

# 2003 - Effluent heads toward wells

Study finds pollutants in city's aquifer

By DAVE MOORE of the Tribune's staff  
Published Monday, December 22, 2003

*"When the city spent \$9.5 million to build wetlands in the low-lying lands of McBaine in the early 1990s, John O'Connor wasn't convinced it was a good idea to pump treated wastewater into the ground near the city's water wells."*

*"A study released by the U.S. Geological Survey last week seems to confirm his suspicion."*



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# 2003 - City's Response to Report

“Columbia City Manager Ray Beck said he hadn't read the USGS report, but he said the report won't prompt the City to discontinue use of the wetlands and to pump the treated effluent directly to the river.”

*“We have an excellent water treatment operation out there right now,” he said.*

*“I think our water supply is very safe. Our goal is to monitor it.”*



# 2004 - Monitoring Wells Elevated in Chlorides

## Well monitors leave aquifer untested

Col. DAILY TRIB. 1/12/04

By DAVE MOORE  
of the Tribune's staff

Think of Columbia's water source as a large orange drink, and residents are drawing from a straw that pulls from 100 feet down.

But Columbians are a thirsty lot — they tug hard on the anecdotal straw and, as a result, also pull water from a wetland that is moistened by the city's sewer effluent and Missouri River water.

The good news is that, so far, readings from monitoring wells indicate only harmless byproducts of sewerage treatment — sodium, chloride and sulfates — are making their way toward the city's water supply near McBaine.

The bad news is that most monitoring wells are only 30 to 40 feet underground. Fourth Ward Councilman Jim Loveless and water-quality professionals agree the groundwater needs to be tracked more closely to protect the city's water supply.

A contract between the state United States Geological Survey, or USGS, and the city approved last Monday by the Columbia City Council extends the agency's contract for monitoring existing wells.

A report released by the USGS in December confirmed the worries voiced

### City insists water supply safe despite wetlands.

by drinking-water-quality advocates that pumping treated effluent onto wetlands near the city's wells might jeopardize the water supply. The report said harmless elements found in effluent — such as chlorides found in urine — are moving from the state-run Eagle Bluffs Wetlands Conservation Area toward the well fields.

Study author Brenda Smith said this morning that, though monitoring wells between the city's wetlands and well fields measure higher groundwater levels than normal, there are too many variables to tell whether water from the wetlands is heading toward the well fields.

While the report doesn't say the city's drinking water supply is in jeopardy, it has reawakened arguments from the early 1990s that the city should be wary about pumping effluent and river water toward its well fields.

"You want to have an early warning parameter that you monitor, to give you an idea if" harmful elements are heading toward the well fields, said John O'Connor. O'Connor is the retired chairman of the University of Missouri-Columbia civil engineering department and past chief of the Illinois State Water Survey. He has

about 48 years experience in the field.

Though wetlands are recognized widely for their ability to remove nitrogen and phosphorus from water, O'Connor said, their abilities to remove other contaminants sometimes found in effluent — such as ibuprofen, caffeine and ephedrine — have not been proved. The city does not check its treated water supply for such contaminants. More detailed groundwater monitoring would more effectively protect the water supply, O'Connor said.

Loveless, who is a wildlife management biologist with the Missouri Department of Conservation at Eagle Bluffs, said he believes little if any surface water makes its way from the wetlands into the aquifer because of the prevalence of clay throughout the area.

Loveless said studies have indicated much of the water filters through the wetlands, then flows directly to nearby Perche Creek.

"I drink the water, too," Loveless said. "I'm not worried that we're jeopardizing our water quality. I don't see it in the studies that have been done."

But, he added, "One of my concerns about" the USGS studies "is that they

don't give us information about what's going on down at the aquifer level."

A group of city and state employees was appointed to formulate a new procedure of how groundwater should be monitored, Loveless said.

But a former member of the group, Larry Vangilder, said the process hasn't progressed because of turnover at the state Department of Conservation.

Normally, the city pumps its effluent into its clay-lined wetlands to the northeast and east of the city's well fields, and that water is blended with river water and pumped to the Eagle Bluffs wetlands, which aren't clay-lined and are south of the well fields.

One option the state and city have is pumping the treated effluent from the city wetlands into a ditch that flows to the Missouri River.

But the city won't exercise that option yet, City Manager Ray Beck said.

"If we ever see a problem of any significance, we can divert to the river," Beck said. "My only concern is that I don't want to create any concern of our residents about" the safety of Columbia's water supply, he said.

Reach Dave Moore at (573) 815-1708  
or dmoore@tribmail.com.

# 2004 - Well monitors leave aquifer untested

Columbia Daily Tribune, Jan. 12, 2004

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# 2007 - Drinking Water Fails TTHM Standard

2007 (May): Columbia's water supply starts to exceed USEPA Maximum Contaminant Level for Total Trihalomethanes (TTHM)

2008 (April): MDNR issues Notice of Violation.

USEPA MCL for TTHM: 80  $\mu\text{g/l}$  as  $\text{CHCl}_3$

Columbia's four quarter average: 82.3  $\mu\text{g/l}$  as  $\text{CHCl}_3$

# Formation of Disinfection By-Products

DBPs formed from reactions between Natural Organic Matter (humic, fulvic acids) in source water and added disinfectant (e.g., Chlorine).

DBPs regulated by USEPA to reduce risks of:  
cancer, liver and kidney damage,  
reproductive problems.

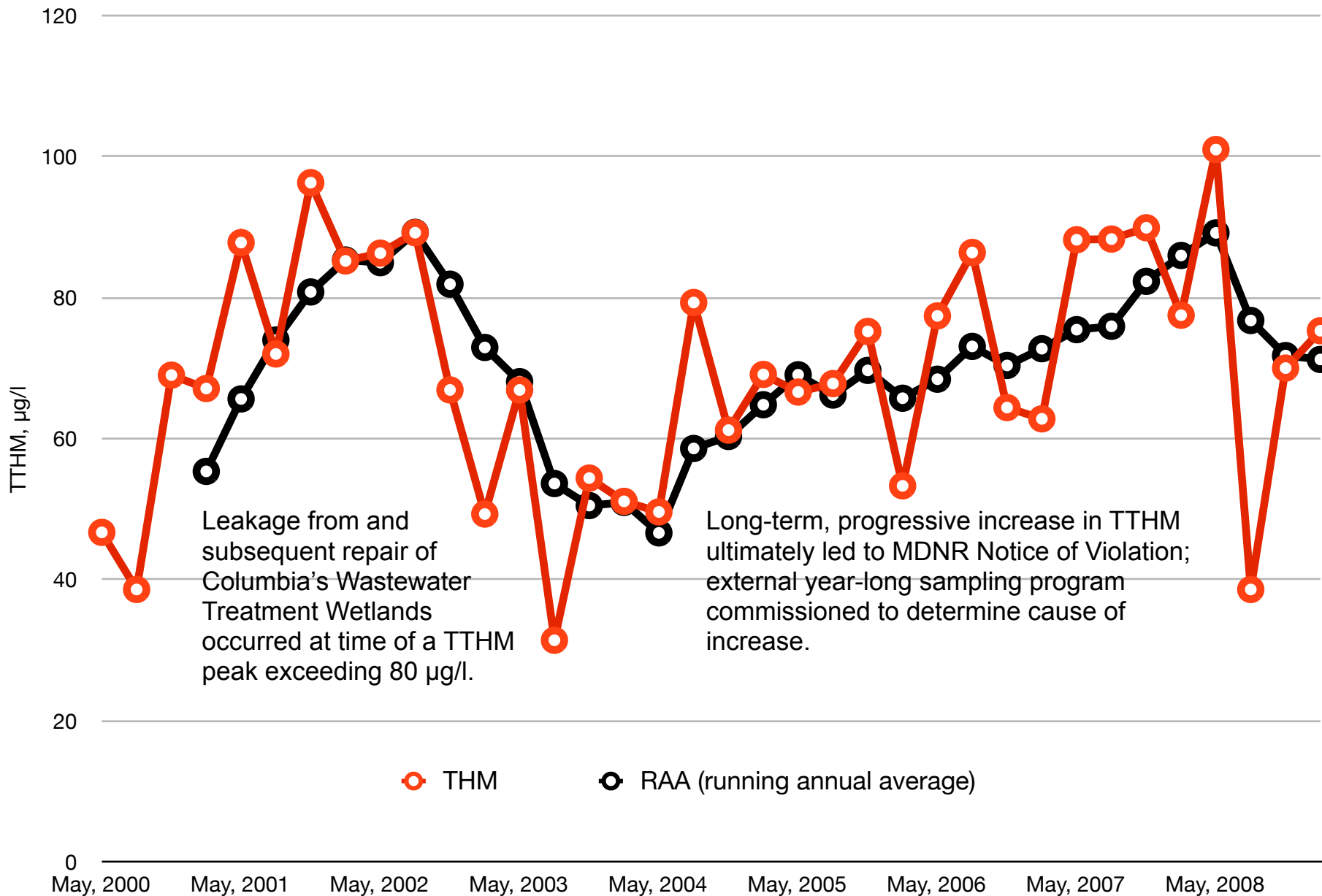
Maximum Contaminant Levels (MCL) have been set for:

Total Trihalomethanes = 80 µg/l  
Haloacetic Acids = 60 µg/l

DBPs may form very slowly (hours or days), depending on:

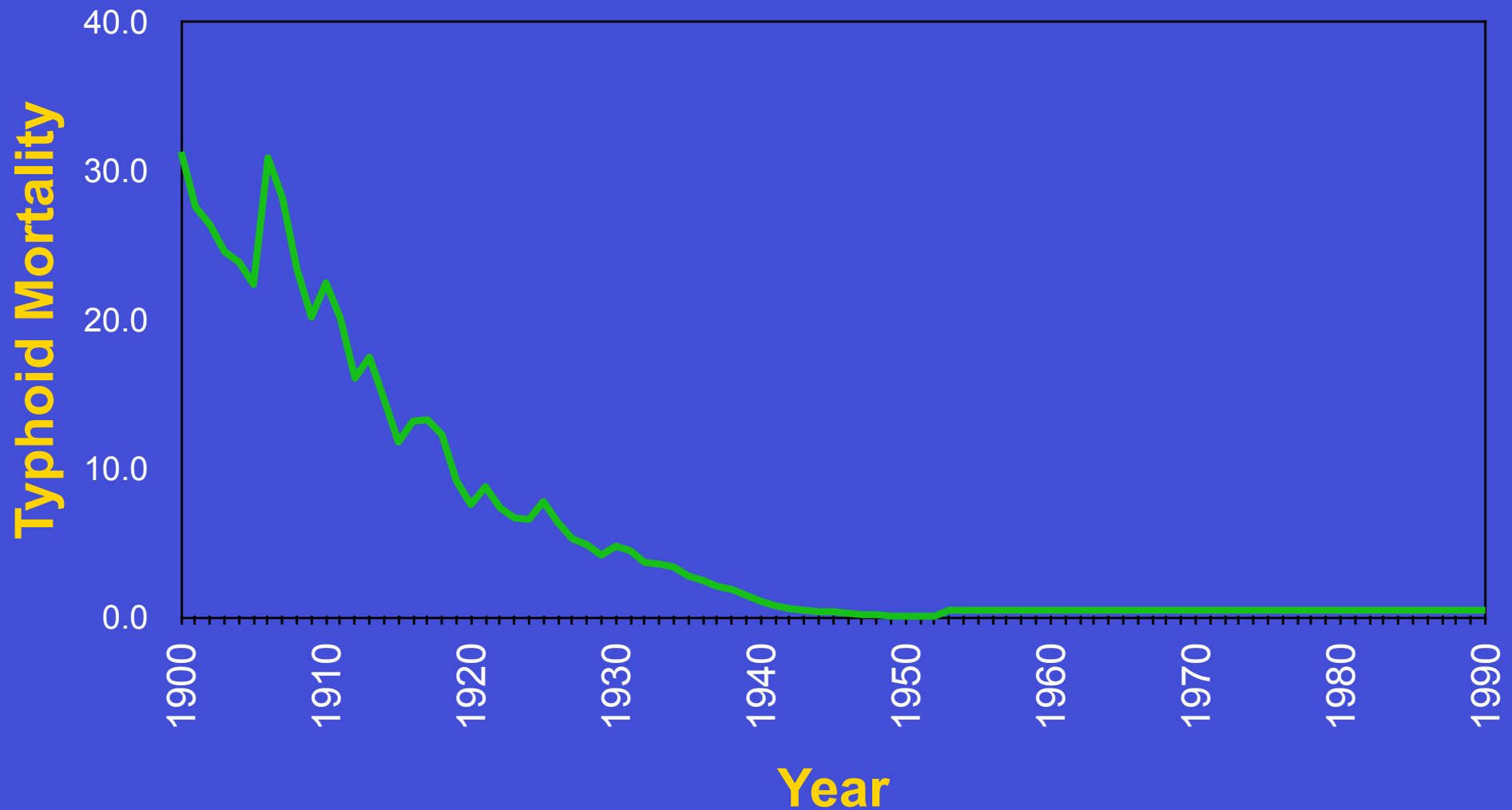
Concentration of NOM in source water  
Amount of chlorine applied  
Water temperature

## City of Columbia Total Trihalomethanes



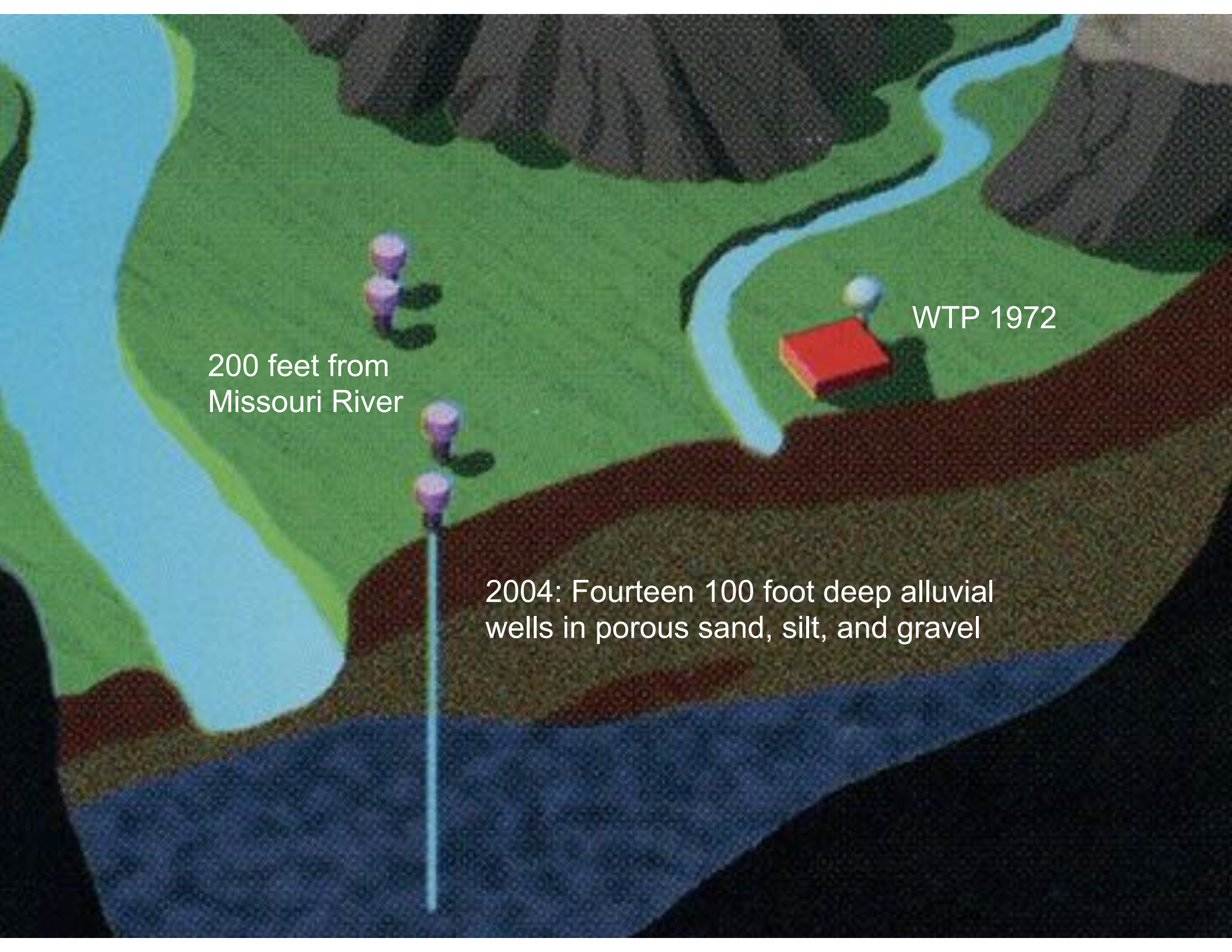
# History of Chlorination in the U.S.

## Typhoid and Cholera Deaths Per 100,000 People



# Columbia Water Treatment Plant - Mc Baine





200 feet from  
Missouri River

WTP 1972

2004: Fourteen 100 foot deep alluvial  
wells in porous sand, silt, and gravel

# Potential Sources of Organic Contaminants

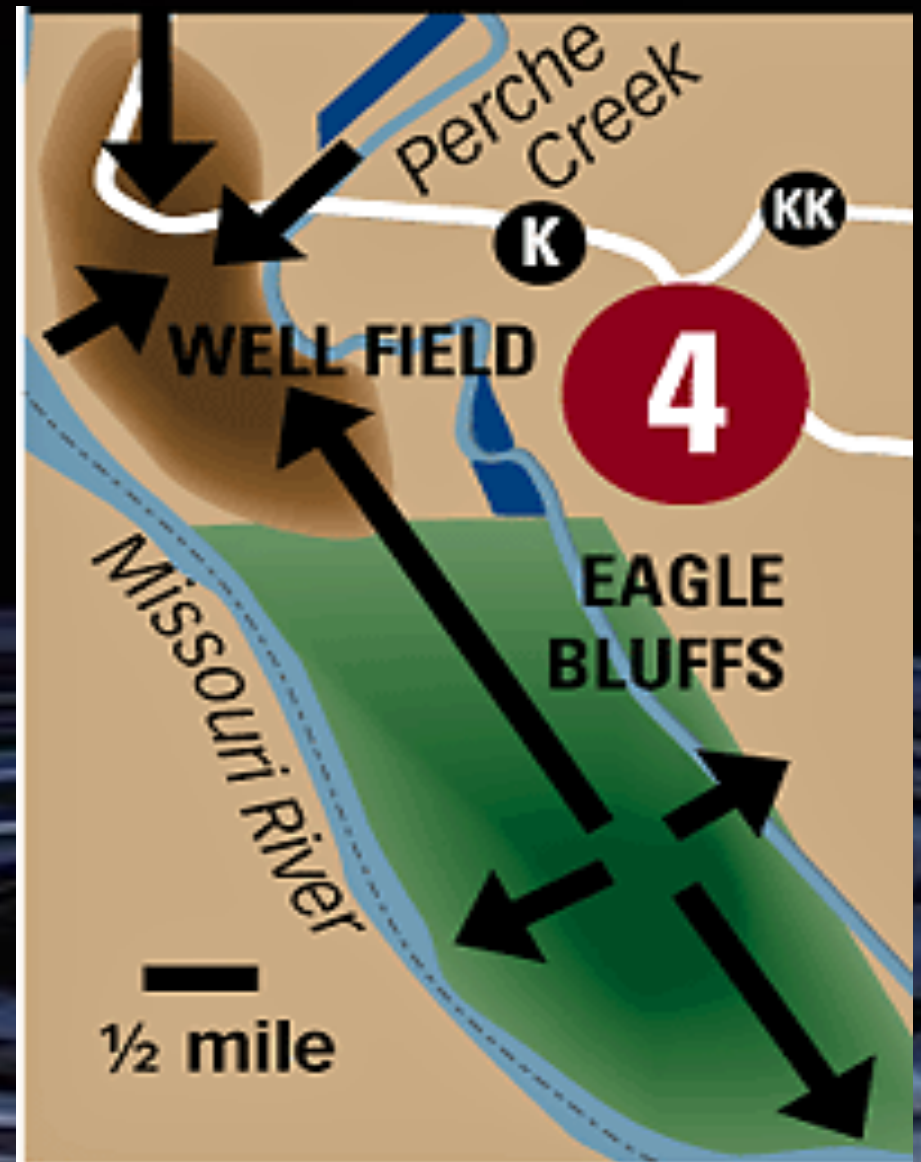
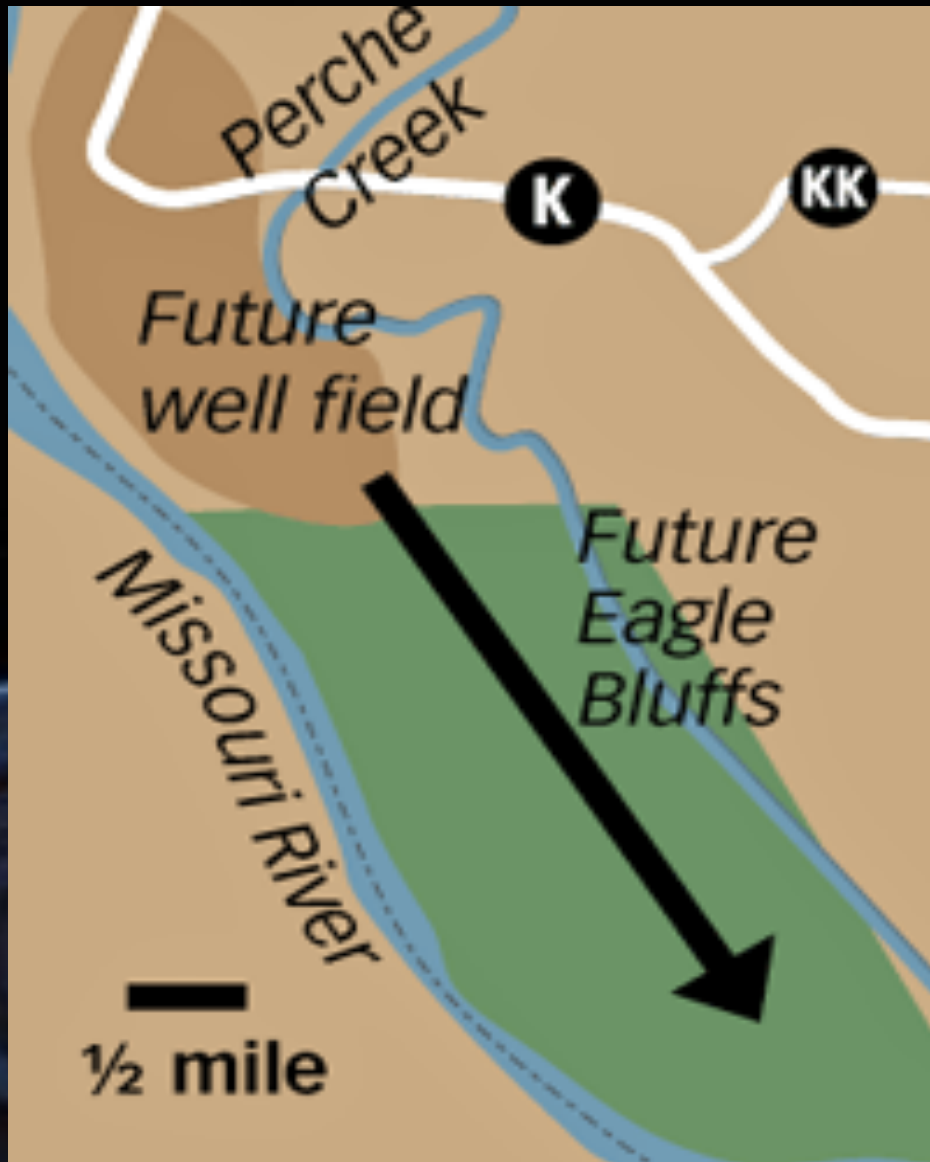


## Department of Conservation Wetlands:

1,300 acres of unlined wetlands receive effluent from Columbia Wastewater Treatment Wetlands



# Changes in Groundwater Flow

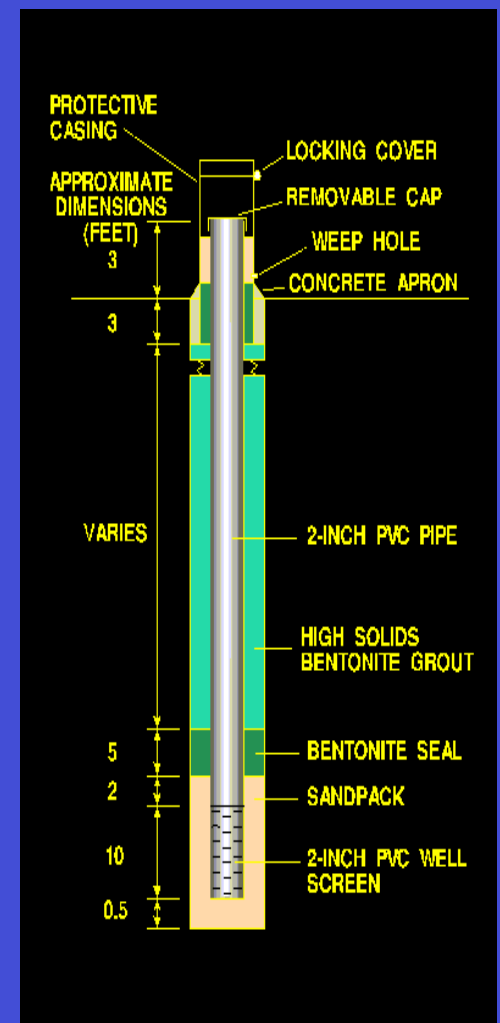




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# USGS Studies (1994 - 2002)

- **Monitoring wells in McBaine bottoms contained elevated levels of sodium, chloride and sulfates**
- **Constituents of wastewater (urine)**
- **USGS studies concluded leaching of Eagle Bluffs cells has reversed natural water flow toward wells**



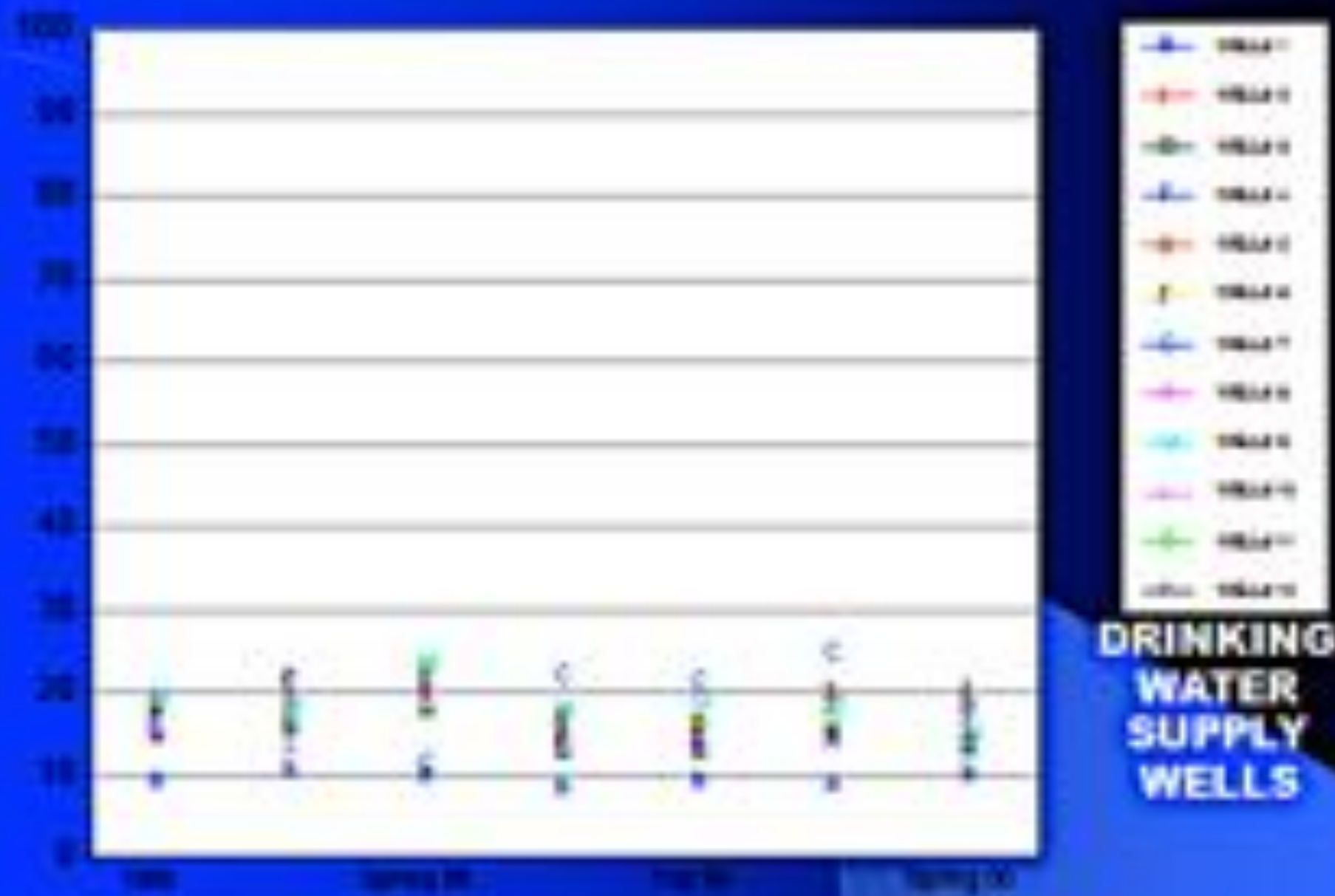
# Chloride: Wastewater Tracer

Concentrations in part per million (ppm)

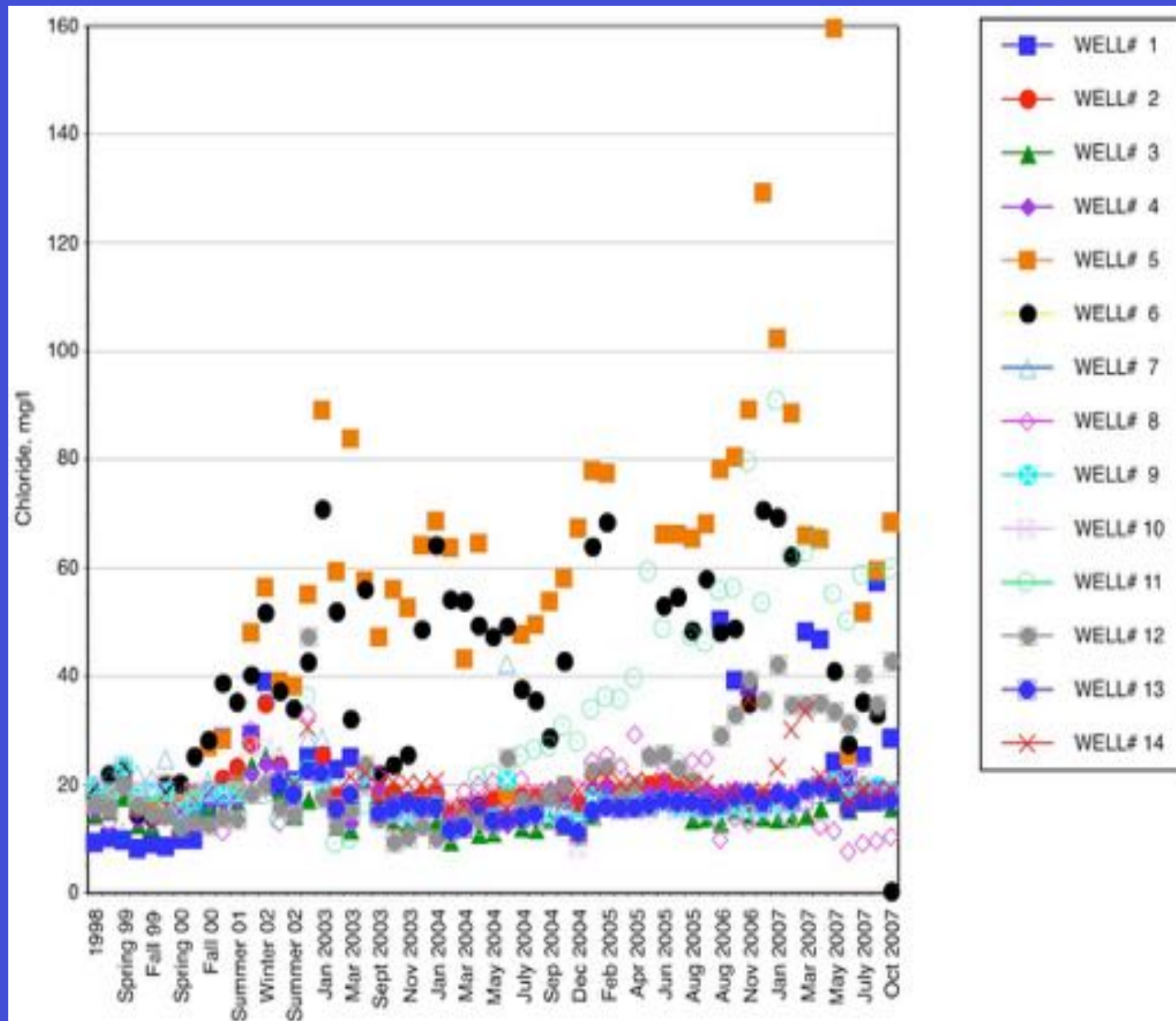
Rainwater	1
Groundwater*	15
MO River	19
Wastewater	240

\* pre-wetlands, 1992-94

# Pre-Wetlands



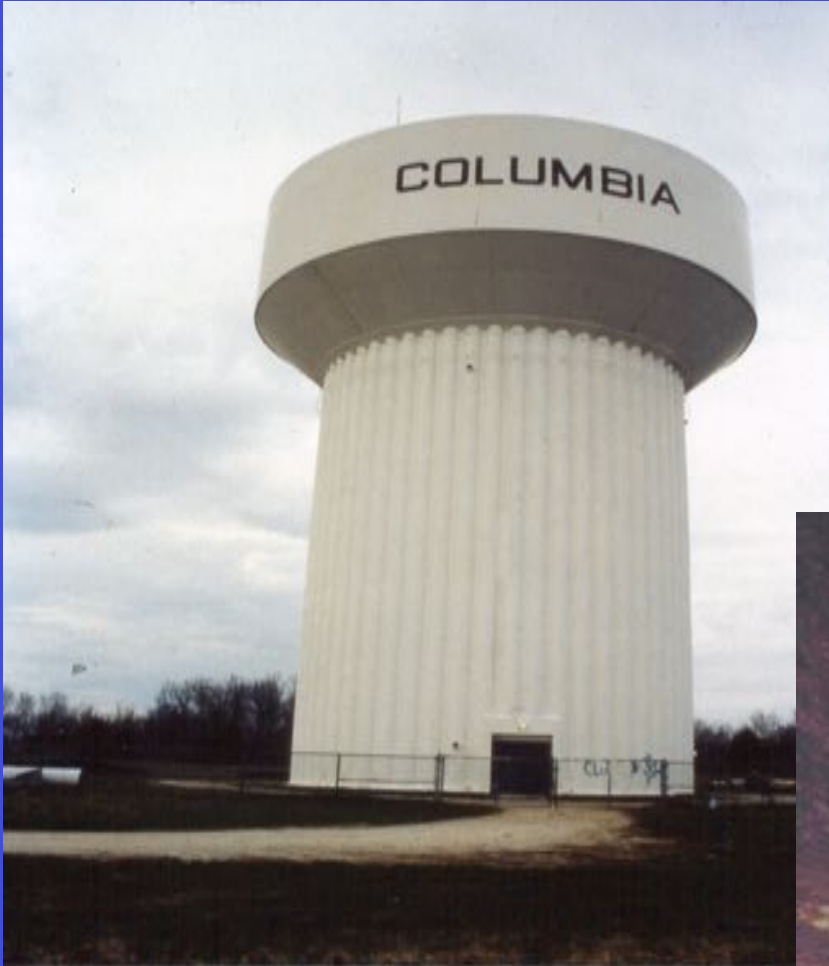
# Chloride Levels in City Wells



# Columbia Distribution System?



# Storage in Water Towers?



# Resolving DBP Problems

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- **Modified Disinfection Practices:  
Initiate Use of Chloramines**
- **Aggressive Flushing Program,  
Frequent Sanitary Inspections,  
Maintenance of Water Towers**
- **Shutdown Wetland Operations**



# **Convert to Chlorine/Ammonia Disinfection**

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**Chlorine plus Ammonia form Chloramines**

**Used by most major water utilities in Missouri, chloramines react more slowly with organic matter and impart less taste to drinking water**



# Consider In-line Booster Chlorination



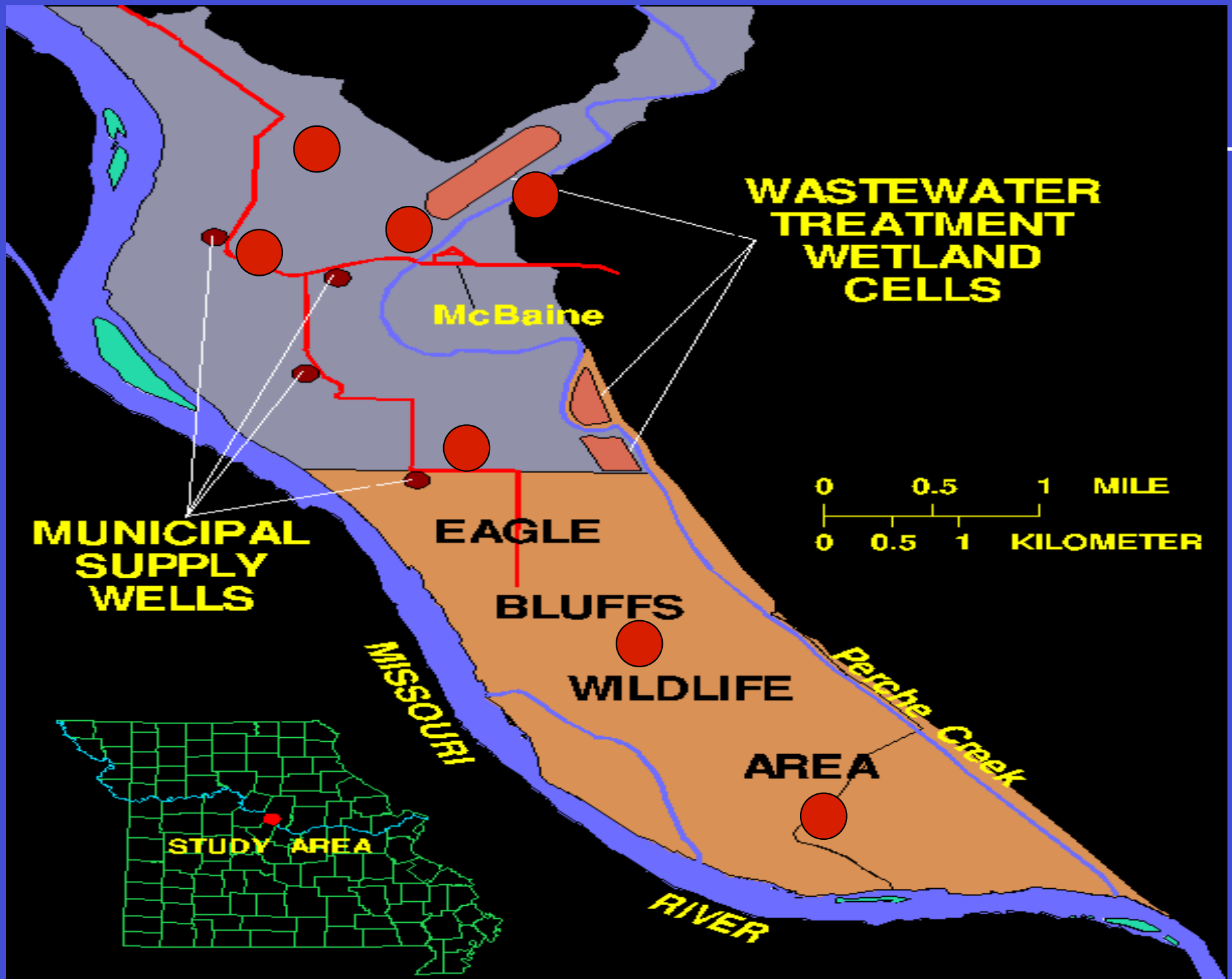
# Flushing and Water Tower Inspection Programs



# 2007 USGS Report on Ground Water Flow and

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- **Data from monitoring wells in McBaine bottoms indicate substantial changes since 1992 in calcium, potassium, sodium, chloride, and sulfate concentrations**
- **Changes began at beginning of operation of the two wetland operations**
- **17 monitoring wells located near wetland cells designated as affected by wastewater effluent**
- **Measurable traces of pharmaceuticals, pesticides, and phenol products found in monitoring wells throughout bottoms**



# **Wastewater Indicator and Pharmaceutical Compounds**

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**Anticoagulants**

**Atrazine**

**Caffeine Metabolite**

**Pain and Fever Reducers**

**Allergy Medicine**

**Anti-coagulants**

**Indole (fragrance)**

**Insecticides**

**Insect Repellents Herbicides**

**Synthetic Resins**

**Mouthwashes**

**Gargles**

**Throat Lozenges**

**Aspirin**

# Columbia Water and Light

Update: March 2009

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- University 'research' (aka, monitoring) program shows that most TTHMs are being formed prior to water entering the distribution system.
- To reduce TTHM formation, Columbia will apply ammonia to the water at a cost of \$200,000.
- The *root cause* of the problem apparently has not been determined, recognized, or addressed.



