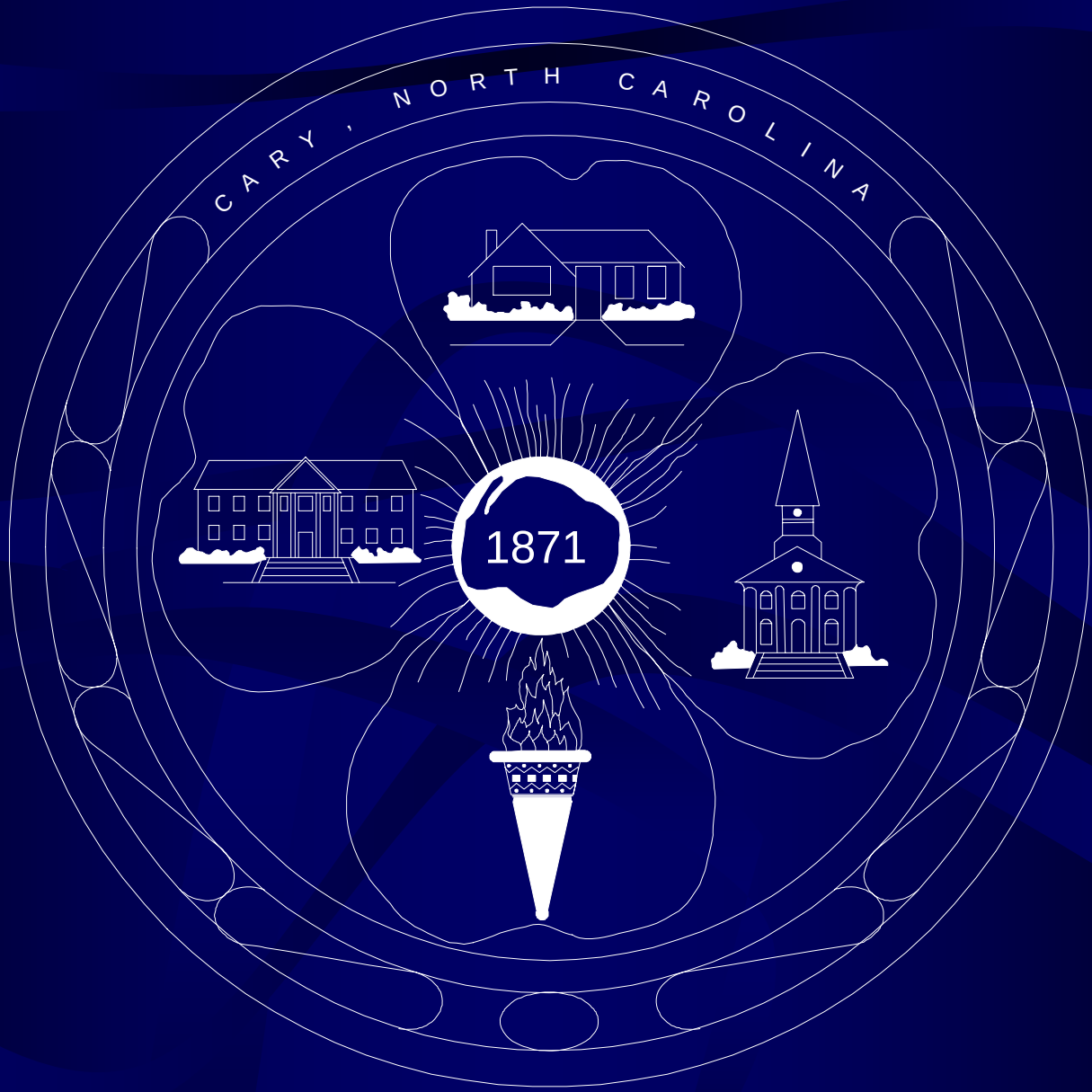
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Western Wake Communities Interbasin Transfer Requirements: Update on Analysis of Harris Lake as a Discharge Alternative

Towns of Apex, Cary, and Morrisville and Wake County (RTP South)

March 11, 2009

Presentation Topics

- Background on IBT Certificate requirements
- Harris Lake model development
- 2008 Monitoring
- Model calibration status
- Next Steps
- Discussion

IBT Certificate

- Issued in July 2001
- Certificate holders include Towns of Cary, Apex and Morrisville and Wake County (RTP South)
- Requirements
  - Max day IBT of 24 mgd
  - Several conditions

Condition 1 of Western Wake Communities IBT Certificate

- After 2010, water supplied from the Haw Basin shall be returned to either the Haw or Cape Fear Basin
- Certificate includes a formula for calculating the required annual return amount

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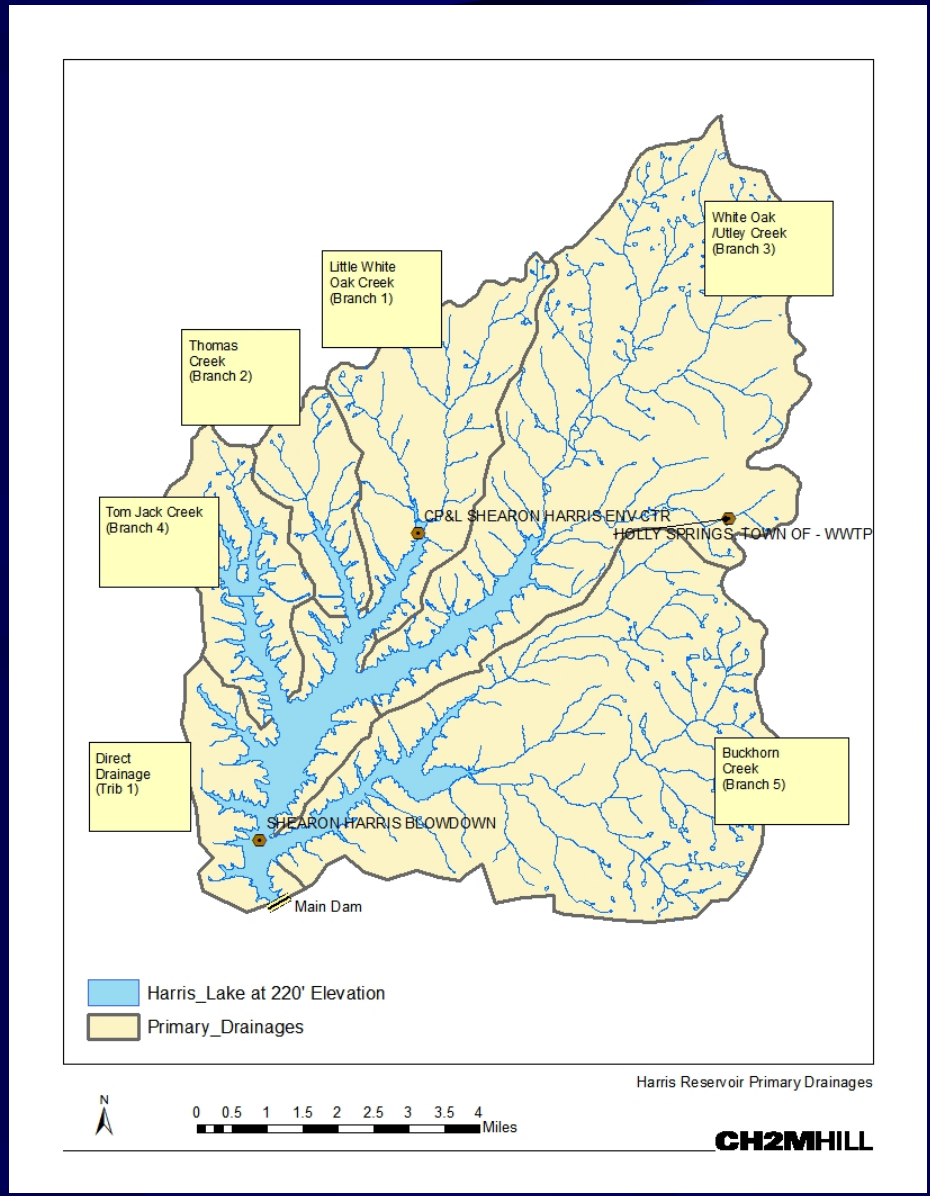
Overall Modeling Process

- Modeling approach – Feb 08
- Modification of monitoring program – Feb 08
- Development of watershed and lake models – May 08
- Screening with BathTub model – May 08
- Initial Model Calibration – Aug 08
- Model Sensitivity to Discharge – Aug 08
- Preliminary model report –Sep 08
- EMC Update on Harris Lake – Sep 08
- 2008 Monitoring data available - Dec 08
- Updated model analyses and meeting w/ DWQ - Feb 09
- Submittal of recalibrated Model and 2008 Harris Lake data – Feb 09
- Submittal of Final Report and Speculative Limits Request – Mar 09
- ***DWQ review comments and decision on Speculative Limits***

Watershed Model Development

- Adapted Utley Creek Generalized Watershed Loading Function (GWLF) model to estimate nonpoint source loading to Harris Lake
- Soil properties, landuse classes, and loading rates are consistent with calibrated Jordan Lake model
- Nutrient loading results compared to Utley Creek total load and Jordan Lake per acre loading rates
- Watershed loads are input to CE-QUAL-W2 but are adjusted based on in-lake calibration

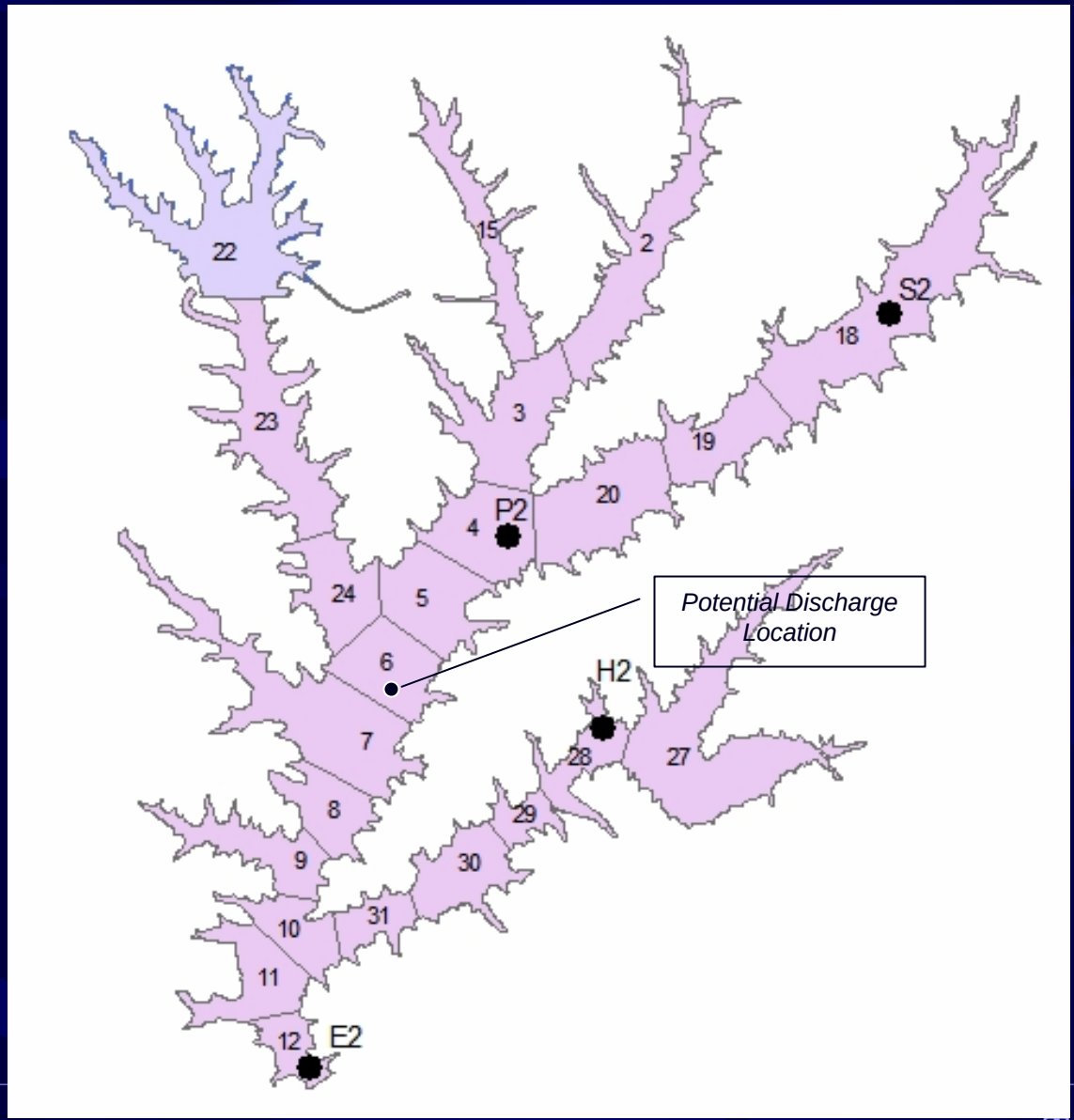
Harris Lake Watershed



Lake Model

- Processed detailed bathymetric data to provide representation in CE-QUAL-W2 model
- Divided lake into segments with similar characteristics
- Processed GWLF and point source nutrient loadings for the period from 2001 – 2007
- Developed meteorological inputs
- Calibrated model to observed lake data (2006)
- Validated model to observed lake data (2007)
- Re-calibrated model to observed lake data (2008)

Harris Lake Model Segmentation



Lake Model Calibration Steps

- Check flow balance
- Calibrate temperature to profiles
- Evaluate balance of organic and inorganic nitrogen species (TKN, NH4, NO3)
- Calibrate total nitrogen and total phosphorus
- Calibrate chlorophyll *a*
- Calibrate dissolved oxygen to profiles

Initial Calibration Observations

- NPS nitrogen species are underestimated
- Focused on NPS phosphorus since it is limiting nutrient
- Temperature and DO predictions are generally very good
- Chlorophyll a simulation captures range and expected pattern of algal growth
  - Underestimates levels during non-growing season
  - Refined using temperature parameters with 2008 data

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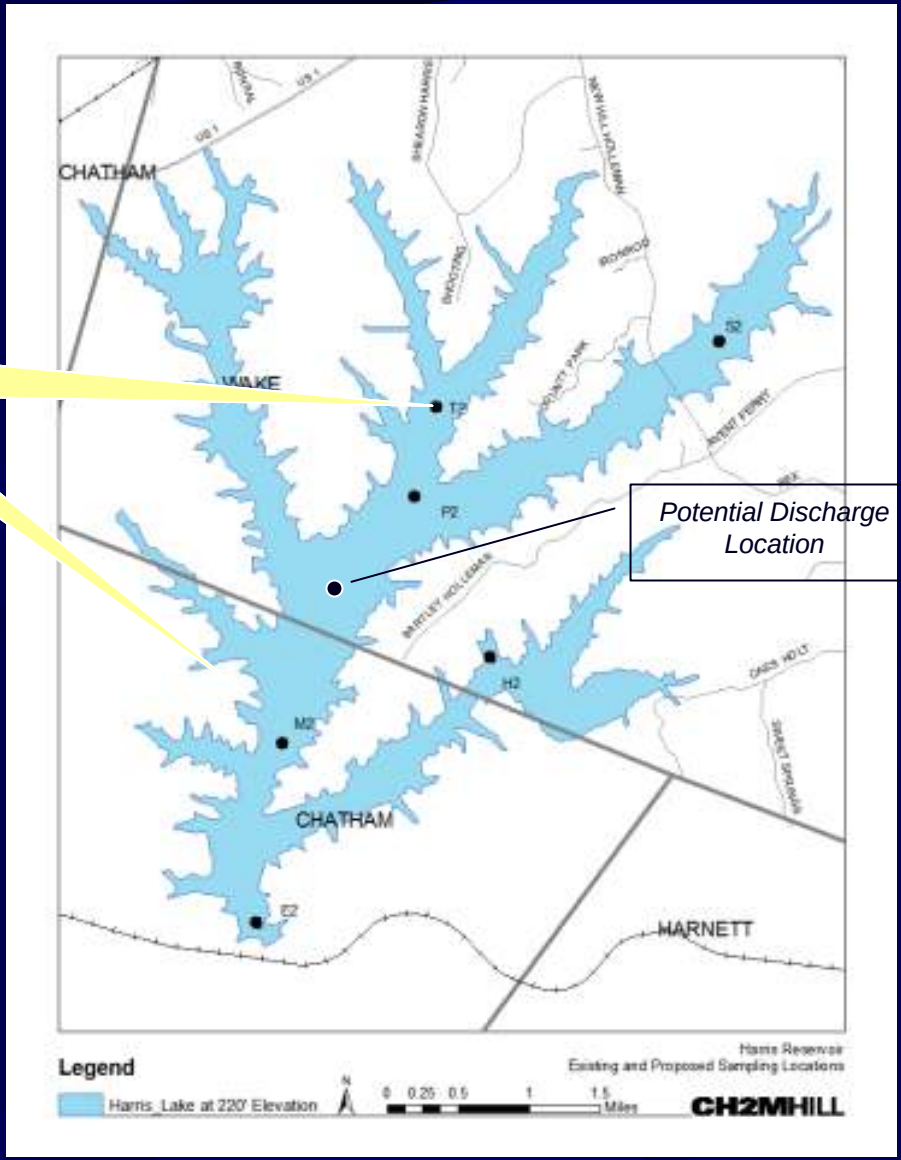
2008 Monitoring Efforts

- Discussions with DWQ, Progress Energy, and the Project Partners used to define more detailed monitoring
- Added two stations, T2 and M2
- Increased frequency from April through November for 2008
  - Analytical water quality parameters sampled monthly (nutrients)
  - Field monitoring performed bi-weekly (temperature, DO, chl a)

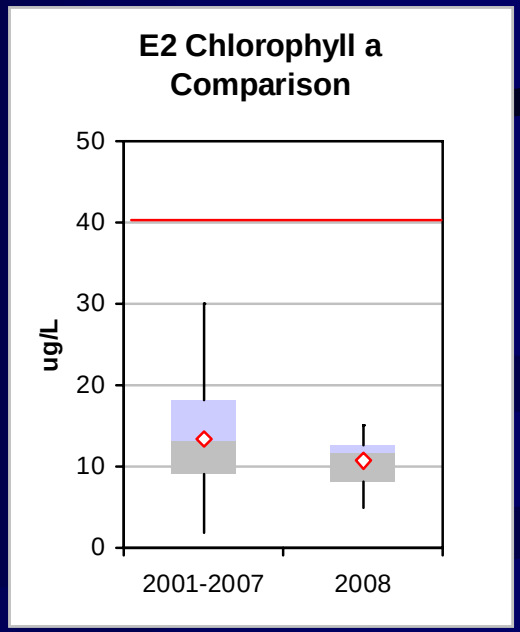
Harris Lake Monitoring Locations

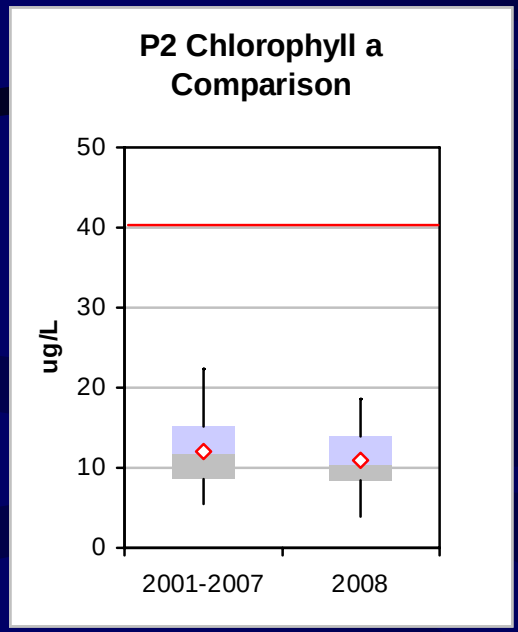


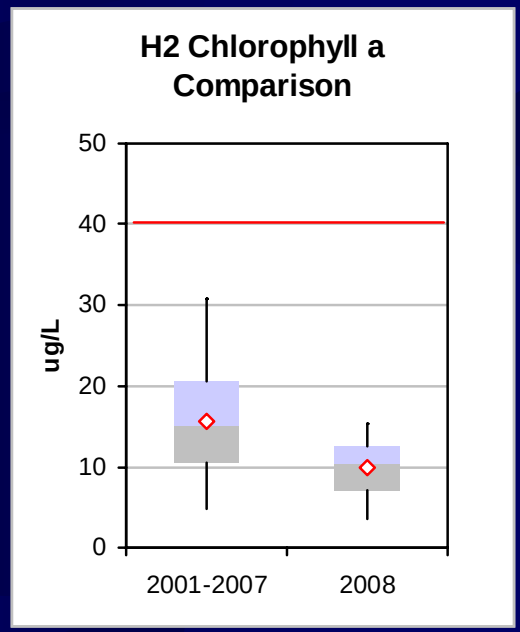
2008 Monitoring Results

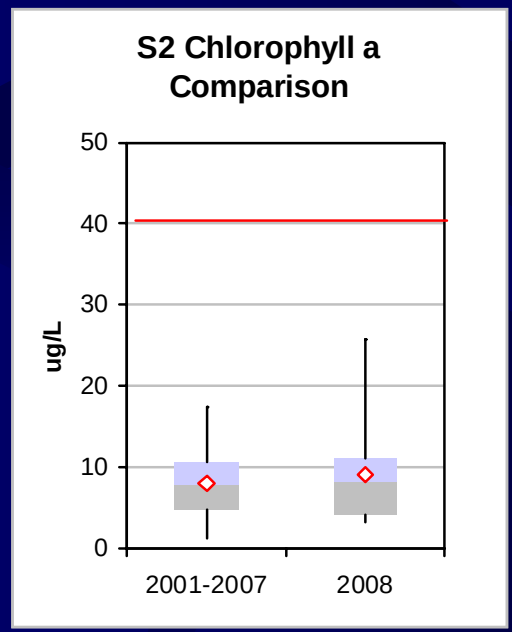
- Compared detailed 2008 monitoring with historical data
  - 2008 observations generally have a smaller range
  - 2008 observations generally have lower means
  - Elevated nutrient levels in the Utley Creek Arm in 2008
  - Highest chl. a was 26 ug/L in February 2008
- 2008 monitoring data was used to provide additional review of model accuracy and to refine chl a simulation

All chlorophyll *a* data since 2001 are less than 40 ug/L WQS









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2008 Re-calibration

- First checked temperature, nutrients, and DO
- Focused on adjustment of chl a concentrations
  - Adjusted algal parameters including light and temperature thresholds
  - Addressed original inaccuracy in cool weather algal growth
- Checked to ensure that low nitrogen was not causing limitation

Re-calibration Conclusions

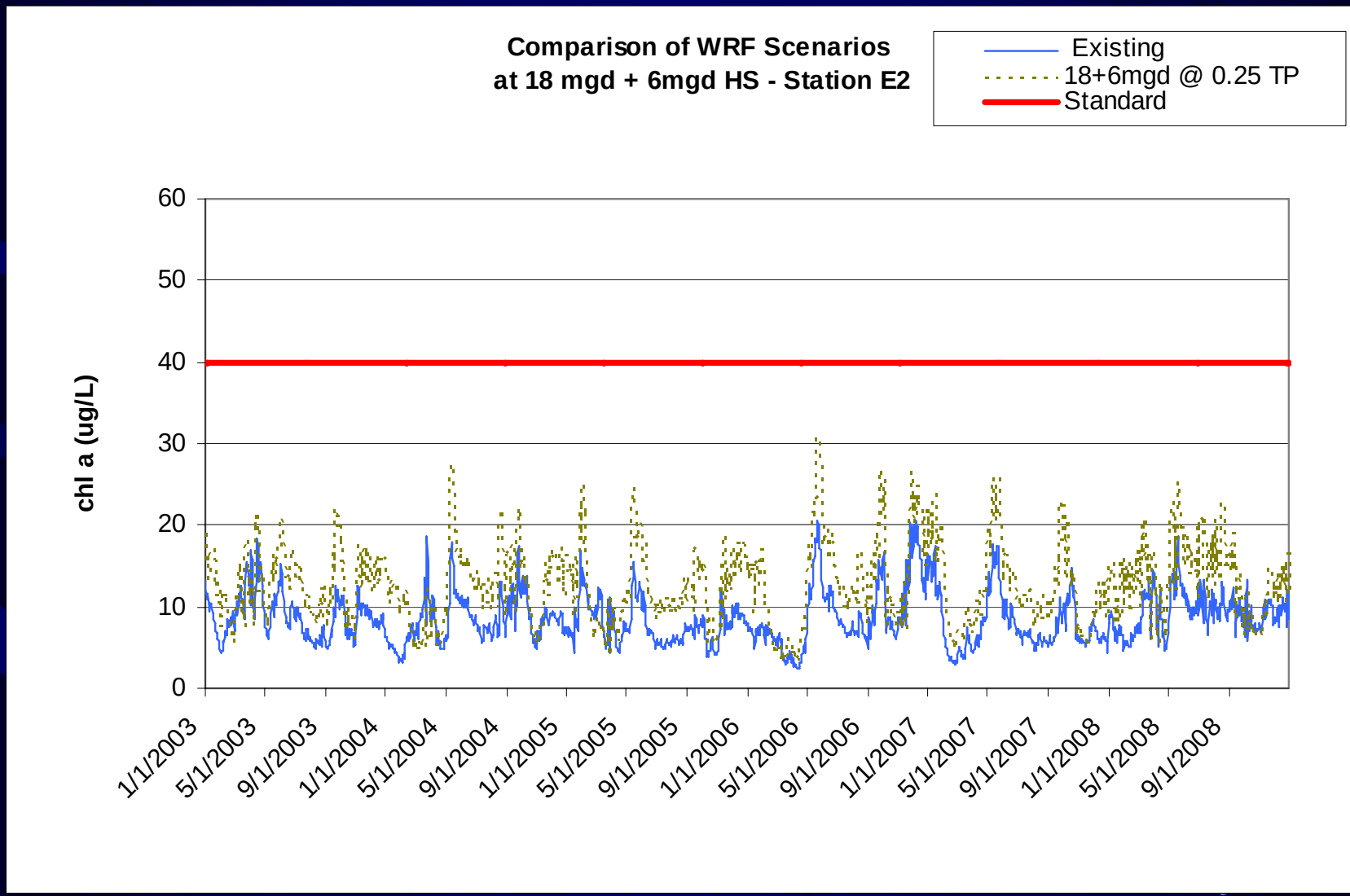
- Original calibration was good for temperature, phosphorus, and DO
- 2008 run still shows underestimation of nitrogen constituents
  - Model results only show P and light limitation
- Chlorophyll a simulation improved by refinement of algal parameters

June 1, 2008 Julian Date 2709 days 12.00 hours

Algal group 1 limiting factor

Layer	Depth	12	16	21	25	32
8	0.70 P	0.5560 P	0.1684 P	0.1550 P	0.2025 P	0.2260
9	1.91 L	0.6482 P	0.1552 P	0.1703 P	0.2754 P	0.4004
10	2.91 L	0.2545 P	0.2385 L	0.2762 L	0.2647 L	0.2329
11	3.91 L	0.0866 L	0.0916 L	0.0956 L	0.0915 L	0.0776
12	4.91 L	0.0291 L	0.0301 L	0.0330 L	0.0317 L	0.0265
13	5.91 L	0.0101 L	0.0105 L	0.0117 L	0.0113 L	0.0094
14	6.91 L	0.0036 L	0.0039 L	0.0042 L	0.0041 L	0.0035
15	7.91 L	0.0013	L	0.0016 L	0.0015 L	0.0013
16	8.91 L	0.0005	L	0.0006 L	0.0006 L	0.0005
17	9.91 L	0.0002		L	0.0002 L	0.0002
18	10.91 L	0.0001			L	0.0001
19	11.91 L	0.0000			L	0.0000
20	12.91 L	0.0000			L	0.0000

Comparison of chlorophyll a concentrations at Station E2 (Near Dam)
Phase 1 = 24 mgd; TP Level = 0.25 mg/L



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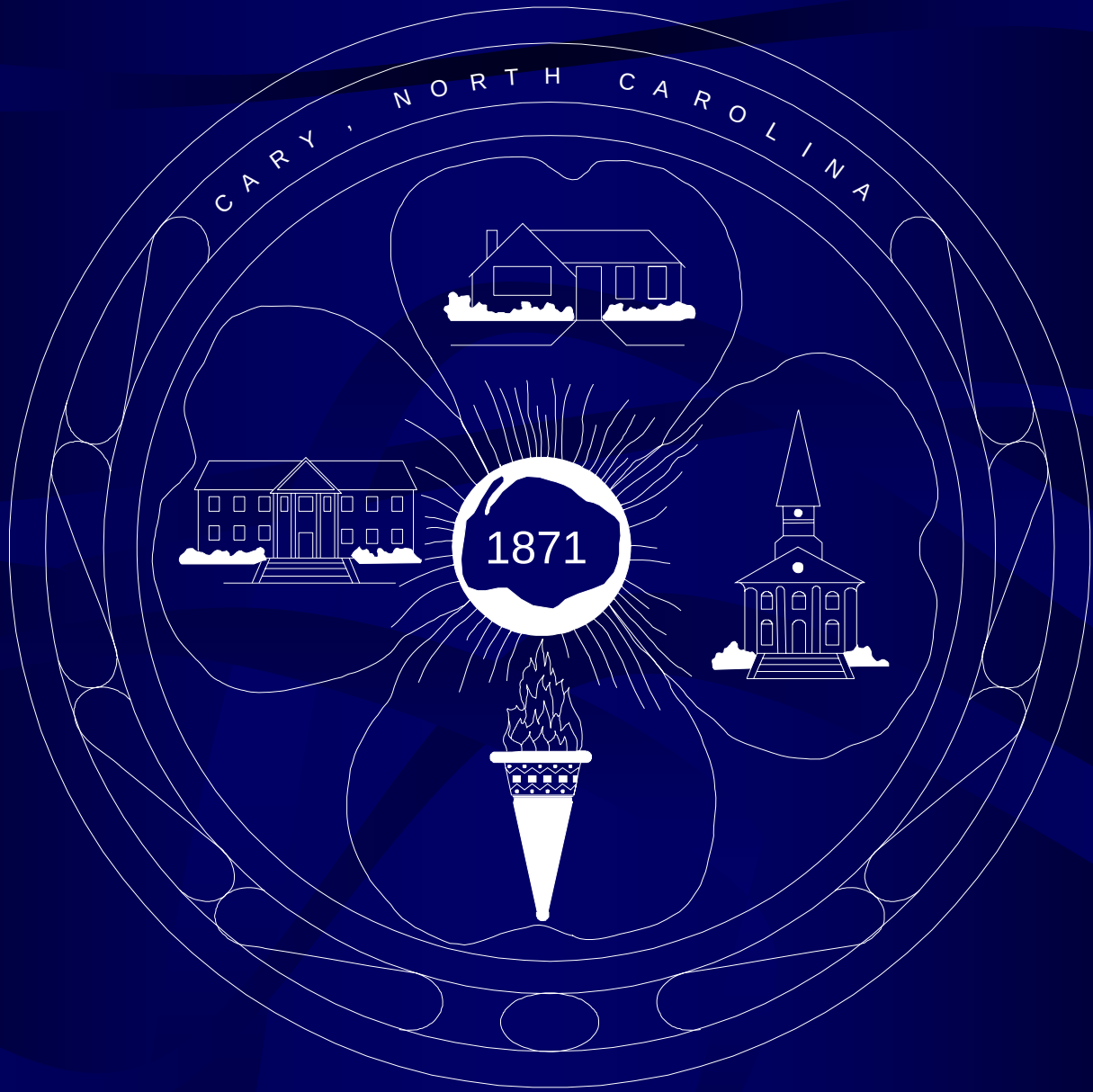
Next Steps

- DWQ meeting to present calibration – Feb 2009
- Provide model and data files to DWQ – Feb 2009
- Submit updated calibration TM to DWQ – Feb 2009
- Complete evaluation of potential scenarios – March 2009
- Modeling Final Report – March 2009
- Submit request for speculative limits – March 2009
- *Respond to DWQ questions and comments*
- *DWQ decision on speculative limits*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