (dus)	Future Water needed	New wells needed @ 1 mgd/well
I: “High”	1.1 million sq. ft.	5192	1.7 mgd	2
II: “Medium”	1.1 million sq. ft.	4767	1.5 mgd	2
III: “Low”	0.6 million sq. ft.	4509	1.4 mgd	2

Can the surficial K-C in Barnegat accommodate new wells?

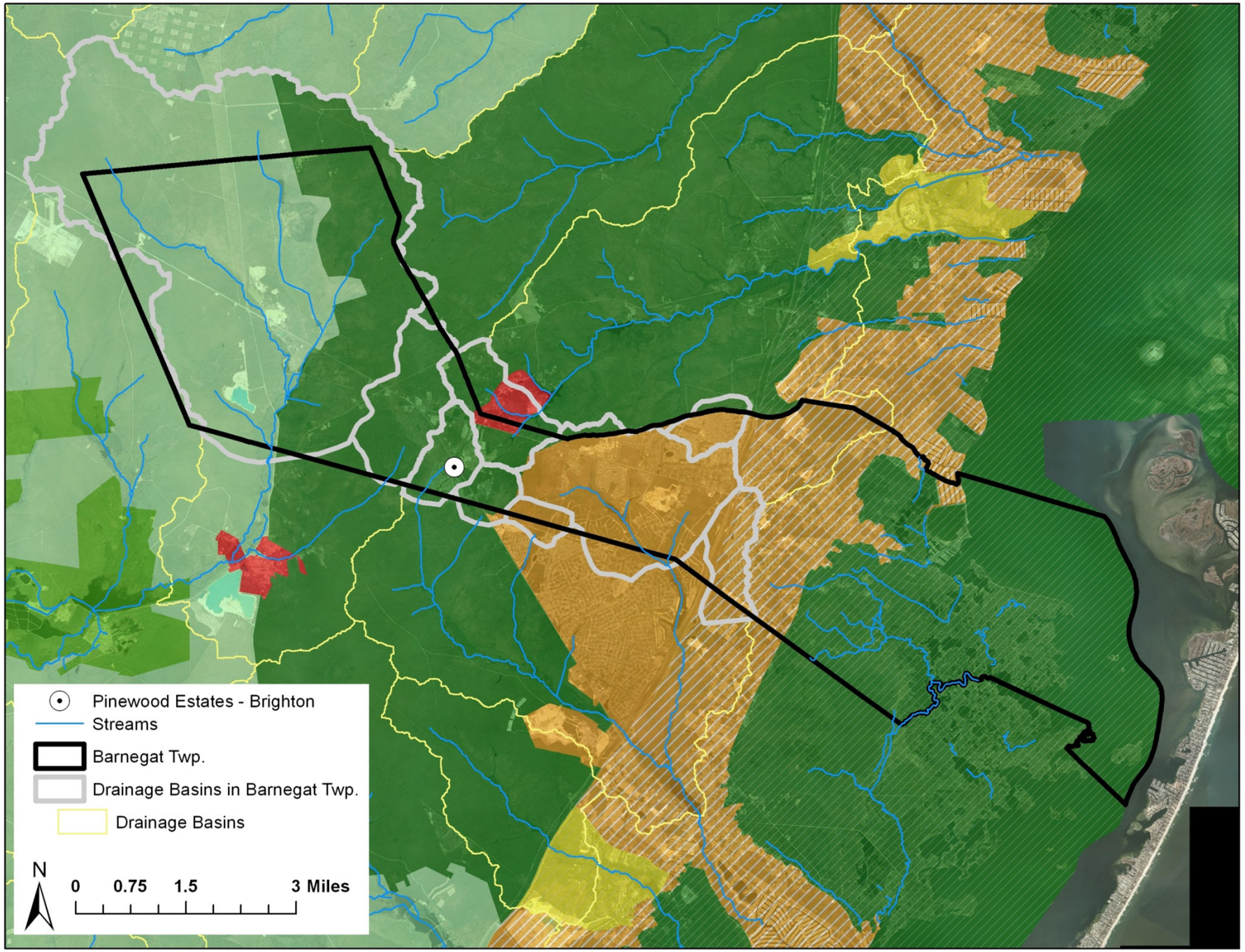
- Is there a possible watershed = ?
  - (what is a watershed? HUC 14, HUC 11, or in-between?)
  - Low Flow margin suggests going as far downstream as possible
- Number of existing wells = ?
- Which watersheds can no longer sustain an additional well due to existing wells = ?
- Is there a basin that can sustain 1 well = ? Two wells?
- Where should a new well be put?

What is a Watershed?

	Number	Ave Size (mi^2)
Pinelands HUC14	225	8.7
PNR HUC11	37	65
Pinelands EIA units	92	21
Watershed sizes for the three study basins (from the USGS Model Rpt)		
McDonalds Study Area		5.52
Morse Mill Study Area		8.35
Albertson Study Area		20.2

What if cannot put a new well in Barnegat?

- Go to neighboring Stafford?
  - Jurisdictional problems
- Go deeper?
  - No free lunches – 60% of deeper comes from surface
- Look to other aquifers?
  - None available
- Look to conjunctive use?
  - No free lunches
- Look to ultimately recharge?
  - Putting emergent pollutants into aquifers?
  - Require high treatment levels?


Pinewood Estates - Brighton
Streams
Barnegat Twp.
Drainage Basins in Barnegat Twp.
Drainage Basins
N
0
0.75
1.5
3 Miles