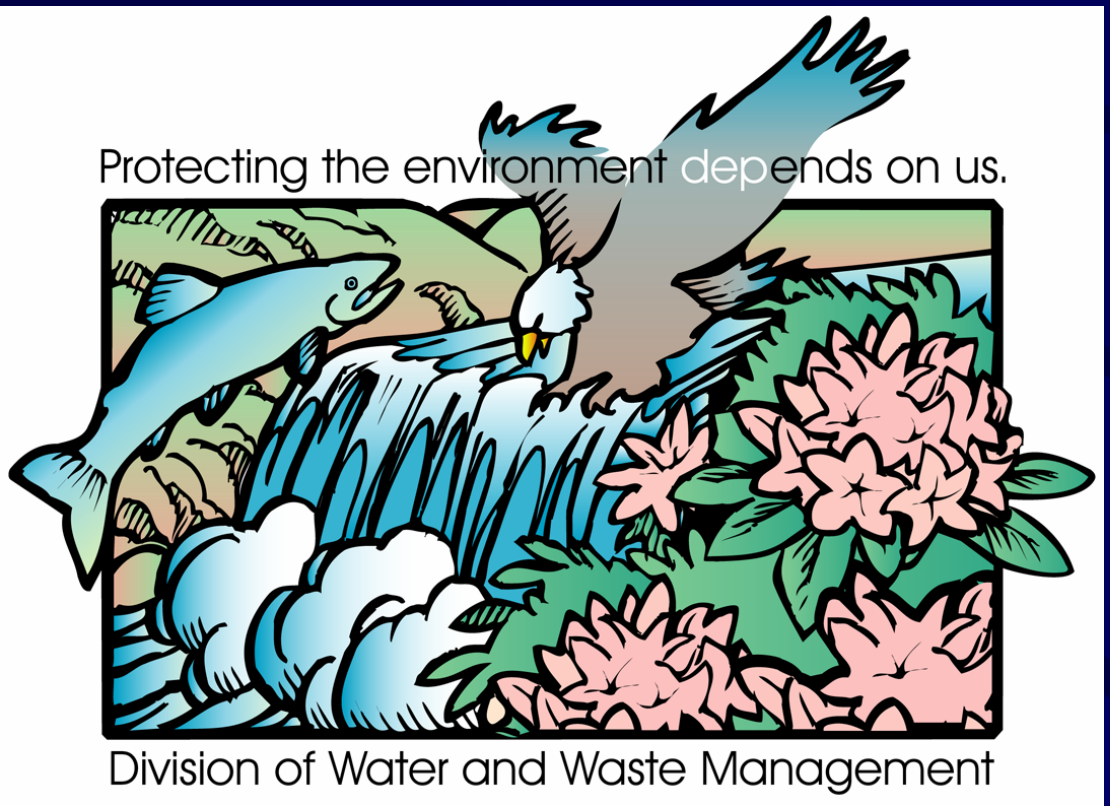
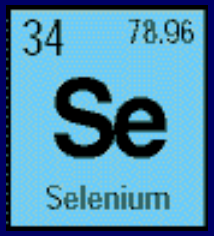
DEP Selenium Study
Background and Progress



Patrick Campbell

April 18, 2006

Selenium – History



- **Current Water Quality Standards:**
  - **5 µg/l chronic (coldwater and warmwater)**
  - **20 µg/l acute (coldwater and warmwater)**
  - **10 µg/l (drinking water)**

- **Discovered in the MTM EIS work**
- **Violations of standards have been observed, streams 303(d) listed, TMDLs developed, appeal, effluent limits, core analysis, material handling, etc.**

Environmental Impact Study of Mountaintop Mining and Valley Fill Operations in West Virginia

EIS data included over 900 water chemistry samples.

Selenium values exceeded WV's WQ criteria and resulted in listing of 9 streams on our 2002 303(d) list of impaired streams:

- 4 from the Coal River Watershed
- 4 from the Guyandotte & one from the Gauley

DEP – Selenium TMDLs

EPA Approved

1. Mud River
2. Stanley Fork
3. Sugartree Branch

Pending Approval

1. Seng Creek
2. Left Fork/White Oak Ck
3. White Oak Creek
4. Trace Branch
5. Beech Creek
6. Left Fork/Beech Ck
7. Beaver Pond Branch
8. James Creek
9. Casey Creek

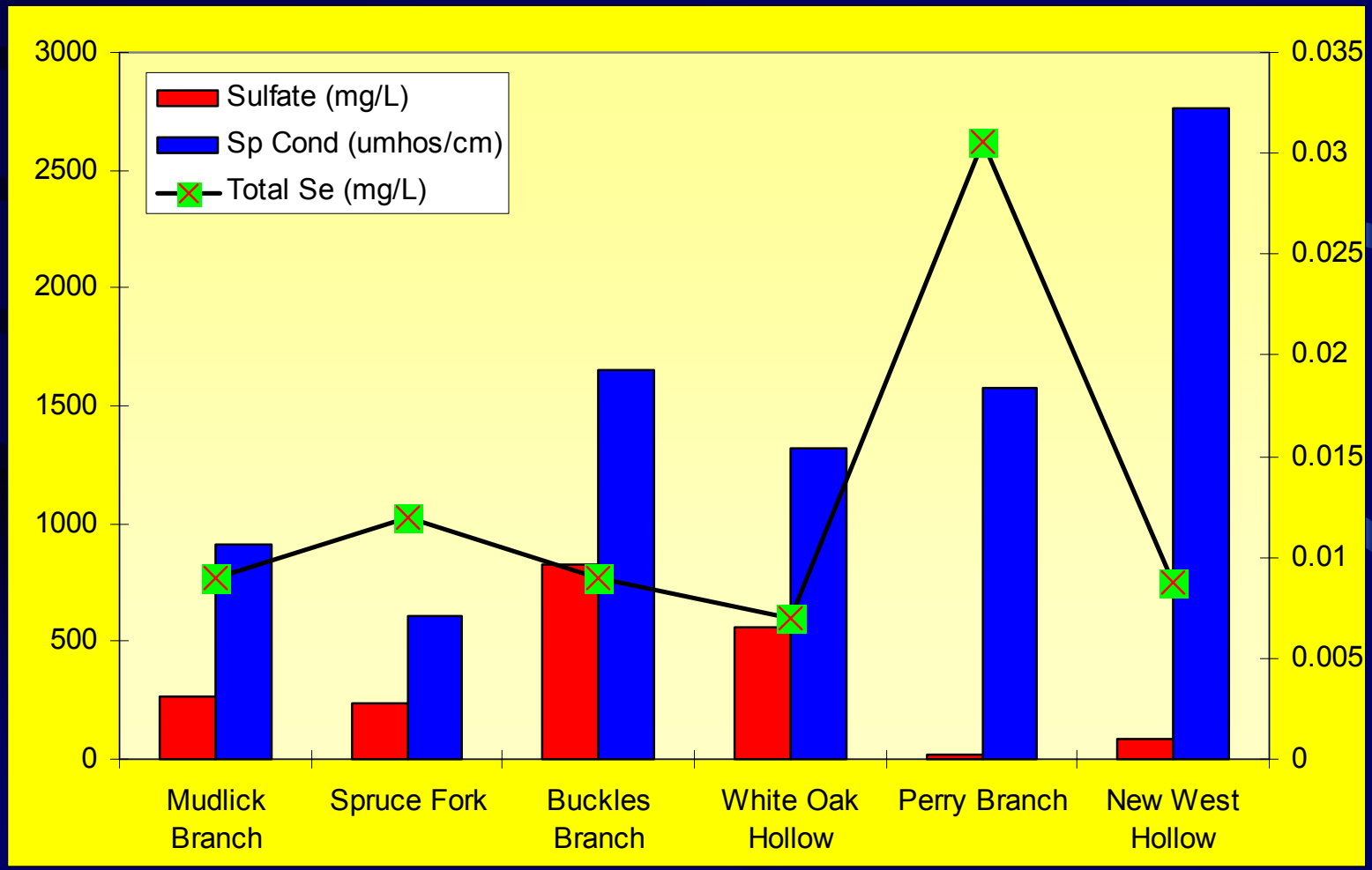
Other DEP Selenium Data

- **1997 Random Sites - no selenium detected**
- **Random sites 2002-2005, 471 samples; 465 no detects**
  - **Some type of mining (valley fills, old surface, ponds, prep plants, etc.) was observed at or near the sites where Se detected**
- **Coal River TMDL study: 1948 WQ samples collected/laboratory analysis for Se, 1840 no detects**
- **Fish - Edible fish tissue 54 samples – LMB Mt. Storm**

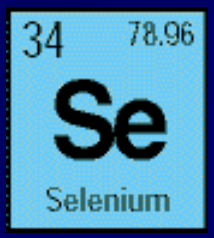
Date	Watershed	Stream Name	Total Se (mg/L)	Sulfate (mg/L)	pH	Sp Cond (umhos/cm)
10-May-05	Coal	Mudlick Branch	0.009	269	8.3	916.00
04-May-05	Coal	Spruce Fork	0.012	234	8.1	608.00
29-Jun-05	Gauley	Buckles Branch	0.009	823	7.6	1650.00
08-Jun-05	Tug Fork	White Oak Hollow	0.007	558	8.1	1323.00
03-May-05	Upper Guyandotte	Perry Branch	0.0306	22.9	8.2	1573.00
27-Apr-05	Upper Kanawha	New West Hollow	0.0088	89	8.5	2767.00

2002-2005 Random Sampling WQ Results

(Se detected)

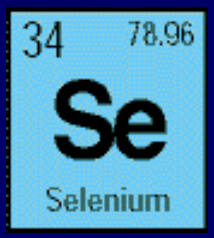


Selenium – EPA



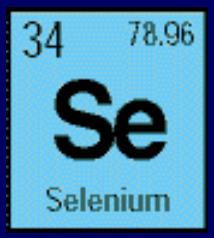
- Noticed for comment revised recommended federal criteria 12/2004
  - Proposed 7.9 ppm body burden # (whole fish – dry weight)
  - Extensive comment received
- Body burden believed to be more reflective of actual environmental impact
- But how do you make that a permit limit?

Selenium – DEP Study



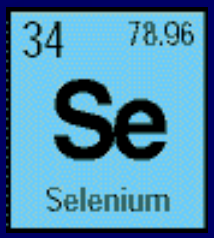
- **Insight into bioaccumulation rates**
- **Notice of Study issued on 11/10/05**
- **Collecting fish from areas where elevated in-stream concentrations observed/believed to be present**
- **Target species whole body bluegill/green sunfish; creek chub/stoneroller as backup**

Selenium – DEP Study



- Looking at 12 sites and 2 controls
  - Lakes and Streams
  - Mining and Flyash Disposal Areas
- Fish Collections - 2 times
  - 146 ground & analyzed thus far
- 12 months WQ sampling

Selenium – DEP Study



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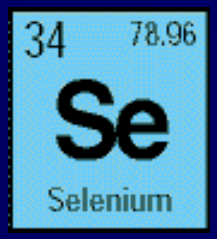


Study Locations

Streams

- **Mud River**
- **Hughes Fk/ 20-mile**
- **Ash Fk/ 20-mile (ref)**
- **Kiah Ck/12-pole**
- **Seng Ck/Coal**
- **White Oak/Coal**
- **Sycamore Ck/Coal (ref)**
- **Beech Ck/Little Coal**
- **Pond Fk/Little Coal**

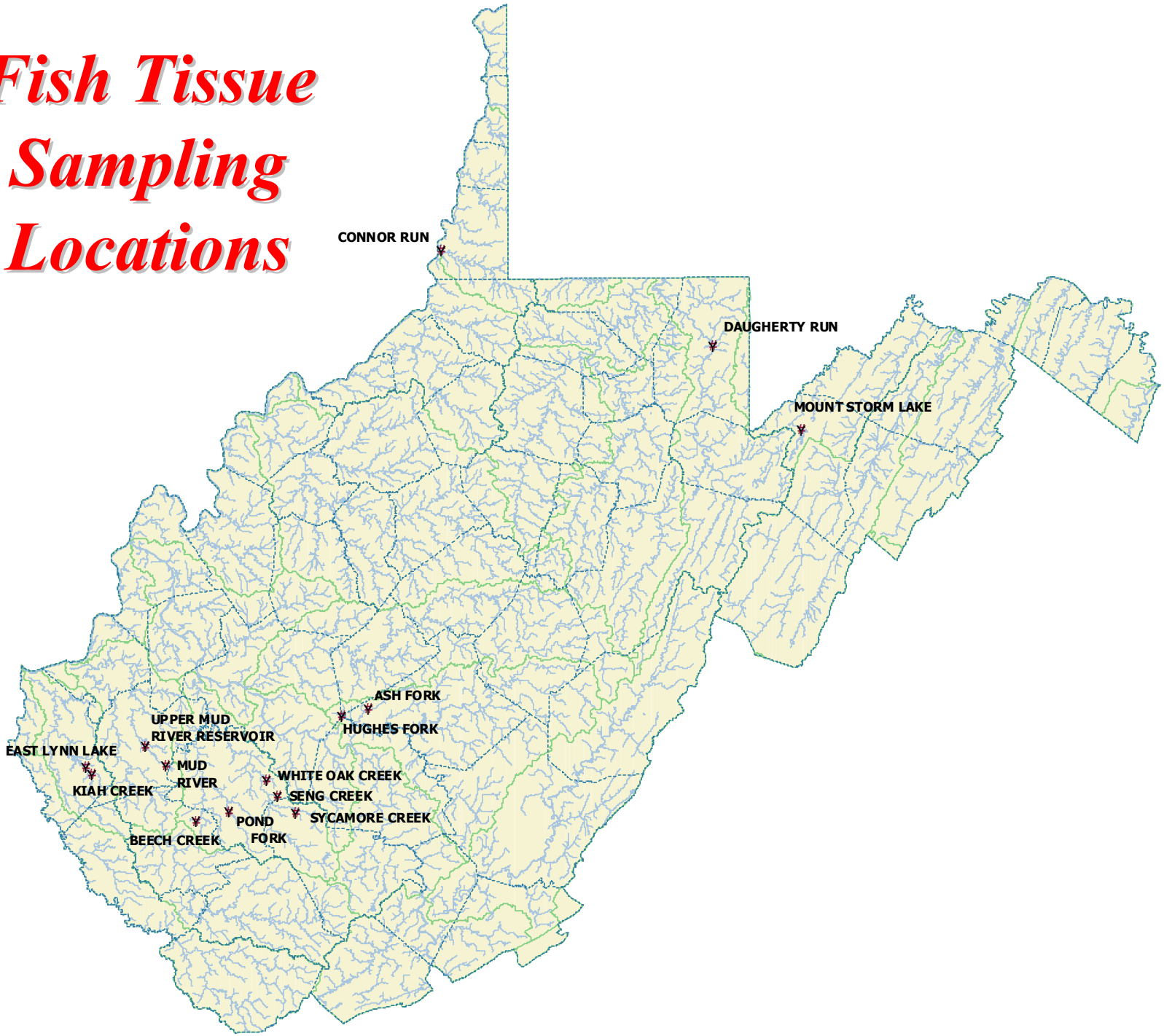
Lakes

- **Mt. Storm Lake**
- **East Lynn Lake**
- **Upper Mud Reservoir**

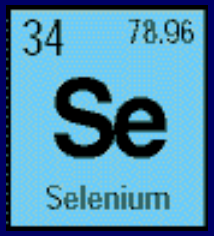
Flyash

- **Connor Run**
- **Daugherty Run**

Fish Tissue Sampling Locations



Preliminary Data



- **14 Sites reporting in…4 mo. wq & 1 set fish**
  - **Water Column <1 µg/l – 42 µg/l**
  - **Fish Body Burden < 1 mg/kg – 60 mg/kg (dry weight)**

- **Using both extremes - WV selenium values would fall in the range of 0.5 to 121 µg/l.**

Determining Se Bioaccumulation Factors

BAF = Tissue Concentration / Water Column Concentration

= Tissue (mg/kg) dry weight / Column (mg/L)

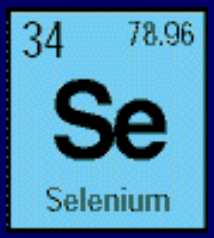
= Tissue (mg/kg) X 1/Column (mg/L)

= L/kg

Ex. BAF = 5.10 (mg/kg) / 0.007 (mg/L)

= 728.57 (L/kg)

= or 728.57 L. or column Se to create 1.0 kg or tissue Se



Extreme BAF Cases

- **White Oak Creek**

  Avg. Water 15.3 ppb

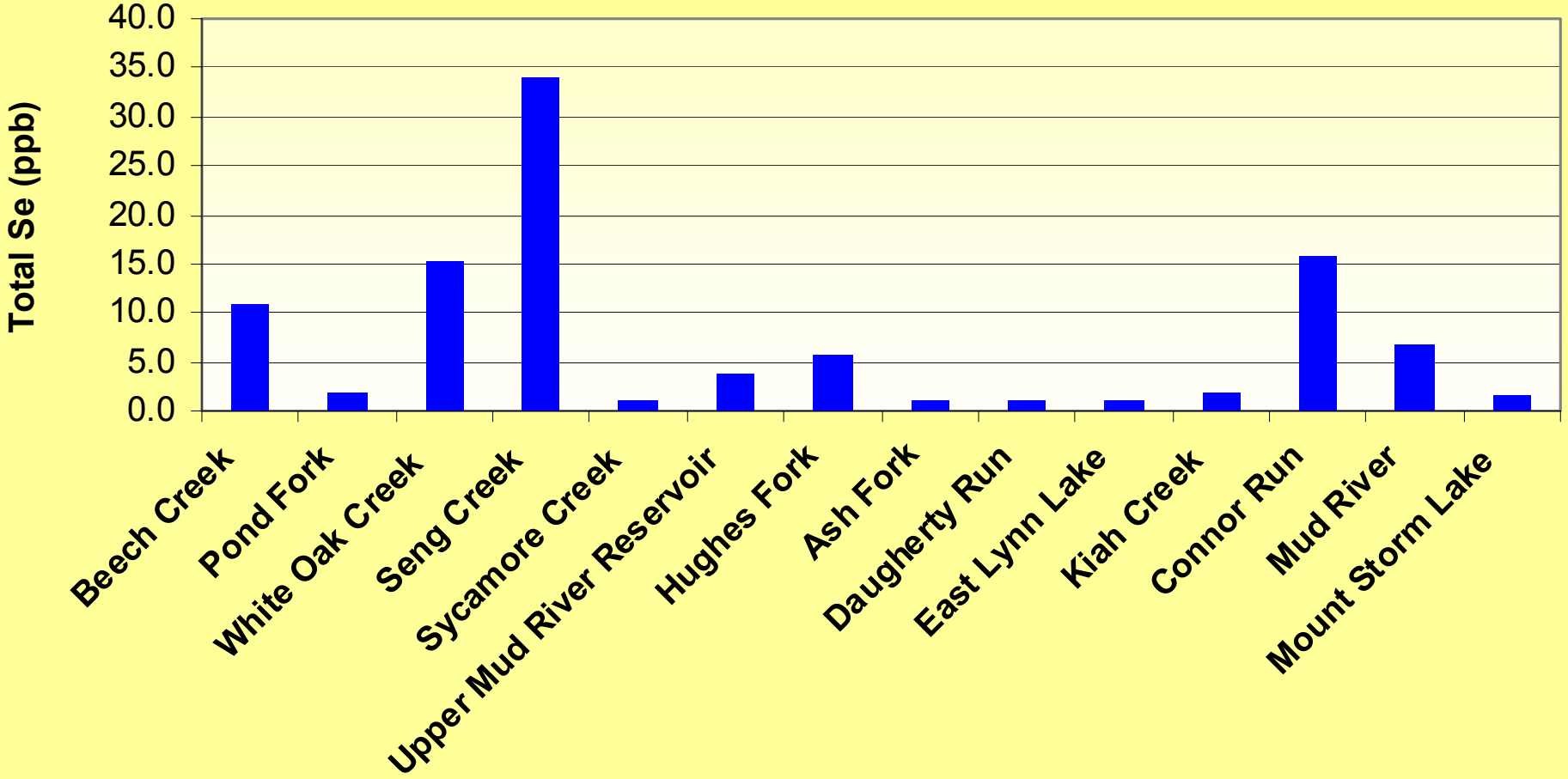
  - **Bluegill <1 ppm**
  - **121 µg/l necessary to protect 7.9 body burden**
  - **BAF = 65.4 (liters/kg)**

- **Mud River Reservoir**

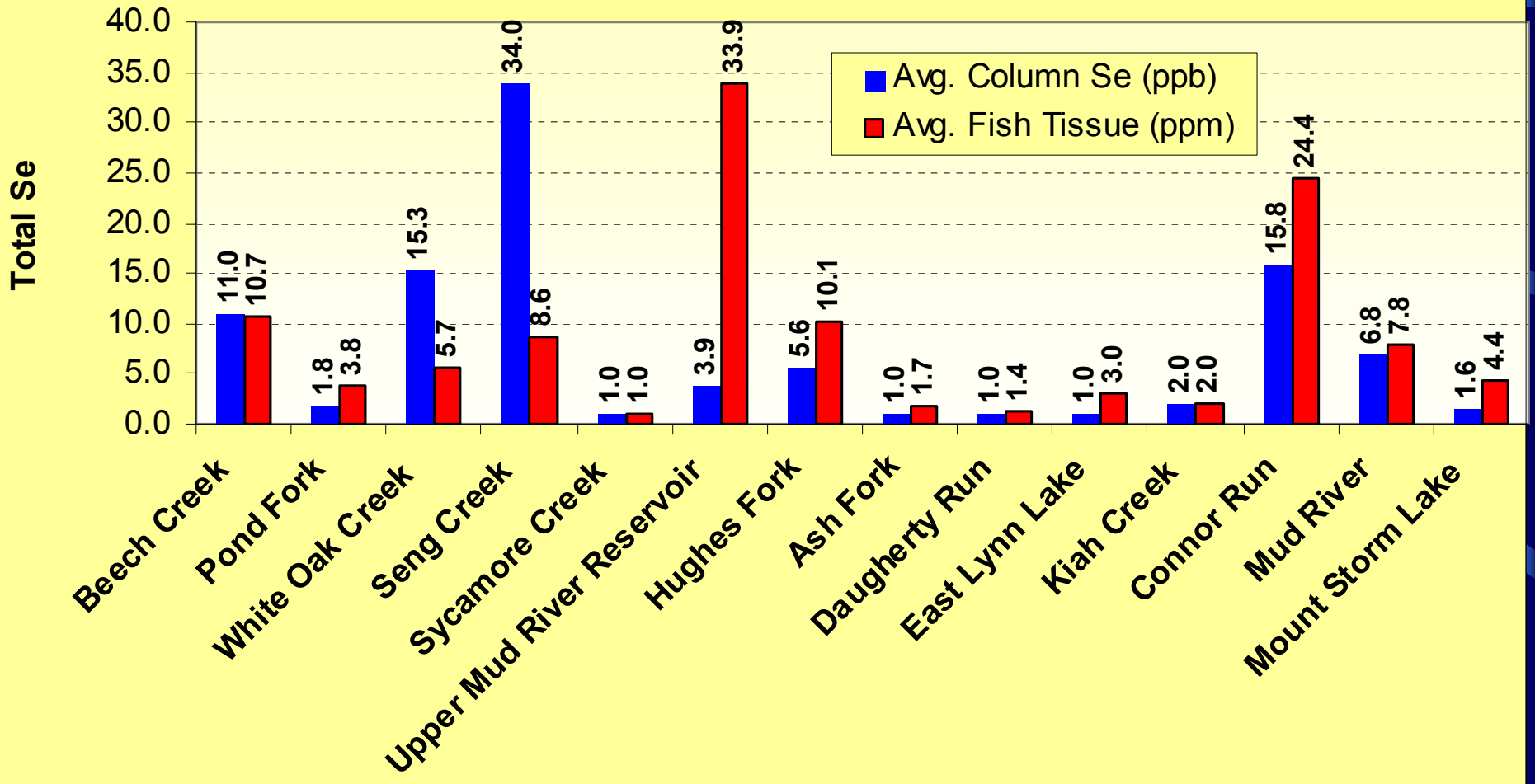
  Avg. Water 3.9 ppb

  - **Bluegill = 60 ppm**
  - **0.5 µg/l necessary to protect 7.9 body burden**
  - **BAF = 15,000 (liters/kg)**

Avg. Water Column Se Values



Avg. Column & Tissue Se Values



Preliminary Observations

Bluegill Tissue

- Streams: <1 – 4.2 ppm / avg. = 2.6 ppm
  - Avg. BAF = 1202 (L/kg)
  - Column # protective of 7.9 ppm = 27.7 µg/L

- Lakes: <1 – 60 ppm / avg. = 13.1 ppm
  - Avg. BAF = 4997 (L/kg)
  - Column # protective of 7.9 ppm = 2.6 µg/L

- Combined: <1 – 60 ppm/ avg. = 10.6 ppm
  - Avg. BAF = 4086 (L/kg)
  - Column # protective of 7.9 ppm = 8.5 µg/L

Preliminary Observations

Green Sunfish Tissue

- **Streams: <1 – 29 ppm / avg. = 10.2 ppm**
  - **Avg. BAF = 1421 (L/kg)**
  - **Column # protective of 7.9 ppm = 12.5 µg/L**

- **Lakes: 22 – 47 ppm / avg. = 30.4 ppm**
  - **Avg. BAF = 7794 (L/kg)**
  - **Column # protective of 7.9 ppm = 1.1 µg/L**

- **Combined: <1 – 47 ppm/ avg. = 13.3 ppm**
  - **Avg. BAF = 2387 (L/kg)**
  - **Column # protective of 7.9 ppm = 10.8 µg/L**

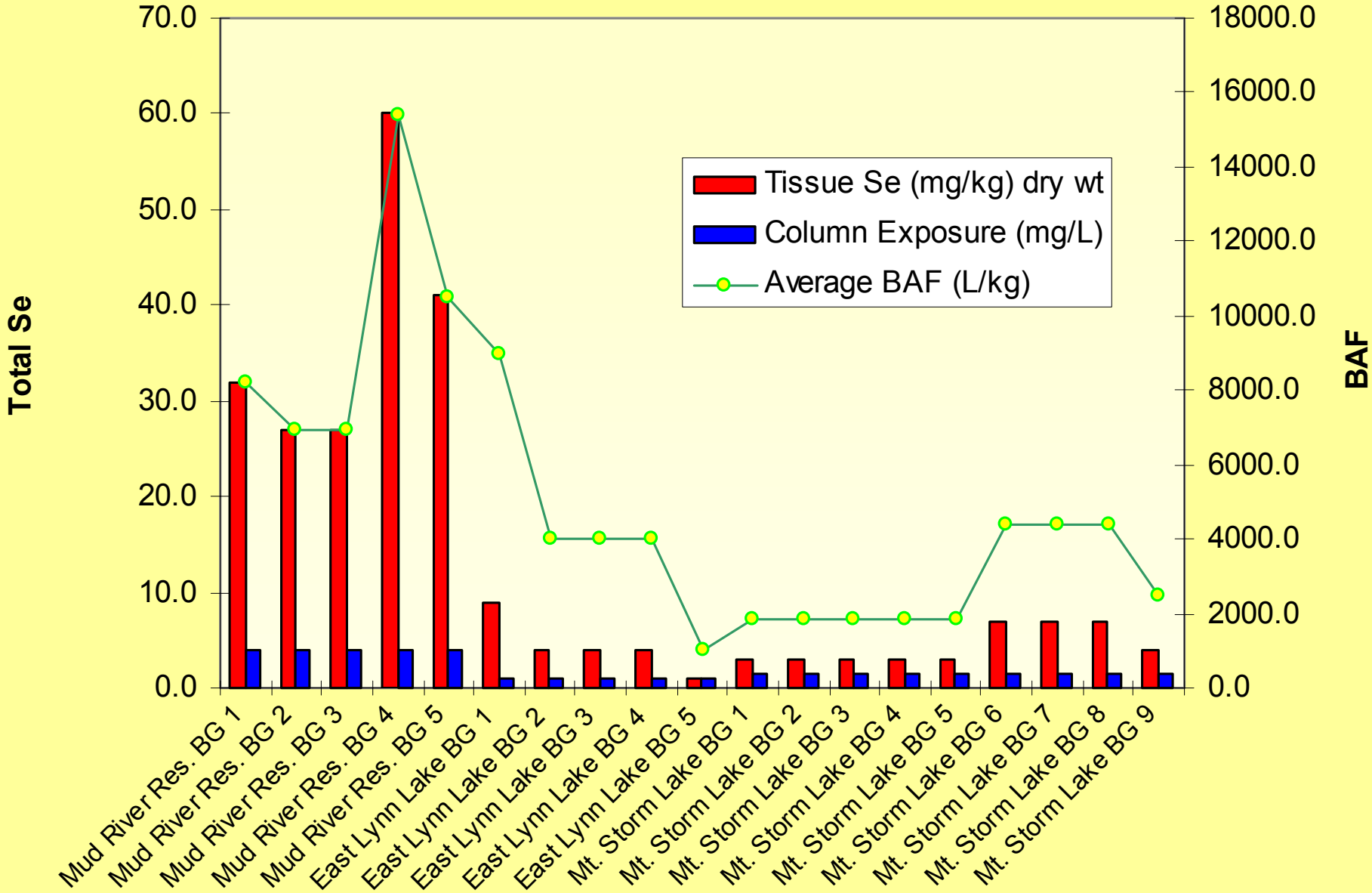
Preliminary Observations

Creek Chub Tissue

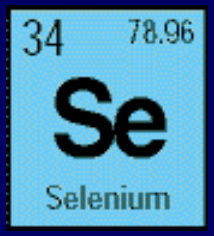
- **Streams: <1 – 30ppm / avg. = 6.8 ppm**
  - **Avg. BAF = 857 (L/kg)**
  - **Column # protective of 7.9 ppm = 21.2 µg/L**

- **Lakes: Not Collected/Expected**

Se Bioaccumulation Among Lake Resident Bluegill



Selenium – Closing



- **Last word of federal recommended criteria**
  - **Late 2008 for criteria and implementation guidance**
  - **7.9 may not be 7.9**
- **2nd rd fish collection just completed**
- **Added column sampling to lakes**
- **Contemplating 3rd round late summer**
- **Add antagonistic trace metals to tissue analysis**
- **Other agencies may take closer look at organ concentrations**

Final thoughts…

- **Current criteria in full effect**
- **Still learning…**


Questions?