Kentucky Rural Water Association
Helping water and wastewater utilities help themselves

RECEIVED

DEC 18 2017

PUBLIC SERVICE COMMISSION

December 11, 2017

Ms. Gwen R. Pinson, Executive Director
Public Service Commission
P. O. Box 615
Frankfort, KY 40602-0615

Re: Case No. 2017-00434 – Filing Deficiency

Dear Ms. Pinson:

Kentucky Rural Water Association submitted an application requesting continuing education credit for Water District Commissioners who attended a training session held at McCreary Co. Water District on November 3, 2017. The deficiency notice references there were no copies of written materials given to water commissioners attending the program.

There were no handouts provided to attendees by the speaker at this class. Copies of the PowerPoints used are included, but attendees did not receive copies of the presentations.

If additional information is needed to cure the deficiency please let me know.

Sincerely,

Janet Cole

Janet Cole
Education Coordinator
j.cole@krwa.org

Enclosures (6)

1151 Old Porter Pike · Bowling Green, KY 42103 · Phone 270.843.2291 · Fax 270.796.8623
www.krwa.org

Rural Water

Safe Drinking Water Act and Clean Water Act

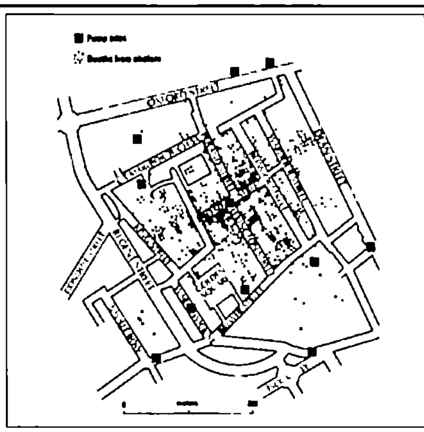
Randall Kelley
Kentucky Rural Water Association

A Bit of History

- Treated water unavailable until late 1800's and early 1900's
- In cities many people stayed sick to one degree or another
- Rural areas less affected, but still had problems
- Waste disposal was non-existent in many cities

A Bit of History

- Cholera played an important role in drinking water history
  - Causes severe diarrhea
  - Can cause death if untreated
  - No affective treatment in 1800's
  - Outbreaks typically killed thousands
- Remember, this is well before the discovery of germs (microorganisms). Civil War.



Safe Drinking Water Act

- 1914 – U.S. Public Health Service (PHS) developed first national standards
  - Bacteriological quality
  - Applied to water moving in interstate commerce (trains)

Safe Drinking Water Act

- 1946 – PHS standards also applied to planes and buses, and standards now include some chemicals
- 1962 – Last revisions to PHS drinking water standards.
  - Emphasis still on waterborne disease though some chemicals included
  - 20 standards-some just recommendations
  - Also recommended use of qualified personnel, water from protected sources, control of pollution of sources, chlorination of water from sources not adequately protected

Safe Drinking Water Act

- Dec. 2, 1970 – USEPA formed
- Dec. 1974 – Congress enacted the Safe Drinking Water Act (SDWA)
  - Set standards for 17 contaminants
- 1977 – Kentucky Division of Water received primacy over implementing SDWA
- 1986 – Congress passed major amendments to the SDWA
  - EPA to regulate 83 contaminants by 1989
  - EPA to regulate 25 new contaminants every 3 years, would have been 258 by 2010

Safe Drinking Water Act

- 1996 – Congress again passes major revisions to SDWA
  - Eliminated requirement for 25 new contaminants every 3 years
  - Standards for about 90 contaminants
  - EPA must do cost benefit analysis in setting standards
  - Expanded consumer information requirements
  - Increased protection of source water

Safe Drinking Water Act

- Cooperative Roles of USEPA, State Primacy Agency, and Local Utilities
- EPA is authorized to
  - 1. Set National Drinking Water Regulations
    2. Conduct special studies and research
    3. Oversee implementation of the Act

Safe Drinking Water Act

- Primacy agency – is responsible for the administration and enforcement of the Act
- Drinking Water Suppliers
  - Day-to-day responsibility for meeting the regulations, including
    1. Routine Monitoring
    2. Reporting results to Regulatory Agency

Clean Water Act

- Clean Water Act passed in 1972
- Cornerstone of surface water quality protection
- Governs discharges to "navigable waters"
- Codified that no right to pollute waters exists in US
- Designed to sharply reduce direct pollutant discharges into waterways, finance municipal wastewater treatment facilities, and manage polluted runoff
- Uses both a regulatory and voluntary/educational approach to achieving goals

Clean Water Act

- What does this mean for utilities....
- Sewage Treatment Plants!!!!
- Also directly impacts stormwater runoff
  - CSO's
- Focused originally on chemical aspects
- Now has shifted to addressing problems through a watershed approach and the idea of "biological integrity"

Clean Water Act

- TMDLs – Total Maximum Daily Loads
- Determine what level of pollutant load would be consistent with meeting water quality standards.
- TMDLs also allocate acceptable loads among sources of the relevant pollutants.

Clean Water Act

- **NPDES permit program**
  Covers point sources of pollution discharging into a surface water body.

- **Section 319**
  Addresses nonpoint sources of pollution, such as most farming and forestry operations, largely through grants.

Clean Water Act

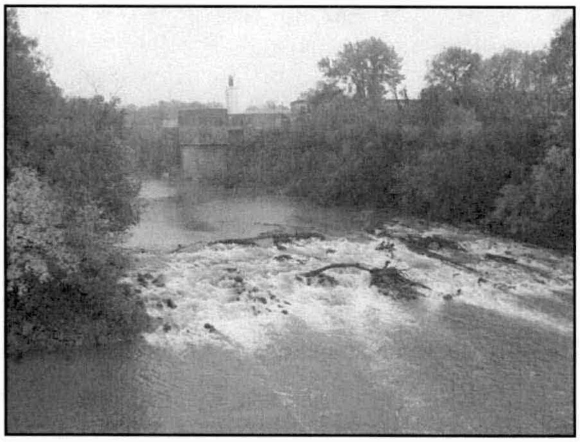
- **State Revolving Funds** (SRF)
  Provides large amounts of money in the form of loans for municipal point sources, nonpoint sources, and other activities.

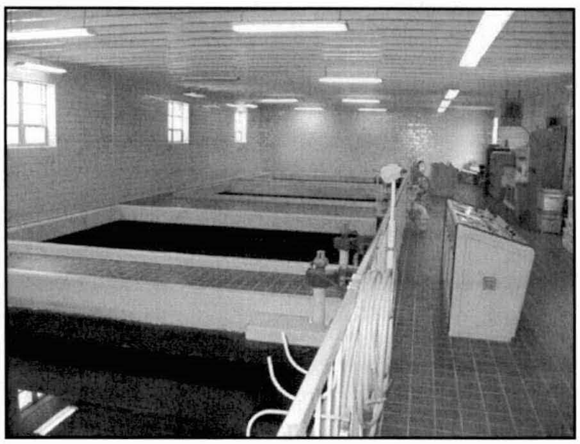
Clean Water Act and the Supreme Court

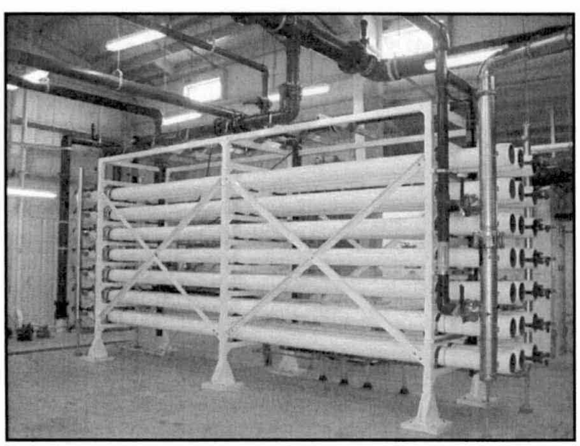
- Rapanos v. United States
- Court attempted to clarify definition of 'waters of the United States' with respect to 'navigable waters'
- USACE position, essentially, was that the language gave them limitless authority
- Court found: Isolated bodies not covered
- Clean Water Restoration Act – proposed changes to change all references to 'navigable waters' to 'waters of the United States'.

So where do they apply?

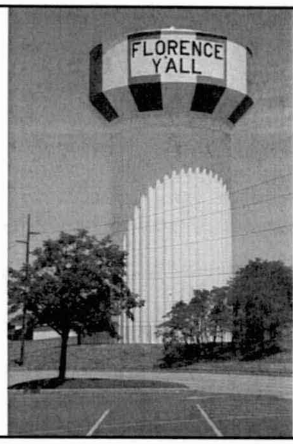
- Where does the Safe Drinking Water Act apply.
- Where does the Clean Water Act apply.

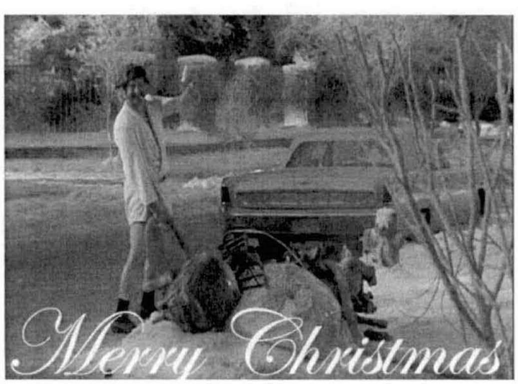







WATER


FLORENCE
Y'ALL


Merry Christmas

Broadway blocked by aging sewer collapse

Repair work wrapping up after section of street caved in Monday

JAMES BRUGGERS

Crews on Wednesday were wrapping up repairs to a collapsed sewer under East Broadway that feeds into a large, Civil War-era brick pipe that's proved troublesome in the recent past.

On Monday, a section of Broadway between First and Second streets caved-in, due to the failing sewer pipe. MSD crews have worked since then to repair the pipe and restore the area, said Steve Tedder, Metropolitan Sewer District spokesman.

The good news is that the failure was to the smaller pipe and not the much larger 90-inch diameter sewer main under Broadway dating to 1867, Tedder said.

In July 2015, a section at Floyd Street caved in during a failure of the main Broadway line, and in June 2014 a portion at Hancock Street collapsed. Each of these repairs took three weeks to repair.

MSD officials, who blame the collapses on "aging infrastructure," were unable to persuade Metro Council to pass a 20 percent rate increase this summer needed to spend $1 billion on capital improvements, including new sewer lines, flood control and drainage projects.

Cave-ins have been a problem for many years.

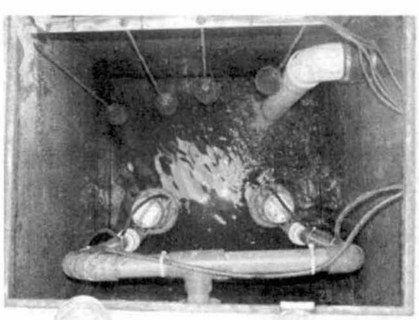
The Courier-Journal in 1989 published a feature story on MSD's aging pipes, quoting former agency executive director Gorden Garner that frequently were occurring and preventing them was impossible short of spending $1 billion to replace all the sewer and drainage pipes.

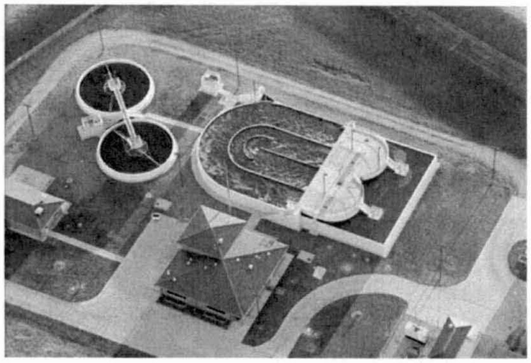
Tedder said crews will have to come back to repave the damaged section of Broadway.

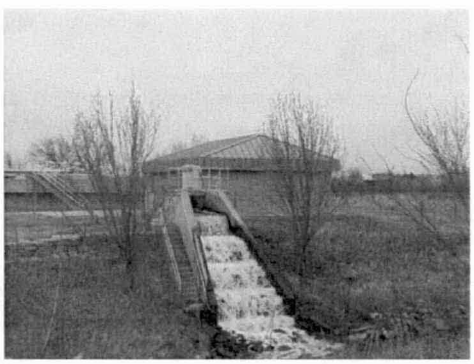
Reach reporter James Bruggers at (502) 582-4645 and at jbruggers@courier-journal.com.

PROVIDED

The brick sewer underneath Broadway dates back to 1867.

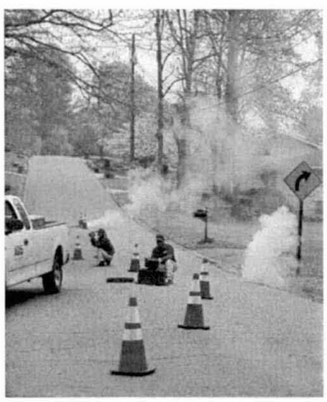


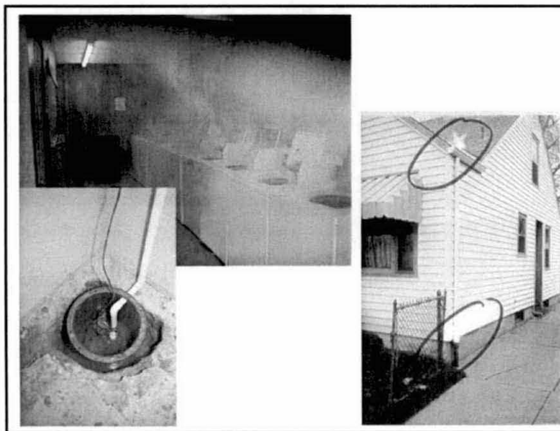


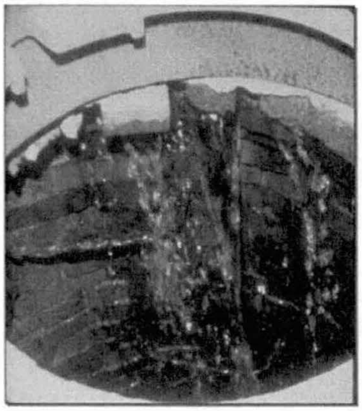


Other Places

- The Clean Water Act may impact your system in other ways.
- You don't have to be in the wastewater business to be affected by the Clean Water Act.



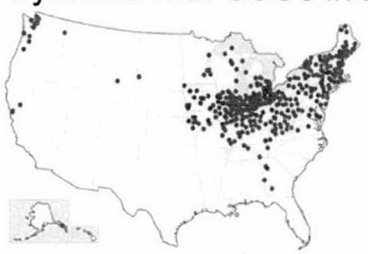




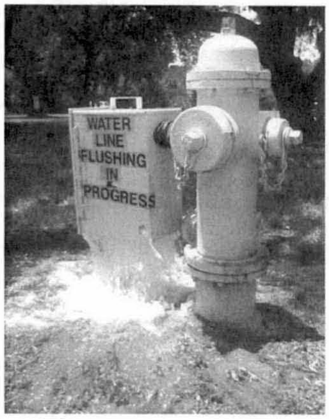

CAUTION
COMBINED SEWER OVERFLOW
Diluted Sewage May Flow Into The River
Here During And After Storms.
Avoid Bodily Contact With Water.
For More Information, Contact
The City Of Peoria
At 309 494-8801

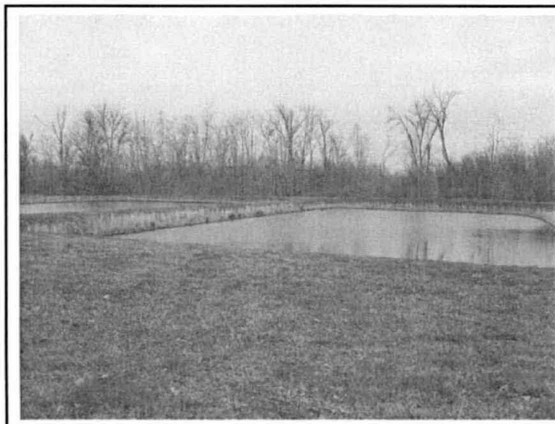

NO SWIMMING
OR WADING IN CREEK
AT ANY TIME
PER R.I.
Department Of Health

17 Systems with CSOs in KY



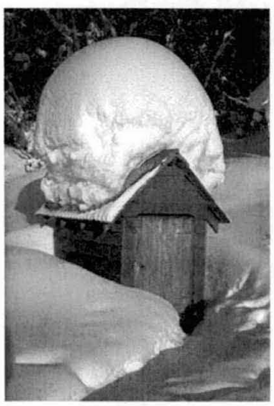
The dots on the map mark cities across our country that use combined sewer systems to transport wastwater to their treatment facilities.


WATER
LINE
FLUSHING
IN
PROGRESS



Lots of Issues!

- EPA
- DOW
- Safe Drinking Water Act
- Clean Water Act
- ETC
- ETC
- ETC
- But I still would rather have indoor plumbing……



Drinking Water Related Disease Outbreaks in the United States

Disease Outbreaks in the US

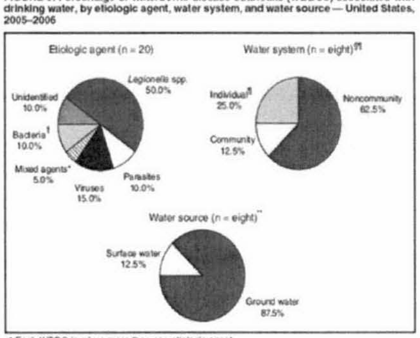
- Center for Disease Control
  - Information about diseases
  - Symptoms
  - Outbreaks
  - Reports
  - www.cdc.gov

Much of the information is geared towards healthcare professionals but can be beneficial to anyone in the water profession

FIGURE 2. Number* of waterborne-disease outbreaks associated with drinking water — United States, 2005–2006

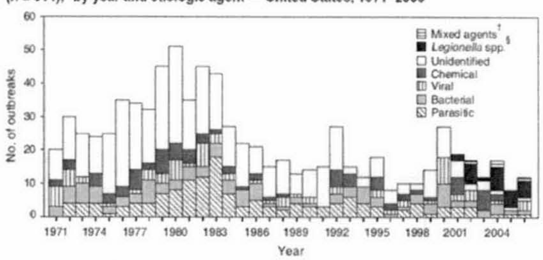
*n = 20; numbers are dependent on reporting and surveillance activities in individual states and do not necessarily indicate that more outbreaks occurred in a given state.

FIGURE 6. Percentage of waterborne-disease outbreaks (WBDOs) associated with drinking water, by etiologic agent, water system, and water source — United States, 2005–2006



* Each WBDO involves more than one etiologic agent.
† Other than *Legionella* spp.
§ Deficiencies 1–4. See Table 10.
¶ Does not include commercially bottled water, therefore, not comparable to summaries before 2003–2004.
** Deficiencies 1–3. See Table 11.

FIGURE 3. Number of waterborne-disease outbreaks associated with drinking water (n = 814),* by year and etiologic agent — United States, 1971–2006



* Single cases of disease related to drinking water (n = 16) have been removed from this figure; therefore, it is not comparable to figures in previous *Surveillance Summaries*.
† Beginning in 2003, mixed agents of more than one etiologic agent type were included in the surveillance system. However, the first observation is a previously unreported outbreak in 2002.
§ Beginning in 2001, Legionnaires' disease was added to the surveillance system, and *Legionella* species were classified separately in this figure.

Questions?

- Randall Kelley
  - Kentucky Rural Water Association
  - r.kelley@krwa.org

Organization of Water and Wastewater Utilities

Randall Kelley
Kentucky Rural Water Association

What's So Great About Kentucky...

...Water and Wastewater Utilities?

7 Contributing Factors

for

Kentucky's Water & Wastewater Utilities

to rank

Among the Best in America!

7 Contributing Factors

1

Climate/Geography

- Kentucky averages nearly 50 inches of rain each year
- Kentucky has the second most stream miles in U.S?
  (Alaska – 1st)
- Kentucky relies more on surface water than groundwater
  The only state in the U.S.

7 Contributing Factors

2

Federal Laws

- The Safe Drinking Water Act (1974)
- The Clean Water Act (1972)
- State Primacy (SDWA -1977, CWA – 1983)

7 Contributing Factors

3

State Laws & Regs

- DOW has been "out front" of most federal regulations
- KRS Chapter 74 established a framework for success!
- PSC jurisdiction has contributed to mostly-solvent utilities

7 Contributing Factors

4

Federal Funding

- USDA Rural Development in Kentucky is GREAT!!!
- Our U. S. Congressional delegation is very supportive
- Kentucky typically receives more from Washington than we pay in taxes

7 Contributing Factors

5

State Funding/Planning

- Kentucky's 20/20 Plan has led to $850 million in funding
- SB 409 led to Planning and Project Profiles
- Kentucky Infrastructure Authority reorganized

7 Contributing Factors

6

KRWA

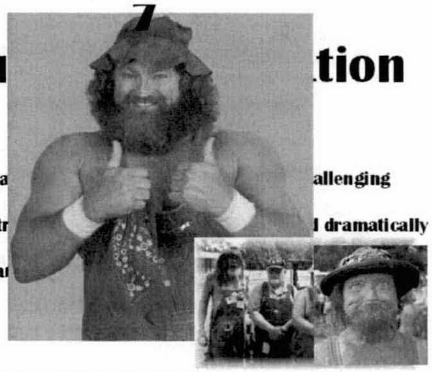
- Interim Loans -$779 Million for over 400 projects
- Flexible Term Loans - $414 Million
- Trained - 73,000
- Assisted - 75,000
- 382 Utility Management Professionals

7 Contributing Factors

Climate/Geography
Federal Laws
State Laws & Regs
Federal Funding
State Funding/Planning
KRWA
Natural Consolidation

7 Contributing Factors

Natu tion



- Surface wa allenging
- Water distr l dramatically
- We're smal

Public Water Systems

A system for the provision to the public of water for human consumption through pipes or other constructed conveyances, if such system has at least fifteen service connections or regularly serves at least twenty-five individuals.

CWS - Community Water System (serves year-round)

Examples: Municipalities, Water Districts, Water Associations, Privately-owned

TNCWS - Transient Non-Community Water System

Examples: Resorts, Restaurants, Motels, Campgrounds, State Parks

NTNCWS - Non-Transient Non-Community Water System

Examples: Schools, RV Parks, Industries, Senior Citizen Centers

Natural Consolidation
Kentucky

YEAR	TNCWS	NTNCWS	CWS	PWS	CHANGE
1974	1058	252	868	2178	
1979	805	252	755	1812	-17 %
1989	400	215	639	1254	-31 %
1999	199	85	497	781	-38 %
2009	49	26	409	484	-38 %
2017	25	15	358	398	-18 %

Wisconsin

PWS	CWS	
10,757	565	VERY SMALL
523	308	SMALL
112	104	MEDIUM
74	74	LARGE
4	4	VERY LARGE

Kentucky

398  358

PWS	CWS	
51	17	VERY SMALL
119	113	SMALL
127	127	MEDIUM
98	98	LARGE
3	3	VERY LARGE

How Much Progress Have We Made?

Pike County

Pike County Public Water Systems - 1974

Non-Transient NCWS

Transient NCWS

Community Water Systems

189
Public Water Systems

Pike County Public Water Systems - 2017

Non-Transient NCWS | Transient NCWS | Community Water Systems

CLOSED

49 Restaurants/Motels
39 Mobile Home Parks
35 Coal Mines
28 Schools
5 State/Federal Properties
4 Churches

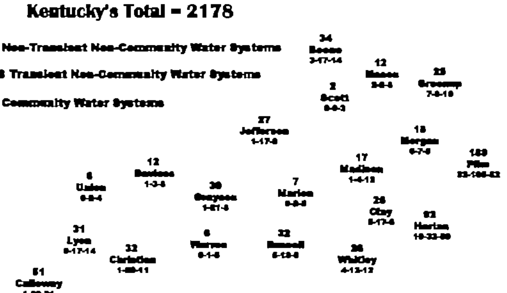
Elkhorn City
Pikeville Water & Sewer Department
Mountain Water District

3 Active Public Water Systems

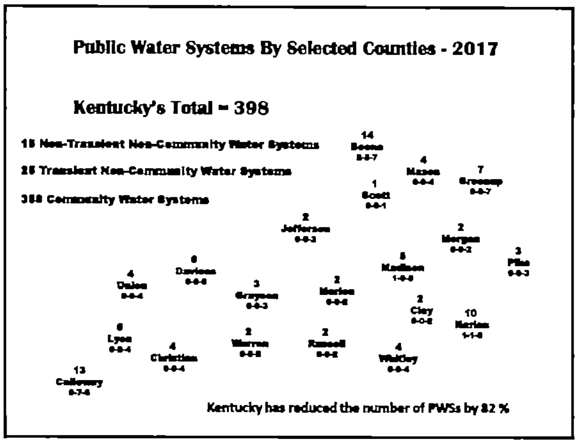
Public Water Systems By Selected Counties - 1974

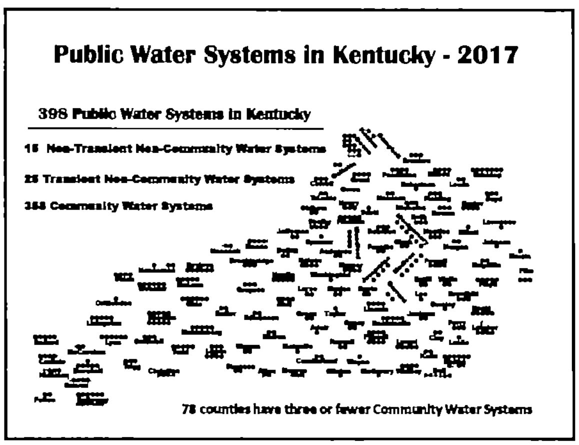
Kentucky's Total = 2178

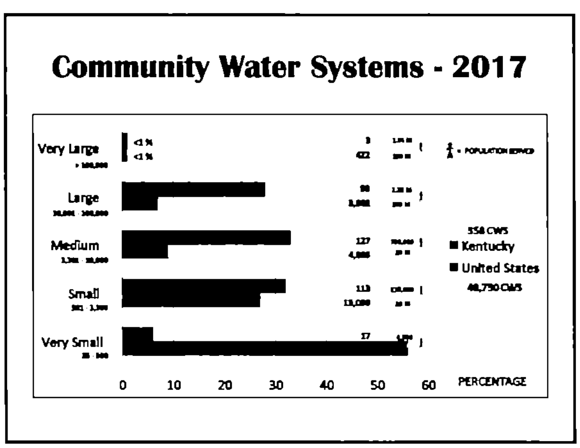
252 Non-Transient Non-Community Water Systems
1088 Transient Non-Community Water Systems
838 Community Water Systems



Source: KY Public Service Commission Tariff Library


Public Water Systems By Selected Counties - 2017
Kentucky's Total = 398
15 Non-Transient Non-Community Water Systems
25 Transient Non-Community Water Systems
358 Community Water Systems
Kentucky has reduced the number of PWSs by 82 %


Public Water Systems in Kentucky - 2017
398 Public Water Systems in Kentucky
15 Non-Transient Non-Community Water Systems
25 Transient Non-Community Water Systems
358 Community Water Systems
78 counties have three or fewer Community Water Systems


Community Water Systems - 2017
Very Large
Large
Medium
Small
Very Small
0
10
20
30
40
50
60
PERCENTAGE
358 CWS
Kentucky
United States

Percentage Served in Kentucky

• Average Population Served	95.4%
• 103 out of 120 Counties	> 90% Serviceable
• Only 5 Counties	< 75% Serviceable

Least Served Counties

Hickman	38.6%	1,891 out of 4,902 people
Carlisle	39.6%	1,921 out of 5,104 people
Ballard	48.1%	3,859 out of 8,249 people
Calloway	67.5%	25,694 out of 37,191 people
Graves	68.7%	25,174 out of 37,121 people

All five counties are in the Purchase Region where groundwater is abundant.

Average Residential Water Rates - 2015

Water Districts & Associations by Area Development District

(Based on actual average usage of 4193 gallons)

Kentucky	***$35***
Western	**$31**
Central	**$33**
Bluegrass	**$38**
Northern	**$37**
Eastern	**$37**

NK $38
BT $36
FI $49
KI $35
GA $37
BS $37
LT $31
BG $38
KR $34
GR $32
PE $37
BR $33
LC $34
CV $35
PU $24

Source: KY Public Service Commission Tariff Library

Water Rate Comparisons - 2015

	5,000 gallons		
	Average	Median	Outside
All Cities (188)	$32	$31	$41
Small Cities (90) (under 1,000)	$37	$36	$48
Medium Cities (53) (1,000 – 4,000)	$31	$29	$40
Large Cities (43) (over 4,000)	$25	$23	$33
Water Districts/Associations (134)	$42	$41	-
All Utilities (322)	$36	$35	-

Sources: KIA, KRWA, Cannon & Cannon

Sewer Rate Comparisons - 2015

	5,000 gallons		
	Average	Median	Outside
All Cities (203)	$35	$33	$41
Small Cities (122) (under 1,000)	$37	$36	$44
Medium Cities (41) (1,001- 2,799)	$32	$31	$39
Large Cities (40) (over 2,800)	$31	$29	$41
Other Utilities (89)	$37	$35	
All Utilities (292)	$35	$34	

Source: KIA, KRWA, Cannon & Cannon Survey

Internal Operations Within a Utility

Effective Management for Utility Boards and Managers

"The problem with communication...is the illusion that it has been accomplished."

George Bernard Shaw

Board and Manager

Effective Communication is a Two-way Street!

Board > Management

Management > Board

Board and Manager

Is this how your Manager feels?

Board and Manager

Board member! Is this how you feel?

Board and Manager

A Good Board…

...hires an effective Manager.

Board and Manager

A Good Board...

- Seeks to Understand the "Big Picture"
- Sets and Approves Reasonable Policies
- Reviews and Follows Policies!

- Gives Manager Direction and Flexibility
- Fairly Evaluates the Manager
- Doesn't Micro-manage!

Board and Manager

A Good Manager...

...develops an <u>effective</u> Board.

How?

Board and Manager

A Good Manager...

- Provides Accurate Information to the Board
- Helps Board Set Reasonable Policies
- Implements and Follows Policies!

- Employs and Directs the Staff
- Is Professional in all Relationships
- Doesn't Micro-manage!

Board and Manager

Board Policies

- Budgets (Operating & Capital)
- Personnel
- Compensation & Classification
- Purchasing
- Investment
- Rates and Charges
- Customer Service

Board and Manager

Budgets

- Budgets are the Board's ultimate policy tool – no activity can legally be accomplished without budget authorization from the Board.

Board and Manager

Budgets

- Budgets should be prepared by Management with Staff input and Board oversight and approval.
- Budget Committee?

Board and Manager

Budgets

- Budgets are not chiseled in stone – they should be flexibly-followed.

  If conditions warrant change, amend the budget!

Board and Manager

Budgets

- A Capital Budget is a longer-term plan for improvements and additions to the utilities infrastructure.
- 3 years? 5 years? 10 years? 20 years?

Board and Manager

Personnel

- Personnel Policies (including Classification & Compensation Plans) are a Manager's most important Policy tool!

Board and Manager

Personnel

- Personnel Policies should be developed with significant input from the Board, Management, and Staff.
- They should always be reviewed by an attorney with experience in personnel and labor laws.

Board and Manager

Purchasing

- Consider adopting the Kentucky Model Procurement Code (KRS Chapter 45A).
- Establish a Small Purchases Policy and set minimum threshold amounts.

Board and Manager

Investments

- Adopt a written Investment Policy that establishes how, when and where surplus funds are invested.

Board and Manager

Rates and Charges

- Adopt cost-based rates and charges.
- Review rates and rate structures periodically.
- Keep your customers informed.

Board and Manager

Customer Service

- Keep your customers informed!
- Keep your customers informed!!
- Keep your customers informed!!!

Board and Manager

Customer Service

- Develop a customer-first approach.
  - New-Customer Package
  - Public Relations and Promotion
  - Stress Customer-Friendliness
- If you make doing business easy for your customer, you make doing business easier!

Board and Manager

Board Reports

- What does the Board want to see?
- What does the Board need to see?
  - Technical Reports?
  - Financial Reports?
  - Management Reports?

Board and Manager

DRINKING WATER ENFORCEMENT

Presented by
Randall Kelley
Kentucky Rural Water Association

ERP/ETT

- ERP – Enforcement Response Policy
- ETT – Enforcement Targeting Tool

- Focus on RTC (return to compliance)
- Looks at all violations incurred by system
- Policy & tool identify priority systems for enforcement response, provide a model to escalate responses to violations; define timely and appropriate actions and clarify what constitutes a formal action.

Enforcement Targeting Formula

- Calculates a score for each water system based on open ended violations over the past 5 years but does not include those that have RTC or on the 'path to compliance' through a specified enforcement actions.
- Formula only considers violations for Federally-regulated contaminants.
- In Kentucky it is the agreed order through the Division of Enforcement.

Enforcement Targeting Formula

- Factors:
  - o Violation severity factor
    - 10 points for each health-based violation
    - 5 points for other health –based violations and Total Coliform Rule (TCR) repeat monitoring violation and for each Nitrate monitoring and reporting violation.
    - 1 point for other monitoring and reporting violations or any other violation
  - o Number of years system violations have not been addressed from 0 to 5.

Next Step of Enforcement

- Once a system hits 11 points, Kentucky Division of Water refers the system to Division of Enforcement (DENF) for formal action.
- DENF will require an administrative conference to discuss the violations (will go back to the last agreed order or all violations even if they have been returned to compliance within last 5 years).

Next Step of Enforcement

- Penalty and content of a draft agreed order will be discussed.
- Penalty and number of days in draft agreed order is a negation process similar to purchasing a house or vehicle.
- Each violation will be discussed and required follow-up actions.

Next Step of Enforcement

Stage 2 Agreed Order requires

- System to determine where DBPs are forming in water plant.
  - Consider Step 2 alternative Total Organic Carbon (TOC) removal process.
  - If DBPs are formed in the plant, optimize coagulation process (including pH adjustment) tor remove additional TOC.

Next Step of Enforcement

Stage 2 requires

- Evaluate the pre-disinfection practices; determine if the point of pre-chlorination can be moved and still maintain adequate concentration contact time (CT inactivation)

phone: 270-843-2291 Kentucky Rural Water Association www.krwa.org

Next Step of Enforcement

Stage 2 requires

- System to determine where DBPs are forming in distribution system by conducting DBP monitoring in distribution system and at the master meter. A monitoring schedule and initial data collection are being required to be submitted to DENF within a specified number of days after execution of the Agreed Order.

Next Step of Enforcement

Stage 2 requires

- Look at
  - If booster chlorination is practice, evaluate if it contributes to DBPs
  - Evaluate tank turnover and system hydraulics to decrease water age
  - Consider benefits of a DPB PBT or a system hydraulic analysis

Next Step of Enforcement

Stage 2 requires

- Develop a corrective action plan detailing steps taken and that will be taken to return system to and maintain compliance.
- CAP shall include timeline for completing corrective actions and date anticipating to return to compliance for 4 consecutive quarters.
- CAP will be submitted within a specified number of days after execution of the Agreed Order and will be reviewed by DOW.

Next Step of Enforcement

Stage 2 requires

- Quarterly reports will be required to be submitted.
- Must include updates for items contained in corrective action plan.

Penalties

- Most likely you will be have a civil penalty of no less than 4 figures if treatment facility. Purchasing systems have not been assessed a civil penalty.
- Stipulated penalties will be assessed for when a system fails to comply with any part of the agreed order.

General Information

- Administrative conference held in Frankfort.
- If you take an attorney, you must let DENF know ahead of time so that they have at least one attorney there as well.
    - o Otherwise you will make a trip to Frankfort for nothing or attorney asked to not attend.
- DENF has conducted some meetings by conference call.

Drinking Water Watch

Use this website to check your systems information such as contact information, population, sampling schedules, sample results, violations, etc…

https://dep.gateway.ky.gov/DWW/

Questions?

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Session 5: Lessons Learned for Drinking Water and Wastewater Systems from Flint, Michigan

There was no PowerPoint for this session. Instructor held an open discussion of the events in Flint, Michigan, how they relate to utilities in Kentucky, events leading up to the crisis, and the lessons to be learned to avoid such a disaster within a utility.

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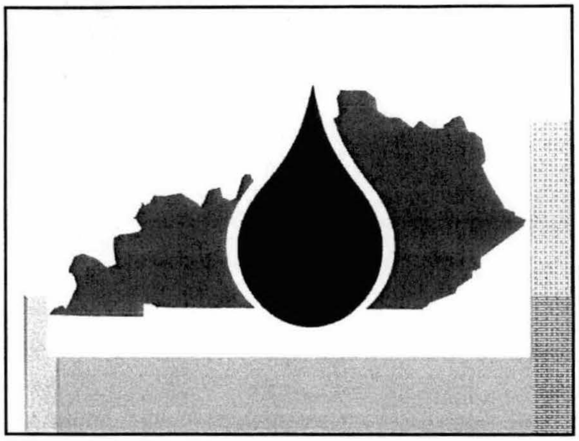
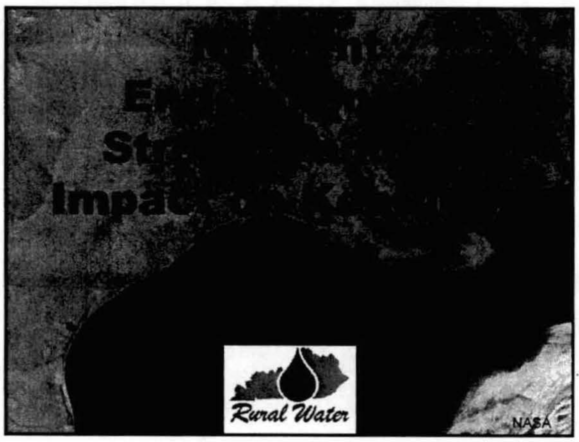
Session 6: Nutrient Enrichment of Streams and Its Impact on Kentucky Utilities





The Gulf of Mexico????

- I am sitting in the middle of Kentucky, why are we talking about the Gulf of Mexico?
- Destin FL?
- The beach?
- Deep sea fishing?

Gulf Hypoxia??

- What is that???
- Is it a new disease?
- Do I get it from lying on the beach too long?

Gulf Hypoxia

- 'Gulf Hypoxia' describes a condition affecting a large area in the Gulf of Mexico along the Louisiana and Texas coastlines.
- Area that has severely reduced levels of D.O.
- Primary cause is pollution coming from the Mississippi River.

Gulf Hypoxia

- Often described as a "Dead Zone"
- Area where D.O. is too low to support life
  - Fish leave
  - Fish eggs, larvae die off
  - Other organisms die out
- Hypoxic zone has been the size of New Jersey and Massachusetts in previous years.

Gulf Hypoxia

- What pollutants?
- Nitrogen: considered the primary cause
  - Gulf waters are nitrogen limited
- Phosphorous: less of a problem, but a bigger problem than previously thought

Gulf Hypoxia

- Seasonal
  - Begins in late spring
  - Fullest extent in late summer
  - Disappears in late fall

What Happens?

- Nitrogen and Phosphorous occur naturally in our streams and rivers
- Comes from soils, bedrock, decaying plants, leaf litter, the atmosphere etc.
- It also occurs naturally in the ocean as well
- Crucial to the growth of algae and aquatic vegetation
- Foundation of the food web

What Happens?

- Why then are Nitrogen and Phosphorous considered pollution?
- Problems begin when too much nitrogen and phosphorous get into aquatic and marine environments
- Promotes increased algae growth
  - Sounds like a good thing!
  - More food for aquatic organisms!
  - So what's the problem?

What Happens?

- Nutrient enrichment, 'eutrophication'
- Too much promotes an overabundance of algae
- Can promote the growth of the 'wrong' kind of algae
  - Difficult to eat
  - Toxins
- All that algae has to go somewhere
  - Dies and decays

What Happens?

- Little streams flow into larger and larger streams
- Pick up more pollutants along the way
- Flow leads to the Mississippi River
- Eventually flows to the Gulf of Mexico

What Happens?

- Much of the nitrogen and phosphorous that ends up in big rivers flows to the Gulf
- Big rivers remove little of the phosphorous and nitrogen
- Tend to have high turbidity
- Little light for algae growth

What Happens?

- Nutrients end up in the Gulf.
- Prevailing currents in the Gulf move water towards Louisiana and Texas coasts
- Unlike the large rivers, Gulf water is clear, plenty of light
- Promotes excess algae growth near the surface

What happens?

- Algae eventually dies off and settles to the bottom and decays
- Dramatically increases BOD!
- Depletes D.O., especially on the bottom
- Gulf naturally around 5.0 mg/l D.O.
- Hypoxic area is 2.0 – 0 mg/l D.O.

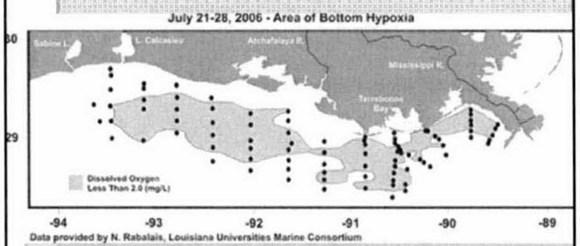
Leads to....

- Mobile organisms leave/avoid the area
- Less mobile organisms are stressed
  - Reduced reproduction
  - Eggs, young may die before maturity
  - Shrimp, clams, oysters, etc
- Dramatically affects the multi-billion dollar commercial and sport fishing industry

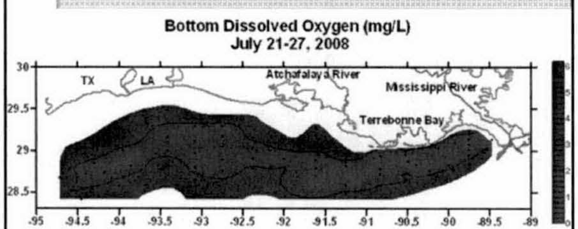
Leads to....

- The result has been described as a 'dead zone''
- Little or no life in the area
- Has increased over the years to 7000-8000 sq. mi.
- Size of New Jersey and Massachusetts
- 2nd largest hypoxic zone in the world
  - Largest is in the Baltic Sea

USEPA



Louisiana Universities Marine Consortium

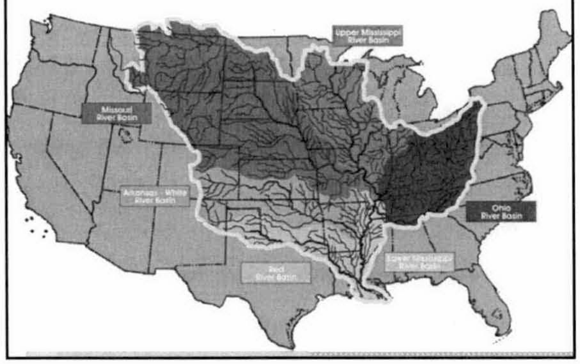


Map of bottom water oxygen levels in mg/L (or ppm). Black line is less than 2 = Hypoxia. Data source: N. Rabalais, Louisiana Universities Marine Consortium, map by B. Babin.

Where is it coming from?

- The Mississippi River drains 41% of the Continental United States
- 1,245,000 sq miles
- 3rd largest river basin in the world
  - Amazon in South America
  - Congo in Africa
- Drains all or part of 31 states and 2 Canadian provinces

Mississippi River Basin



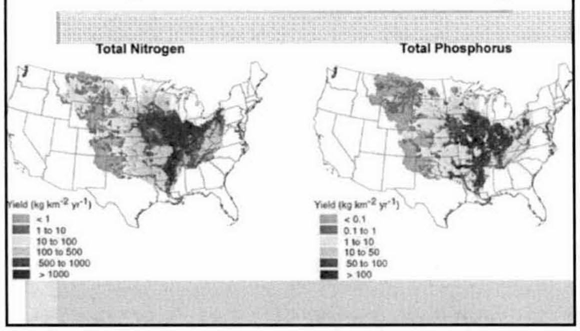
Where is it coming from?

- Some states drain entirely to Mississippi
  - Kentucky, Iowa, Kansas, Arkansas
- Some only a portion
  - Texas, New York, Ohio, New Mexico
- Differences between states
  - Populations, rural vs. urban
- Agricultural differences
  - Corn vs. Soybeans vs. Wheat etc.
  - Pasture vs. row crops

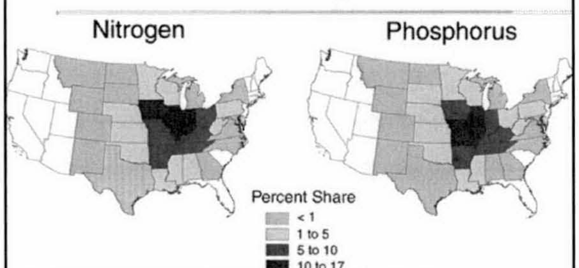
USGS Report

- USGS released a report accounting for each state's contribution
  - Nitrogen
  - Phosphorous
- Results questioned but the report is public now

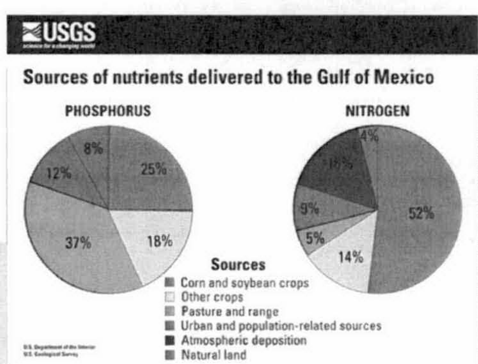
Sources of Nitrogen and Phosphorous. USGS map



Sources broken down by state. USGS map.



Sources broken down by type.



Share of the nutrient flux (mass per time) delivered to the Gulf of Mexico from States in the Mississippi and Atchafalaya River Basins.

(Note: The States are listed in descending order of their percentage contribution to the total nutrient flux delivered to the Gulf of Mexico.)

Total Nitrogen				Total Phosphorus			
State	Percent of Total Flux	Cumulative Percent of Total Flux	Delivered Yield (kg km^{-2} yr^{-1})	State	Percent of Total Flux	Cumulative Percent of Total Flux	Delivered Yield (kg km^{-2} yr^{-1})
Illinois	16.8	16.8	1734.9	Illinois	12.9	12.9	117.4
Iowa	11.3	28.1	1547.2	Missouri	12.1	25.0	89.4
Indiana	10.1	38.2	1806.6	Iowa	9.8	34.8	89.2
Missouri	9.6	47.8	800.5	Arkansas	9.6	44.4	94.6
Arkansas	6.9	54.7	750.1	Kentucky	9.0	53.4	113.4
Kentucky	6.1	60.8	879.5	Indiana	8.4	61.8	132.3
Tennessee	5.5	66.3	757.2	Tennessee	5.3	67.1	81.9
Ohio	5.4	71.7	1082.3	Mississippi	4.4	71.5	101.6
Mississippi	3.4	75.1	863.5	Ohio	4.1	75.6	72.1
Nebraska	3.2	78.3	244.6	Oklahoma	3.3	78.9	24.3
Kansas	3.1	81.4	221.7	Nebraska	3.3	82.2	21.9
Minnesota	2.9	84.3	340.7	Kansas	2.6	84.8	18.2
Wisconsin	2.7	87.0	406.8	Louisiana	2.4	87.2	67.4
Oklahoma	2.5	89.5	206.1	Wisconsin	2.4	89.6	31.7
Pennsylvania	1.9	91.4	705.0	West Virginia	2.1	91.7	52.3
West Virginia	1.8	93.2	905.9	Minnesota	2.0	93.7	20.1
Louisiana	1.7	94.9	513.0	Pennsylvania	1.9	95.6	61.9
Alabama	1.1	96.0	925.6	South Dakota	1.6	97.2	11.0
South Dakota	0.9	96.9	72.0	Alabama	0.9	98.1	72.7
North Carolina	0.6	97.5	534.2	Texas	0.7	98.8	8.3
Texas	0.6	98.1	80.9	Virginia	0.4	99.2	31.0
Virginia	0.5	98.6	377.7	New York	0.2	99.4	36.0
Montana	0.4	99.0	20.3	North Carolina	0.2	99.6	13.2
North Dakota	0.2	99.2	34.6	Colorado	0.2	99.8	2.1
New York	0.2	99.4	634.7	North Dakota	0.1	99.9	1.2
Georgia	0.2	99.6	590.1	Montana	0.1	100.0	0.2
Wyoming	0.1	99.7	11.7	Georgia	0.1	100.0	36.5
Colorado	0.1	99.8	8.0	Maryland	<0.1	100.0	37.5
Maryland	<0.1	99.9	640.9	Michigan	<0.1	100.0	1.2
Michigan	<0.1	100.0	61.0	Wyoming	<0.1	100.0	0.2
New Mexico	<0.1	100.0	0.1	New Mexico	<0.1	100.0	<0.1

Kentucky's Role

- 6.1% of Nitrogen
  - 6th largest contributor
- 9.0% of Phosphorous
  - 5th largest contributor
- KDOW has initially disputed this

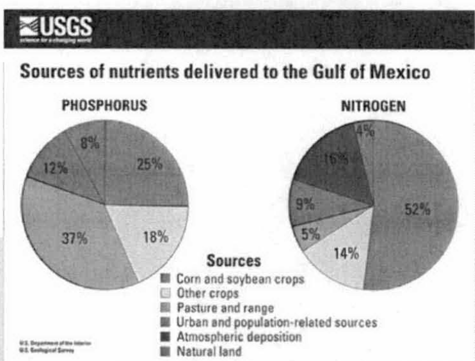
Back to the Utilities

- Gulf hypoxia is partly responsible for phosphorous and nitrogen regs
- Wastewater
  - Phosphorous: 1 ppm
  - Nitrogen: depends on receiving stream
- Why the new regulations?
  - Not directly toxic (like ammonia)
  - Not directly harmful (like low D.O.)
  - WHY NOW?

Back to the Utilities

- Are wastewater utilities a big contributor?
- Not really.
  - Not specified, lumped in with urban and population related sources
  - Quite small compared to agricultural sources

Sources broken down by type.



Back to the Utilities

- So why the new wastewater regulations
- USEPA attempting to limit nutrient inputs
- Point sources
  - Pipes, specific sources
- Non-point source
  - Runoff for streets, fields

Back to the Utilities

- Point sources easier to regulate
  - Technically easier, regulations in place
  - Politically easier
- Non-point sources are difficult
  - Difficult to determine how much is coming from one field or another
  - Politically more difficult
  - Nonetheless, it is an increasing area of interest.

Back to the Utilities

- Nutrient enrichment in rivers also affects water treatment
- Increased algae lead to increased carbon (TOC) in streams
- HABs!! An issue that is getting more and more attention
- Affects raw water quality
- Potentially affecting, TOC, THM and HAA5 levels.

Harmful Algal Blooms in the Ohio Rivers, others

Conclusion

- Nutrient enrichment dramatically impacts rivers as well as the Gulf of Mexico
- Nutrients affect source water quality at water treatment plants
- Excess algae growth may increase THM and HAA 5 production

Conclusion

- Reducing nitrogen and phosphorous improves water quality
- Improved raw water quality at water treatment plants
- Wastewater plants are not the major contributors
- Gulf Hypoxia may be the impetus for more Federal regulations.

Questions??

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