# WATER QUALITY AND DOUBLE BAYOU







## WATER QUALITY

 Water Quality = chemical, physical, and biological characteristics of water with respect to its suitability for a particular purpose or designated use.



## WATER QUALITY LAW AND POLICY

**Surface Water Quality** 

o Federal Water Pollution Control Act (1948)

Amended 1972 and 1977: Clean Water Act(CWA)

- Foundation of surface water quality protection in U.S.
- Restore and maintain chemical, physical, biological characteristics of nation's waters
- Requires states to set <u>standards</u> for surface water quality and regulate wastewater discharge.

 EPA has "delegated" responsibility for the CWA to the Texas Commission on Environmental Quality.

### **TEXAS AND WATER QUALITY**

 Clean Water Act→ Texas and other states must establish standards for measuring the health of surface water bodies

- Standards must describe how surface water bodies are used (designated usage)
- States must carry out a program to regularly monitor the status of water quality in relation to those standards

 The Texas Commission on Environmental Quality (TCEQ) is charged with managing the quality of water resources in Texas

 TCEQ works with a variety of partners throughout state on managing water quality and quantity



## **TEXAS AND WATER QUALITY**

- TCEQ uses standards and criteria to define and evaluated the quality of surfaces waters in Texas
  - Plans how water quality will be managed in State
  - Establishes water quality standards
  - Issues permits for point source dischargers



Manages programs to prevent urban nonpoint TCEQ source pollution

 Texas State and Soil Water Conservation Board (TSSWCB)

- Administers State's soil and water conservation law
- Manages programs to prevent agriculture/silvicultural (forestry) nonpoint source pollution



## SURFACE WATER QUALITY STANDARDS



Quality standards for each designated usage

## SURFACE WATER QUALITY STANDARDS



## **EVALUATING SURFACE WATER QUALITY**

- Sampling, laboratory analysis, and data analysis
  - Sampling performed by various State partners
    - •Quality Assurance
    - Laboratory accreditation



- TCEQ performs data analysis for Integrated Report
  - Rigorous protocol for data analysis procedures
  - Criteria versus screening levels
  - o7 year assessment period
  - Geomean versus number exceeded
  - Underrepresentation versus Overrepresentation

## HOW IS WATER QUALITY MEASURED?

- Some aspects of water quality are determined with samplers on-site
  - Temperature
  - Acidity (pH)
  - Dissolved oxygen
  - Electrical conductance (an indirect indicator of dissolved minerals)
- Other types of samples are sent to a laboratory - chemicals or pathogens
- Water quality data is only as good as the methods and procedures used to acquire the data.
  - Stringent protocols are crucial





#### HOW ARE WATER QUALITY SAMPLES COLLECTED?

#### **o** Selection of Sampling Locations

- Spatial Representation
- Continuity of past data at sample stations for comparison
- Access to sampling site safety, ease of access, public land

#### Sample collection steps

- Preparation for Sample Collection
- Sample Collection
- Sample Processing
- Laboratory Analysis



### EXAMPLE OF USGS PREPARATION FOR SAMPLE COLLECTION

#### Multi-parameter instruments must be tested and the sensors calibrated before each field use.

 Temperature, Specific electrical conductance (SC), Dissolved oxygen (DO), pH and Turbidity are all calibrated using known standards.





#### EXAMPLE OF USGS PROTOCOL - SAMPLE COLLECTION

#### • Prepare for sampling

- Choose vehicle location to prevent contamination sample from emissions
- Assemble sampling equipment and set up a clean work space.
- Select the number and distance of increments
- Collect sample water and put in churn for compositing
  - Inspect each subsample as it is collected, looking for overfilling
  - Empty the subsample into a fieldrinsed churn or cone splitter



Figure 7. Depth-integrated sample collected by use of the equal-width-increment method.







## EXAMPLE OF USGS SAMPLE PROCESSING

#### **Clean Hands/Dirty Hands technique:**

- Designate the Clean Hands (CH) person and the Dirty Hands (DH) person before field work begins.
  - **CH duties**: Has the only contact with sample bottle; transfers sample from sampler to splitter; filters, extracts, and preserves sample.
  - **DH duties**: Operates sampling equipment and manages any contact with potential sources of contamination.
  - **CH and DH**: Both wear appropriate disposable, powderless gloves.



## LABORATORY ANALYSIS

- Need to provide consistent methodology for national assessment and trends analysis.
- Annual laboratory accreditation is a requirement for Quality Assurance.
- Sample preservation techniques can only slow the chemical and biological changes that continue after sample is removed from parent source.
- Each constituent has different "holding times"
- For most constituents the holding times may range from 1-365 days
- For biological indicators (i.e. bacteria) the holding time is as low as 6 hrs





## SURFACE WATER QUALITY STANDARDS

 Every two years, the TCEQ must report to the EPA the extent to which the State's water bodies are meeting the surface water quality standards

#### Texas Integrated Report

 Describes status of ALL surface water bodies in Texas that were evaluated, tested and monitored in recent seven years

#### <u>CWA 303(d) list</u>

 Identifies ALL "impaired" surface water bodies not meeting criteria for designated uses

To download the State's 303(d) and Integrated Reports: http://www.tceq.texas.gov/waterquality/assessment

To download the State's Surface Water Quality Monitoring Data http://www.tceq.texas.gov/waterquality/cleanrivers/data/samplequery.html

### FROM THE TCEQ 2012 TEXAS INTEGRATED REPORT - TEXAS 303(D) LIST

SegID: 2422B	Double Bayou West Fork (unclassified water body) From the Trinity Bay confluence to Belton Road in Cha	ambers County	WEST FORK
Parameter(s)		Category	Year Segment First Listed
bacteria		5c	2006
2422B_01	From the Trinity Bay confluence to Belton Road		
Parameter(s)		Category	Year Segment First Listed
depressed dissolved oxygen		5b	2004
2422B_01	From the Trinity Bay confluence to Belton Road		
<u>Parameter(s)</u>		<u>Category</u>	Year Segment First Listed
dioxin in edible tissue		5a	2010
2422B_01	From the Trinity Bay confluence to Belton Road		
Parameter(s)		Category	Year Segment First Listed
PCBs in edible tissue		5a	2010
2422B_01	From the Trinity Bay confluence to Belton Road		

As required under Sections 303(d) and 304(a) of the federal Clean Water Act, the 303(d) list identifies the water bodies in or bordering Texas for which effluent limitations are not stringent enough to implement water quality standards, and for which the associated pollutants are suitable for measurement by maximum daily load.

#### FROM THE TCEQ 2012 TEXAS INTEGRATED REPORT - TEXAS 303(D) LIST

SegID: 2422D	Double Bayou East Fork (unclassified water body)	Durante of STL 65	EAST FORK
Provension (c)	From the Trinity Bay confidence to a point 2.0 km (1.0 m		Very Compact First List 1
Parameter(s)		Category	<u>1ear Segment First Listed</u>
dioxin in edible t	issue	5a	2010
2422D_01	From the Trinity Bay confluence to a point 2.6 km (1.6 m	1) upstream of SH 65	
Parameter(s)		Category	Year Segment First Listed
PCBs in edible tissue		5a	2010
2422D_01	From the Trinity Bay confluence to a point 2.6 km (1.6 m	i) upstream of SH 65	

As required under Sections 303(d) and 304(a) of the federal Clean Water Act, the 303(d) list identifies the water bodies in or bordering Texas for which effluent limitations are not stringent enough to implement water quality standards, and for which the associated pollutants are suitable for measurement by maximum daily load.

#### FROM THE TCEQ 2012 TEXAS INTEGRATED REPORT WATER BODIES WITH CONCERNS FOR USE ATTAINMENT AND SCREENING LEVELS

SEG ID:         2422B         Double Bayou West Fork (unclassified water body)           From the Trinity Bay confluence to Belton Road in Chambers County	WEST FORK
Parameter(s)         chlorophyll-a         2422B_01       From the Trinity Bay confluence to Belton Road	<u>Level of Concern</u> CS
Parameter(s)         depressed dissolved oxygen         2422B_01       From the Trinity Bay confluence to Belton Road	<u>Level of Concern</u> CS
SEG ID:       2422D       Double Bayou East Fork (unclassified water body)         From the Trinity Bay confluence to a point 2.6 km (1.6 mi) upstream of SH	EAST FORK
SEG ID:       2422D       Double Bayou East Fork (unclassified water body)         From the Trinity Bay confluence to a point 2.6 km (1.6 mi) upstream of SH         Parameter(s)         bacteria         2422D_01         From the Trinity Bay confluence to a point 2.6 km (1.6 mi) upstream of SH 65	Level of Concern CN

CS - Concern for water quality based on screening levels

STATIONS USED IN DOUBLE BAYOU FOR TCEQ'S 2012 SURFACE WATER ASSESSMENT

Note: TCEQ's 2012 Integrated Report included data from an East Fork station (20288) that was included in West Fork calculations •We noted the error and confirmed it with TCEQ •The corrected data did not change the status of the impairments for either fork



## DOUBLE BAYOU SAMPLES TCEQ USED FOR 2012 INTEGRATED REPORT

- Submitting entities include (entity responsible for submitting the data to the TCEQ)
  - Trinity River Authority
  - TCEQ
  - Houston-Galveston Area Council
- Collecting entities include (entity actually collecting samples in the field)
  - TCEQ Field Operations
  - TCEQ Regional Office
  - United States Geological Survey
  - Trinity River Authority Lake Livingston Project
- Assessment period for 2012 Integrated Report
  - 12/1/2003-11/30/2010

### **DISSOLVED OXYGEN**

- Designated Use: Aquatic Life
- Low DO levels can indicate an excessive demand on the oxygen in the system.



< 0.5 mg/L Anoxic – Oxygen dependent animals die</p>
< 3 mg/L Hypoxic - Most aquatic organisms cannot survive</p>
4-5 mg/L Aquatic organisms become stressed
6-9 mg/L Optimal for many aquatic organisms
> 10 mg/L Oxygen saturation

#### **DISSOLVED OXYGEN – GRAB SAMPLES** West Fork - Samples TCEQ used for 2012 Integrated Report Dissolved Oxygen Samples from Double Bayou Stations Dissolved Oxygen grab minimum criteria Dissolved Oxygen grab screening level WEST FORK 16 14 Dissolved Oxygen, mg/l 12 10 8 6 4 2

0 Jun-03 Nov-04 Mar-06 Aug-07 Dec-08 May-10

## **DISSOLVED OXYGEN – GRAB SAMPLES**

#### • East Fork - Samples TCEQ used for 2012 Integrated Report

EAST FORK

- Dissolved Oxygen Samples from Double Bayou Stations
- -Dissolved Oxygen grab minimum criteria
- —Dissolved Oxygen grab screening level



#### • DO West Fork 24-hour Average Samples TCEQ used for 2012 Integrated Report

WEST FORK

Dissolved Oxygen 24-hour average samples

—Dissolved Oxygen 24-hour Avg criteria



#### DO West Fork 24-hour Minimum Samples TCEQ used for 2012 Integrated Report



 DO East Fork 24-hour Average Samples TCEQ (corrected) for 2012 Integrated Report

EAST FORK

- Dissolved Oxygen 24-hour average samples
- —Dissolved Oxygen 24-hour Avg criteria



#### DO East Fork 24-hour Minimum Samples TCEQ (corrected) for 2012 Integrated Report

EAST FORK

Dissolved Oxygen 24-hour minimum samples

—Dissolved Oxygen 24-hour Min criteria



#### BACTERIA

- Designated Use: Contact Recreation
- Testing for *E. coli*, enterococci, and fecal coliform bacteria in water are used as indicators for presence of other pathogenic bacteria that pose health hazards.
- Elevated bacteria levels cannot support primary recreation in the bayous, and could be a problem for oysters in the bay.
- Aerobic decomposition of excess fecal matter can also reduce dissolved oxygen levels.

#### **BACTERIA – GRAB SAMPLES**

 West Fork Enterococcus Samples TCEQ used for 2012 Integrated Report

WEST FORK Enterococcus samples, MPN/100 ml 25000 20000 15000 10000 5000 1200 1000 800 600 400 200 0 Jan-04 Feb-08 Jul-09 **Nov-10** Sep-02 May-05 Oct-06 Apr-12

Enterococcus, MPN/100 ml

#### **BACTERIA – GRAB SAMPLES**

Enterococcus, MPN/100ml

 East Fork Enterococcus Samples TCEQ used for 2012 Integrated Report



#### CHLOROPHYLL-A & NUTRIENTS

- Designated Use: Contact Recreation
- Indicator of phytoplankton abundance and biomass in coastal and estuarine waters
- Chlorophyll-a is a green pigment found in plants that absorbs sunlight and converts it to sugar during photosynthesis using nutrients such as phosphorus and nitrogen
- High levels often indicate poor water quality and low levels often suggest good conditions BUT it is the overall cycle that is important - phytoplankton populations can exhibit significant spatial and temporal variation; it is the long-term persistence of elevated levels that can be problematic

#### **NUTRIENTS – GRAB SAMPLES**



#### West Fork Samples TCEQ used for 2012 Integrated Report



#### **NUTRIENTS – GRAB SAMPLES**

#### East Fork Samples TCEQ used for 2012 Integrated Report



Nutrient Screening Level

EAST FORK



## **CLOSING REMARKS**

- Water Quality is important for evaluating the overall health of the stream
- Water Quality sampling, lab analysis and data analysis are all important processes in determining water quality
  - Stringent protocol and procedures necessary at every step for quality assurance
- Double Bayou
  - Concerns on both forks for certain constituents
  - But numbers are such that getting de-listed is an attainable goal



#### QUESTIONS?

## **TEXAS AND WATER QUALITY**

- TCEQ works with a variety of partners throughout state to focus on managing water quality and quantity
  - Texas State Soil and Water Conservation Board (TSSWCB)
  - Texas Parks and Wildlife Department (TWPD)
  - Texas Water Development Board (TWDB)
  - Clean Rivers Program (CRP)
  - River Authorities Trinity River Authority (TRA)
  - Texas General Land Office (GLO)
  - U.S Geological Survey (USGS)
  - County and municipal governments
  - Texas Department of State Health Services
  - Educators, universities and research organizations
  - Citizens and interest groups
  - Agricultural producers and associations
  - Regional councils of government

#### BACK UP SLIDES

#### DISSOLVED OXYGEN – TCEQ METHODS

Dissolved Oxygen

- Grab dissolved oxygen measurements are compared to the average DO criterion value and a concern is identified when this screening level is exceeded more than eight percent of the time using the binomial method
- The DO grab screening level is compared to the measurement taken at the surface or to the average of measurements in the mixed surface layer when a profile of measurements is reported

#### BACTERIA – TCEQ METHODS

#### Bacteria

- The recreation use is not supported if the geometric average of the samples collected over the assessment period (two to seven years) exceeds the criterion or if the criteria for individual samples are exceeded greater than 25 percent of the time using the binomial method.
- Enterocuccus
  - o 35 mpn/100 ml geoemtric mean

**FROM TCEQ GUIDANCE<sup>1</sup>: NUMBER OF SAMPLES AND EXCEEDANCES TO** DENTIFY **IMPAIRMENT**, **CONCERNS, AND TO DELIST PARAMETERS** BY THE **BINOMIAL METHOD- GRAPHIC TABLES** 



<sup>1</sup>2012 Guidance for Assessing and Reporting Surface Water Quality in Texas (May, 2012) In Compliance with Sections 305(b) and 303(d) of the Federal Clean Water Act

**FROM TCEQ GUIDANCE<sup>1</sup>: NUMBER OF SAMPLES AND EXCEEDANCES TO DENTIFY MPAIRMENT**, **CONCERNS, AND TO DELIST PARAMETERS BY** THE BINOMIAL METHOD-**GRAPHIC TABLES** 



<sup>1</sup>2012 Guidance for Assessing and Reporting Surface Water Quality in Texas (May, 2012) In Compliance with Sections 305(b) and 303(d) of the Federal Clean Water Act

#### FROM TWS WATERSHED STEWARD TRAINING



## SAMPLE PROCESSING

- 1. Organic compounds—Raw (wholewater or unfiltered) samples first, followed by filtered samples.
- 2. Organic carbon.
- Inorganic constituents, nutrients, radiochemicals, isotopes: For surface water, raw samples first, followed by filtered samples.
- 4. Capsule-filtered DOC followed by radon and chlorofluorocarbons.
- 5. Microorganisms.



### EXAMPLE OF USGS PREPARATION FOR SAMPLE COLLECTION

 USGS policy requires that equipment for water samples be properly cleaned before contacting the sample and that the effectiveness of the cleaning procedures be quality controlled.

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#### **EXPLANATION**

 DIW
 Distilled/deionized water

 Imethanol
 Current protocol includes methanol rinse except for equipment used to sample for organic-carbon analyses. SAFETY ALERT: Methanol is highly flammable; fumes can be hazardous to human health.

 PBW
 Pesticide-grade blank water

 VPBW
 Volatiles- and pesticide-grade blank water

### DISSOLVED OXYGEN WEST FORK- GRAB SAMPLES TCEQ USED FOR 2012 INTEGRATED REPORT

- Submitting entities (entity responsible for submitting the data to the TCEQ)
  - Trinity River Authority
  - TCEQ
- Collecting Entity (entity actually collecting samples in the field)
  - TCEQ Field Operations
  - Trinity River Authority Lake Livingston Project
- Assessment period for 2012 Integrated Report
  - 12/1/2003-11/30/2010
- 123 assessed samples, 8 DO minimum exceedances, 17 DO screening level exceedances
- Stations 10657, 18361, 20016

### DISSOLVED OXYGEN EAST FORK- GRAB SAMPLES TCEQ USED FOR 2012 INTEGRATED REPORT

- Submitting entities (entity responsible for submitting the data to the TCEQ)
  - Trinity River Authority
  - TCEQ
- Collecting Entity (entity actually collecting samples in the field)
  - TCEQ Regional Office
  - Trinity River Authority Lake Livingston Project
- Assessment period for 2012 Integrated Report
  - 12/1/2003-11/30/2010
- 100 assessed samples, 8 DO minimum exceedances, 14 DO screening level exceedances
- Stations 10658, 20288

### DISSOLVED OXYGEN WEST FORK – 24-HR SAMPLES TCEQ USED FOR 2012 INTEGRATED REPORT

- Submitting entities (entity responsible for submitting the data to the TCEQ)
  - Trinity River Authority
  - Houston-Galveston Area Council
- Collecting Entity (entity actually collecting samples in the field)
  - United States Geological Survey
  - Trinity River Authority Lake Livingston Project
- Assessment period for 2012 Integrated Report
  - 12/1/2003-11/30/2010
- 10 assessed sample periods, 5 DO 24-hr Avg and 4 24-hr Min screening level exceedances
- o Stations 10657, 18361, 20016

#### DISSOLVED OXYGEN EAST FORK – 24-HR SAMPLES TCEQ USED FOR 2012 INTEGRATED REPORT

- Submitting entities (entity responsible for submitting the data to the TCEQ)
  - Trinity River Authority
- Collecting Entity (entity actually collecting samples in the field)
  - Trinity River Authority Lake Livingston Project
- Assessment period for 2012 Integrated Report
  - 12/1/2003-11/30/2010
- 4 assessed sample periods, 1 DO 24-hr Avg and 1 24-hr Min screening level exceedances
- Station 20288

### BACTERIA- WEST FORK ENTEROCOCCUS TCEQ USED FOR 2012 INTEGRATED REPORT

- Submitting entities (entity responsible for submitting the data to the TCEQ)
  - Trinity River Authority
  - TCEQ
- Collecting Entity (entity actually collecting samples in the field)
  - TCEQ Regional Office
  - Trinity River Authority Lake Livingston Project
- Assessment period for 2012 Integrated Report
  - 12/1/2003-11/30/2010
- 44 assessed samples, geomean assessed at 66.90 MPN/100 ML, exceeding criteria of 35 MPN/100 ML
- o Stations10657 and 18361

### BACTERIA- EAST FORK ENTEROCOCCUS TCEQ USED FOR 2012 INTEGRATED REPORT

- Submitting entities (entity responsible for submitting the data to the TCEQ)
  - Trinity River Authority
  - TCEQ
- Collecting Entity (entity actually collecting samples in the field)
  - TCEQ Regional Office
  - Trinity River Authority Lake Livingston Project
- Assessment period for 2012 Integrated Report
  - 12/1/2003-11/30/2010
- 31 assessed samples, geomean assessed at 43.76 MPN/100 ML, listed as Use Concern
- o Stations10658 and 20288

### NUTRIENTS – WEST FORK ENTEROCOCCUS TCEQ USED FOR 2012 INTEGRATED REPORT

- Submitting entities (entity responsible for submitting the data to the TCEQ)
  - Trinity River Authority
  - TCEQ
- Collecting Entity (entity actually collecting samples in the field)
  - TCEQ Regional Office
  - Trinity River Authority Lake Livingston Project
- Assessment period for 2012 Integrated Report
  - 12/1/2003-11/30/2010
- Only chlorophyll-a listed for Screening Level Concern (no exceedances for Ammonia and Orthophosphate, very few for Nitrate and Total Phosphorus)
- Stations 10657, 18361 and 20016

### NUTRIENTS – EAST FORK ENTEROCOCCUS TCEQ USED FOR 2012 INTEGRATED REPORT

- Submitting entities (entity responsible for submitting the data to the TCEQ)
  - Trinity River Authority
  - TCEQ
- Collecting Entity (entity actually collecting samples in the field)
  - TCEQ Regional Office
  - Trinity River Authority Lake Livingston Project
- Assessment period for 2012 Integrated Report
  - 12/1/2003-11/30/2010
- No listings for Screening Level Concern
- Stations 10658, 20288

## **TCEQ INTEGRATED REPORT**

<u>Category 5</u>: The water body does not meet applicable water quality standards or is threatened for one or more designated uses by one or more pollutants.

•<u>5a</u> - A TMDL is underway, scheduled, or will be scheduled.

<u>5b</u> - A review of the water quality standards for this water body will be conducted before a TMDL is scheduled.
<u>5c</u> - Additional data and information will be collected before a TMDL is scheduled.