

Drinking Water Quality Problems: What You Need to Know

FOD PWS Training 5/12/05

Alicia Diehl

Public Drinking Water Section

512/239-1626



Outline

- Drinking water quality issues
 - ▶ In general order of risk
 - ◆ Pathogens
 - ◆ Chemicals
 - ◆ Specifics:
 - ▶ What, Who, When, Where, Why
- Tools
 - ◆ Where you can go to find information
- Questions, Answers



Note

- Many experience levels
- Try to provide info useful for all
 - ◆ For some it may be old news
 - ▶ Y'all can help with questions and answers!
- What you need to know?
 - ▶ Depends on the systems, constituents in your Region
- Acronyms summarized in handouts



*Drinking water quality,
potential problems....*



Drinking water quality

- *What:* Constituents
- *Who:* Contractor, PWS, customer
- *Where:*
 - ◆ Entry point, plant, distribution system?
- *When:*
 - ◆ Self-schedule or TCEQ- schedule?
- *Why:*
 - ◆ Public health protection, risk evaluation and rule compliance



Types of problems

- ◆ **Maximum Contaminant Level, Treatment Technique violations**
- ◆ Samples at incorrect locations
 - ▶ Unapproved locations
- ◆ Samples **not collected**
- ◆ Results not reported
 - ▶ Failure to pay for analysis
- ◆ **Public Notification** not done
 - ▶ Or TCEQ not informed
- ◆ Files not retained



Constituent Groups

- Pathogens (and disinfection)
 - ◆ Short term health effects (“acute”)
 - ◆ Gastroenteric, respiratory
- Chemicals
 - ◆ Short term (just a couple)
 - ◆ Most long term health effects
 - ▶ Cancer risk, central nervous system, organs
 - ◆ Bad teeth
 - ◆ Aesthetic effect/no health effect



Pathogens...
(and disinfection)



Pathogens

- Distribution system:
 - ◆ Coliform samples
 - ◆ Disinfectant residual
- Surface water treatment plant
 - ◆ Pathogen **inactivation and removal**
 - ◆ No direct measure of pathogens



Pathogens: Distribution

● Coliform

- ▶ Under Total Coliform Rule
- ◆ All public water systems monitor
 - ▶ Including transient noncommunities (TNCs)
- ◆ Bacteria indicate distribution system problem/issue
- ◆ Samples are collected by system
 - ▶ Sent to lab
- ◆ Reported by lab,
but reporting is still the PWS's responsibility



Pathogens: Distribution

- **Disinfectant** in distribution system
 - ◆ All public water systems monitor
 - ▶ Including TNCs
 - ◆ Surface water treaters report on SWMOR
 - ◆ Others (not TNCs) report on DLQOR
 - Disinfection Level Quarterly Operating Report
 - ▶ TNCs retain records at system for file review



Pathogens: Distribution

- Most problems:
 - ◆ Monitoring, reporting, and
 - ◆ Failure to provide public notice (all types)
- Most important:
 - ◆ Positive samples
 - ▶ Especially those confirmed by repeat (acute MCL)
 - ◆ May need Boil Water Notice



Pathogens: In SWTP

SWTP = Surface Water Treatment Plant

- Surface water pathogens
 - ▶ *Viruses, Giardia, Cryptosporidia*
 - ▶ Under Surface Water Treatment Rules
 - ▶ TCEQ Design rules
- ◆ Surface Water Monthly Operating Reports
 - ▶ Not direct measurement of pathogens
 - ▶ Measure **REMOVAL**
 - Through sedimentation, filtration, etc
 - ▶ and **INACTIVATION** thru disinfection



Pathogens: In SWTP

SWTP = Surface Water Treatment Plant

- Most problems:
 - ◆ Failure to report (or can't fill out form)
 - ◆ Turbidity over 0.3, 1.0, or 5.0 NTU
 - ◆ Failure to show pathogen inactivation
- Most important
 - ◆ Turbidity over 5.0 = Boil Water Notice
 - ◆ Turbidity over 1.0, May = BWN
 - ◆ Inactivation inadequate...



Pathogens/Disinfection: Summary

Types of Samples

Coliform

Disinfectant

Turbidity &
Microbial
Inactivation

Who collects Samples?

PWS Distribution
system operator

PWS Surface
Water Plant
Operator

Health Concerns?

Gasto-enteric
disease,
nausea,
dehydration,
diarrhea,
death

Where is it from?

Bacteria are
everywhere...

Disinfectant is
applied for
pathogen
inactivation

Compliance determined by PDWS

***cite as Area of Concern if problem found thru file review
unless immediate risk to public health***

Chemicals...



Chemicals

- Primary Chemicals
 - ▶ Nitrate/Nitrite
 - ▶ Inorganic: Minerals, Metals groups
 - ▶ Organics: Volatile and Synthetic
 - ▶ Asbestos
- Disinfection byproducts (primary)
 - ▶ Trihalomethanes, haloacetic acids
 - Chlorite (Chlorine dioxide)
 - Bromate (Ozone)
- Lead, Copper (primary)
- Secondaries



Chemical Samples

- Collected by contractor
 - ◆ sample collection contract,
 - ◆ Two labs perform analysis
 - ▶ With EXTRA Quality Control,
- Scheduled by PDWS/DWQT
 - ◆ At rule frequency, but...
 - ◆ As few as possible
 - ▶ To save PWSs money



Chemical Sample Collection

- Texas stakeholders and TCEQ (TNRCC/TDH) have an old agreement:
 - ◆ Water systems pay fees - TCEQ collects routine chemical samples
 - ◆ **Before 1997**, FOD collected all routine chemical samples
 - ◆ **Starting in 1997**, contractor hired to collect samples



Nitrate/Nitrite...

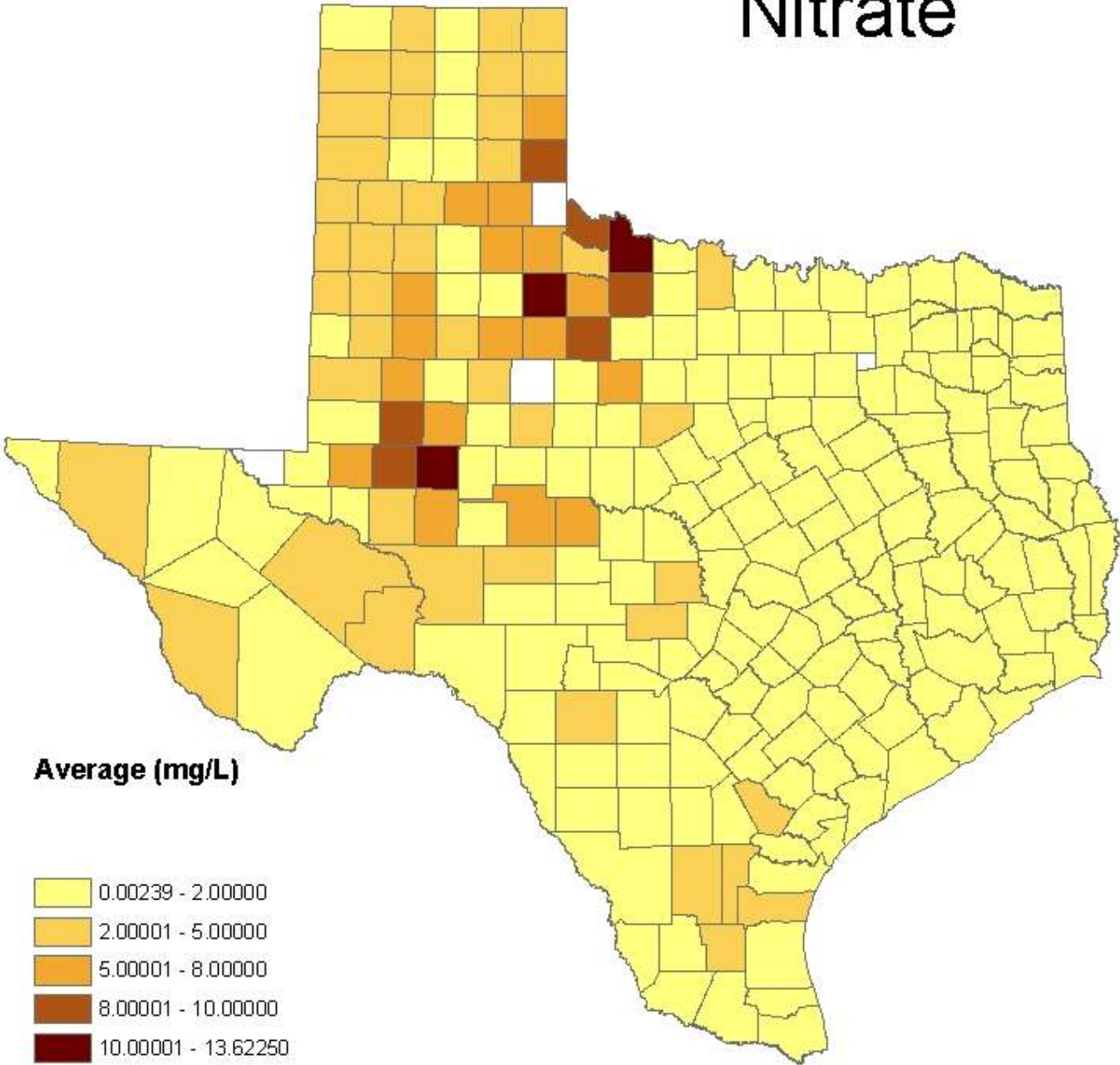


Nitrate

- All systems - annual samples
 - ▶ Including TNCs
 - ◆ Health effect: Methhemoglobinemia
 - ▶ Blue baby syndrome
 - ◆ Violators tend to be on-going
 - ▶ Quarterly sampling for violators
 - ▶ Systems must provide other water to kids
 - ▶ Public Notification any single quarter that exceeds, quarters when violation exists
 - ◆ New detection of level over MCL
 - ▶ Requires 24 hour confirmation sample collection



Nitrate



Nitrification

Side note: non-regulatory

- Nitrite

- ◆ May form in systems that are using chloramines incorrectly
- ◆ Not regulated, but may be in the future
- ◆ Serious health concern
- ◆ TCEQ is collecting free ammonia and nitrite samples for baseline of occurrence because of potential acute risk
 - ▶ Not compliance samples



Nitrate/Nitrite Summary

Types of Samples

Nitrate/
Nitrite

Who collects Samples?

TCEQ's
Contractor

Health Concerns?

ACUTE health
risk to infants:
Blue-baby
syndrome

Where is it from?

Fecal
contamination,
fertilizer, natural
occurrence

Compliance determined by PDWS
cite as Area of Concern if problem noted on CCI



Inorganics/Radiochems...



Inorganic Chemicals

- Inorganics

- ◆ Arsenic, fluoride
- ◆ Note about asbestos

- Radiochems

- ▶ Gross alpha, Radium 226/228, Uranium
- ▶ Not gross beta or man-made radioactivity

- Entry Point samples

- ▶ When a system violates, their monitoring is increased to quarterly

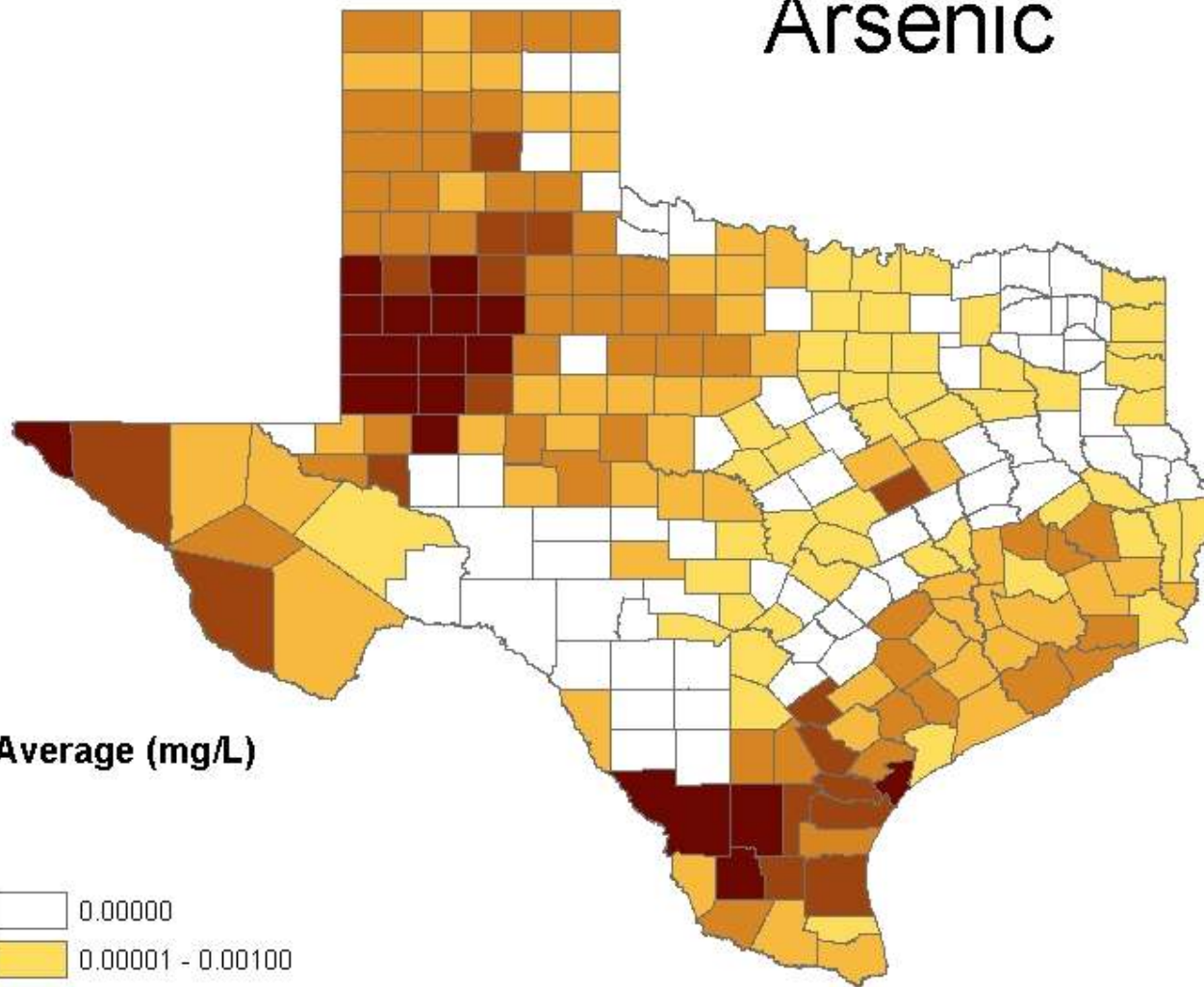


IOCs: Arsenic

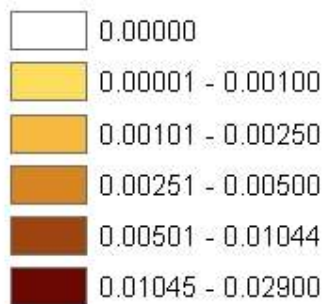
- Arsenic
 - ◆ MCL will be dropping from 50 ug/L
 - ◆ To 10 ug/L
- Now: 2 violators
- Next year: 250 violators?
 - ◆ Compliance Agreement for violators
 - ◆ Requires Feasibility Study
 - ▶ To determine cost of blending, treatment, developing new source, etc.



Arsenic



Average (mg/L)

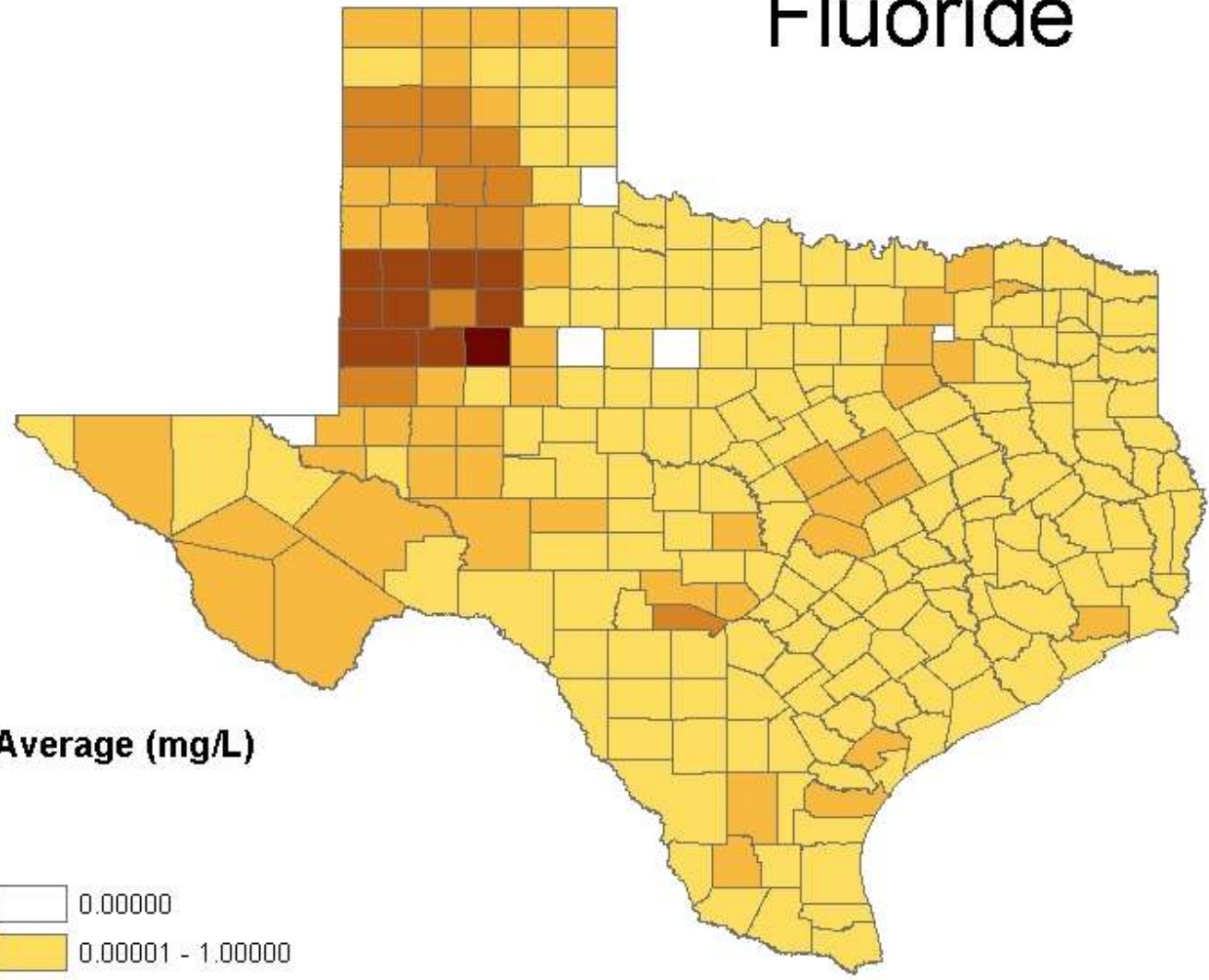


IOCs: Fluoride

- Health effect: Bad teeth for kids
 - ◆ Primary MCL: 4 mg/L
 - ◆ Secondary MCL: 2 mg/L
- Violators of either MCL or SCL
 - ◆ Provide water to kids
 - ◆ Sample quarterly, Notify quarterly
- Generally long term problem
 - ◆ Compliance Agreement, Feasibility Study



Fluoride



Average (mg/L)

- 0.00000
- 0.00001 - 1.00000
- 1.00001 - 2.00000
- 2.00001 - 3.00000
- 3.00001 - 4.00000
- 4.00001 - 5.00000

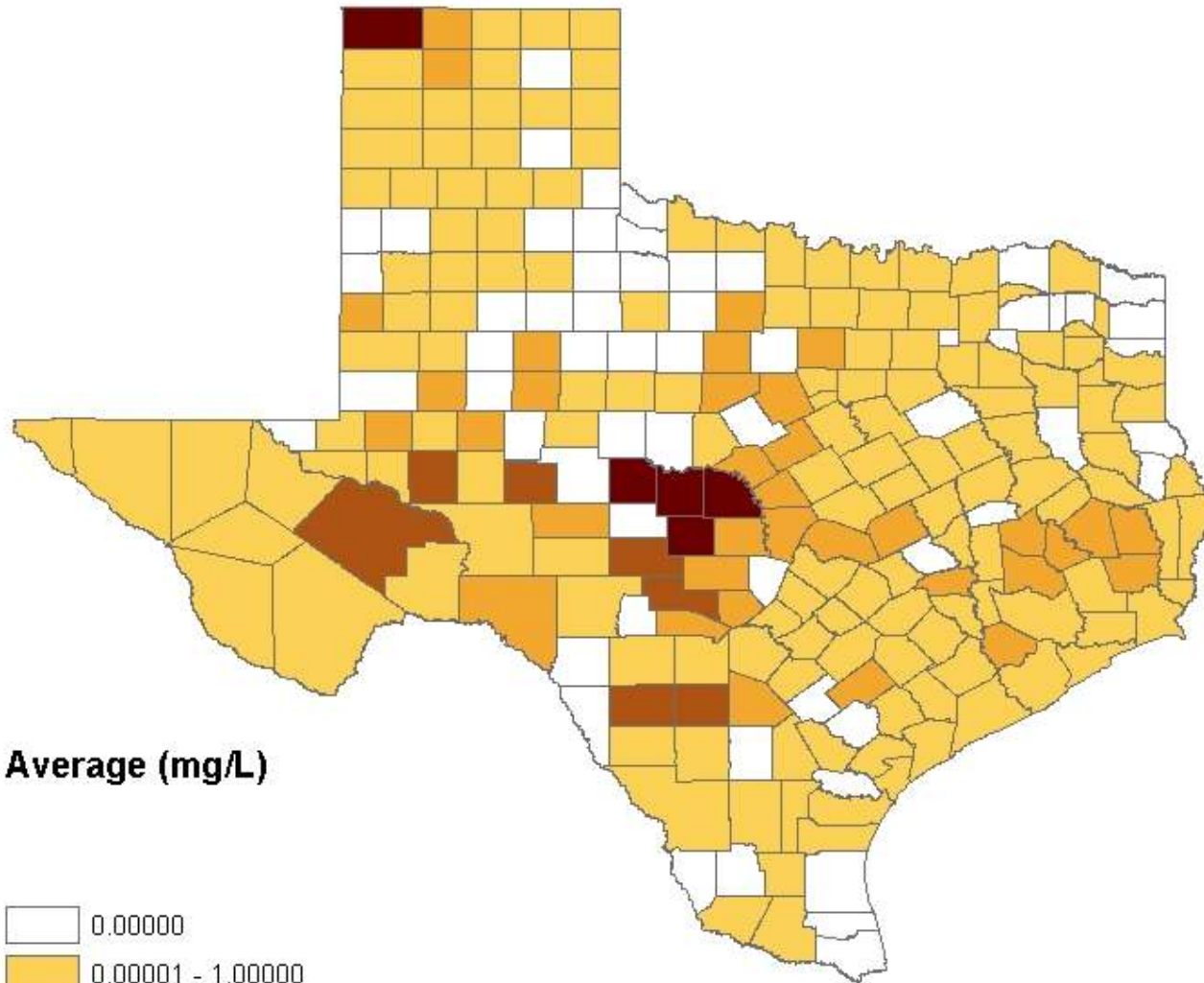


IOCs: Radionuclides

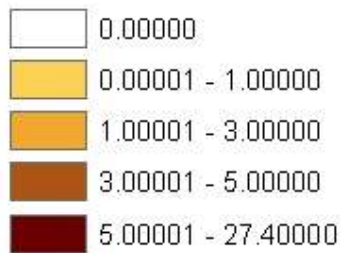
- Health effect: carcinogens, mutagens
- Entry point samples
 - ◆ Quarterly for violators, much longer term for others
- Uranium standard added in 2004
 - ◆ Resulted in handful of new violators



Combined Radium



Average (mg/L)



IOC, Rads Summary

Types of Samples	Who collects Samples?	Health Concerns?	Where is it from?
Inorganics (IOC) (metals & minerals)	TCEQ's Contractor	Cancer, CNS	Source water
Fluoride		Bad teeth	Source water
Asbestos		Polyps	Asbestos / Cement Pipe
Radiochemicals		Cancer	Source water

Compliance determined by PDWS
cite as Area of Concern if problem noted on CCI

Volatile and Synthetic Organic Chemicals...

VOCs and SOCs



Organic Chemicals

SOCs and VOCs

- Detections trigger follow-up sampling
 - ◆ To determine potential source of contamination (PSOC)
 - ◆ May be RAW WATER (well) samples
- Relatively few violators
 - ◆ Intense scrutiny from those interested in pollution



SOCs and VOCs

- SOC = Synthetic organic chemical
 - ◆ “man-made”
 - ◆ Pesticides, herbicides,
- VOC - Volatile organic chemical
 - ◆ Gas, oil
 - ◆ Tank coatings
 - ▶ System would be smart to call us when coating tanks, we can delay sampling



VOCs, SOCs Summary

Types of Samples

Volatile Organic Chemicals

Synthetic Organic Chemicals

Who collects Samples?

TCEQ's Contractor

Health Concerns?

Cancer, CNS

Where is it from?

Source water geology, Possible contamination from human activity

Compliance determined by PDWS

cite as Area of Concern if problem noted on CCI

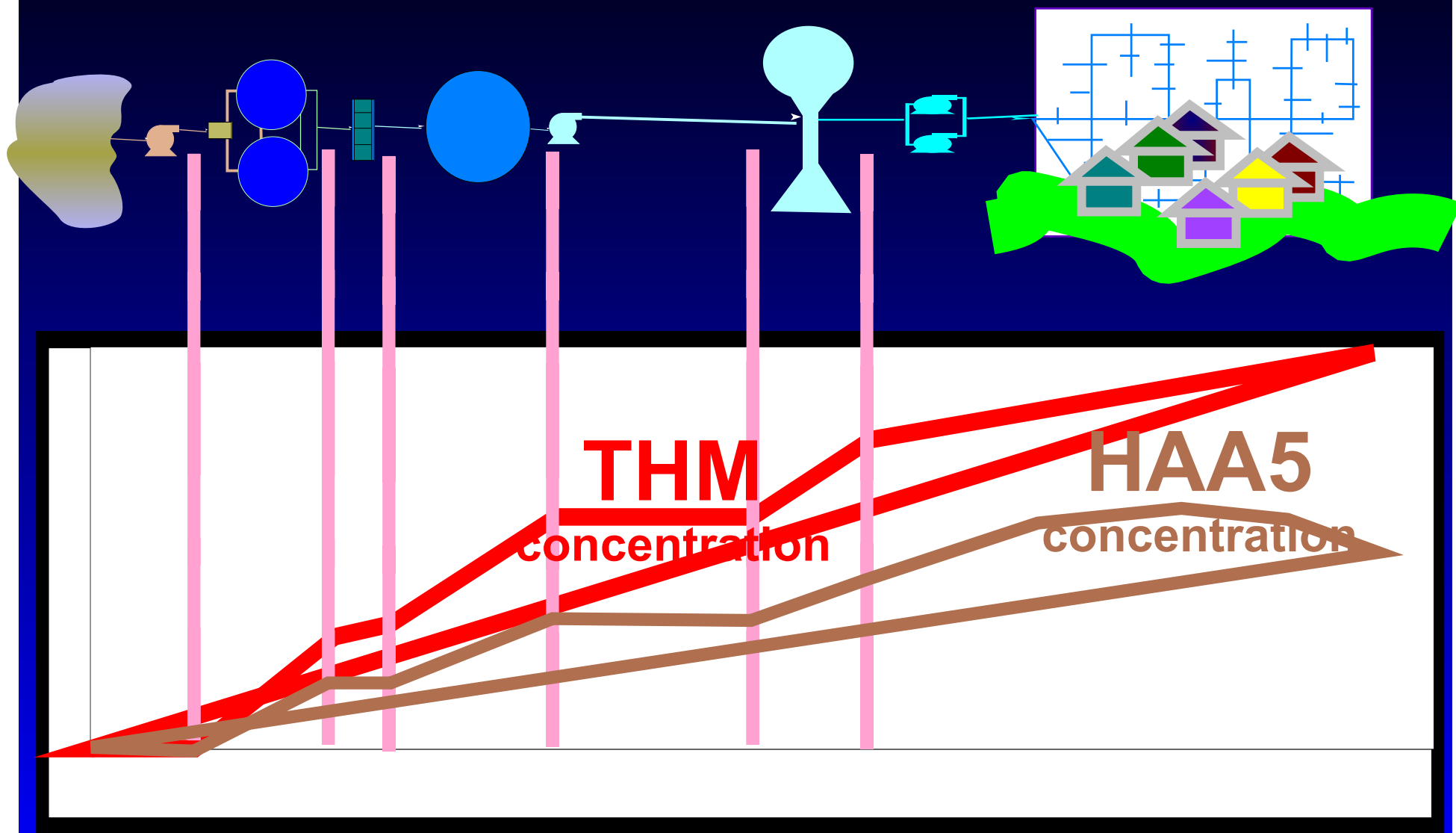
Coordinate with Water Quality or Remediation Staff to follow up on detections and arrange for additional sampling

Disinfection Byproducts (DBPs)...

*Total Trihalomethanes (TTHM) and
Haloacetic Acids (group of five) (HAA5)*



THMs and HAAs Form in the System



DBPs: THM, HAA

- Sampling is WITHIN Distribution System - NOT at entry point
 - ◆ Sampling is annually to quarterly
 - ▶ System busting MCL at any site goes to full (quarterly) monitoring
- There will be a Stage 2 DBP rule coming that will increase sampling



DBPs: THM, HAA

- About 20 systems over 10,000
 - ◆ Violated Stage 1 Rule 2002 - 2004
 - ◆ Took 1 to 9 quarters to fix problem
- About 250 systems under 10,000
 - ◆ Violated Stage 1 Rule in 2004 (and Q105)
 - ◆ May take longer for these folks to fix
- Treaters: Agreed Order
 - ◆ Purchasers: Compliance Agreement



DBP Summary

Types of Samples

Disinfection by-products

Who collects Samples?

TCEQ's Contractor
(in Dist. System)

Health Concerns?

Cancer?
(Miscarriage?)

Where is it from?

Made when chlorine reacts with natural carbon (TOC)

Compliance determined by PDWS
cite as Area of Concern if problem noted on CCI



Lead / Copper



Lead / Copper

- Sampled in customer's home
- Detections result from
 - ◆ Corrosion of lead or copper plumbing
- Root cause: Corrosive water, metal
 - ◆ “All-plastic” sampling waivers available for new systems with PVC
- Very few violators



Lead / Copper

- Although Lead is very toxic
 - ◆ Most exposure to children is through
 - ▶ Contaminated soil
 - ▶ Lead-based paint



Secondary Constituents



Secondaries

- No adverse health effect
- But!
 - ◆ Cause most customer complaints
- Taste, odor, etc.
 - ◆ Unpleasant aesthetic effects



Secondaries

- Secondary fluoride discussed before
 - ◆ PDWS requires notification,
 - ◆ And provision of good water to kids
- Iron / Manganese
 - ◆ PDWS requires treatment
 - ▶ Because treatment is relatively inexpensive,
 - ▶ And customers almost always complain
- Other secondaries:
 - ◆ Your discretion



Tools for drinking water quality ...



Tools

- Monitoring Plan
- Sample Cost Estimate Letter
- PWS Data Sheet (iWUD)
- Consumer Confidence Report
 - ▶ (Annual Report of Drinking Water Quality)
- Guidance Documents
 - ◆ Regulatory Guidance
 - ◆ Staff Guidance



PWS Monitoring Plan

- Designate sample sites
 - ◆ Raw (source) water,
 - ◆ In (surface water) treatment plant,
 - ◆ Entry point,
 - ▶ Freshly treated or blended water enters the distribution system
 - ▶ Representative sample site
 - ◆ Distribution system
 - ▶ Representing the whole distribution system
 - ▶ Longest time in system (farthest from plant)



PWS Monitoring Plan

Cont'd

- Compliance checked at CCI
 - ◆ Or at time of sampling
- There is a check box for “Yes”
 - ◆ If the system has one
- We sent reminder letters to all again this spring
 - ◆ And NOV's to SWTPs



PWS Sample Cost Estimate Letters

- Summarizes all likely sampling
 - ◆ For each PWS
 - ◆ For ~ next 9 years
 - ◆ Includes waiver and cost info
- PDFs of all letters for Region
 - ◆ Sent to Regional Directors annually
- Searchable format, easy to use



Consumer Confidence Report Templates

- ◆ Summarizes most recent data, violations
 - ▶ Through last calendar year: 2004
- ◆ Available on internet:
 - ▶ <http://www.tnrcc.state.tx.us/permitting/waterperm/pdw/ccr.html>
- ◆ To navigate, from the main TCEQ page:
 - ▶ Select "Drinking Water & Water Availability"
 - ▶ Select "Public Drinking Water"
 - ▶ Select "2004 CCR - Updated Information"



PWS Data Sheet

- Shows
 - ◆ Active entry points
 - ◆ Active plants
 - ◆ Treatment type and purpose
 - ◆ Aquifer
- Can deduce likely monitoring
 - ◆ And likely source water quality



Regulatory Guidance

- RG 195: Rules
- RG 379: Standards
- RG 384: Monitoring Plan
- RG 211: Surface Water MOR
- RG 379: Total Organic Carbon
- RG 421: Coliform
- RG 407: Disinfection Level QOP



Internal and Staff Guidance

- Staff Guidance:
 - ▶ <http://www.tnrcc.state.tx.us/permitting/waterperm/pdw/guidance.html>
- Internal guidance:
 - ▶ Revised annually
 - ◆ Drinking Water Sampling Guide
 - ◆ PWS Data Sheet Guide (draft)
 - ◆ Quality Assurance Project Plan for PWSSP



THANK YOU!

Questions?

Answers?



Bonus slides...



PDWS Contacts

Dial... 512-239- ____ (last four digits)

6061	Joaquin Montes, Bact
6775	Sally Paramo, Bact
5040	Gregg Tatum, Bact
5844	Matt Court, Bact
6963	Teri Cisneros, PWS Data Sheet info
6040	Marie Knipfer, Sample Sites
5723	Kristi Krieg, Radionuclides
6045	Debra Cerda, Nitrate, DBPs
6046	Jack Schulze, Surface water treatment
3465	Cindy Bronnenberg, Surface water
4729	Amrit Jhanji, Surface water
R-10	Sam Turner, Surface water



Acronyms

DBP	Disinfection byproduct
THM	Trihalomethane
TTHM	Total trihalomethanes (sum of 4 species)
HAA	Haloacetic acid
HAA5	Haloacetic acid-sum of 5 regulated species
RAA	Running annual average
MCL	Maximum contaminant level
MRDL	Maximum residual disinfectant level
LAS	Liquid ammonium sulfate
TOC	Total organic carbon
GUI	Ground water under the influence of SW
SW	Surface water
>	greater than
<	less than



Acronyms, cont.

PWS Public water system
C community PWS
NTNC nontransient noncommunity PWS
TNC transient noncommunity PWS

SWMOR Surface Water Monthly Operating Report
DLQOR Disinfection Level Quarterly Op. Report
GW/PW Ground Water/Purchased Water MOR
MOR
CCR Consumer Confidence Report

WSD Water Supply Division
PDWS Public Drinking Water Section
DWQT Drinking Water Quality Team



Acronyms for Rules

SDWA	Safe Drinking Water Act
TCR	Total Coliform Rule
LCR	Lead/Copper Rule
II/V	Phase II/V Chemical Rules
THMR	Trihalomethane Rule
DBP1	Stage 1 Disinfection Byproduct Rule
DBP2	Stage 2 Disinfection Byproduct Rule
SWTR	Surface Water Treatment Rule
IESWTR	Interim Enhanced SWTR
LT1	Long Term Stage 1 Enhanced SWTR
LT2	Long Term Stage 2 Enhanced SWTR
GWR	Ground Water Rule
UCMR	Unregulated Contaminant Monitoring Rule
CCL	Contaminant Candidate List



Units and Symbols

mg/L	Milligrams per liter (= ppm)
ppm	parts per million
ug/L	micrograms per liter (= ppb)
ppb	parts per billion
ng/L	nanograms per liter
ppt	parts per trillion
>	greater than
<	less than
NTU	Nephelometric turbidity units
SUVA	Specific ultraviolet absorbance



Chemicals

$\text{Cl}_2(\text{g})$	Chlorine (gaseous)
$\text{HOCl} /$ OCl^-	Hypochlorous acid / Hypochlorite ion (free chlorine)
NH_3	Ammonia
NH_4^+	Ammonium ion
NH_4SO_4^-	Ammonium sulfate
ClNH_2	Monochloramine
Cl_2NH	Dichloramine
Cl_3N	Trichloramine (odor problem)
$\text{N}_2(\text{g})$	Nitrogen gas
NO_3^-	Nitrate
NO_2^-	Nitrite



TCEQ Rules relating to Drinking Water Quality

- 290 Subchapter F, inclusive
- Some of 290 Subchapter D:
 - ◆ 290.46(f),
 - ◆ 290.46(b), (c), (d)
 - ◆ 290.46(g)
 - ◆ 290.46(q)
 - ◆ 290.46(s)



History....



History

- ▶ Safe (public) drinking water
- ▶ **1913**- chlorination required
Vic Ehlers - wiped out typhoid in Texas
- ▶ **1937**- “The Rules” in Texas
Design, operation
- ▶ **1973**- EPA (fed) Safe Drinking Water Act
“The Standards” (in Texas, too)
Texas has “primacy”
By running the PWS Supervision Program



Public Water Supply Supervision Program

Plan
Approval

Source
Water
Assessments

Enforce-
ment

Sanitary
Surveys
(CCIs)

Operator
Certification

National
Primary
Drinking
Water
Standards
Compliance

Lab
Approval



Public Water Supply Supervision Program

- Primacy for drinking water means
 - ◆ \$6 million to TCEQ (PPG)
 - ◆ \$60 million SRF to TWDB for systems
 - ▶ State Revolving Fund (SRF)
 - Loans to systems
 - Set-aside: Projects
 - Such as Chemical Sample Collection Contract
 - ◆ Must have “state match”



PWSSSP in TCEQ

Many parts to the PWSSSP (Public Water Supply Supervision Program)

Not to scale

