Dickinson Bayou Watershed Data Report

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PREPARED IN COOPERATION WITH THE TEXAS COMMISSION ON ENVIRONMENTAL QUALITY AND U.S. ENVIRONMENTAL PROTECTION AGENCY

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Introduction

Dickinson Bayou begins near Alvin in Brazoria County as an intermittent stream and flows east for approximately 24 miles through Galveston County into Dickinson Bay and then into Galveston Bay, draining 99.7 mi^2 (258.2 km^2) (See map below).[i] The soil in the Gulf Coast Prairies and Marshes region through which it drains consists of clays and clay loams, loams and silt loams, and fine sandy loams. Clay does not allow precipitation to percolate through easily and therefore adds to runoff. Cities within the watershed are Dickinson, Alvin, League City, Santa Fe, and Algoa.[ii] Land use is 10.04% developed, 7.75% agricultural, and 82.21% natural.[iii]

The Texas Coastal Watershed Program, in cooperation with the Texas Commission on Environmental Quality (TCEQ) and the Galveston Bay Estuary Program (GBEP), organized the Dickinson Bayou Watershed Partnership to protect, preserve and restore the quality of the Dickinson Bayou Watershed and its communities in response to the fact that the bayou and some of the tributaries have been listed as impaired by the TCEQ. This partnership has developed a Watershed Protection Plan, which is a coordinated framework for implementing prioritized and integrated water quality protection and restoration strategies driven by environmental objective. Details can be found at http://www.dickinsonbayou.org/.[iv]

In alignment with Texas Stream Team's core mission, monitors attempt to collect data that can be used in decision-making processes, to promote a healthier and safer environment for people and aquatic inhabitants. While many assume it is the responsibility of Texas Stream Team to serve as the main advocate for volunteer monitor data use, it has become increasingly important for monitors to be accountable for their monitoring information and how it can be infused into the decision-making process, from "backyard" concerns to state or regional issues. To assist with this effort, Texas Stream Team coordinates with monitoring groups and government agencies to propagate numerous data use options.

Among these options, volunteer monitors can directly participate by communicating their data to various stakeholders. Some options include: participating in the Clean Rivers Program (CRP) Steering Committee Process; providing information during "public comment" periods; attending city council and advisory panel meetings; developing relations with local Texas Commission on Environmental Quality and river authority water specialists; and, if necessary, filing complaints with environmental agencies; contacting elected representatives and media; or starting organizing local efforts to address areas of concern.

The Texas Clean Rivers Act established a way for the citizens of Texas to participate in building the foundation for effective statewide watershed planning activities. Each CRP partner agency has established a steering committee to set priorities within its basin. These committees bring together the diverse interests in each basin and watershed. Steering committee participants include representatives from the public, government, industry, business, agriculture, and environmental groups. The steering committee is designed to allow local concerns to be addressed and regional solutions are recommended. For more information about participating in these steering committee meetings and to contribute your views about water quality, contact the appropriate CRP partner agency for your river basin at: http://www.tceq.state.tx.us/compliance/monitoring/crp/partners.html.

Currently, Texas Stream Team is working with various public and private organizations to facilitate data and information sharing. One component of this process includes interacting with watershed stakeholders at CRP steering committee meetings. A major function of these meetings is to discuss water quality issues and to obtain input from the general public. While participation in this process may not bring about instantaneous results, it is a great place to begin making institutional connections and to learn how to "work" the assessment and protection system that Texas agencies use to keep water resources healthy and sustainable.

In general, Texas Stream Team efforts to use volunteer data may include the following:

1. Assist monitors with data analysis and interpretation
2. Analyze watershed-level or site-by-site data for monitors and partners
3. Screen all data annually for values outside expected ranges
4. Network with monitors and pertinent agencies to communicate data
5. Attend meetings and conferences to communicate data
6. Participate in CRP stakeholder meetings
7. Provide a data viewing forum via the Texas Stream Team Data Viewer
8. Participate in professional coordinated monitoring processes to raise awareness of areas of concern

Information collected by Texas Stream Team volunteers utilizes a TCEQ and EPA approved quality assurance project plan (QAPP) to ensure data are correct and accurately reflects the environmental conditions being monitored. All data are screened for completeness, precision and accuracy where applicable, and scrutinized with data quality objective and data validation techniques. Sample results are intended to be used for education and research, baseline, local decision making, problem identification, and others uses deemed appropriate by the data user.

Water Quality Parameters

Water Temperature

Fish are cold-blooded and therefore depend on the temperature of water to be able to carry out processes such as metabolism and reproduction. Sources of warm water include powers plants' effluent after it has been used for cooling or hydroelectric plants which release warmer or cooler water (depending on the time of year) near the point of release. On a yearly scale, the amount of dissolved oxygen in the water decreases as temperatures increase, and vice versa, because warmer, less dense water can hold less oxygen molecules than cooler, more dense water. However, on a daily scale, the amount of dissolved oxygen in the water increases as temperatures increase, and vice versa, because of photosynthesis adding oxygen to the water body. Water temperature variations are most detrimental when they occur rapidly, leaving the biotic community no time to adjust. However, volunteer monitoring occurs at a particular time, so these variations are not covered in this report.

Dissolved Oxygen

Oxygen is necessary for the survival of most organisms. Too little oxygen will lead to asphyxiation of aquatic organisms. Too much oxygen (supersaturation) can cause bubbles to develop in cardiovascular systems, which could be fatal. Dissolved oxygen (DO) levels below 2 milligrams per liter (mg/L) can lead to asphyxiation, and levels above 20 mg/L can lead to supersaturation. The most suitable aquatic environment exhibits levels above 5 mg/L. High concentrations of nutrients can lead to excessive surface vegetation growth, which may starve subsurface vegetation of sunlight, and therefore limit the amount of dissolved oxygen in a water body due to limited photosynthesis. This process is enhanced when the subsurface vegetation dies and consumes oxygen when decomposing. They may also result from high groundwater inflows as groundwater is typically low in dissolved oxygen due to minimal aeration or high temperatures which reduce oxygen solubility.

pH

pH is a measure of acidity or alkalinity. The scale measures the concentration of hydrogen ions on a range of 0 to 14 and is reported in standard units (su). The range is logarithmic. Therefore, every 1 unit change means the acidity increased or decreased 10-fold. Sources of low pH (acidic) can include acid rain and runoff from acid-laden soils. Acid rain is mostly caused by coal power plants with minimal contributions from the burning of other fossil fuels and other processes such as volcanic emissions. Soil-acidity can be caused by excessive rainfall leaching alkaline materials out of soils, acidic parent material, crop decomposition creating hydrogen ions, or high-yielding fields which have drained the soil of all alkalinity. Sources of high pH include geologic composition as in the case of limestone increasing alkalinity and the dissolving of carbon dioxide in water. Carbon dioxide is water soluble, and as it dissolves it forms carbonic acid, an alkaline molecule. The most suitable range for healthy organisms is 6.5-9.

Specific Conductivity

Specific conductivity is a measure of the ability of a body of water to conduct electricity. It is measured in microSiemens per centimeter (µS/cm). A body of water is more conductive if it has more dissolved materials such as nutrients and salts, which indicate poor water quality if they are abundant. High concentrations of nutrients lower dissolved oxygen, the process of which was described in the previous section. High concentrations of salt can inhibit water absorption and limit root growth for vegetation, lead to an abundance of more drought tolerant plants, and cause dehydration of fish and amphibians.   Sources of total dissolved solids (TDS) can include agricultural runoff, domestic runoff, or discharges from wastewater treatment plants.

Secchi Depth and Total Depth


Secchi Disk

The Secchi Disk is used to determine the clarity of the water, a condition known as turbidity. The disk shown on the right is lowered into the water until it is no longer visible, and the depth is recorded. Highly turbid waters pose a risk to wildlife by clogging the gills of fish, reducing visibility, and carrying contaminants. Reduced visibility can harm predatory fish or birds that depend on good visibility to find their prey. Contaminants are most commonly transported in sediment rather than in the water. Average Secchi Depth readings below Total Depth readings indicate highly turbid water. Readings that are equal to total depth indicate clear water. Low total depth observations have a potential to concentrate contaminants.

Salinity

Salinity is a measure of dissolved salts in the water. Water bodies near the coast mix with salt water from the ocean to form a unique ecosystem exhibiting a gradual transition from low salt concentrations near the fresh water input to higher salt concentrations near the salt water input. The normal range for estuaries is 0-35 parts per thousand (ppt). The ocean has a salinity of 35 ppt, which is the same as saying it is 3.5% salt. 90% of the salt will be sodium chloride, which is popularly known as table salt. The remaining 10% consists of calcium, magnesium, sulfur, and potassium. Concentrations of salt affect the biotic community according to their adaptability. Many species need a certain level of salinity in order to survive, but some can tolerate a wide range of salinity. Adverse affects on an ecosystem depend on ambient conditions. Volunteer monitoring aid in determining these ambient conditions.

Watershed Data Analysis

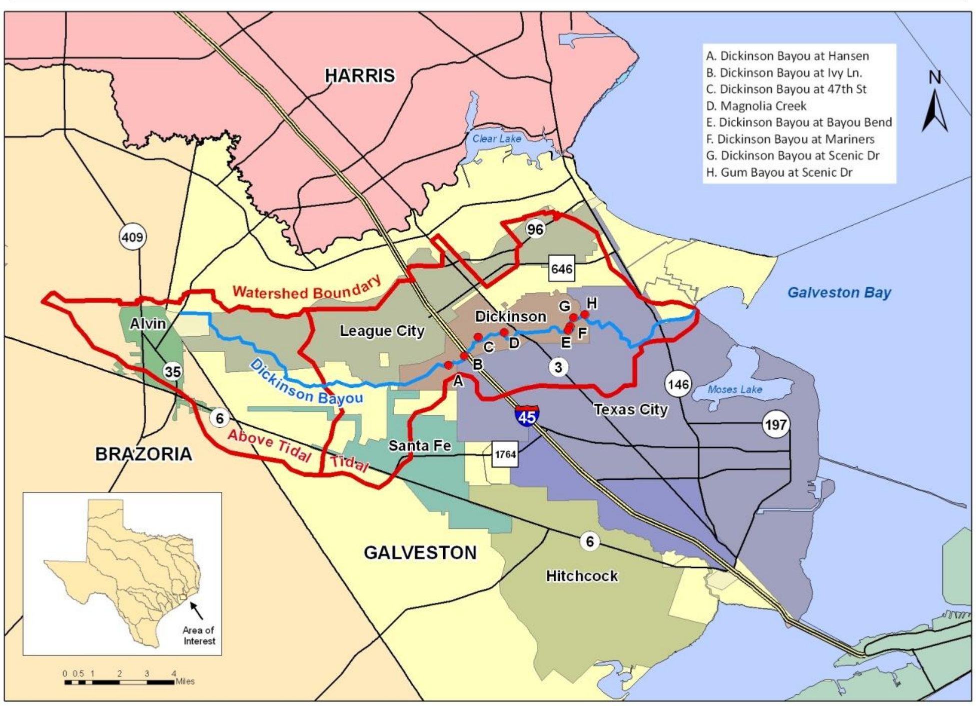
The section explains how to interpret the data shown below**.** The red lines shown on the graphs are the standard according to the 2000 Texas Water Quality Standards for the watersheds which the sites fall within. At least ten samples from the last seven years with approximately the same interval between sampling events are required for a data set to be considered adequate. 10% of these samples must then exceed the standard for the water body to be considered impaired. The water temperature standard is a maximum level. The conductivity standard is a maximum average amount. The dissolved oxygen standard is a minimum level, and the pH standards are a range. It is important to note that the amount of exceedance is only for reference. Regulatory action by the TCEQ is based on more/different data than that of the Texas Stream Team.

Volunteer water quality monitor data is available for the following segments within the watershed: Dickinson Bayou Tidal, Geisler Bayou (also known as Magnolia Creek), and Moses Lake. The following table shows impairments within these segments, according to the 2008 Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d). The entire list of impairments within this watershed can be found at http://www.tceq.state.tx.us/compliance/monitoring/water/quality/data/wqm/305_303.html. The bacteria impairment affects contact recreation (swimming, fishing, etc.). The low dissolved oxygen impairment affects aquatic life.

TCEQ 2008 303(d) List and Water Quality Inventory						
Segment	**ID**	**Area**	**Impairment**	**Concern**	**First Listed**	**Source**
Dickinson Bayou Tidal	1103_01	From 2.5 miles downstream of FM 517 to the Bordens Gully confluence	Bacteria Low Dissolved Oxygen		1996	Urban Runoff/Sewers & Non-point Source
	1103_02	From the Bordens Gully confluence to the Benson Bayou confluence			1996	
	1103_03	From the Benson Bayou confluence to the confluence with Gum Bayou			1996	
Geisler Bayou	1103C_01	From confluence with Dickinson Bayou tidal to IH 45 in Galveston County	Bacteria	Low Dissolved Oxygen	2002	

Dickinson Bayou Summary Statistics (Dec. 2003 - Feb. 2008)						
Parameter	**Range**	**Mean**	**Std. Dev.**	**Standard**	**% Exceedance**	**# Exceedance**
Water Temperature (°C)	13-30	23.05	5.94	35 (max.)	0	0/35
Dissolved Oxygen (mg/L)	3.2-9.8	5.64	2.06	3 (min.)	2.86	1/35
pH (su)	7-9	7.65	0.39	6.5-9	0	0/35

Texas Stream Team Volunteer Water Quality Monitoring Sites
Dickinson Bayou



Site-by-Site Data Analysis

Dickinson Bayou At Hansen					
Parameter	**Values**		**Mean**	**TCEQ Standard**	**Exceedance**
Sample Dates	10/6/07	11/6/07			
Sample Time	10:00	14:30	12:15		
Total Depth (m)	0.89	0.73	0.81		
Secchi Depth (m)	0.15	0.48	0.32		
Water Temperature (oC)	29.5	20.2	24.85	35 (max.)	No
Specific Conductivity (µS/cm)	None	3700	3700		
Dissolved Oxygen (mg/L)	None	5.3	5.3	3 (min.)	No
pH (su)	7.5	8.5	8	6.5-9	No
Salinity (ppt)	3.9				

Data collected by Kat Kirst

Dickison Bayou At Scenic Drive			
Parameter	**Value**	**TCEQ Standard**	**Exceedance**
Sample Date	11/28/07		
Sample Time	12:22		
Total Depth (m)	1.25		
Secchi Depth (m)	0.04		
Water Temperature (oC)	16.5	35 (max.)	No
Specific Conductivity (µS/cm)	3900		
Dissolved Oxygen (mg/L)	6.5	3 (min.)	No
pH (su)	8.3	6.5-9	No

Data collected by Kat Kirst

Dickinson Bayou At Bayou Bend			
Parameter	**Value**	**TCEQ Standard**	**Exceedance**
Sample Date	10/13/07		
Sample Time	10:08		
Total Depth (m)	0.92		
Secchi Depth (m)	0.47		
Water Temperature (oC)	26	35 (max.)	No
Specific Conductivity (µS/cm)	6000		
Dissolved Oxygen (mg/L)	3.75	3 (min.)	No
pH (su)	7.5	6.5-9	No

Data collected by R.J. Christie

Dickinson Bayou At Mariners					
Parameter	**Values**		**Mean**	**TCEQ Standard**	**Exceedance**
Sample Dates	10/5/07	11/4/07			
Sample Time	10:00	9:32	9:46		
Total Depth (m)	1.08	1.07	1.08		
Secchi Depth (m)	0.45	0.52	0.49		
Water Temperature (^oC)	27.5	21	24.25	35 (max.)	No
Specific Conductivity (µS/cm)	3100	6400	4750		
Dissolved Oxygen (mg/L)	7.1	9.1	8.1	3 (min.)	No
pH (su)	8	9	8.5	6.5-9	No

Data collected by Jan Culbertson

Dickinson Bayou @ 47th Street			
Parameter	**Value**	**TCEQ Standard**	**Exceedance**
Sample Time	11:00		
Total Depth (m)	3		
Secchi Depth (m)	0.3		
Water Temperature (^oC)	23	35 (max.)	No
Specific Conductivity (µS/cm)	12800		
Dissolved Oxygen (mg/L)	6.8	3 (min.)	No
pH (su)	7.2	6.5-9	No

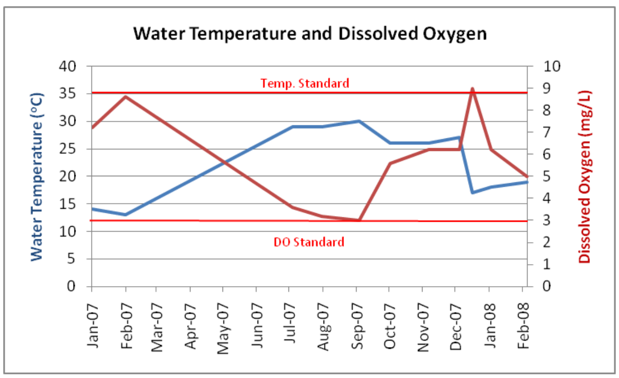
Data collected by Jim Keese

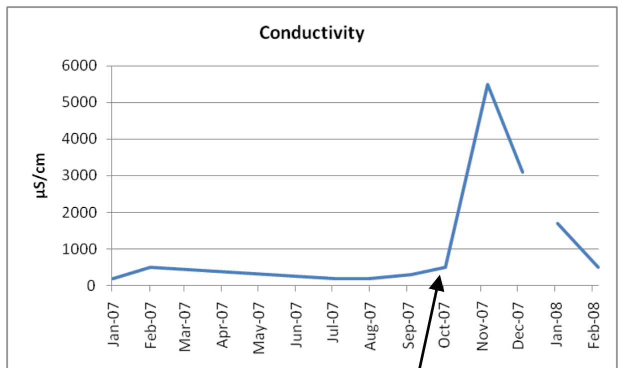
Gum Bayou At Scenic Drive			
Parameter	**Value**	**TCEQ Standard**	**Exceedance**
Sample Date	11/28/07		
Sample Time	11:32		
Total Depth (m)	3.25		
Secchi Depth (m)	0.05		
Water Temperature (oC)	15	35 (max.)	No
Specific Conductivity (µS/cm)	2600		
Dissolved Oxygen (mg/L)	5.7	3 (min.)	No
pH (su)	7.5	6.5-9	No

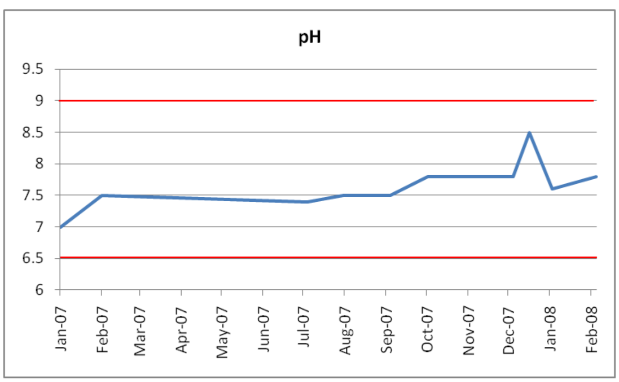
Data collected by Peggy Wright

Dickinson Bayou At Ivy Ln.						
Parameter	#	% Complete	Min.	Mean.	Max.	Std. Dev.
Sample Time	13	100	10:00	12:19	16:00	2:16
Total Depth (m)	13	100	0.41	0.75	1.4	0.28
Secchi Depth (m)	13	100	0.17	0.35	0.5	0.16
Water Temperature (°C)	13	100	13	23.54	30	6.33
Specific Conductivity (µS/cm)	12	92	200	1091.67	5500	1637.33
Dissolved Oxygen (mg/L)	13	100	3	5.43	9	2.05
pH (su)	13	100	7	7.62	8.5	0.35
Salinity (ppt)	1	7	21.2	21.20	21.2	N/A

Parameter	TCEQ Standard	# Exceedance
Water Temperature (°C)	35 (max.)	0/13
Dissolved Oxygen (mg/L)	3 (min.)	0/13
pH (su)	6.5-9	0/13





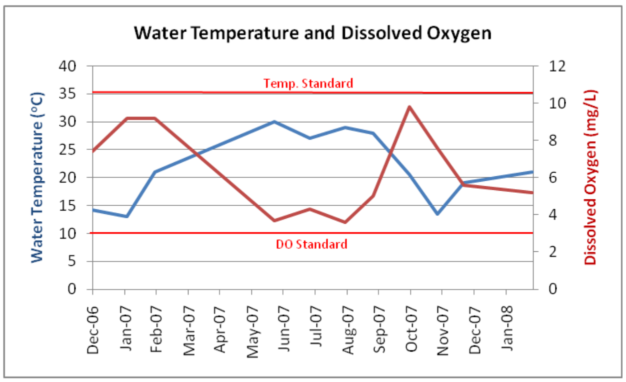


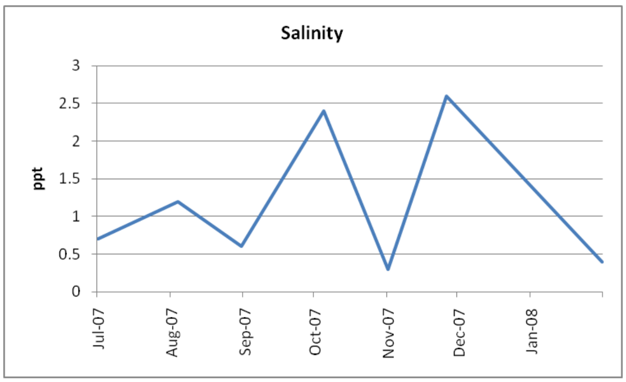
The spike in conductivity here occurred when there had been 32 days since the last precipitation event. The average amount of days since the last precipitation event is 7.5, so it had been raining regularly. Then, it stopped raining. This rise is conductivity could indicate an increase of salinity levels from Galveston Bay, which can affect the integrity of the biotic system.

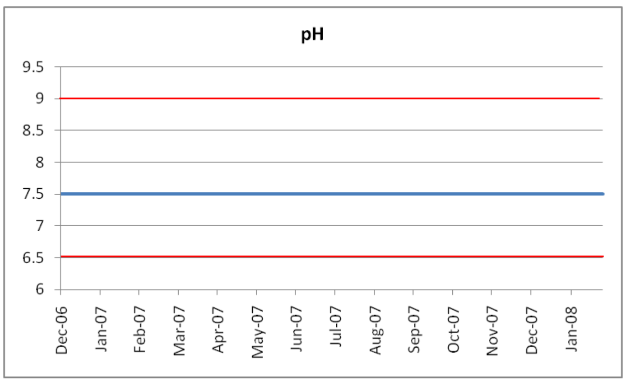
Data collected by Sara Snell

Magnolia Creek						
Parameter	#	% Complete	Min.	Mean.	Max.	Std. Dev.
Sample Time	14	100	10:15	13:06	15:05	1:15
Total Depth (m)	14	100	0.86	1.41	1.81	0.28
Secchi Depth (m)	14	100	0.16	0.29	0.3	0.08
Water Temperature (^{o}C)	14	100	13	23.01	30	6.35
Specific Conductivity (µS/cm)	1	7	400	400	400	N/A
Dissolved Oxygen (mg/L)	14	100	3.6	5.87	9.8	2.30
pH (su)	14	100	7.5	7.5	7.5	0
Salinity (ppt)	9	64	0.3	1.12	2.6	0.84

Parameter	TCEQ Standard	# Exceedance
Water Temperature (^{o}C)	35 (max.)	0/14
Dissolved Oxygen (mg/L)	3 (min.)	0/14
pH (su)	6.5-9	0/14







Data collected by Frank Bundy

[i] Dickinson Bayou Watershed Partnership, *Watershed Information*, 18 November 2005, available from http://www.dickinsonbayou.org/watersheds/info/info.htm, accessed 1 April 2010.

[ii] Dickinson Bayou Watershed Partnership, *Dickinson Bayou Watershed*, May 2004, available from http://www.dickinsonbayou.org/watersheds/info/documents/DickinsonBrochure.pdf, accessed 1 April 2010.

[iii] Dickinson Bayou Watershed Partnership Habitat Workgroup, *Habitats of the Dickinson Bayou Watershed,* 27 April 2006, available from *http*://www.dickinsonbayou.org/documents/DB_Hab_plan_12_07.pdf, accessed 1 April 2010.

[iv] Texas State Soil and Water Conservation Board, *Watershed Protection Plan Program,* n.d., available from *http*://www.tsswcb.state.tx.us/wpp#watersheds, accessed 1 April 2010.