Lake Worth Watershed Data Report DRAFT

October 2016

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Introduction

Texas Stream Team is a volunteer-based citizen water quality monitoring program. Citizen scientists collect surface water quality data that may be used in the decision-making process to promote and protect a healthy and safe environment for people and aquatic inhabitants. Citizen scientist water quality monitoring occurs at predetermined monitoring sites, at roughly the same time of day each month. Citizen scientist water quality monitoring data provides a valuable resource of information by supplementing professional data collection efforts where resources are limited. The data may be used by professionals to identify water quality trends, target additional data collection needs, identify potential pollution events and sources of pollution, and to test the effectiveness of water quality management measures.

Texas Stream Team citizen scientist data are not used by the state to assess whether water bodies are meeting the designated surface water quality standards. Texas Stream Team citizen scientists use different methods than the professional water quality monitoring community. These methods are not utilized by Texas Stream Team due to higher equipment costs, training requirements, and stringent laboratory procedures that are required of the professional community. As a result, Texas Stream Team data do not have the same accuracy or precision as professional data, and are not directly comparable. However, the data collected by Texas Stream Team provides valuable records, often collected in portions of a water body that professionals are not able to monitor frequently, or monitor at all. This long-term data set is available, and may be considered by the surface water quality professional community to facilitate management and protection of Texas water resources. For additional information about water quality monitoring methods and procedures, including the differences between professional and volunteer monitoring, please refer to the following sources:

- Texas Stream Volunteer Water Quality Monitoring Manual
- Texas Commission on Environmental Quality (TCEQ) Surface Water Quality Monitoring Procedures

The information that Texas Stream Team citizen scientists collect is covered under a TCEQ-approved Quality Assurance Project Plan (QAPP) to ensure that a standard set of methods are used. All data used in watershed data reports are screened by the Texas Stream Team for completeness, precision, and accuracy, in addition to being scrutinized for data quality objectives and with data validation techniques.

The purpose of this report is to provide analysis of data collected by Texas Stream Team citizen scientists. The data presented in this report should be considered in conjunction with other relevant water quality reports in order to provide a holistic view of water quality in this water body. Such sources include, but are not limited to, the following potential resources:

- Texas Surface Water Quality Standards
- Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d)
- Texas Clean Rivers Program partner reports, such as Basin Summary Reports and Highlight Reports
- TCEQ Total Maximum Daily Load reports
- TCEQ and Texas State Soil and Water Conservation Board Nonpoint Source Program funded reports, including Watershed Protection Plans

Questions regarding this watershed data report should be directed to the Texas Stream Team at (512) 245-1346.

Watershed Location and Physical Description

Location

Lake Worth is located within or adjacent to the city limits of Fort Worth, Texas, and it serves as an impoundment of the West Fork of the Trinity River (TCEQ 2014). The lake itself spans 3,558 acres, and has a maximum depth of 22 feet (TCEQ 2014, TPWD). The Lake Worth watershed contains 2,064 square miles across Tarrant and Parker counties (TCEQ 2014). It is located directly south of the Eagle Mountain Reservoir, which is managed by the Tarrant Regional Water District (NCTCOG 2011, TCEQ 2014). The lake and the West Fork eventually drain into the Upper Trinity River through the Upper Trinity River basin (NCTOG 2011).

The lake level fluctuates on a moderate level and is considered to have stained clarity (TPWD). Aquatic vegetation is minimal, although shallow areas containing cattails and emergent plant species to exist (TPWD). Lake Worth has been stocked numerous times in the past with various species, mostly bass and catfish (TPWD). White crappies are also located within the lake (TPWD).

Land Use and Impairments

The Lake Worth Watershed land usage is classified as approximately 35 percent urban and 60 percent rural, and its primary uses are for recreation and drinking water for the City of Fort Worth (TCEQ). The lake is home to many fishing docks, piers, and boat houses that offer ample infrastructure for fishing purposes (TPWD). The watershed itself is highly developed as it encompasses areas of northwest Fort Worth (NCTCOG 2011).

There are two major military-industrial facilities located on the south side of Lake Worth: US Naval Air Station Joint Reserve Base—Fort Worth (NASFW) and Air Force Plant No. 4 (AFP4) (TCEQ). The Resource Conservation and Recovery Act (RCRA) has classified both facilities as cleanup areas, and AFP4 is considered a site of major interest in combating rising levels of toxic polychlorinated biphenyls (PCBs) that have negatively impacted fish populations within the lake (TCEQ). Lake Worth has also been a trap for high loads of sediment from its watershed, requiring large levels of dredging to restore its original status as an area for recreation ("Water," City of Fort Worth).

TMDL and I-Plans

The Texas Commission on Environmental Quality commissioned a total maximum daily load project (TMDL) to determine pollutant loads necessary to restore the watershed's original uses, and the State of Texas developed an implementation plan to reduce pollutant loads within the watershed (TCEQ). Although there is no Watershed Protection Plan (WPP) developed for the Lake Worth watershed yet, the Tarrant Regional Water District (TRWD) and Texas A&M AgriLife are currently cooperating in an effort to develop a WPP. (NCTCOG 2011). As of 2016, baseline modeling of the watershed using a Soil & Water Assessment Tool (SWAT) is complete. Two WPP implementation steps are currently in progress, including an evaluation of Best Management Practices (BMPs) and developing a monitoring plan. The scheduled completion date for these steps is Fall 2016 ("Update," City of Fort Worth 2016).

The City of Fort Worth has also taken an active role in assisting with watershed management through their Capital Improvement Implementation Plan (CIIP). CIIP facilitates projects such as dredging, sanitary improvements, and constructing boat ramps and nature trail/city park improvements ("Water," City of Fort Worth 2015). Fort Worth also adopted the Lake Worth Vision Plan in 2011 in conjunction with the Lake Worth Regional Coordination Committee (LWRCC), which focuses on restoring the lake's water quality and recreational character as well as developing sustainable communities in the area to increase livability in the area (City of Fort Worth 2016).

Endangered Species and Conservation Needs

Tarrant County has several federal and state listed endangered or threated species which include:

Birds	American Peregrine Falcon	Mammals	Gray Wolf
	Bald Eagle		Red Wolf
	Interior Least Tern	Mollusks	Louisiana Pigtoe
	Peregrine Falcon		Sandback Pocketbook
	Red Knot		Texas Heelsplitter
	Whooping Crane	Reptiles	Texas Horned Lizard
Fishes	Shovelnose Sturgeon		Timber Rattlesnake

Tarrant County may also see several Species of Greatest Conservation Need (SGCN). These species are in decline or they are rare and are in need of attention in order to recover and prevent them from becoming listed species (Texas Parks & Wildlife 2016):

Birds	Henslow's Sparrow	Plants	Auriculate False Foxglove
	Sprague's Pipit		Glen Rose Yucca
	Western Burrowing Owl		Hall's Prairie Clover
Crustaceans	An Amphipod		Osage Plains False Foxglove
	Bifurcated Cave Amphipod		Reverchon's Curfpea
	Ezell's Cave Amphipod		Texas Milk Vetch
Mammals	Plains Spotted Skunk		Topeka Purple-Coneflower
Reptiles	Texas Garter Snake		

Water Quality Parameters

Water Temperature

Water temperature influences the physiological processes of aquatic organisms and each species has an optimum temperature for survival. High water temperatures increase oxygen-demand for aquatic communities and can become stressful for fish and aquatic insects. Water temperature variations are most detrimental when they occur rapidly; leaving the aquatic community no time to adjust. Additionally, the ability of water to hold oxygen in solution (solubility) decreases as temperature increases.

Natural sources of warm water are seasonal, as water temperatures tend to increase during summer and decrease in winter in the Northern Hemisphere. Daily (diurnal) water temperature changes occur during normal heating and cooling patterns. Man-made sources of warm water include power plant effluent after it has been used for cooling or hydroelectric plants that release warmer water. Citizen scientist monitoring may not identify fluctuating patterns due to diurnal changes or events such as power plant releases. While citizen scientist data does not show diurnal temperature fluctuations, it may demonstrate the fluctuations over seasons and years.

Dissolved Oxygen

Oxygen is necessary for the survival of organisms like fish and aquatic insects. The amount of oxygen needed for survival and reproduction of aquatic communities varies according to species composition and adaptations to watershed characteristics like stream gradient, habitat, and available stream flow. The TCEQ Water Quality Standards document lists daily minimum Dissolved Oxygen (DO) criteria for specific water bodies and presumes criteria according to flow status (perennial, intermittent with perennial pools, and intermittent), aquatic life attributes, and habitat. These criteria are protective of aquatic life and can be used for general comparison purposes.

The DO concentrations can be influenced by other water quality parameters such as nutrients and temperature. High concentrations of nutrients can lead to excessive surface vegetation growth and algae, which may starve subsurface vegetation of sunlight, and therefore limit the amount of DO in a water body due to reduced photosynthesis. This process, known as eutrophication, is enhanced when the subsurface vegetation and algae die and oxygen is consumed by bacteria during decomposition. Low DO levels may also result from high groundwater inflows due to minimal groundwater aeration, high temperatures that reduce oxygen solubility, or water releases from deeper portions of dams where DO stratification occurs. Supersaturation typically only occurs underneath waterfalls or dams with water flowing over the top.

Specific Conductivity and Total Dissolved Solids

Specific conductivity is a measure of the ability of a body of water to conduct electricity. It is measured in micro Siemens per cubic centimeter ($\mu S/cm^3$). A body of water is more conductive if it has more dissolved solids such as nutrients and salts, which indicates poor water quality if they are overly abundant. High concentrations of nutrients can lower the level of DO, leading to eutrophication. High concentrations of salt can inhibit water absorption and limit root growth for vegetation, leading to an abundance of more drought tolerant plants, and can cause dehydration of fish and amphibians. Sources of Total Dissolved Solids (TDS) can include agricultural runoff, domestic runoff, or discharges from wastewater treatment plants. For this report, specific conductivity values have been converted to TDS using a conversion factor of 0.65 and are reported as mg/L.

pH

The pH scale measures the concentration of hydrogen ions on a range of 0 to 14 and is reported in standard units (su). The pH of water can provide useful information regarding acidity or alkalinity. The range is logarithmic; therefore, every 1 unit change is representative of a 10-fold increase or decrease in acidity. Acidic sources, indicated by a low pH level, 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 natural 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 that have drained the soil of all alkalinity. Sources of high pH (alkaline) 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. The most suitable pH range for healthy organisms is between 6.5 and 9.

Texas Surface Water Quality Standards

The Texas Surface Water Quality Standards establish explicit goals for the quality of streams, rivers, lakes, and bays throughout the state. The standards are developed to maintain the quality of surface waters in Texas so that it supports public health and protects aquatic life, consistent with the sustainable economic development of the state.

Water quality standards identify appropriate uses for the state's surface waters, including aquatic life, recreation, and sources of public water supply (or drinking water). The criteria for evaluating support of those uses include DO, temperature, pH, TDS, toxic substances, and bacteria.

The Texas Surface Water Quality Standards also contain narrative criteria (verbal descriptions) that apply to all waters of the state and are used to evaluate support of applicable uses. Narrative criteria include general descriptions, such as the existence of excessive aquatic plant growth, foaming of surface waters, taste- and odor producing substances, sediment build-up, and toxic materials. Narrative criteria are evaluated by using screening levels, if they are available, as well as other information, including water quality studies, existence of fish kills or contaminant spills, photographic evidence, and local knowledge. Screening levels serve as a reference point to indicate when water quality parameters may be approaching levels of concern.

Data Analysis Methodologies

Data Collection

The field sampling procedures are documented in Texas Stream Team Water Quality Monitoring Manual and its appendices, or the TCEQ Surface Water Quality Monitoring Procedures Manual, Volume 1 (August 2012). Additionally, all data collection adheres to Texas Stream Team's approved Quality Assurance Project Plan (QAPP).

Table 1: Sample Storage, Preservation, and Handling Requirements

Parameter	Matrix	Container	Sample Volume	Preservation	Holding Time
E. coli	Water	Sterile Polystyrene (SPS)	100	Refrigerate at 4ºC*	6 hours
Nitrate/Nitrogen	Water	Plastic Test Tube	10 mL	Refrigerate at 4ºC*	48 hours
Orthophosphate/Phosphorous	Water	Glass Mixing Bottle	25 mL	Refrigerate at 4ºC*	48 hours
Chemical Turbidity	water	Plastic Turbidity Column	50 mL	Refrigerate at 4ºC*	48 hours

*Preservation performed within 15 minutes of collection.

Processes to Prevent Contamination

Procedures documented in Texas Stream Team Water Quality Monitoring Manual and its appendices, or the TCEQ Surface Water Quality Monitoring Procedures Manual, Volume 1 (August 2012) outline the necessary steps to prevent contamination of samples, including direct collection into sample containers, when possible. Field Quality Control (QC) samples are collected to verify that contamination has not occurred.

Documentation of Field Sampling Activities

Field sampling activities are documented on the field data sheet. For all field sampling events the following items are recorded: station ID, location, sampling time, date, and depth, sample collector's name/signature, group identification number, conductivity meter calibration information, and reagent expiration dates are checked and recorded if expired.

Sampling is still encouraged with expired reagents and bacteria media; however, the corresponding values will be flagged in the database. Detailed observational data are recorded, including water appearance, weather, field observations (biological activity and stream uses), algae cover, unusual odors, days since last significant rainfall, and flow severity.

Comments related to field measurements, number of participants, total time spent sampling, and total round-trip distance traveled to the sampling site are also recorded for grant and administrative purposes.

Data Entry and Quality Assurance

Data Entry

The citizen scientists collect field data and report the measurement results on Texas Stream Team approved physical or electronic datasheet. The physical data sheet is submitted to the Texas Stream Team and local partner, if applicable. The electronic datasheet is accessible in the online DataViewer and, upon submission and verification, is uploaded directly to the Texas Stream Team Database.

Quality Assurance & Quality Control

All data are reviewed to ensure that they are representative of the samples analyzed and locations where measurements were made, and that the data and associated quality control data conform to specified monitoring procedures and project specifications. The respective field, data management, and Quality Assurance Officer (QAO) data verification responsibilities are listed by task in the Section D1 of the QAPP, available on the Texas Stream Team website.

Data review and verification is performed using a data management checklist and self-assessments, as appropriate to the project task, followed by automated database functions that will validate data as the information is entered into the database. The data are verified and evaluated against project specifications and are checked for errors, especially errors in transcription, calculations, and data input. Potential errors are identified by examination of documentation and by manual and computer-assisted examination of corollary or unreasonable data. Issues that can be corrected are corrected and documented. If there are errors in the calibration log, expired reagents used to generate the sampling data, or any other deviations from the field or *E. coli* data review checklists, the corresponding data is flagged in the database.

When the QAO receives the physical data sheets, they are validated using the data validation checklist, and then entered into the online database. Any errors are noted in an error log and the errors are flagged in the Texas Stream Team database. When a citizen scientist enters data electronically, the system will automatically flag data outside of the data limits and the citizen scientist will be prompted to correct the mistake or the error will be logged in the database records. The certified QAO will further review any flagged errors before selecting to validate the data. After validation the data will be formally entered into the database. Once entered, the data can be accessible through the online DataViewer.

Errors, which may compromise the program's ability to fulfill the completeness criteria prescribed in the QAPP, will be reported to the Texas Stream Team Program Manager. If repeated errors occur, the citizen scientist and/or the group leader will be notified via e-mail or telephone.

Data Analysis Methods

Data are compared to state standards and screening levels, as defined in the Surface Water Quality Monitoring Procedures, to provide readers with a reference point for amounts/levels of parameters that may be of concern. The assessment performed by TCEQ and/or designation of impairment involves more complicated monitoring methods and oversight than used by volunteers and staff in this report. The citizen water quality monitoring data are not used in the assessments mentioned above, but are intended to inform stakeholders about general characteristics and assist professionals in identifying areas of potential concern.

Standards & Exceedances

The TCEQ determines a water body to be impaired if more than 10% of samples, provided by professional monitoring, from the last seven years, exceed the standard for each parameter, except for *E. coli* bacteria. When the observed sample value does not meet the standard, it is referred to as an exceedance. At least ten samples from the last seven years must be collected over at least two years with the same reasonable amount of time between samples for a data set to be considered adequate. The 2014 Texas Surface Water

Quality Standards report was used to calculate the exceedances for the Lake Worth Watershed, as seen below in Table 2.

Table 2: Summary of Surface Water Quality Standards for the Lake Worth Watershed

Parameter	Texas Surface Water Quality Standard 2014
Water Temperature (°C)	32.8
Total Dissolved Solids (mg/L)	500
Dissolved Oxygen (mg/L)	5.0
pH (su)	6.5-9.0
E.coli (CFU/100 mL)	126 (geomean during sampling period)

Methods of Analysis

All data collected from the Lake Worth Watershed were exported from the Texas Stream Team database and were then grouped by site.

Once compiled, data was sorted and graphed in Microsoft Excel 2010 using standard methods. Trends over time were analyzed using a linear regression analysis in Minitab v 15. Statistically significant trends were added to Excel to be graphed. The cut off for statistical significance was set to a p-value of ≤ 0.05. A p-value of ≤ 0.05 means that the probability that the observed data matches the actual conditions found in nature is 95%. As the p-value decreases, the confidence that it matches actual conditions in nature increases.

For this report, specific conductivity measurements, gathered by citizen scientists, were converted to TDS using the TCEQ-recommended conversion formula of specific conductivity 0.65. This conversion was made so that volunteer-gathered data could be more readily compared to state-gathered data.

Lake Worth Watershed Data Analysis

Lake Worth Watershed Maps

Numerous maps were prepared to show spatial variation of the parameters. The parameters mapped include DO, pH, and TDS. There is also a reference map showing the locations of all active sites. For added reference points in all maps, layers showing monitoring sites, cities, counties, and major highways were included. All shapefiles were downloaded from reliable federal, state, and local agencies.

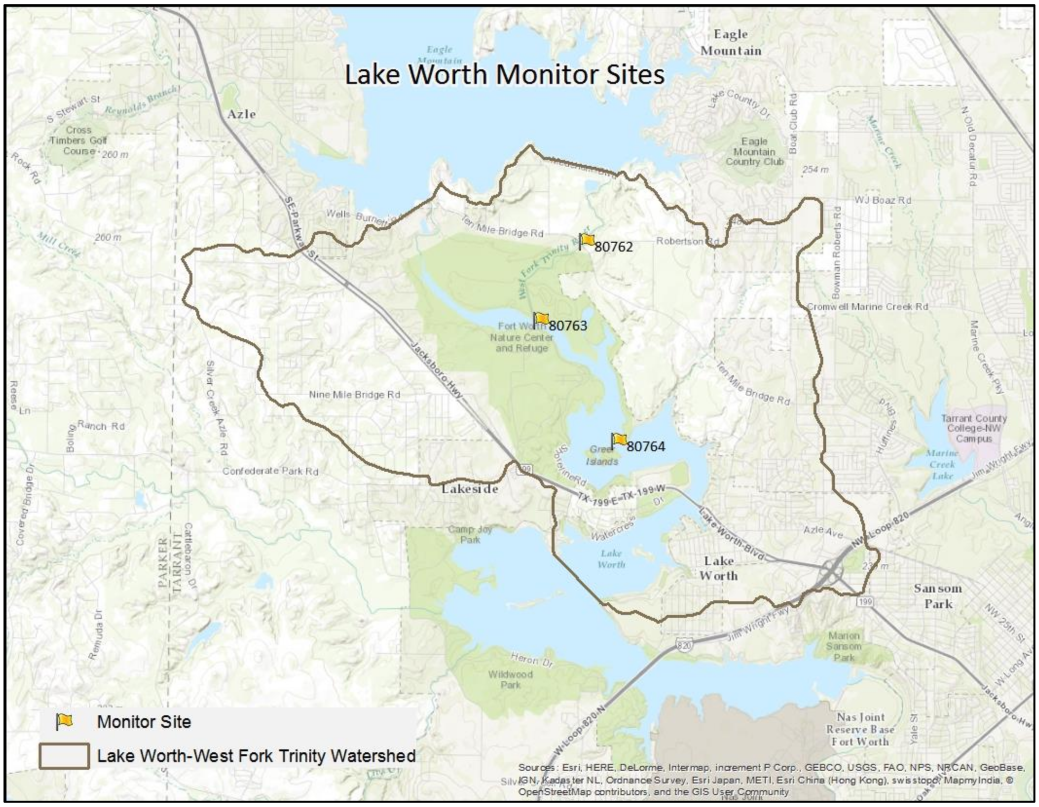


Figure 1: Map of the Lake Worth Watershed with Texas Stream Team Monitor Sites

Lake Worth Watershed Trends over Time

Sampling Trends over Time

Sampling in the Lake Worth Watershed began in September of 2012 and continues to this day. A total of 94 monitoring events from 3 sites were analyzed. Monthly monitoring occurred on a consistent basis between 2012 and 2015.

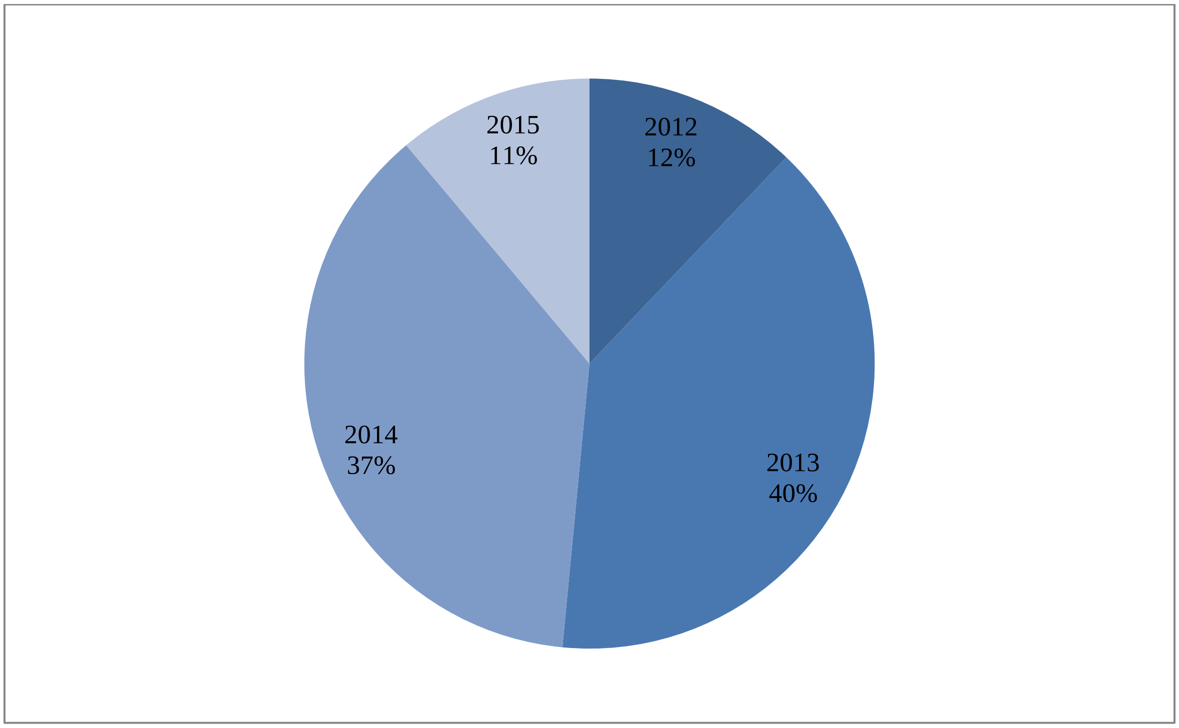


Figure 2: Breakdown of monitoring events by year.

Table 3: Descriptive parameters for all sites in the Lake Worth Watershed

Lake Worth Watershed September 2012 – March 2015				
Parameter	Number of Samples	Mean ± Standard Deviation	Min	Max
Total Dissolved Solids (mg/L)	95	242 ± 41	156	332
Water Temperature (°C)	95	18.0 ± 8.4	3.1	31.1
Dissolved Oxygen (mg/L)	93	7.7 ± 2.1	3.9	12.2
pH	94	7.4 ± 0.4	7.0	8.5

There were a total of 99 sampling events between 9/13/2012 and 12/22/2015.

Trend Analysis over Time

Air and water temperature

A total of 95 air and water temperature samples were taken in this watershed between 2012 and 2015. Water temperature never exceeded the TCEQ optimal temperature of 32.8 °C. The mean water temperature was 18.0°C. Water temperature ranged from a low of 3.1 °C in February of 2014 to a high of 31.1 °C in July of 2014. Air temperature ranged from a low of 0.7 °C in February of 2014 to a high of 34.1 in July of 2013.

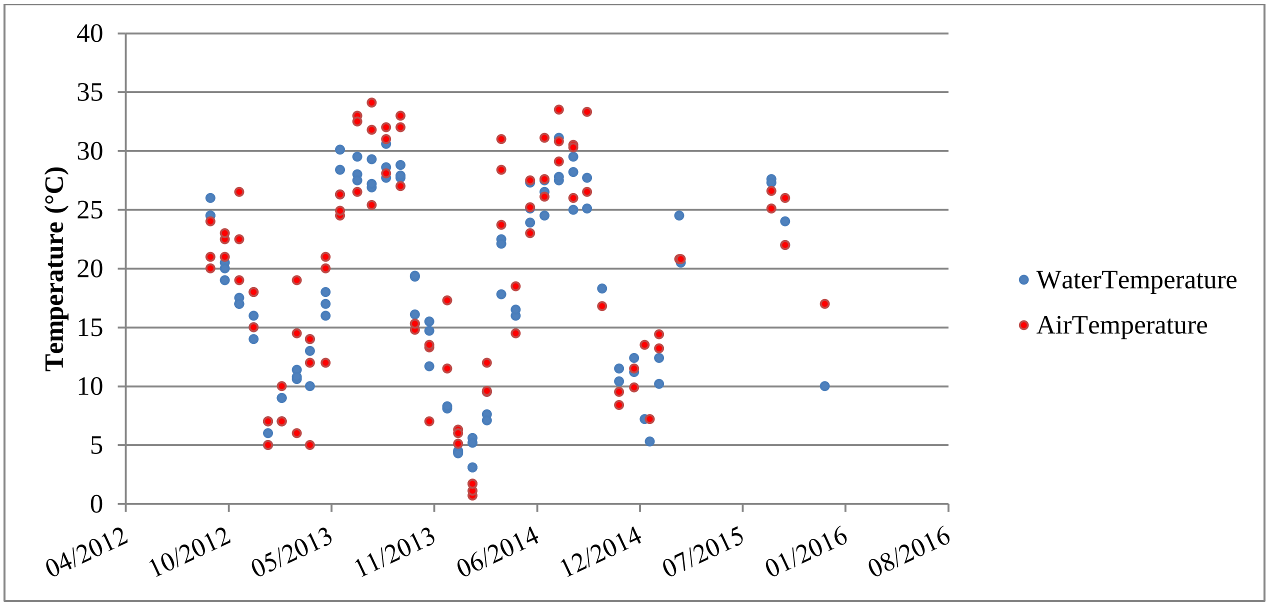


Figure 3: Air and water temperature over time at all sites within the Lake Worth Watershed

Total Dissolved Solids

Citizen scientists conducted a total of 95 TDS measurements in the watershed. The mean TDS concentration for all sites was 242 mg/L. The minimum TDS concentration was 156 mg/L in June of 2014. The maximum TDS concentration was 332 mg/L and was taken in March of 2014. There was no increase or decrease in TDS concentration over time recorded for this watershed.

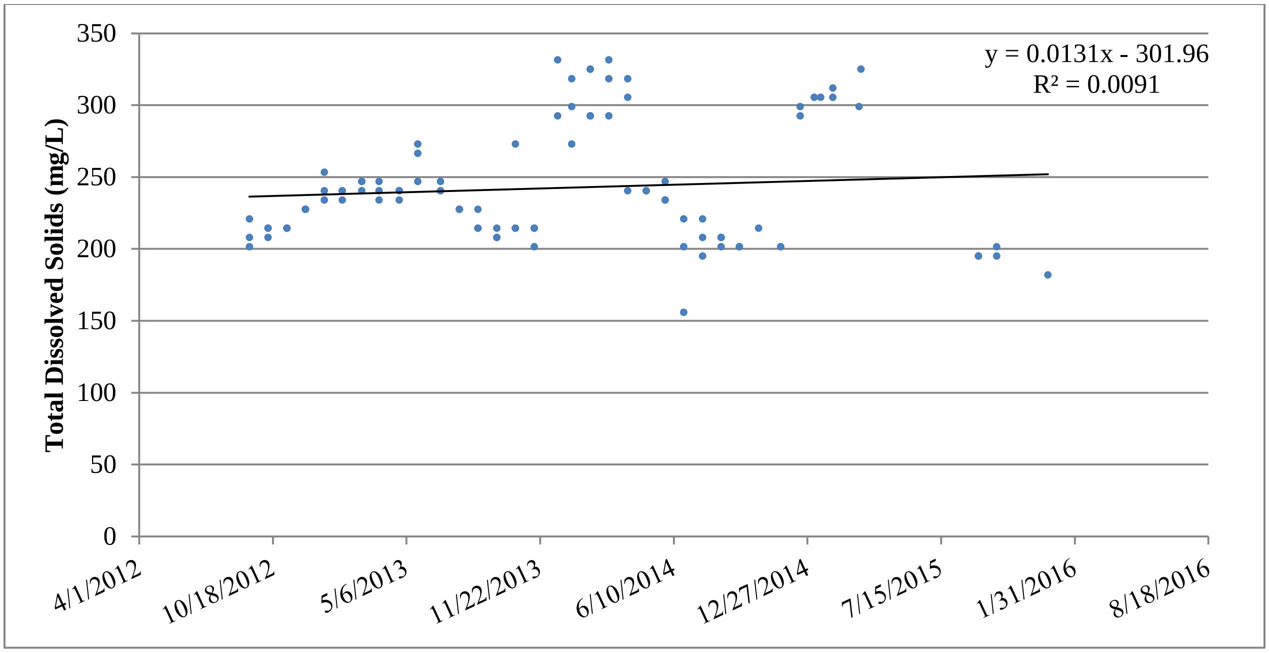


Figure 4: Total dissolved solids over time at all sites within the Lake Worth Watershed

Dissolved Oxygen

Citizen scientists collected a total of 93 dissolved oxygen samples in this watershed. The mean DO concentration was 7.7 mg/L. The minimum DO concentration was 3.9 mg/L and was recorded in July of 2013. The maximum DO concentration was 12.2 mg/L and was recorded in February of 2014.

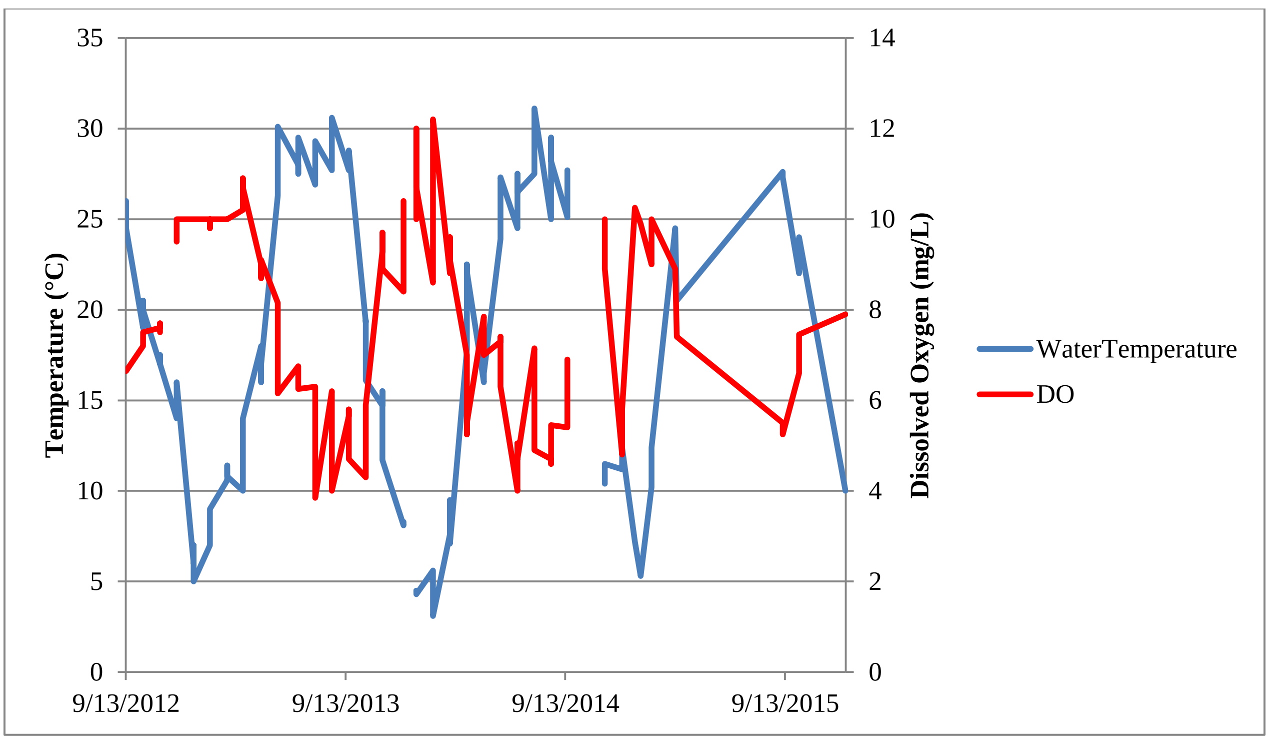


Figure 5: Water temperature and dissolved oxygen over time at all sites within the Lake Worth Watershed

pH

Citizen scientists took 94 pH samples in this watershed. The mean pH was 7.4 and it ranged from a low of 7.0 to a high of 8.5 in January of 2013. There was a significant decrease in pH over time in this watershed (p = 0.000) and the R^2 of 0.42 indicates a strong relationship over time.

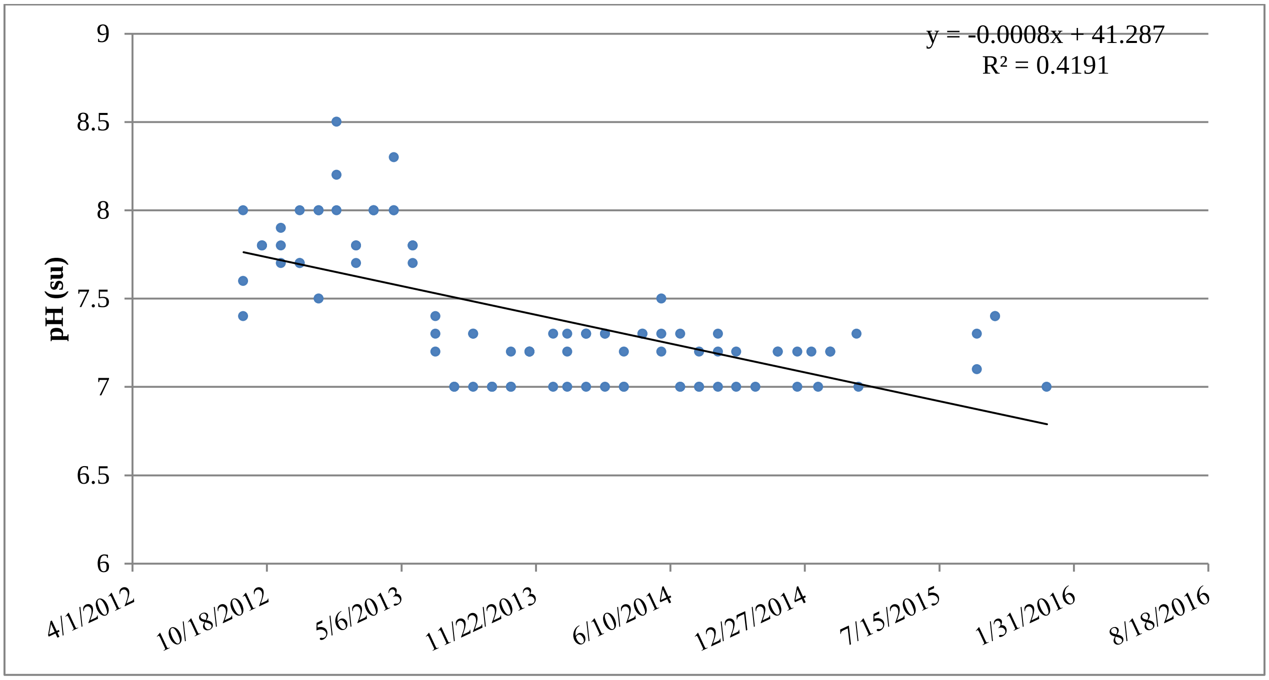


Figure 6: pH over time at all sites within the Lake Worth Watershed

Lake Worth Watershed Site by Site Analysis

The following sections will provide a brief summarization of analysis, by site. The average minimum and maximum values recorded in the watershed. These values are reported in order to provide a quick overview of the watershed. The TDS, DO, and pH values are presented as an average, plus or minus the standard deviation from the average. Please see Table 4 on the following page, for a quick overview of the average results.

As previously mentioned in the 'Water Quality Parameters' section, TDS is an important indicator of turbidity and specific conductivity. The higher the TDS measurement, the more conductive the water is. A high TDS result can indicate increased nutrients present in the water. Site 80762 had the highest overall average for TDS, with a result of 246 ± 46 mg/L. Site 80764 had the lowest average TDS, with a result of 243 ± 33 mg/L.

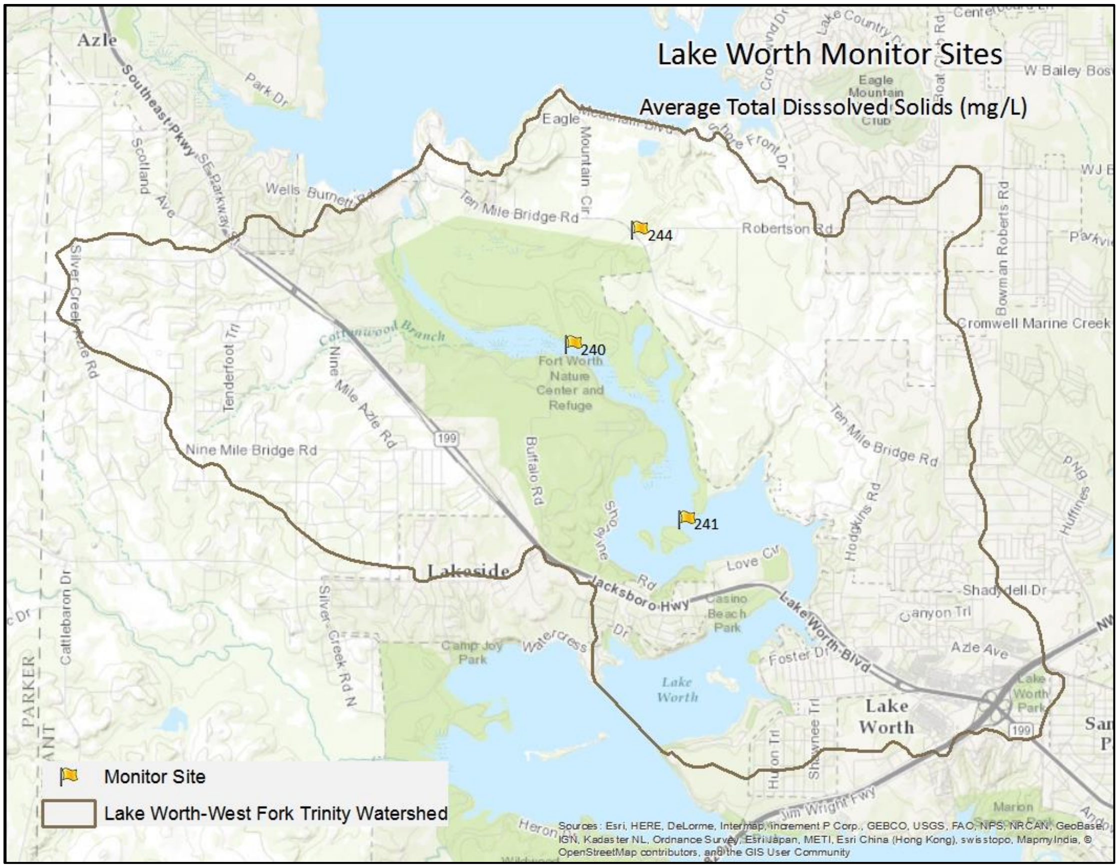


Figure 7: Map of the average total dissolved solids for sites in the Lake WorthWatershed

The DO measurement can help to understand the overall health of the aquatic community. If there is a large influx of nutrients into the water body than there will be an increase in surface vegetation growth, which can then reduce photosynthesis in the subsurface, thus decreasing the level of DO. Low DO can be dangerous for aquatic inhabitants, which rely upon the dissolved oxygen to breathe. Another contributing factor is that the surface vegetation growth can sink to the bottom, with the bacteria that subsequently decompose the vegetation using the sub-surface oxygen via the respiration reaction. The DO levels can also be impacted by temperature; a high temperature can limit the amount of oxygen solubility, which can also lead to a low DO measurement. Sites 80762 and 80764 had the lowest average DO reading, with a result of 7.6 ± 2.0 mg/L and 7.6 ± 2.6 mg/L respectively. Site 80763 had the highest average DO reading, with a result of 8.1 ± 2.0 mg/L.

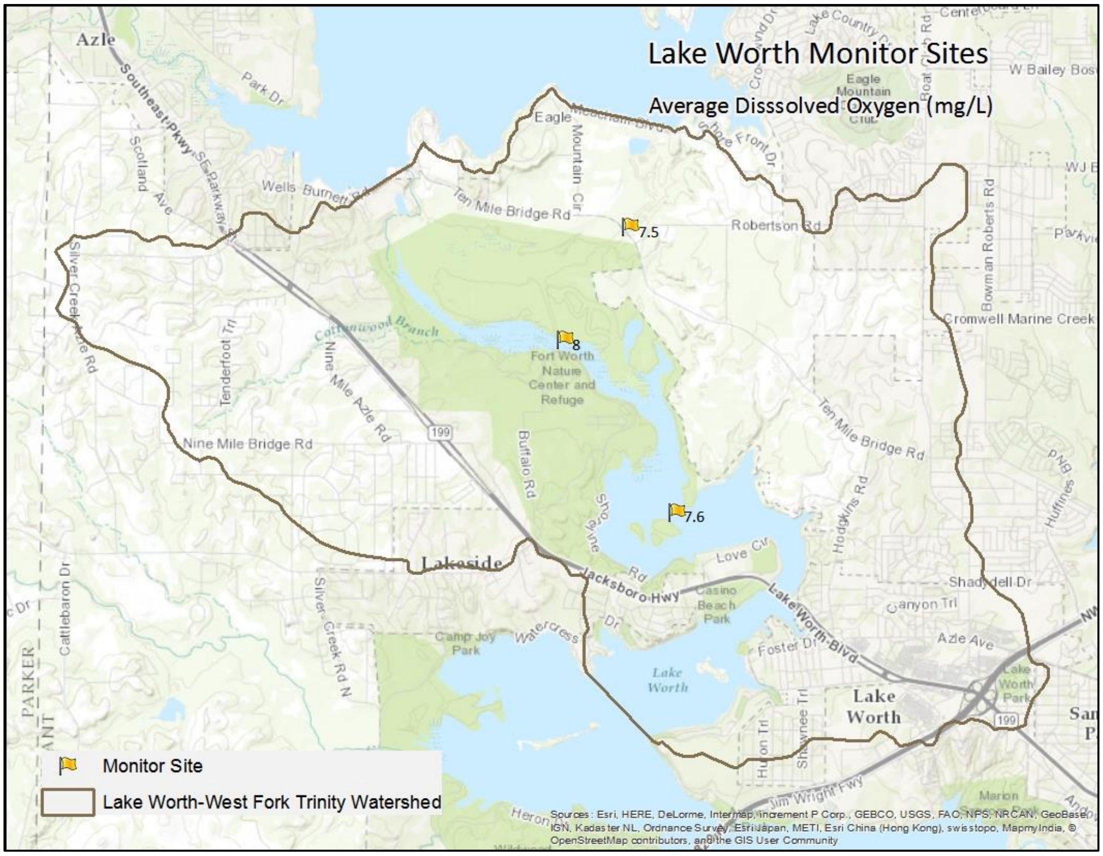


Figure 8: Map of the average dissolved oxygen for sites in the Lake Worth Watershed

The pH levels are an important indicator for the overall health of the watershed as well. Aquatic inhabitants typically require a pH range between 6.5 and 9 for the most optimum environment. Anything below 6.5 or above 9 can negatively impact reproduction or can result in fish kills. There were no reported pH levels outside of this widely accepted range. Site 80764 had the highest average pH level, with a result of 7.5 ± 0.4. Sites 80762 and 80763 had the lowest average pH level, with a result of 7.4 ± 0.4.

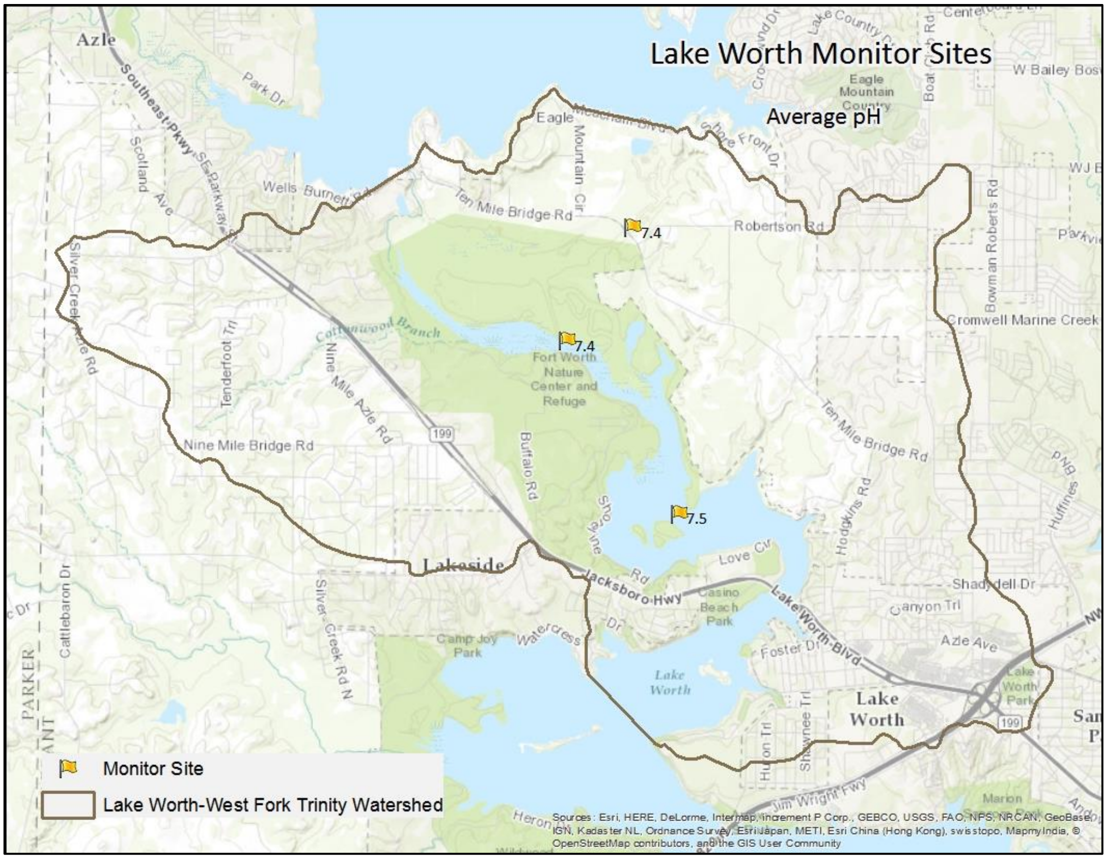


Figure 9: Map of the average pH for sites in the Lake Worth Watershed

Please see Table 4 for a summary of average results at all sites. Additionally, it is also important to note that there was variation in the number of times each site was tested, the time of day at which each site was tested, and the time of month the sampling occurred. While this is a quick overview of the results, it is important to keep in mind that there is natural diurnal and seasonal variation in these water quality parameters. Texas Stream Team citizen scientist data is not used by the state to assess whether water bodies are meeting the designated surface water quality standards.

Table 4: Average Values for all sites

Site Number	TDS (mg/L)	DO (mg/L)	pH
80762	244 ± 46 (max)	7.5 ± 1.9 (min)	7.4 ± 0.4 (min)
80763	240 ± 41	8.0 ± 2.0 (max)	7.4 ± 0.3 (min)
80764	241 ± 31 (min)	7.6 ± 2.6 (min)	7.5 ± 0.4 (max)

Site 80762 – West Fork Trinity River at Ten Mile Bridge Road

Site Description

This site is at the Ten Mile Bridge crossing in the upper reaches of Lake Worth. The West Fork Trinity River comes out of Eagle Mountain Dam and flows down into Lake Worth. This stretch of the Trinity

River is essentially the connection between the two reservoirs. This site is north of the Fort Worth Nature Center. The riparian area at this location is heavily wooded with pecans and oak trees.

Sampling Information

This site was sampled 34 times between September 2012 and March 2015.

Table 5: Descriptive parameters for Site 80762

Parameter	Number of Samples	Mean ± Standard Deviation	Min	Max
Total Dissolved Solids (mg/L)	35	244 ± 46	156	332
Water Temperature (°C)	35	17.4 ± 8.0	4.4	28.0
Dissolved Oxygen (mg/L)	34	7.5 ± 1.9	4.0	10.2
pH	35	7.4 ± 0.4	7.0	8.3

Site was sampled 35 times between 9/13/2012 and 10/6/2015.

Air and water temperature

Citizen scientists collected 35 air and water temperatures at this site. The mean water temperature was 17.4 °C. The minimum water temperature was 4.4 °C and was recorded in January of 2014. The maximum water temperature was 28.0 °C and was recorded in June of 2013. Air temperature ranged from a low of 0.7 °C in February 2014 to a high of 30.8 °C in July of 2014.

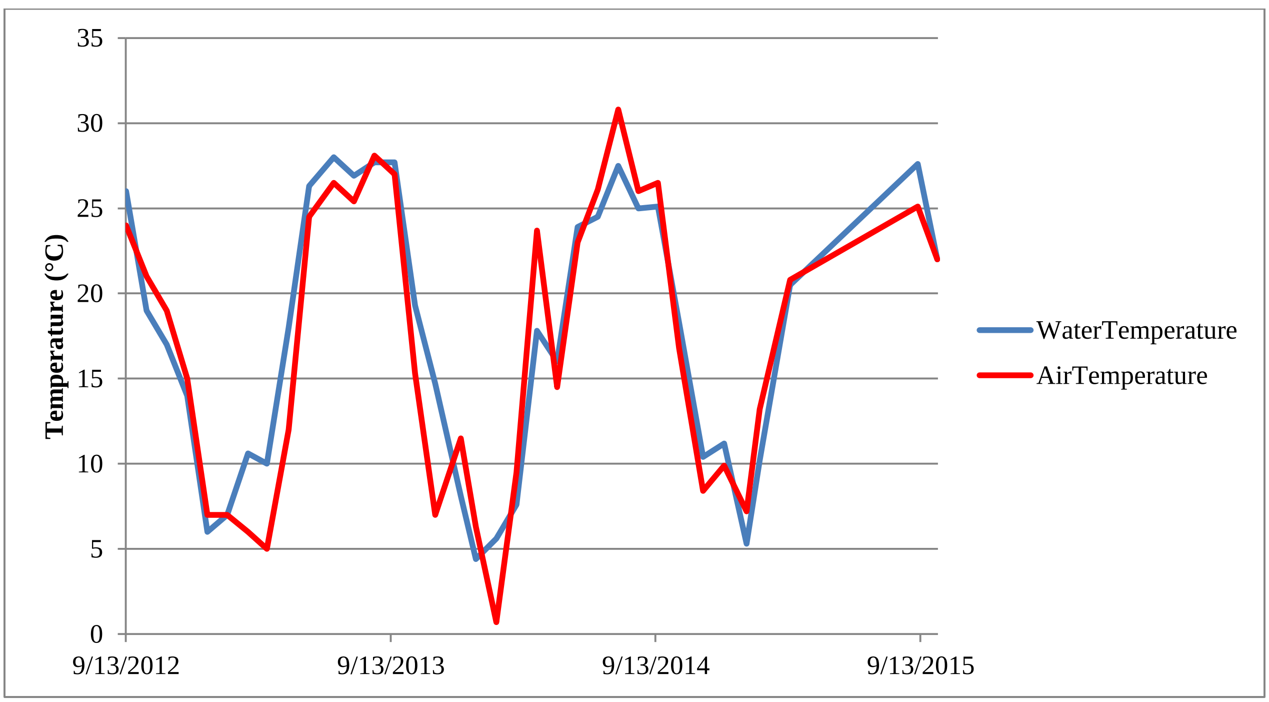


Figure 10: Air and water temperature at site 80762

Total Dissolved Solids

Citizen scientists collected 35 total dissolved solids measurements at this site. The mean TDS was 244 mg/L and it ranged from a low of 156 mg/L in June of 2014 to a high of 332 mg/L in December of 2013. There was no significant relationship between TDS concentrations and time observed at this site.

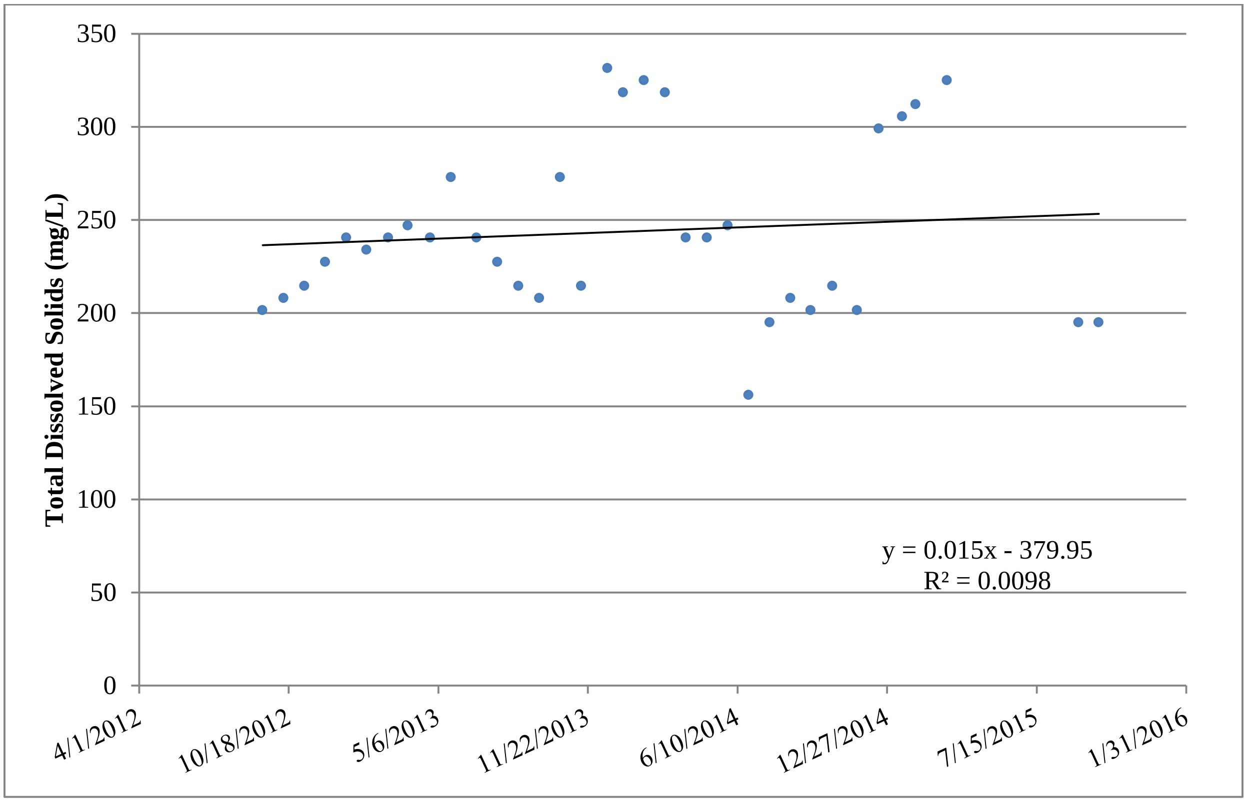


Figure 11: Total dissolved solids at site 80762

Dissolved Oxygen

Citizen scientists took a total of 34 dissolved oxygen samples from this site. The mean DO was 7.5 mg/L and it ranged from a low of 4.0 mg/L in June 2014 to a high of 10.2 mg/L in March 2013. There was no significant relationship between DO and time observed at this site.

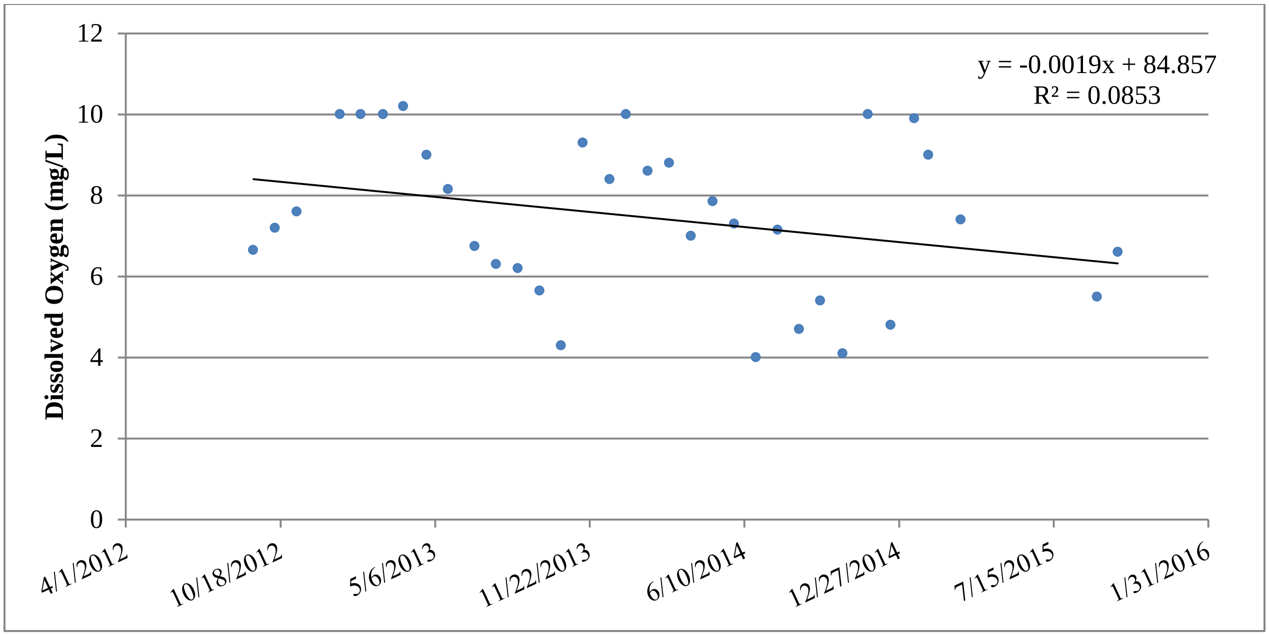
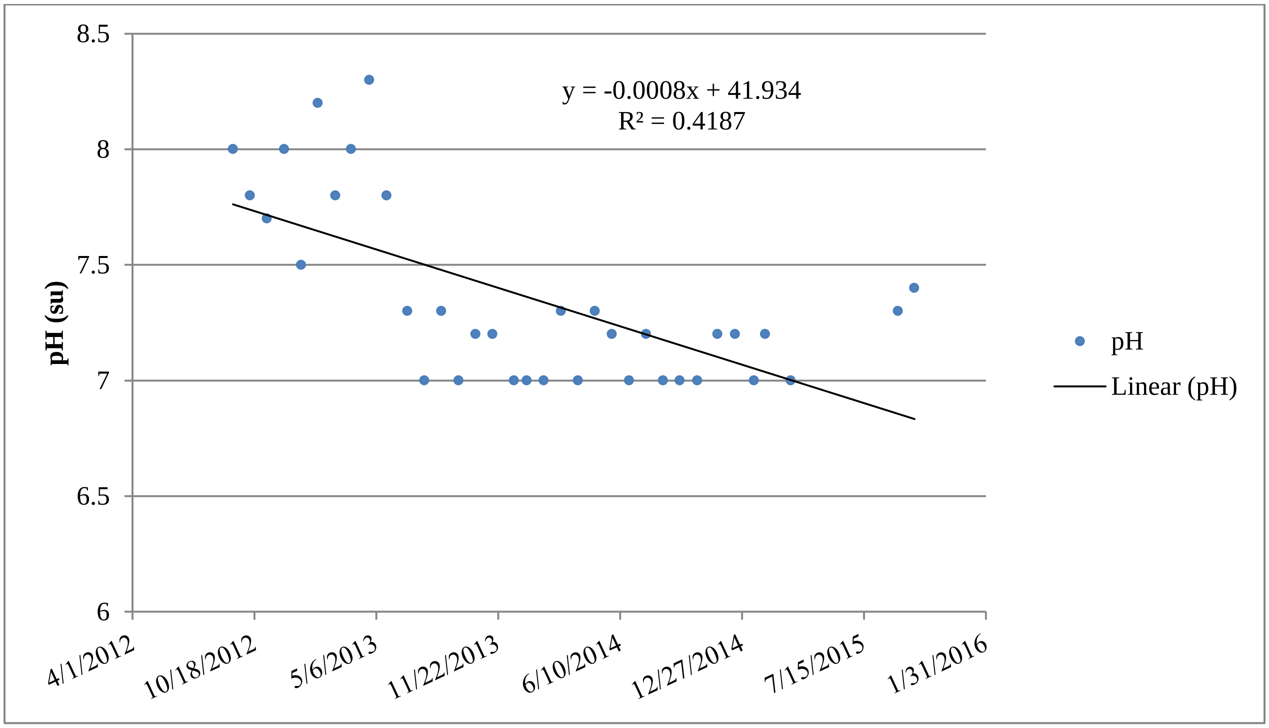


Figure 12: Dissolved oxygen at site 80762

pH

Citizen Scientists collected 35 pH measurements from this site. The mean pH was 7.4 and it ranged from a low of 7.0, recorded many times, to a high of 8.3 in April 2013. There was a significant decrease in pH over time observed at this site ($p = 0.000$) with a strong R^2 value of 0.42.



Field Observations

The flow at this site was usually low or normal. The algae cover was absent or rare at this site. The water clarity was clear or cloudy, and the water had a light green color.

Site 80763 – Lake Worth at Todd Island Crossing

Site Description

This site is located on the West Fork of the Trinity River in the upper reaches of Lake Worth. It is located within the Fort Worth Nature Center and Refuge. The site is on a bend in the river near Shoreline Road. A dirt road branches off of Shoreline, and crosses a shallow stretch of what used to be the main channel of the Trinity River, but still receives water from the Eagle Mountain Spillway. This site is located in a heavily wooded area.

Sampling Information

This site was monitored 34 times between September 2012 and December 2015. The site was usually monitored between 10:00 and 12:00.

Table 6: Descriptive parameters for Site 80763

Parameter	Number of Samples	Mean ± Standard Deviation	Min	Max
Total Dissolved Solids (mg/L)	34	240 ± 41	182	332
Water Temperature (°C)	34	18.2 ± 8.3	4.5	29.5
Dissolved Oxygen (mg/L)	33	8.0 ± 2.0	4.6	12.0
pH	34	7.4 ± 0.3	7.0	8.0

Site was sampled 34 times between 9/13/2012 and 12/22/2015.

Air and water temperature

Citizen Scientists recorded 34 air and water temperature samples at this site. The mean water temperature was 18.2 °C and it ranged from a low of 4.5 °C in January of 2014 to a high of 29.5 °C in August of 2014.

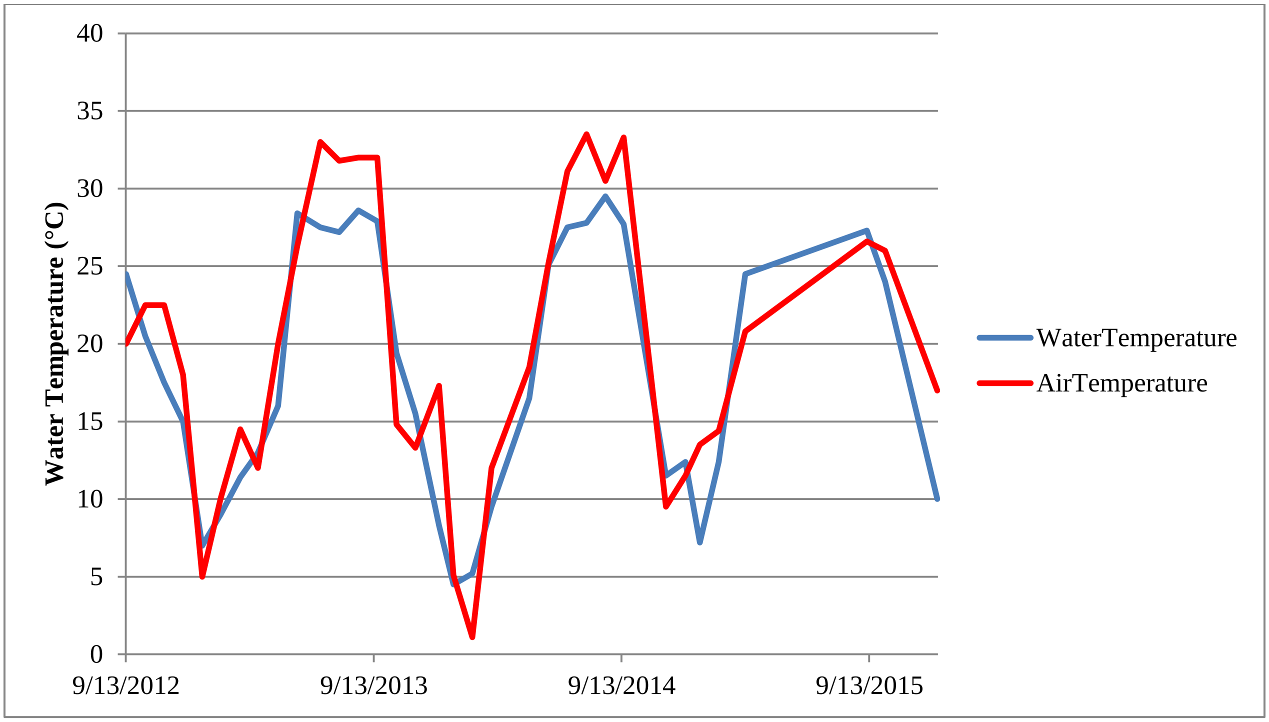


Figure 13: Air and water temperature at site 80763

Total Dissolved Solids

Citizen scientists recorded 34 total dissolved solids measurements at this site. The mean TDS was 240 mg/L and it ranged from a low of 182 mg/L in December 2015 to a high of 332 mg/L in March of 2014. There was no significant relationship between TDS and time observed at this site.

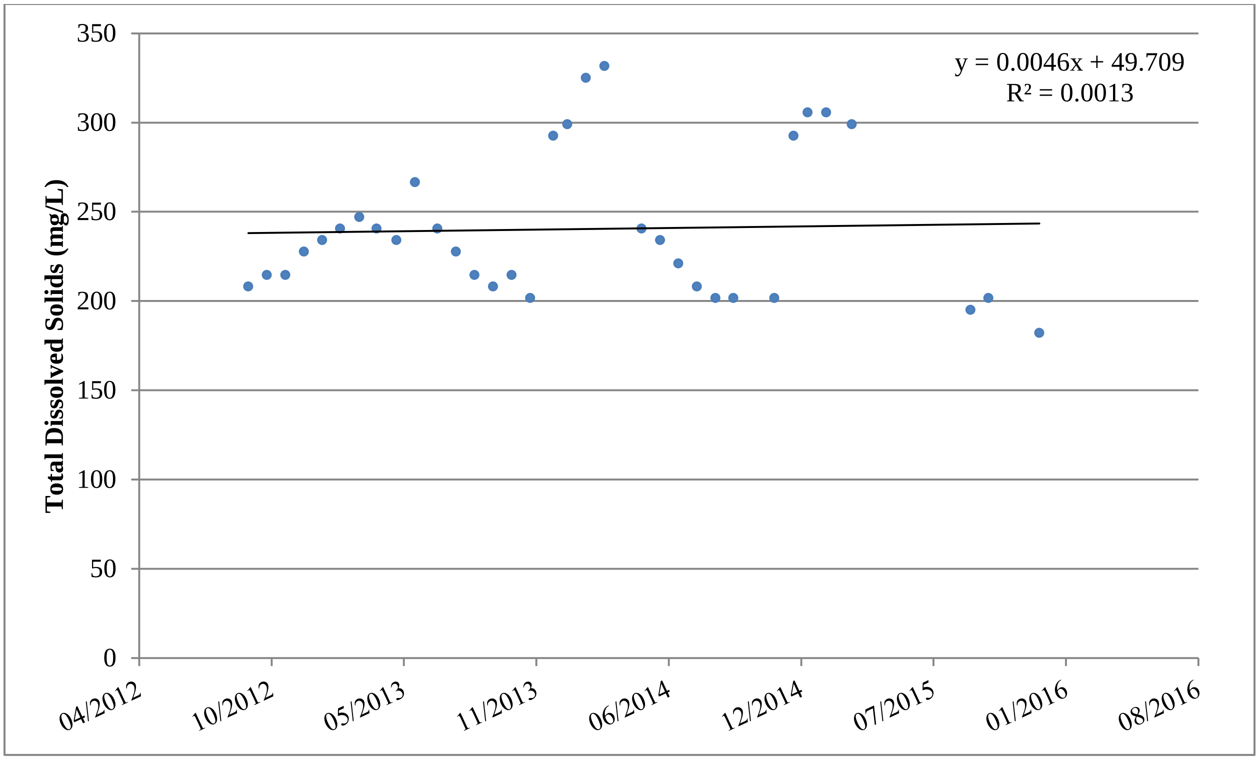


Figure 14: Total dissolved solids at site 80763

Dissolved Oxygen

Citizen scientists collected 33 dissolved oxygen samples at this location. The mean DO concentration was 8.0 mg/L and it ranged from a low of 4.6 mg/L in August 2014 to a high of 12.0 mg/L in January of 2014. There was no significant relationship between DO and time observed at this site.

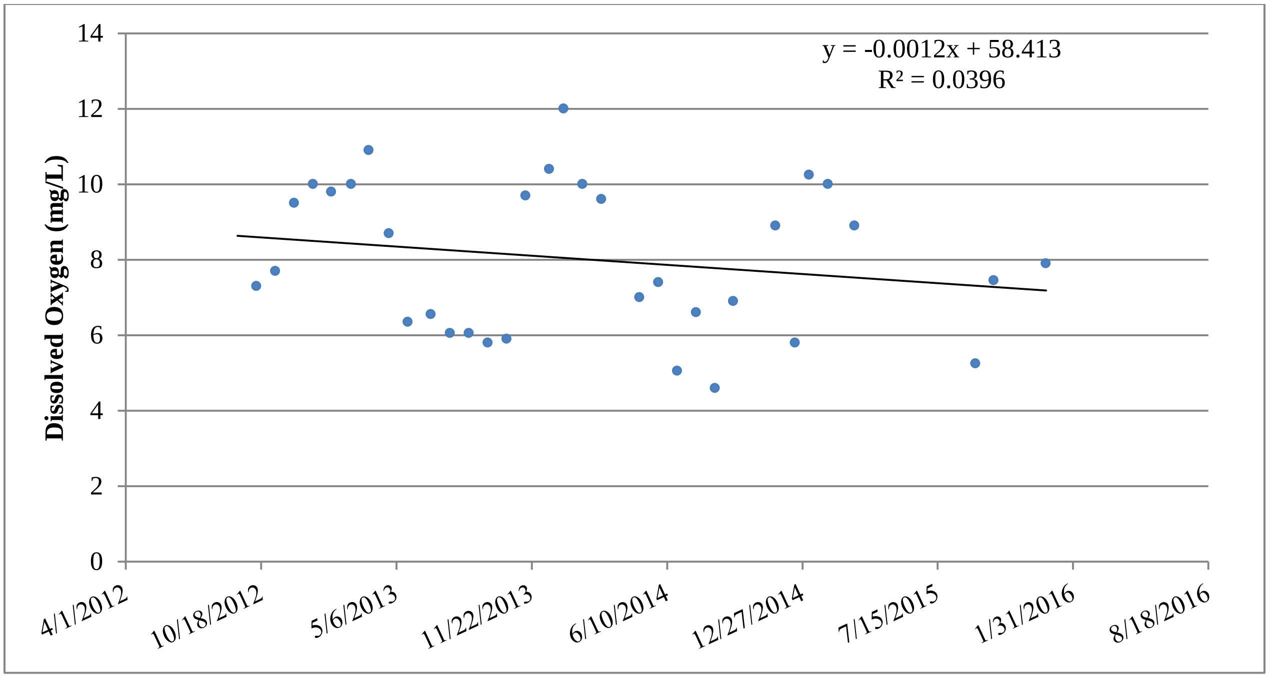


Figure 15: Dissolved oxygen at site 80763

pH

Citizen scientists collected 34 pH samples from this site. The mean pH was 7.4 and it ranged from a low of 7 recorded many times to a high of 8.0 recorded 4 times throughout this period. There was a significant relationship between pH and time observed at this site ($p = 0.000$) with a strong relationship between the two variables indicated by a relatively high R^2 of 0.39.

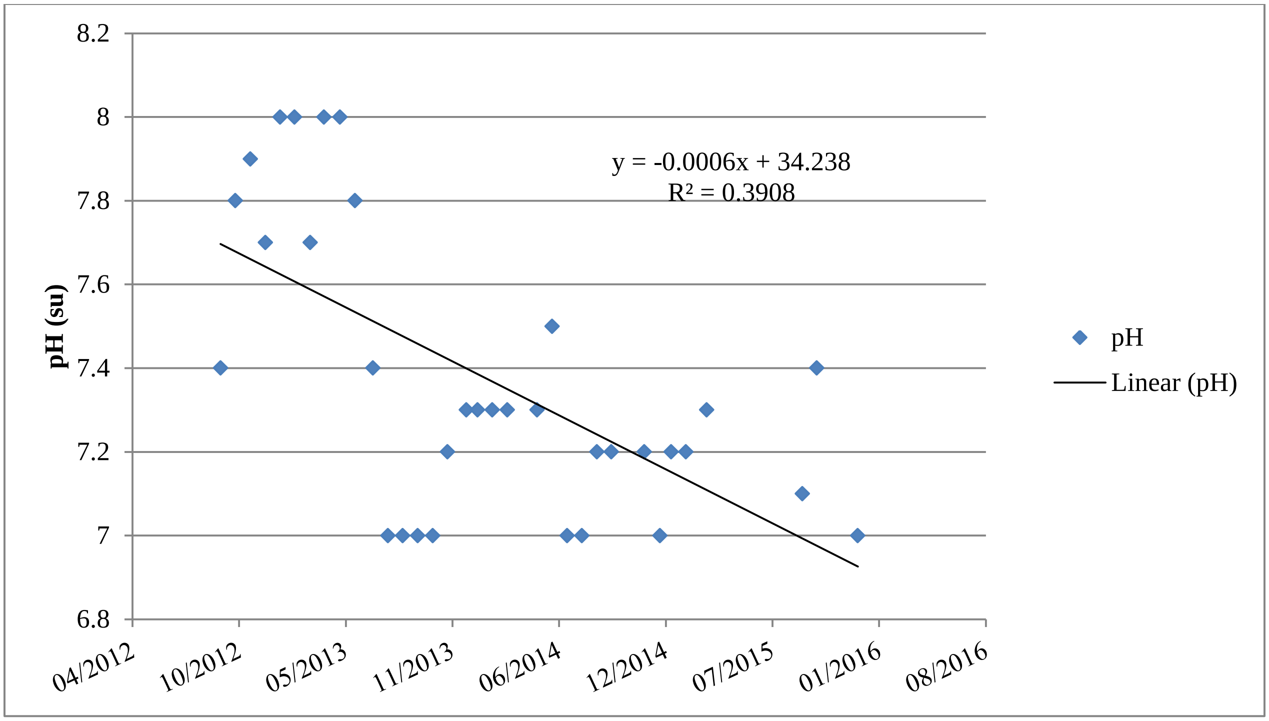


Figure 16: pH at site 80763

Field Observations

Flow was recorded as low or normal at this site. The algae was absent or rare. The color was mostly reported as light green, but it was also reported as clear or tan on several occasions. The water clarity was mostly cloudy with a few monitoring events where the water was clear.

Site 80764 – Lake Worth at Greer Island Peninsula

Site Description

This site was located on a small spit of land jutting out of Greer Island in the Fort Worth Nature Center. Although it is an island in Lake Worth, Greer Island is connected to the main shoreline by a berm with a dirt road on it.

Sampling Information

This site was sampled 30 times between September 2012 to October 2014. The site was usually sampled between the hours of 10:00 and 13:00.

Table 7: Descriptive parameters for Site 80764

Parameter	Number of Samples	Mean ± Standard Deviation	Min	Max
Total Dissolved Solids (mg/L)	26	243 ± 33	202	319
Water Temperature (°C)	26	18.6 ± 9.6	3.1	31.1
Dissolved Oxygen (mg/L)	26	7.6 ± 2.6	3.9	12.2
pH	25	7.5 ± 0.4	7.0	8.5

Site was sampled 30 times between 9/13/2012 and 10/21/2014.

Air and water temperature

This site was measured 26 times for air and water temperature. The mean water temperature was 18.6 °C and ranged from a low of 3.1 °C in February 2014 to a high of 31.1 °C in July of 2014. The air temperature ranged from a low of 1.7 °C in February of 2014 to 34.1 °C in July of 2013.

Figure 17: Air and water temperature at site 80764

Total Dissolved Solids

There were 26 TDS measurements collected at this site. The mean TDS concentration was 243 mg/L and it ranged from a low of 202 mg/L in June of 2014 to a high of 319 mg/L in April of 2014. There was no significant relationship between TDS concentrations and time observed at this site.

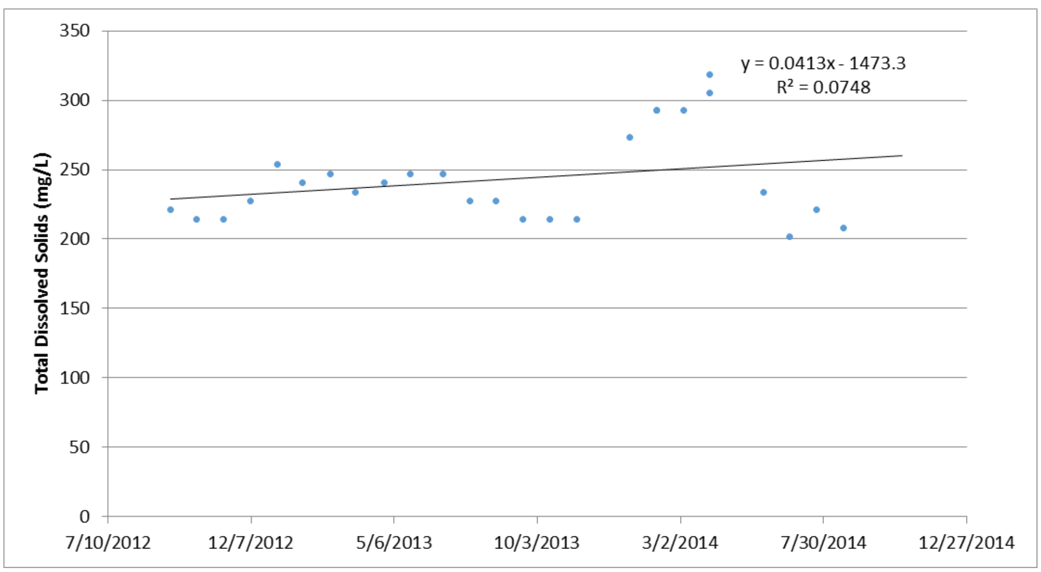


Figure 18: Total dissolved solids at site 80764

Dissolved Oxygen

Citizen scientists took 26 dissolved oxygen samples at this site. The mean DO concentration was 7.6 mg/L and it ranged from a low of 3.9 mg/L to a high of 12.2 in February of 2014. There was no significant increase or decrease in DO over time observed at this site.

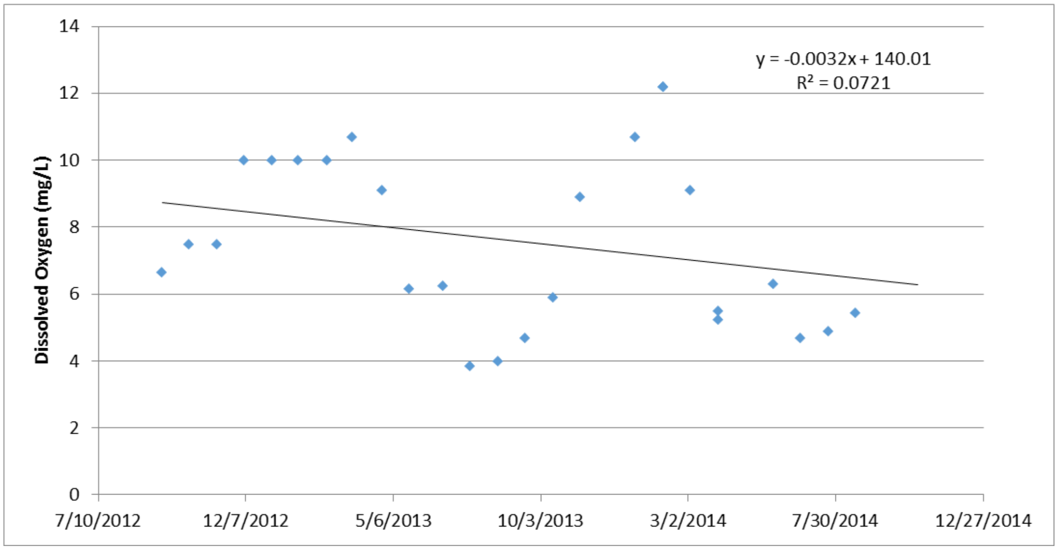


Figure 19: Dissolved oxygen at site 80764

pH

Citizen scientists took 25 pH measurements at this site. The mean pH was 7.5. The minimum pH was 7.0 and it was recorded several times at this site. The maximum pH was 8.5 and it was recorded in January of 2013. There was a significant decrease in pH over time observed at this site ($p = 0.000$). The R^2 value of 0.54 indicates a strong relationship between the two variables.

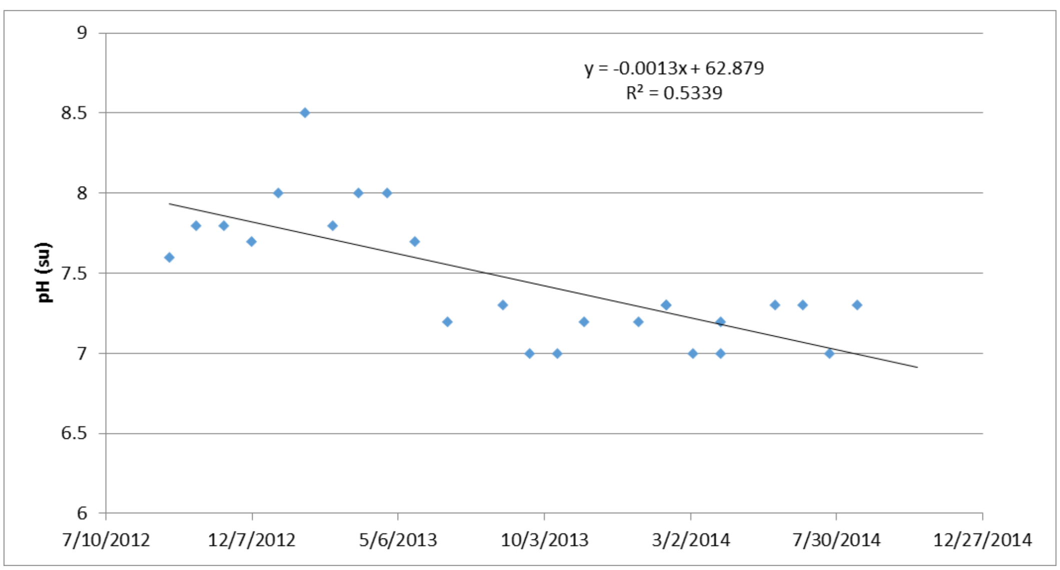


Figure 20: pH at site 80764

Field Observations

The flow at this site was recorded as low or normal. Algae cover was almost always absent. The water color was described as light green, dark green, or tan. Water clarity was always cloudy or turbid.

Lake Worth Watershed Summary

Lake Worth watershed is located in both Tarrant and Parker counties as it is situated within and adjacent to Ft. Worth. It serves as an impoundment of the West Fork of the Trinity River and is managed by the Tarrant Regional Water District (TRWD). The land usage is primarily rural with 35% of the area being used for urbanization. Its aquatic vegetation is limited; however, fisheries within the area stock the lake with various species of bass and catfish. This makes Lake Worth a very active recreation destination. It is also one of the major suppliers for the Ft. Worth's drinking water.

Due to two major military facilities located on the south side of the lake, rising levels of toxic polychlorinated biphenyl have been recorded which greatly impact the fish ecosystems. In addition, heavy sediment loads from the watershed enter into the lake that causes it to require massive amounts of dredging to maintain recreational activities. Currently, Lake Worth has a Total Maximum Daily Load (TMDL) implemented to determine its pollutant loads. A Watershed Protection Plan has not been implemented as of Fall 2016 but the TRWD and Texas A&M AgriLife are currently in the process of developing BMPs and a monitoring plan. The City of Fort Worth is also assisting with watershed management through their Capital Improvement Implementation Plan and their Lake Worth Vision Plan.

Three sites within the watershed have been tested from 2012 to 2015 for total dissolved solids (TDS), water temperature, dissolved oxygen (DO), and pH levels. There was not a significant difference in TDS during the observed time throughout the entire monitoring period. The mean DO concentration was that of 7.7 mg/L within the watershed, and no significant decreases in DO over time occurred. In addition, pH showed no significant decrease over the observed time throughout all sites. Being near Ft. Worth and with high recreational activity taking place within the lake and the watershed, the implementation of a WPP and regular water quality monitoring will assist in maintaining the health of this waterway.

Get Involved with Texas Stream Team!

Once trained, citizen scientists can directly participate in monitoring 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 (TCEQ) and river authority water specialists, and, if necessary, filing complaints with environmental agencies, contacting elected representatives and media, or starting organized 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 stakeholder 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 to be formulated. For more information about participating in these steering committee meetings, please 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 become involved in the assessment and protection system that Texas agencies use to keep water resources healthy and sustainable.

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Appendix A- List of Tables and Figures

Tables

Figures