Meeting with State and Local Officials on DEIS for the ESP at the North Anna Site

U.S. Nuclear Regulatory Commission

January 19, 2005

Attachment 2

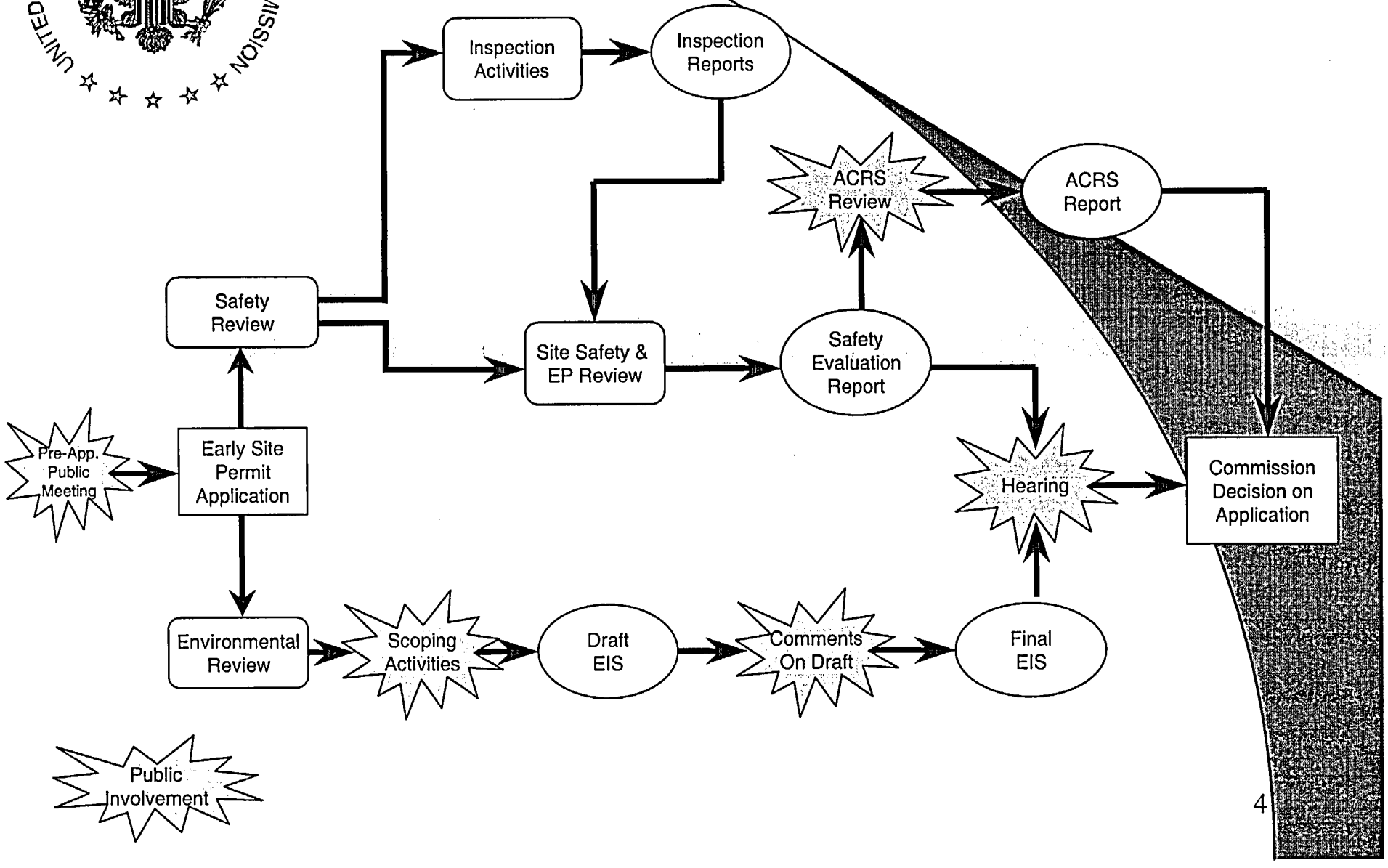
What is an early site permit?

- An NRC decision that ensures that the proposed site is suitable for construction and operation of a nuclear power plant or plants
- The permit is <u>not</u> authorization or a decision to actually build and operate a plant
- Site Preparation and limited construction activities allowed with an approved site redress plan

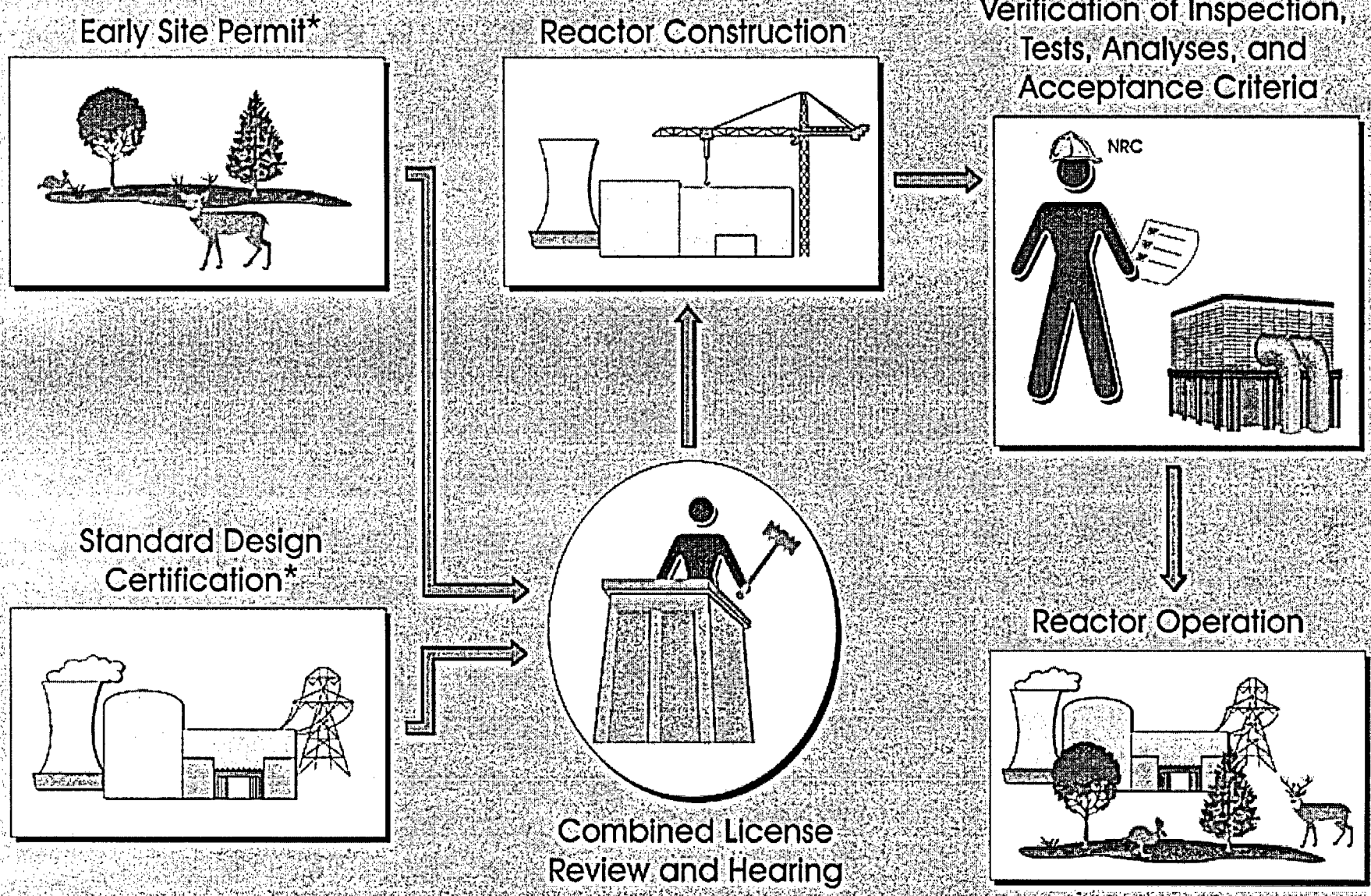
Why does an applicant want an early site permit?

- Allows an applicant to "bank" a site for up to 20 years
- Reduces licensing uncertainty
- Resolves siting issues before construction

Early Site Permit Review Process



Combined Licenses, Early Site Permits, and Standard Design Certifications

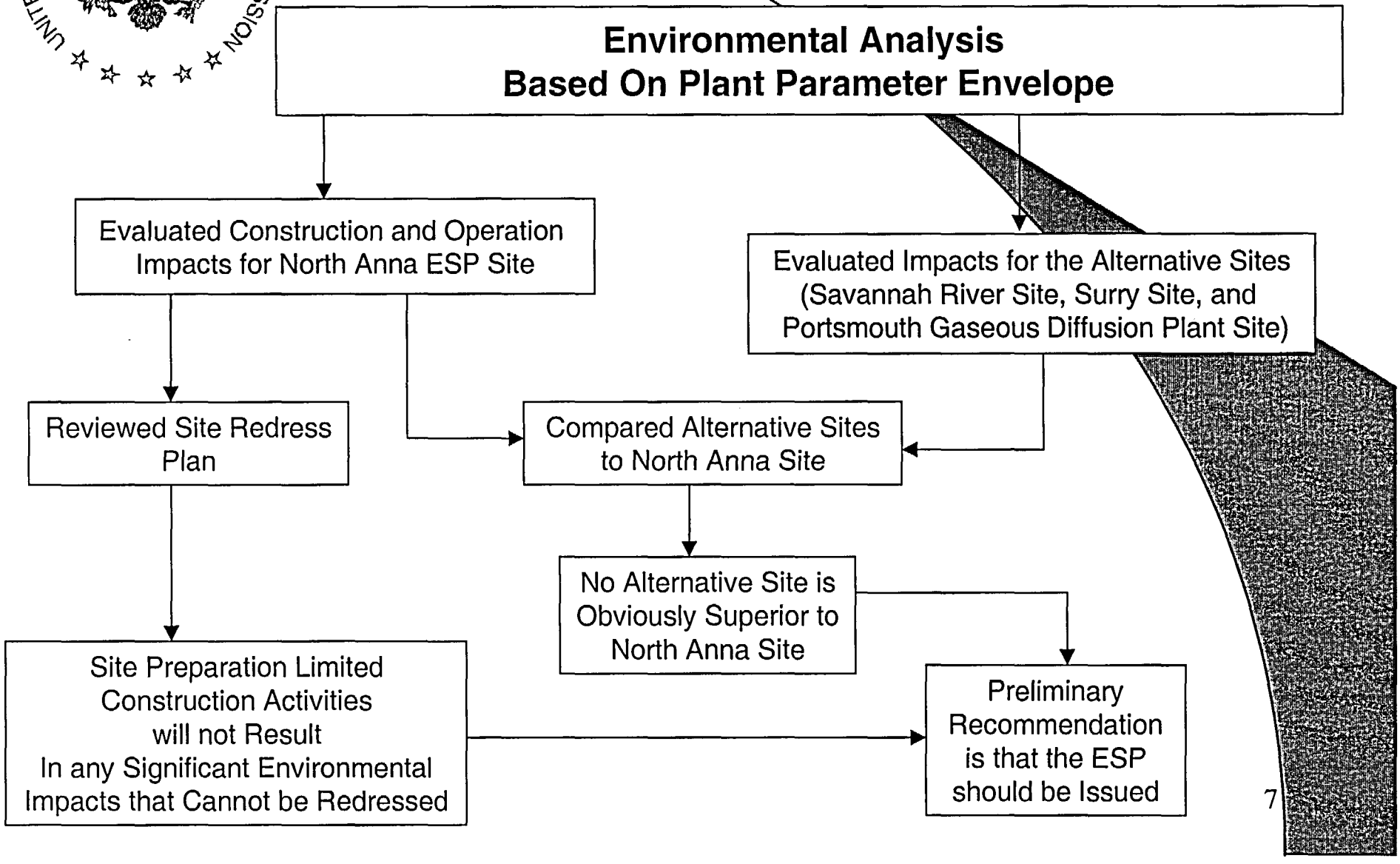


* or equivalent process

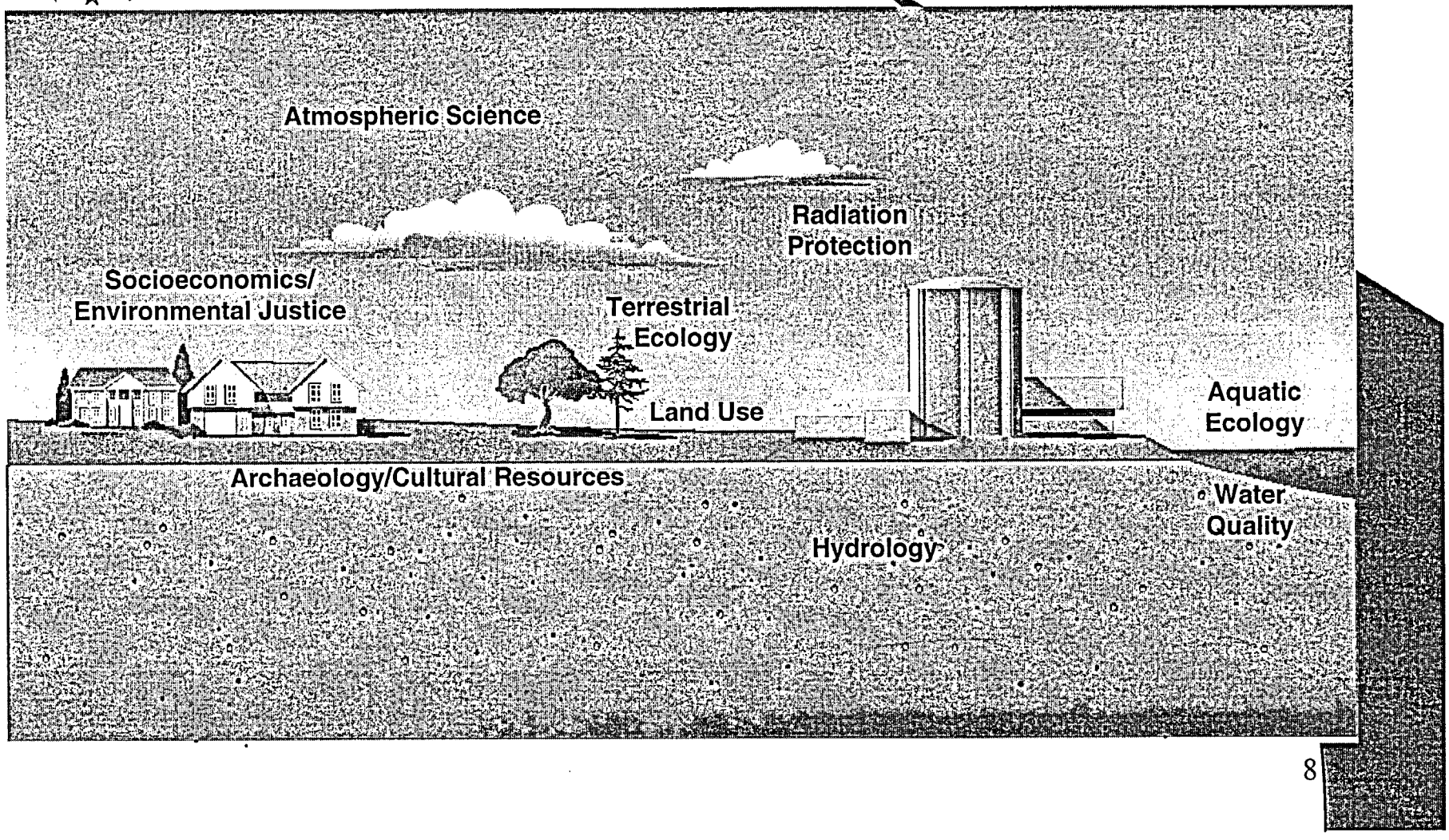
Dominion's Plant Parameter Envelope (PPE)

- What is a PPE?
  - A surrogate for actual design parameters used because a design has not yet been selected
  - A set of values of plant design parameters that the applicant believes bounds the design characteristics
- Why would Dominion use a PPE?
  - Defers a reactor design(s) decision until the CP/COL stage
- Which reactor types are the basis for Dominion's PPE?
  - Five light-water reactors
  - Two gas-cooled reactors

Analysis Approach



Team Expertise



Point of Contact for DEIS

- Agency point of contact:

  Jack Cushing

  (800) 368-5642, Ext. 1424
- Draft EIS is available at the Louisa County Public Library and the NRC's Public Document Room in Rockville, Maryland
- Draft EIS can also be viewed at: www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1811/index.html

Environmental Review Milestones

- Draft EIS issued – December 10, 2004
- Comment period ends – March 1, 2005
- Final EIS – August 2005
- Hearing Decision – February 2006
- Commission decision – June 2006

Environmental Impacts of Construction and Operation

- Land Use
- Air Quality
- Water Use and Water Quality
- Terrestrial and Aquatic Resources
- Threatened or Endangered Species
- Socioeconomic Resources
- Environmental Justice
- Historic and Cultural Resources
- Human Health

Other Environmental Impacts Evaluated

- Postulated Design-Basis Accidents
- Postulated Severe Accidents
- Uranium Fuel Cycle and Solid Waste Management
- Transportation of Radioactive Materials
- Decommissioning

Lake Anna Usage

- **Lake Anna**
  - Created for North Anna Power Station
  - Lake Anna used to cool existing Units 1 and 2
  - Lake Anna proposed to cool ESP Unit 3
  - Dry-tower cooling proposed to cool ESP Unit 4
- **Other Major Uses of Lake Anna**
  - Recreation and fishing
- **Downstream Issues**
  - Municipal water supplies
  - Aquatic environment
  - Recreation

Cooling System Impacts of ESP Unit 3

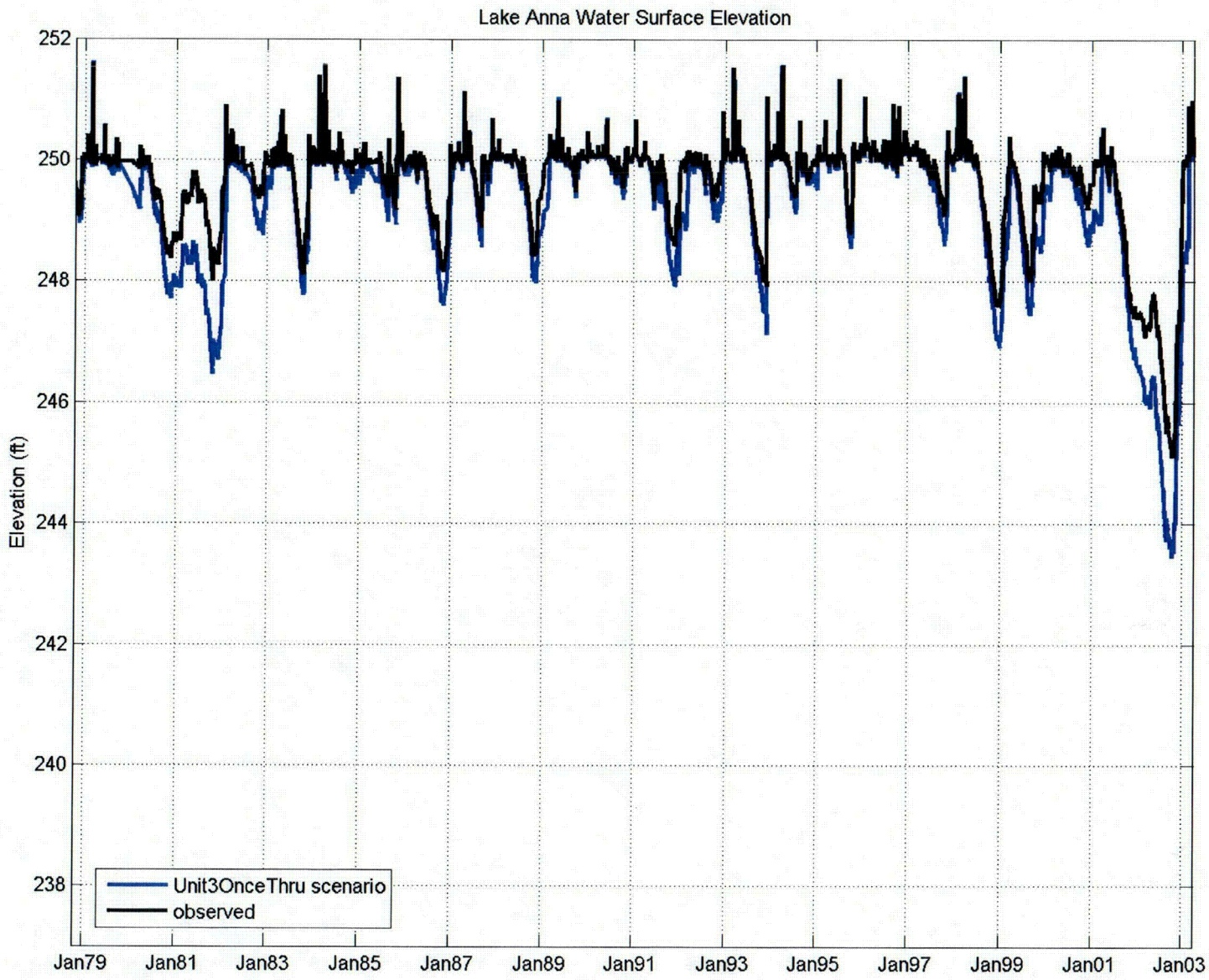
- **Evaluations Including Modeling of**
  - Discharge of waste heat
  - Evaporation
  - Circulation of water
- **Conclusions**
  - Impact SMALL during normal water years
  - Impact MODERATE during severe drought years
  - Verification needed at CP/COL stage to ensure impacts of actual discharge design are within PPE Bounds

Striped Bass Recreational Fishing

- **Background**
  - Non-native species introduced for recreational fishing
  - "Put-grow-take" fishery – stocked annually
  - Prefer cooler water than Lake Anna
  - One of most thermally sensitive fish species in lake
- **Conclusions**
  - Impacts on fishing resulting from heat stress to fish – SMALL during cooler months and non-drought years
  - Impacts on fishing resulting from heat stress to fish – MODERATE during droughts without mitigation
  - Mitigation – stocking more fish, stocking larger fish, managing the fishery to provide more catch opportunities of larger fish

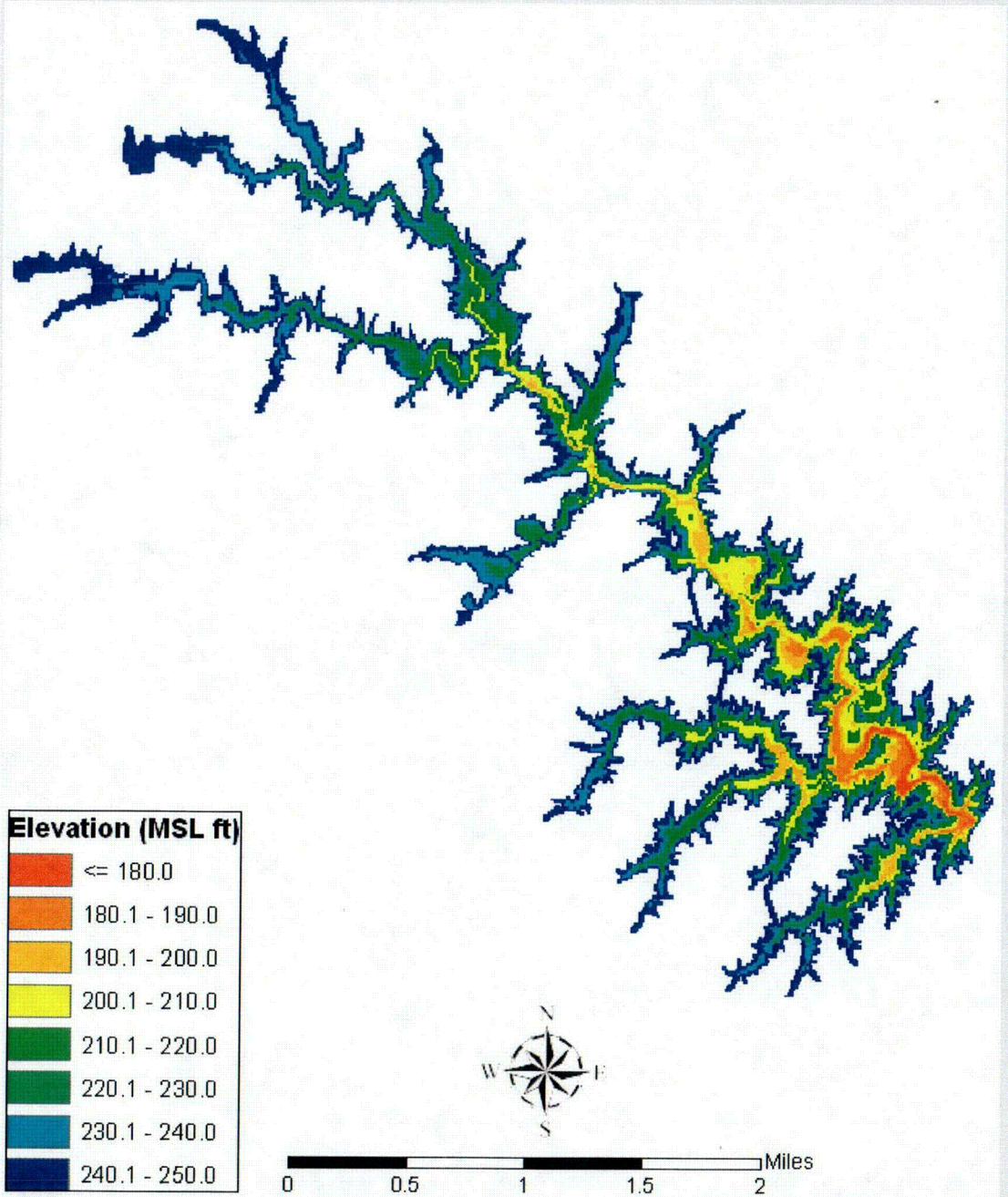
Radiological Impacts

- Exposures to the public and to workers
  - Estimated doses to public well within regulatory design objectives and standards
  - No observable health impacts to public
  - Occupational doses estimated slightly lower than those from current reactors
- Impacts to biota evaluated and found to be acceptable
- Conclusion – radiological impacts from construction and operation would be SMALL


Lake Anna Water Surface Elevation
Elevation (ft)
252
250
248
246
244
242
240
238
Jan79
Jan81
Jan83
Jan85
Jan87
Jan89
Jan91
Jan93
Jan95
Jan97
Jan99
Jan01
Jan03
Unit3OnceThru scenario
observed

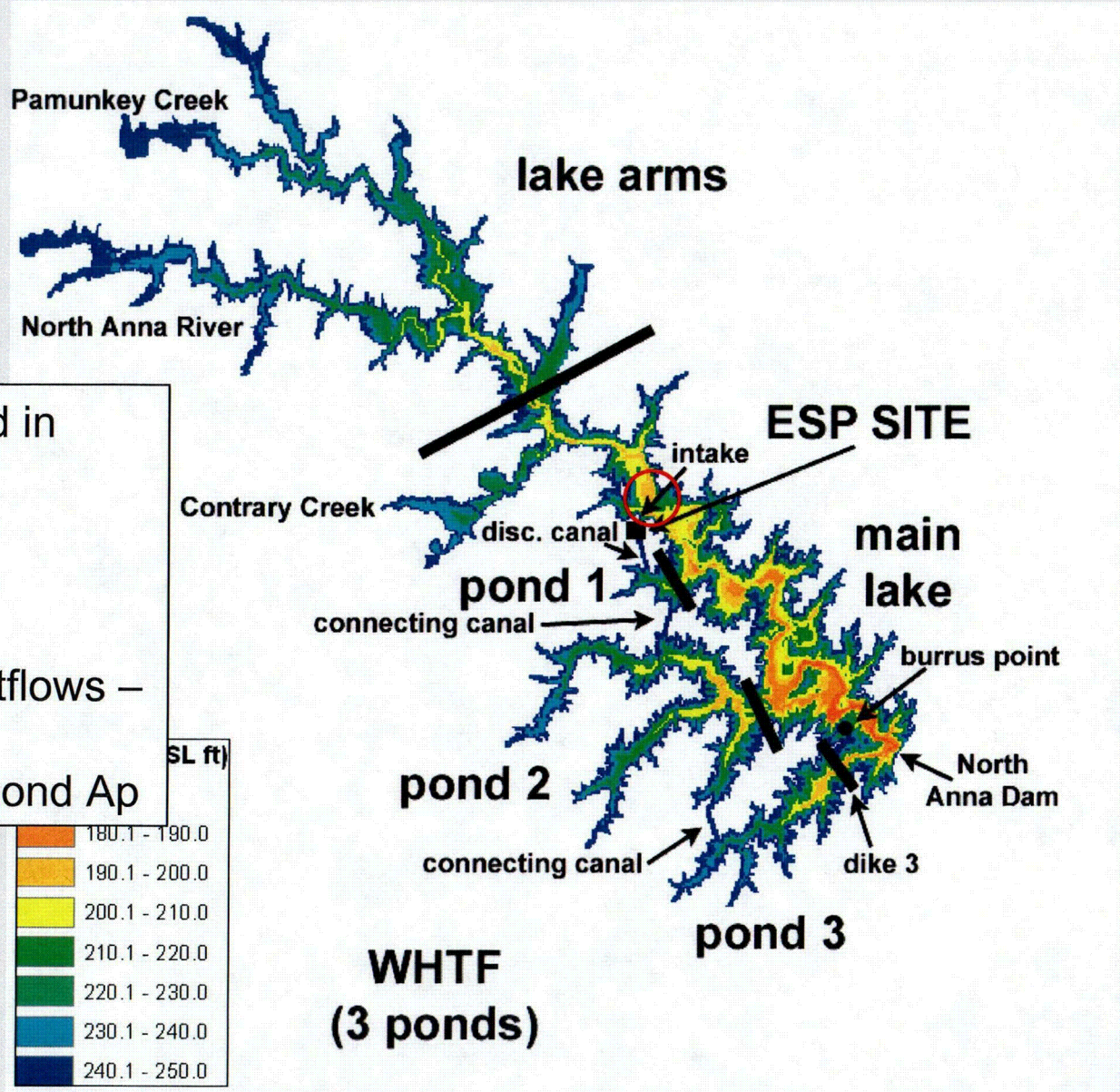
C01

PNNL Digitized
1:24K USGS DRG



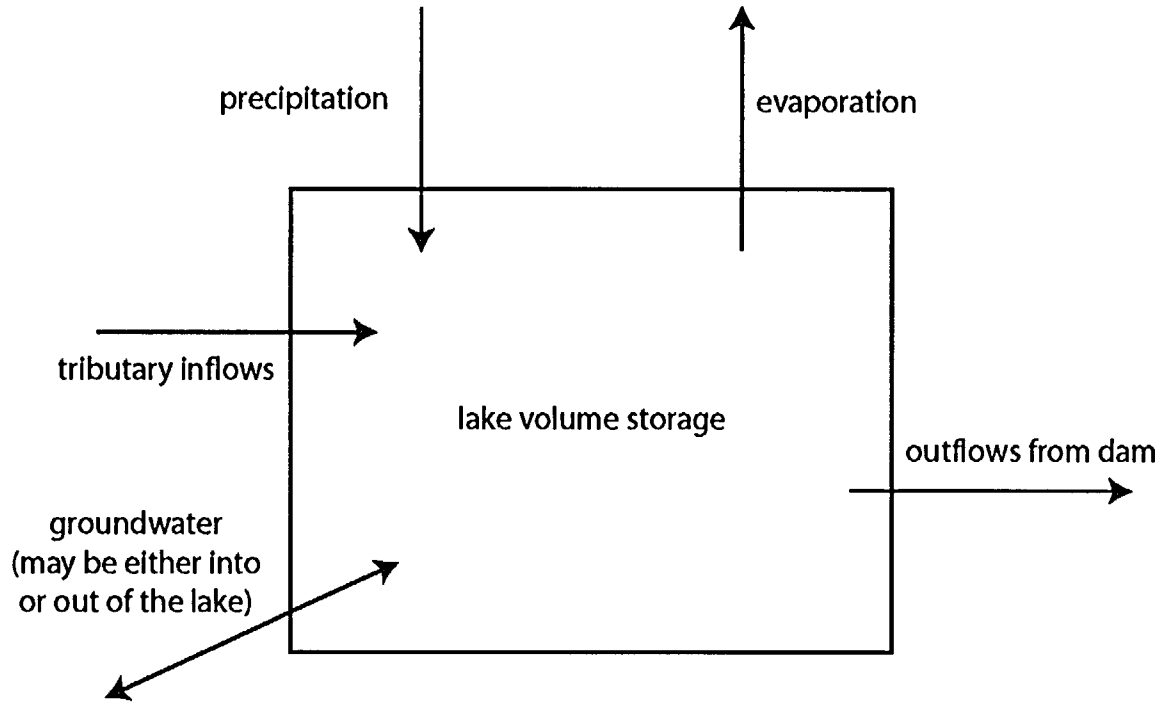
C02

- Tributaries not gaged in recent drought
- Observed WSE
- Time-series T data
- No water vel
- No recorded dam outflows – only rating curve
- Met data from Richmond Ap

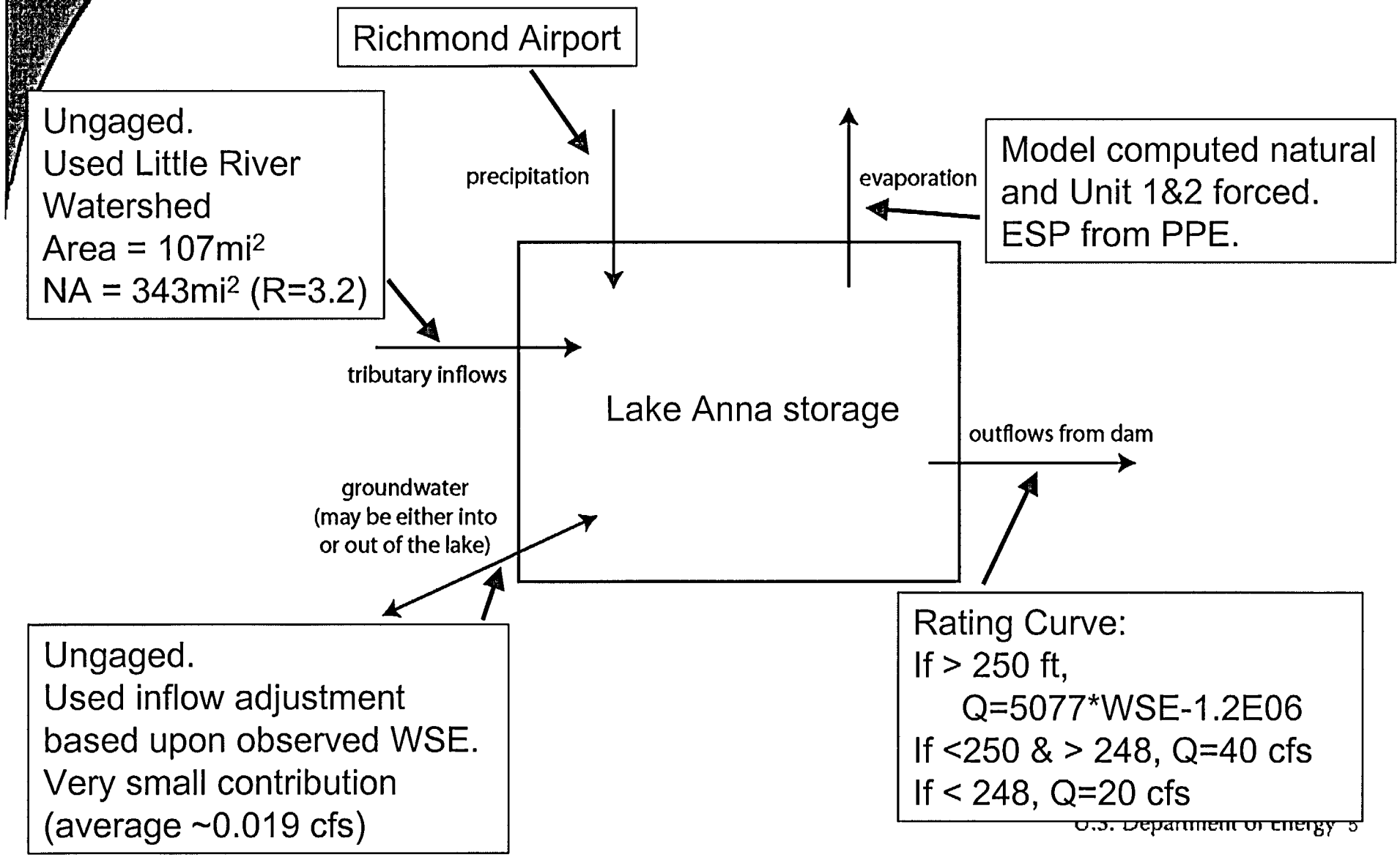


C03

Water Budget

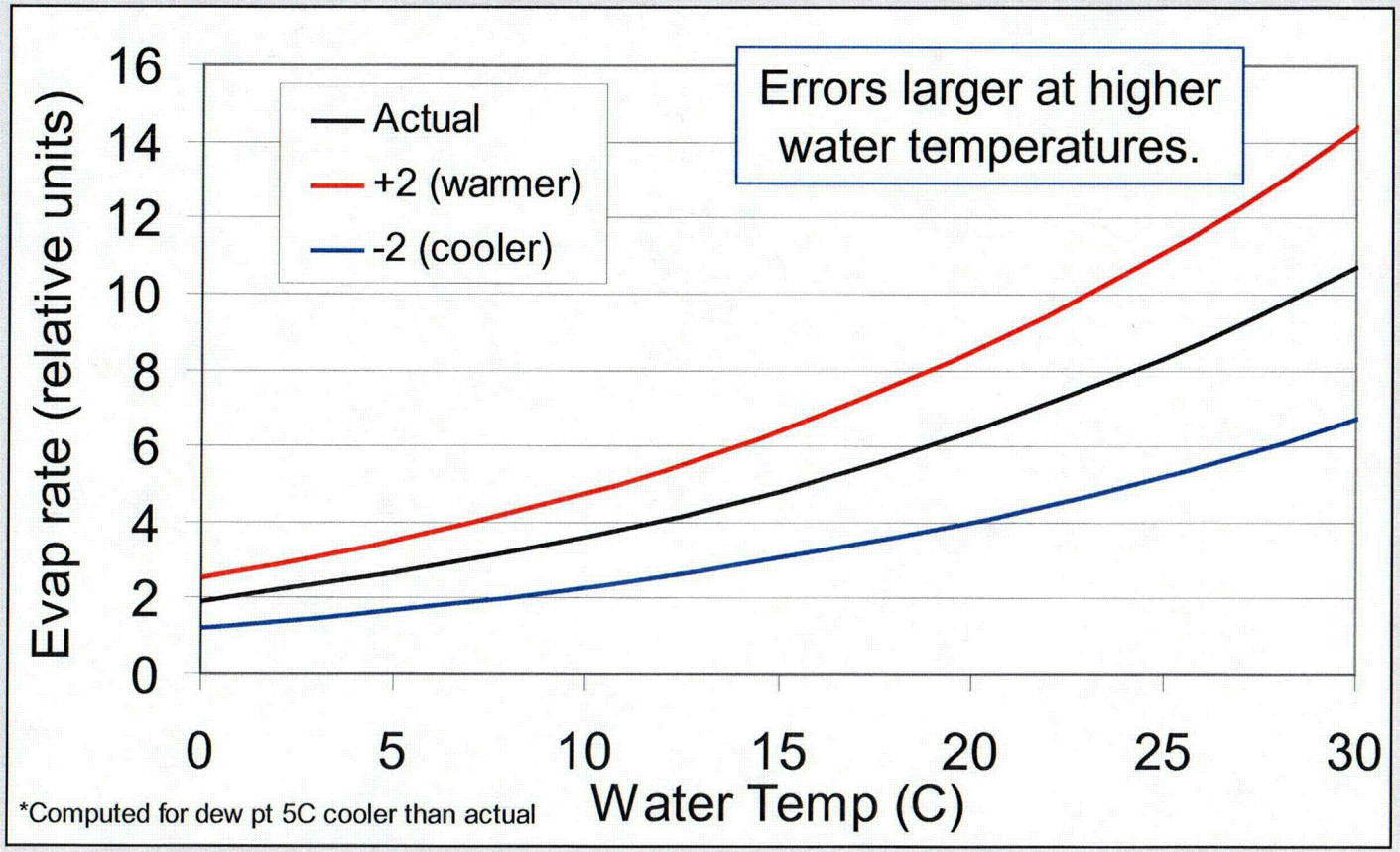


Water Budget of Lake Anna



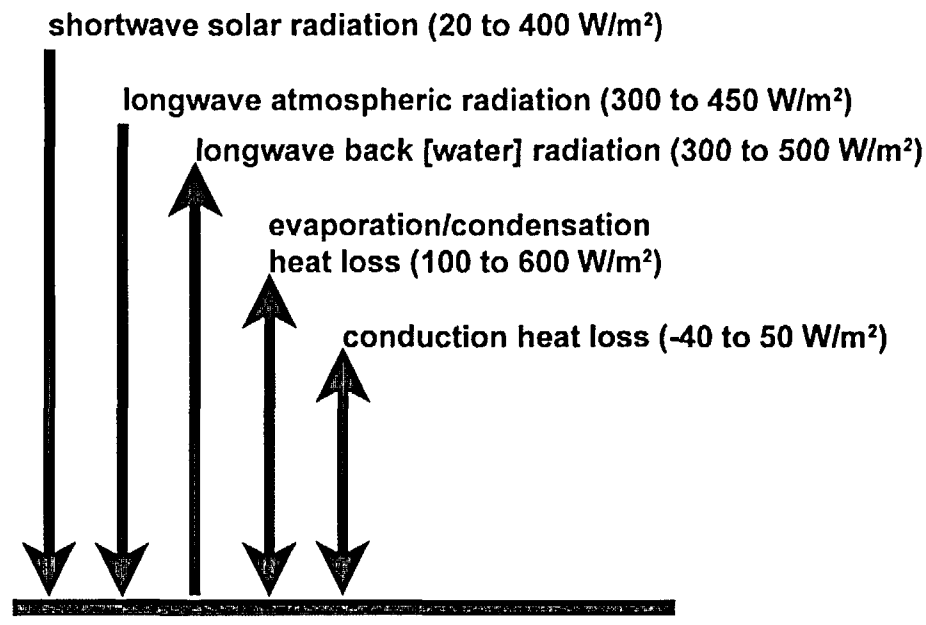
What does this mean at NA?

Evaporation rate is highly non-linear and small errors in water temp can have large impacts!



COY

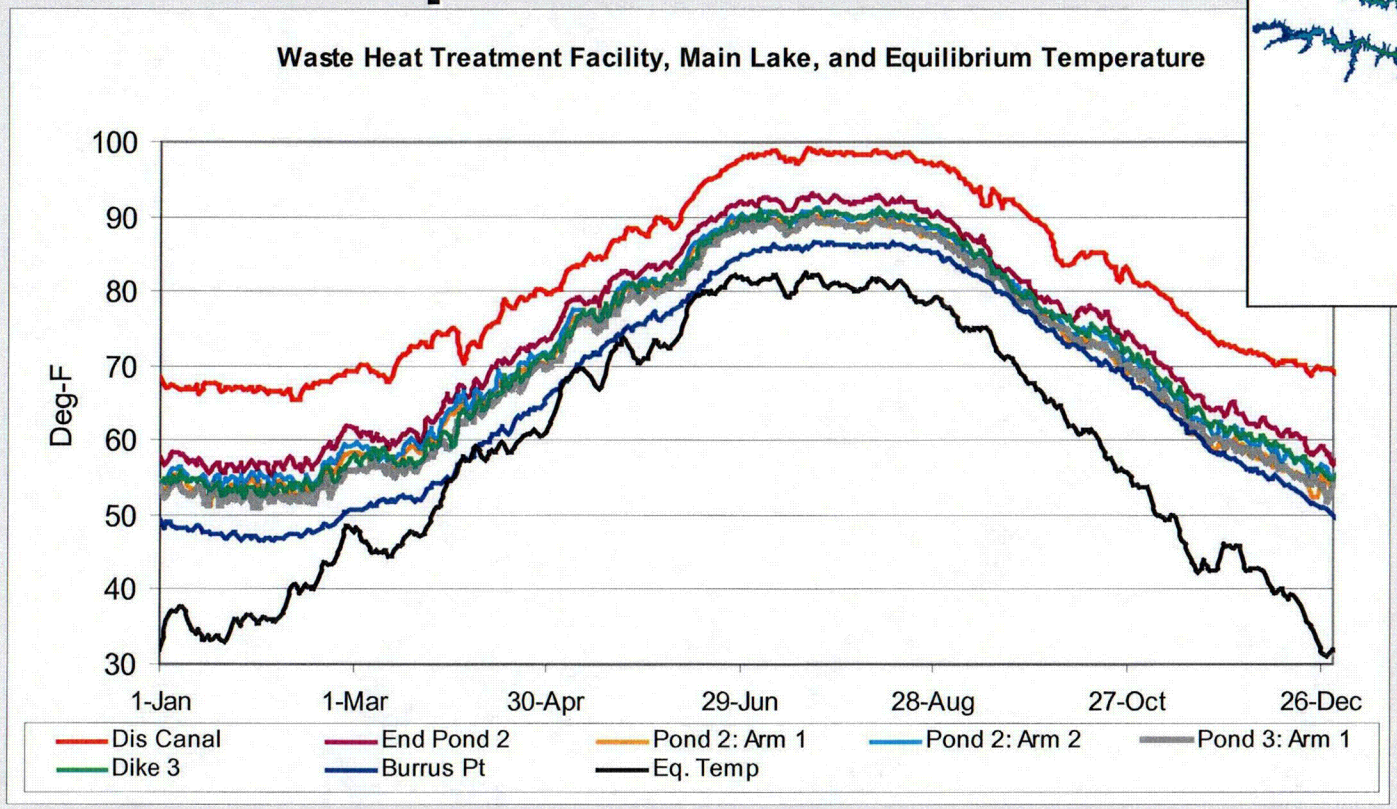
Equilibrium Temperature concept

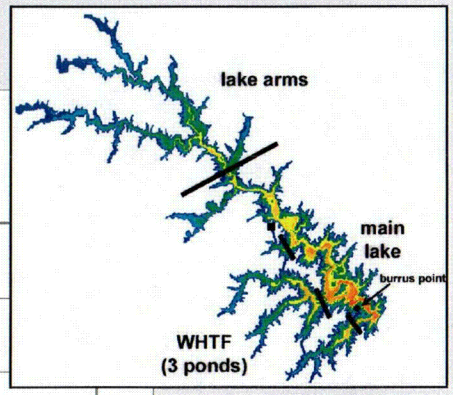


Net rate at which heat crosses the water surface
(typical values of mean-daily rates at mid-latitudes)

Equilibrium temperature is when the net flux of heat = 0. Because of diurnal fluctuations, the temperature is usually computed on a daily time step.

LakeWBT Schematization: 4 temperature "zones"…





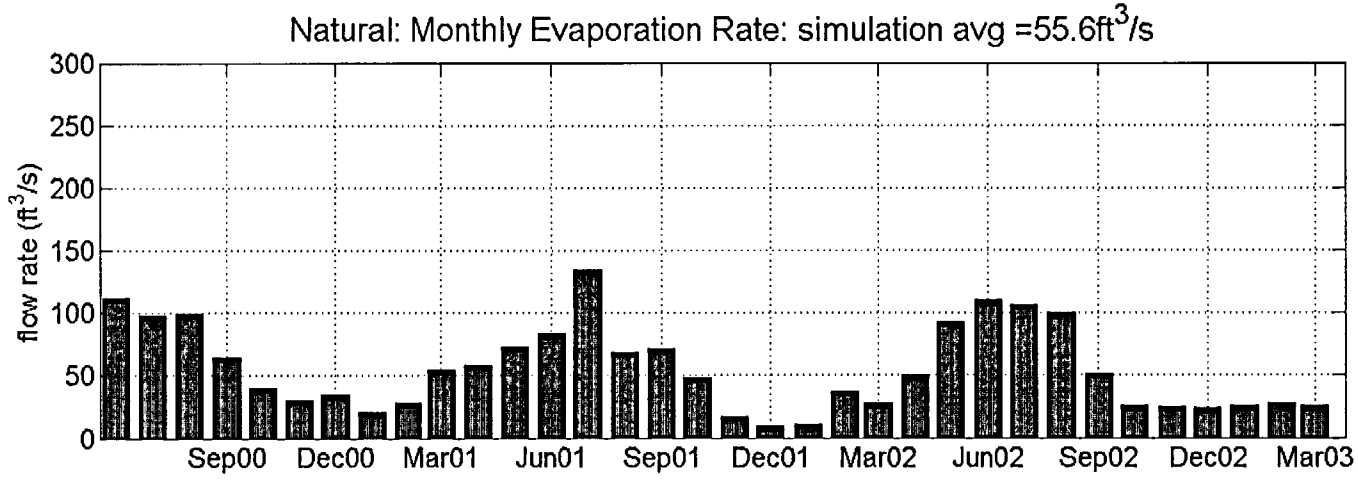
Step 1: Calib only

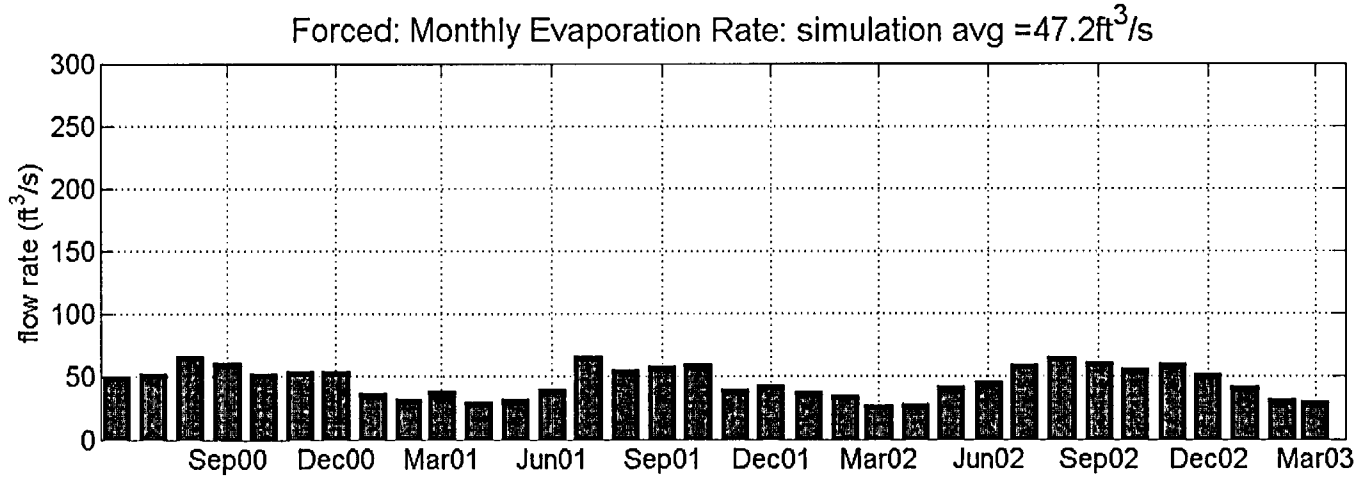
- main WHTF = discharge canal
- WHTF arms = dike 3 with exp. temp decay volume adj.
- main lake = Burrus Pt with exp. temp decay volume adj.
- lake arms = equilibrium temperature

These were validated w/ field data

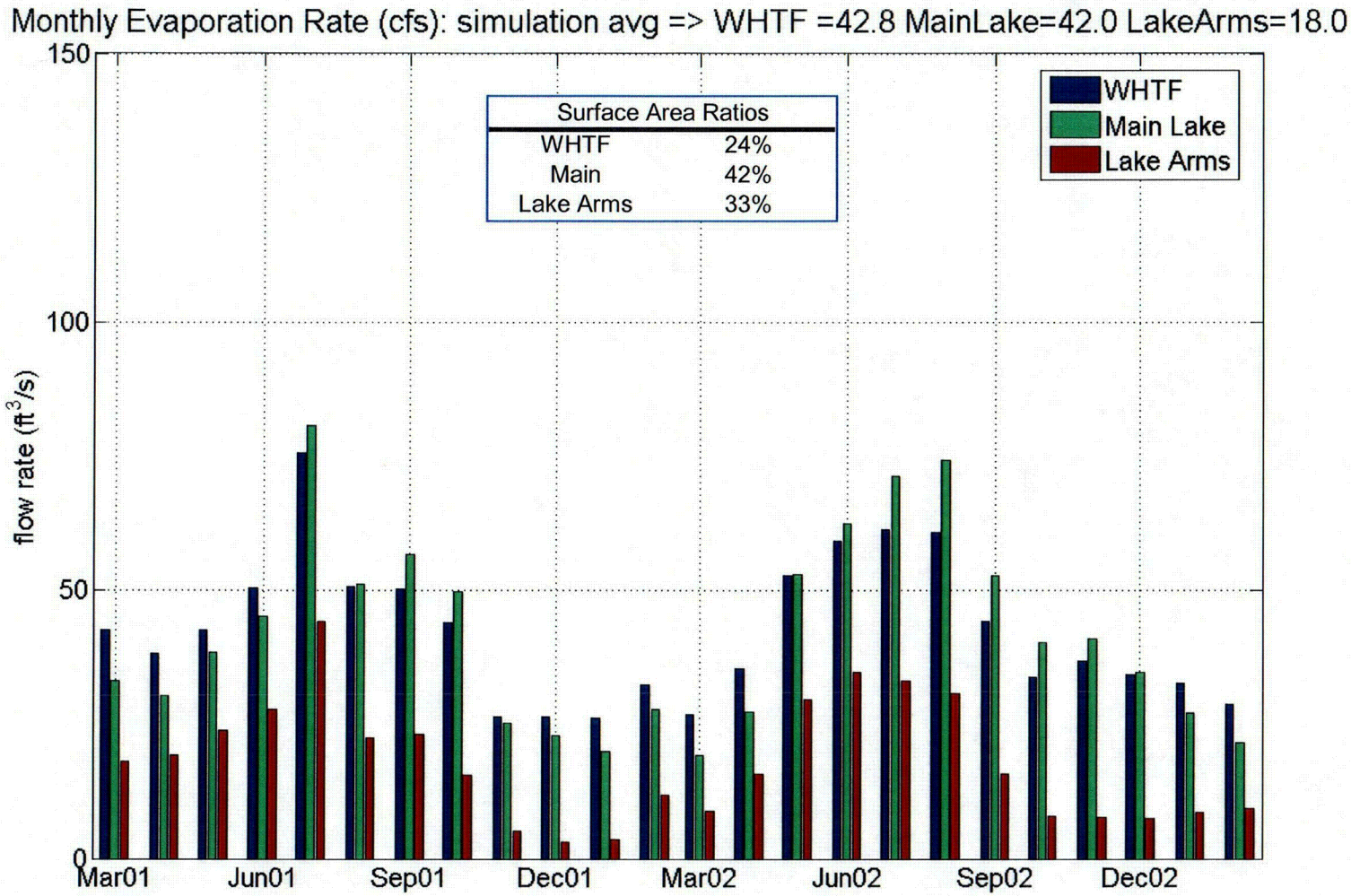
C05

How does evaporation rate change during yr?





Where does most of the evaporation occur?

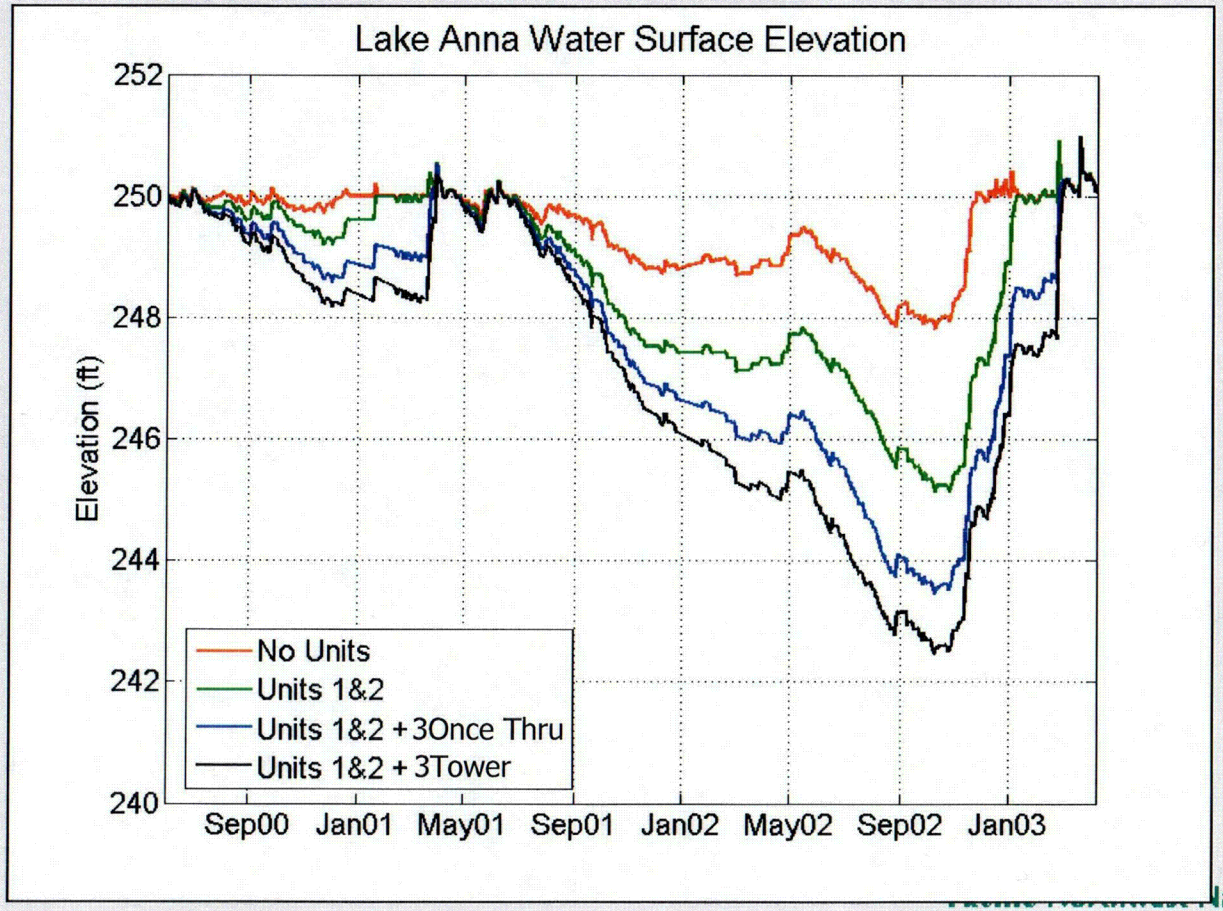


C06

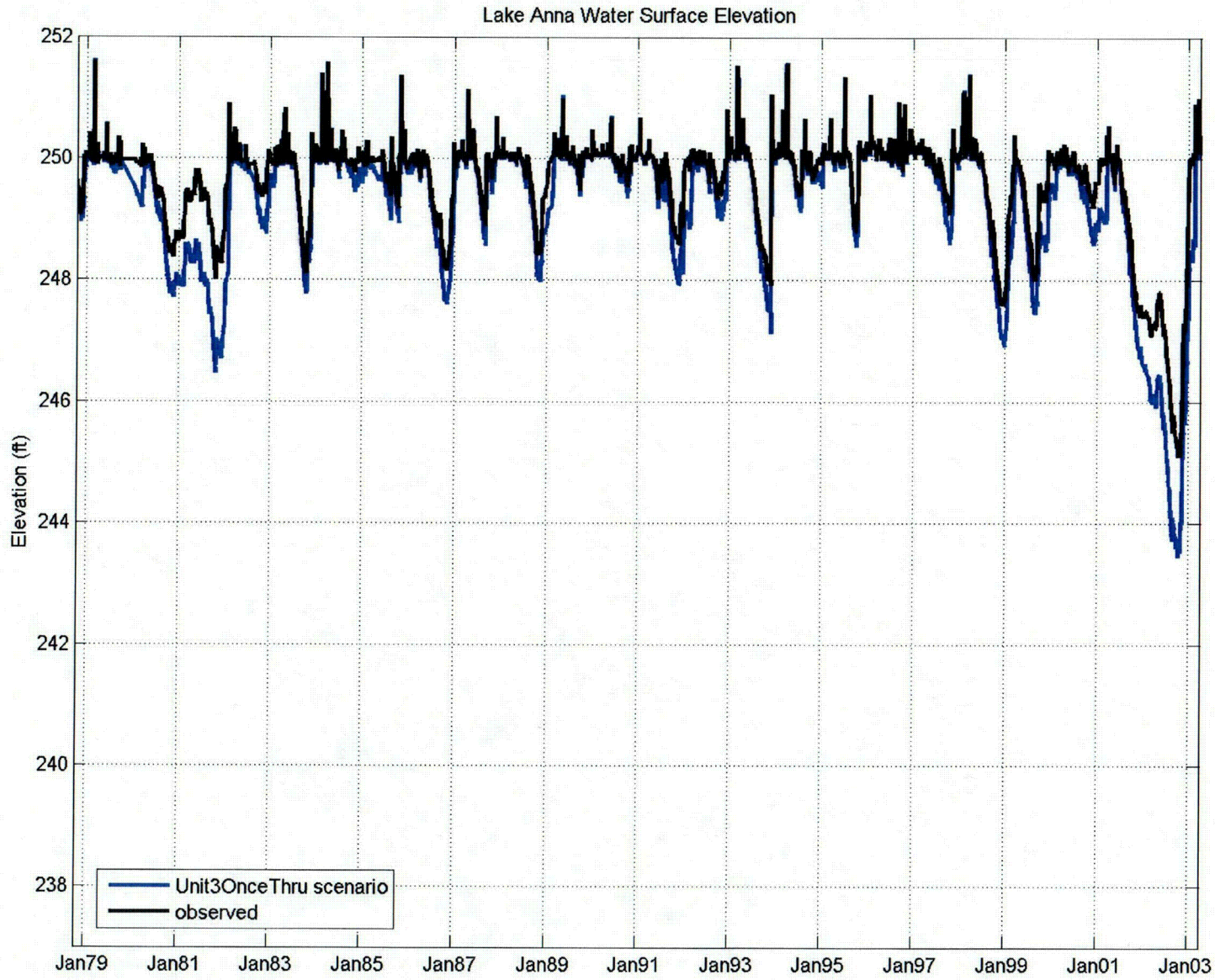
Step 2: Scenario Analysis

Scenario	Sim Avg Nat Evap. (cfs)	Sim Avg Forced Evaporation (cfs)	Minimum WSE (ft)
No Units	57.3	0	247.9
Units 1 & 2	55.6	47.2	245.1
U 1 & 2 + U 3 Once Thru	54.2	69.2	243.4
U 1 & 2 + U 3 Tower	53.3	83.1	242.4

Minimum WSE occur in October, 2002



C07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Jan03
Unit3OnceThru scenario
observed

C08

Evaporation Rate Calculations

Most evaporation rate formulas can be written as:

$$E = f(W)(e_{ws} - e_a) \qquad [m^3/s/m^2 \text{ or in/year}]$$

$$f(W) = a_0 + a_1 W + a_2 W^2 \ldots$$

LakeWBT (water balance & thermal analysis):

$$E = 1.523x10^{-9}\ W\ (e_{ws} - e_a)$$ TVA (1972) & Bras (1990) [m/s]

$$e_{ws} = 6.11 \exp\left[\frac{L_{water}}{R_v}\left(\frac{1}{273.15} - \frac{1}{(T_{water} + 273.15)}\right)\right]$$

$$e_a = 6.11 \exp\left[\frac{L_{dew\,pt}}{R_v}\left(\frac{1}{273.15} - \frac{1}{(T_{dew\,pt} + 273.15)}\right)\right]$$

vapor pressures for water and atm just above water [mbar]

$$L = 4186.8\,(597.3 - 0.57 * T)$$

LakeWBT Solution for Water Balance

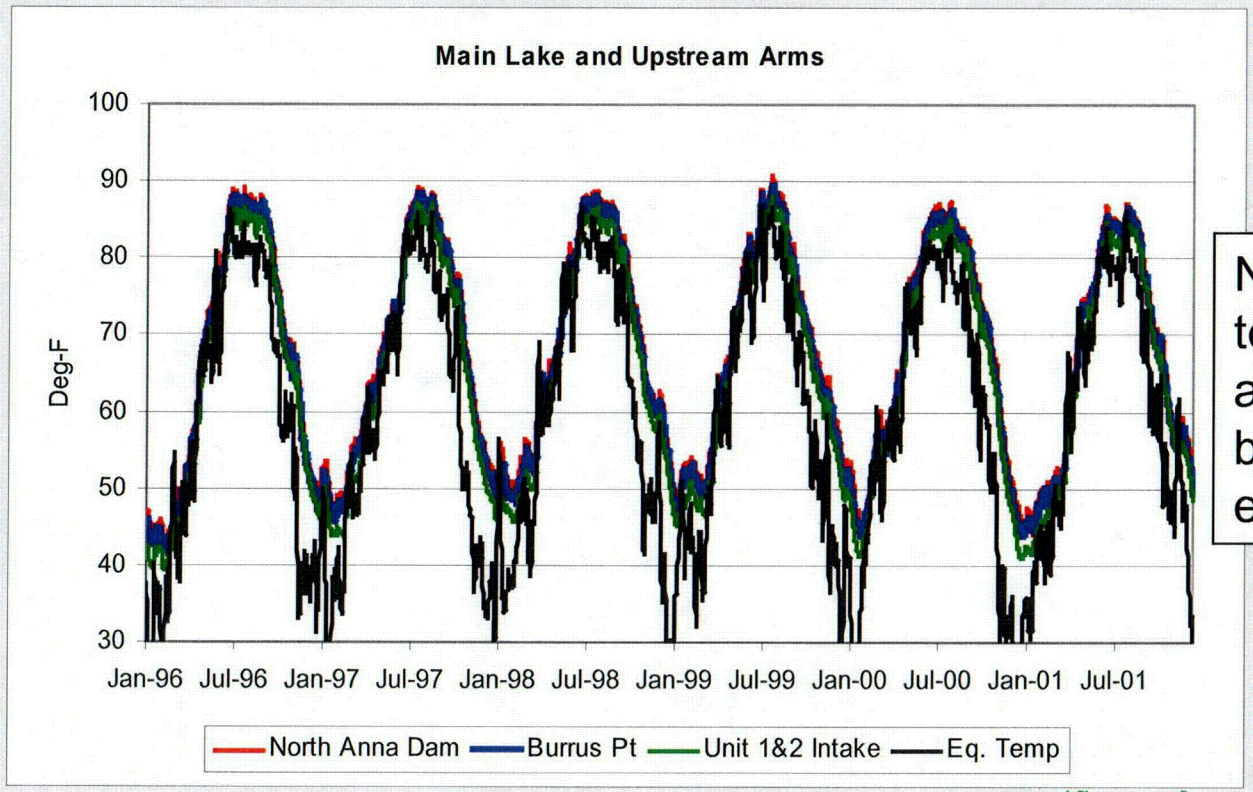
- Step 1: Calibrate Model
  - Compute natural (background) evaporation
  - Compute forced evaporation from Units 1 & 2
  - Compute inflow adjustment to force conservation of mass over period (observed WSE matches simulated)
- Step 2: Scenario Analysis
  - Use PPE values for ESP unit evaporation rate
  - Use forced evaporation from Step 1
  - Natural evaporation is impacted by lake drawdown
  - Units 1&2 shut off at Elev 244', Unit 3 off at Elev 242'

Step1….

OK, but evaporation is highly dependent upon the water temperature…

Solution: use existing condition (only!) MIT calibrated data set.

Time series of water temperatures indicates lake temps are relatively constant, even for very different water years.



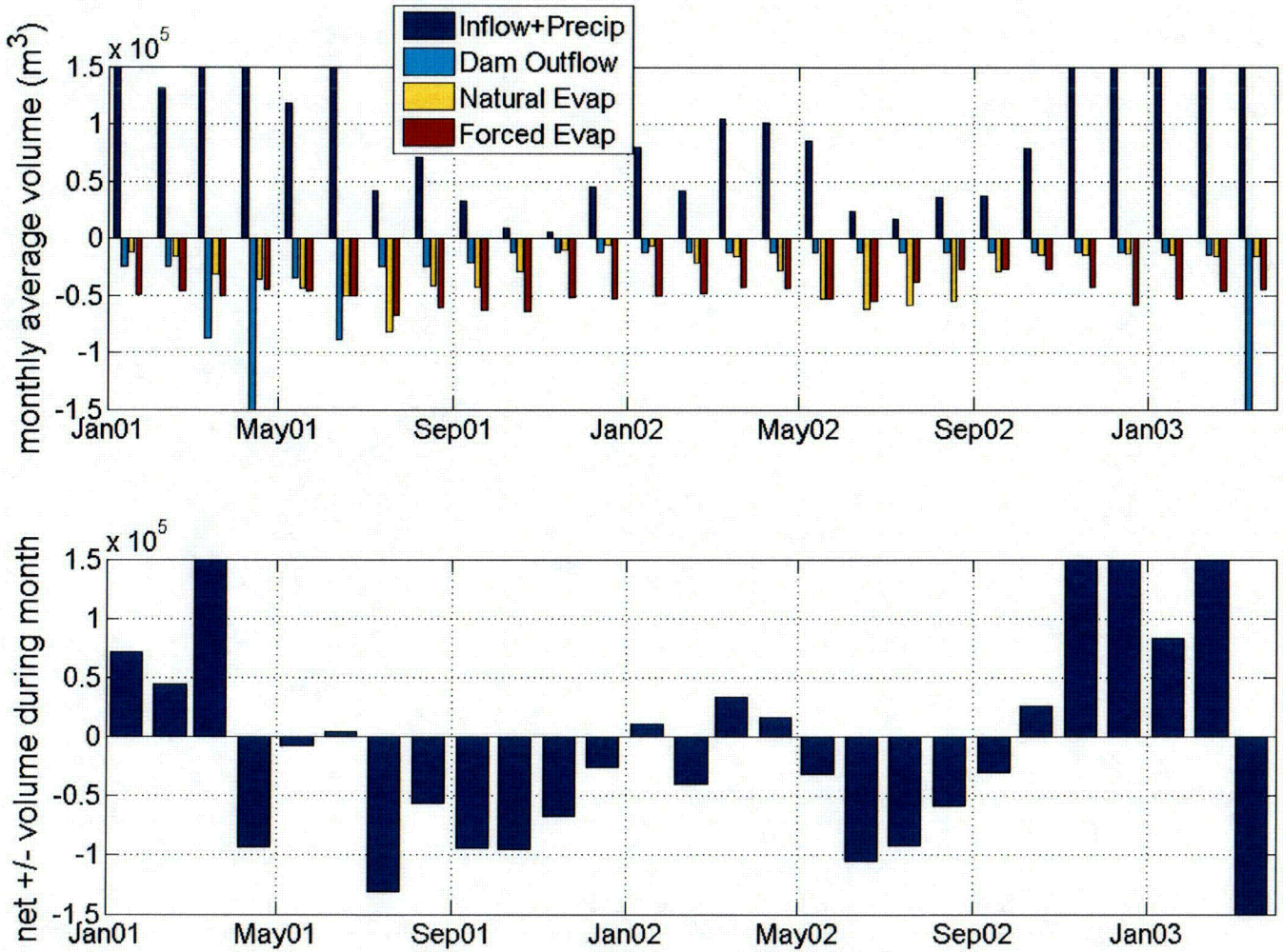
Note: main lake temps are almost identical, but above equilibrium

C09

Step 1: Model Calibration Results

- Simulated 1978-2003. Found Fall 2002 period to be the most critical
  - Alternative simulations focused on 2001-2003 period.
- Inflow adjustment was small
  - On the order of 12 cfs
  - Indicates Little River Watershed has a response to similar to North Anna Watershed
- Natural evaporation rate = ~39 in/yr which closely matches other data sources.

What does the U 1&2 + U3Tower scenario water budget look like?



C10