Plum Creek Watershed Data Report

April 2013

The Meadows Center for Water and the Environment
Texas State University

Texas State University
San Marcos
The rising STAR *of Texas* ™

The preparation of this report was prepared in cooperation with, and financed through, grants from the Texas Commission on Environmental Quality and the U.S. Environmental Protection Agency.

Table of Contents

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 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 is 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 at all, or monitor as frequently. 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 Characterization

Plum Creek rises in Hays County near FM 2770 north of Kyle, runs 52 miles southeast through Caldwell County, passes through Lockhart and Luling, and joins the San Marcos River at the Caldwell-Gonzales County line. The Plum Creek Watershed has a drainage area of 397 mi^2 (1,028 km^2) within the Guadalupe River Basin, which drains South Central Texas from the Hill Country to the Gulf of Mexico. This report covers data collected from 2007-2012 at eighteen sites in the Plum Creek Watershed including three tributaries: Town Branch, Clear Fork Plum Creek, and Salt Creek.

Plum Creek originates in limestone along the terminus of the Edwards Plateau and then flows through two major Texas ecoregions, the Northern Blackland Prairies and the Southern Post Oak Savanna. The Blackland Prairie region is characterized by fine-textured, clay-like soils and vertisols that form gently rolling hills along the upper sections of the creek and flat plains in the lower sections. The land supports native grassland, but most of the area around Plum Creek has been converted to suburban homes or cropland. The Southern Post Oak Savanna region is differentiated from the Blackland Prairie by bands of claypan soils that underlie the sand. This leads to grasslands in the sandy soils and post oak woodlands growing on the lower claypan soils. Most of this area has been converted to limited cropland or rangeland. Along Plum Creek the following species dominate the riparian area: Hackberry, Willow, Sycamore, Giant Ragweed, Poison Ivy, and Yaupon Holly.

Water Quality Parameters

Water Temperature

Fish are ectothermic 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 releases warmer water 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. While volunteer monitoring data does not show diurnal temperature fluctuation, it does show the fluctuation 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, 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 dies 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 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.

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, an alkaline molecule. The most suitable pH range for healthy organisms is between 6.5 and 9.

Secchi disk and total depth

The Secchi disk is used to determine the clarity of the water, a condition known as turbidity. The disk 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. Turbid waters allow very little light to penetrate deep into the water, which in turn decreases the density of phytoplankton, algae, and other aquatic plants. This reduces the DO in the water due to reduced photosynthesis. Contaminants are most commonly transported in sediment rather than in the water. Turbid waters can results from sediment washing away from construction sites, erosion of farms, or mining operations. Average Secchi disk transparency (a.k.a. Secchi depth) readings that are less than the total depth readings indicate turbid water. Readings that are equal to total depth indicate clear water. Low total depth observations have a potential to concentrate contaminants.

E. coli Bacteria

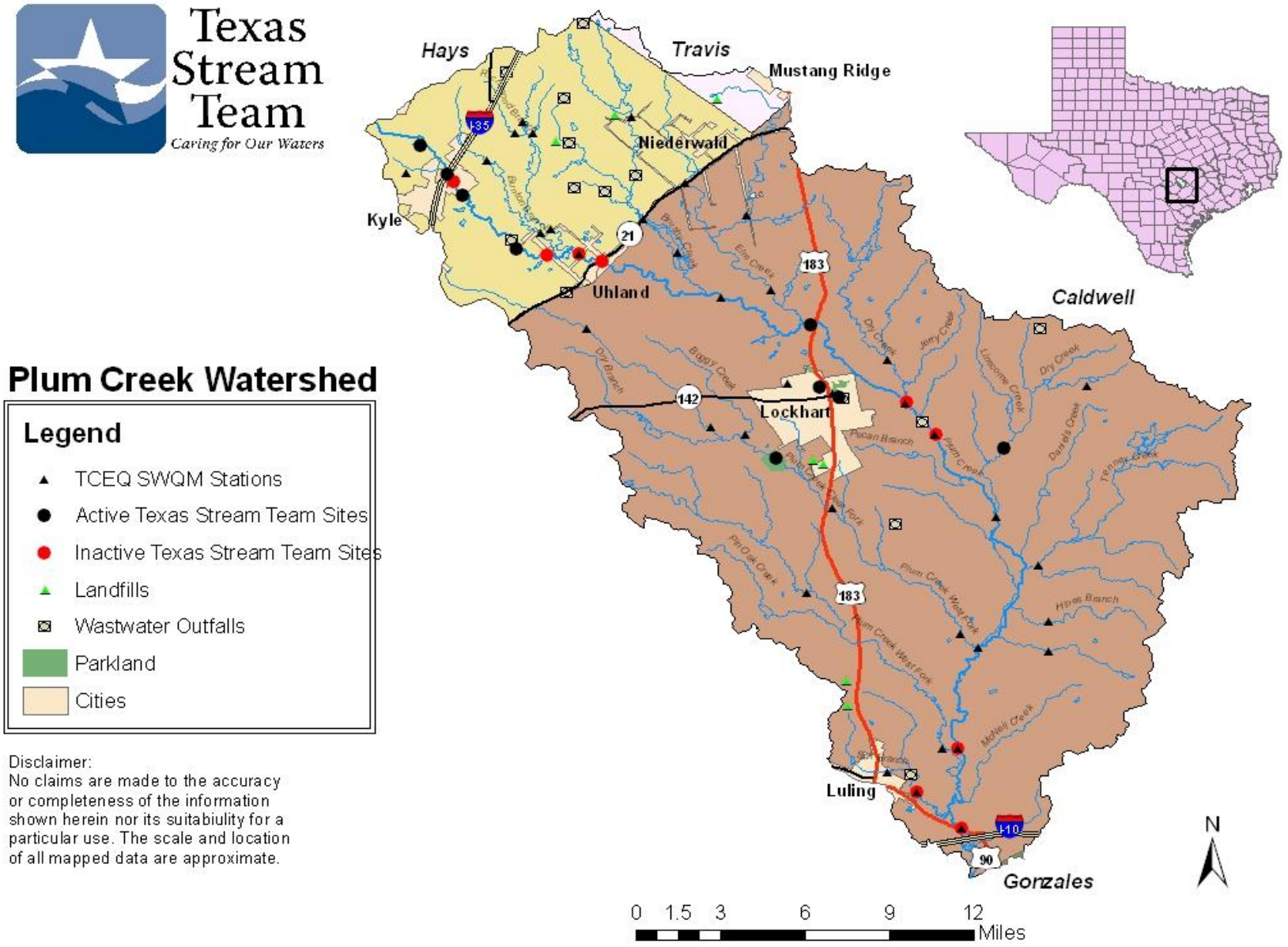
E. coli bacteria originate in the digestive tract of endothermic organisms. The EPA has determined E. coli to be the best indicator of the degree of pathogens in a water body, which are far too numerous to be tested for directly, considering the amount of water bodies tested. A pathogen is a biological agent that causes disease. The standard for an E. coli impairment is based on the geometric mean of the E. coli measurements taken. The standard for contact recreational use of a water body such as Plum Creek is 126 CFU/100 mL. A water body is considered impaired if the geometric mean is higher than this standard.

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 enjoyment 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 dissolved oxygen, temperature, pH, dissolved minerals, 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.



Map 1: Plum Creek Watershed

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 (October 2008). 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.

Container Key: SPS = Sterile Polystyrene

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 (October 2008) 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.

For all *E.coli* sampling events, station ID, location, sampling time, date, and depth, sample collector's name/signature, group identification number, incubation temperature, incubation duration, *E.coli* colony counts, dilution aliquot, field blanks, and media expiration dates are checked and recorded if expired. Values for all measured parameters are recorded. If reagents or media are expired, it is noted and communicated to Texas Stream Team.

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

Citizen Scientists collect field data and reports 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 monitor enters data electronically, the system will automatically flag data outside of the data limits and the monitor 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 monitor 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 2010 Texas Surface Water Quality Standards report was used to calculate the exceedances for Plum Creek, as seen below in Table 2.

Table 2: Summary of Surface Water Quality Standards for Plum Creek

Parameter	Texas Surface Water Quality Standard 2010*
Water Temperature (°C)	32.2
Total Dissolved Solids (mg/L)	1120
Dissolved Oxygen (mg/L)	5.0
pH (su)	6.5-9.0
E.coli (CFU)	126 (geomean during sampling period)

Methods of Analysis

All data collected from Plum Creek and its tributaries was exported from the database and grouped by site. Data was reviewed and, for the sake of data analysis, only one sampling event per month, per site was selected for the entire study duration. If more than one sampling event occurred per month, per site, the most complete, correct, and representative sampling event was selected.

Once compiled, data was sorted and graphed in Microsoft Excel 2010 using standard methods. Upstream to downstream trends and 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.

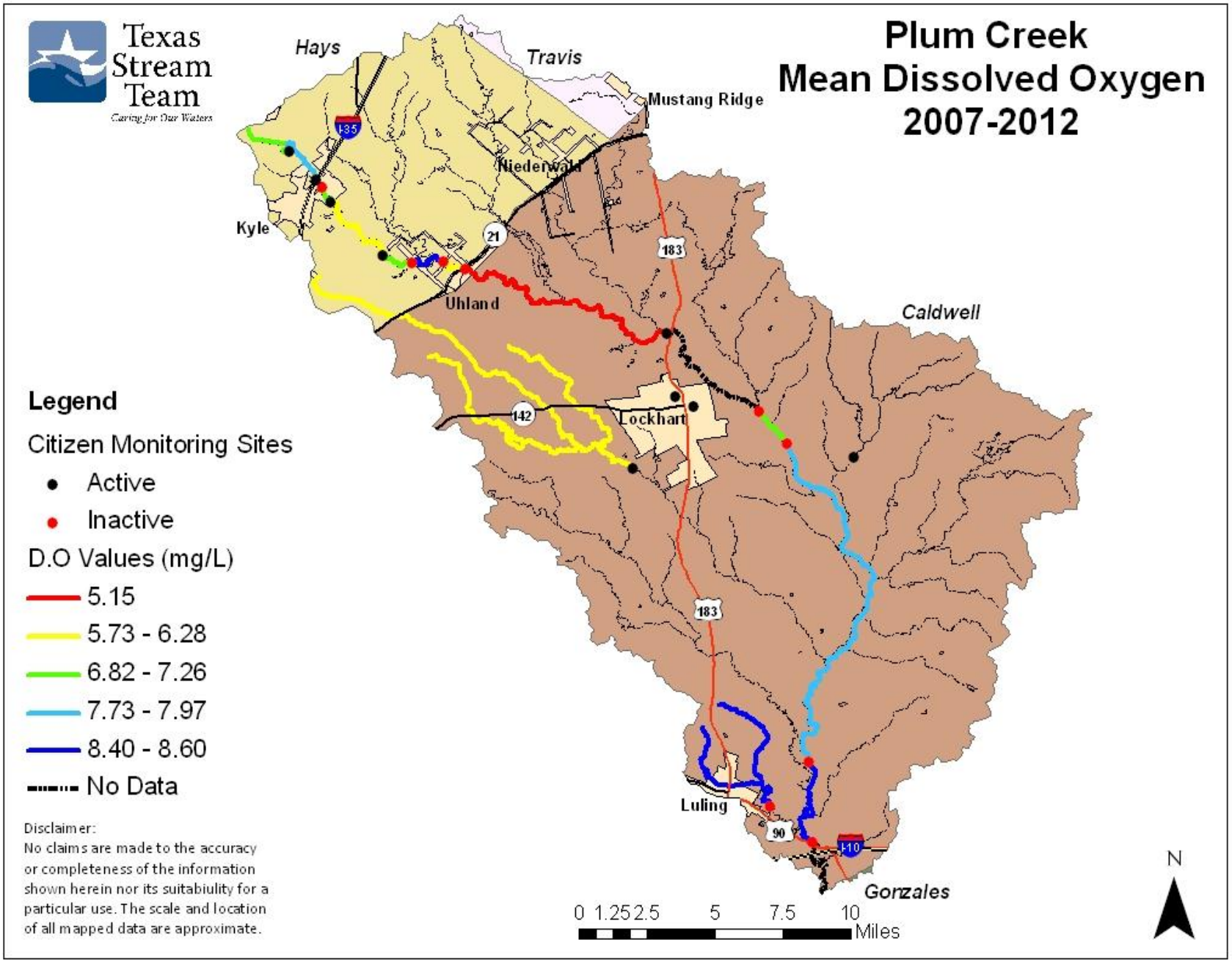
For this report, specific conductivity measurements, gathered by citizen scientists, was converted to TDS using the TCEQ-recommended conversion formula of specific conductivity 0.65. This conversion was made so that volunteer gathered data could be more readily compared to state gathered data. Geomeans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

Plum Creek Data Analysis

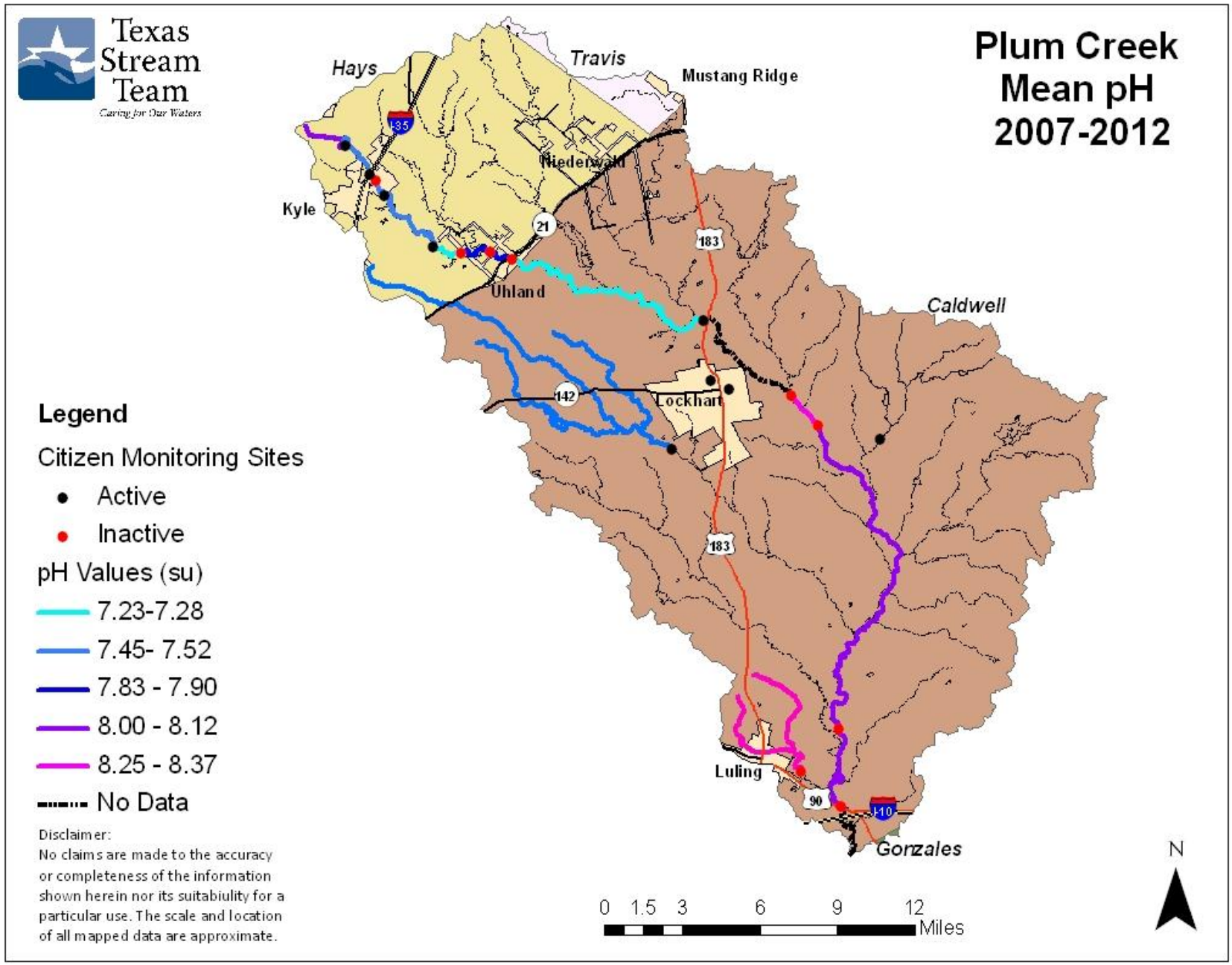
Plum Creek Maps

For this report, numerous maps were created to visually display a variety of information. Maps were created to show spatial variation of the parameters. The parameters mapped include DO, pH, specific conductivity, and number of monitoring site events (Maps 2-5). An average of all values taken between the

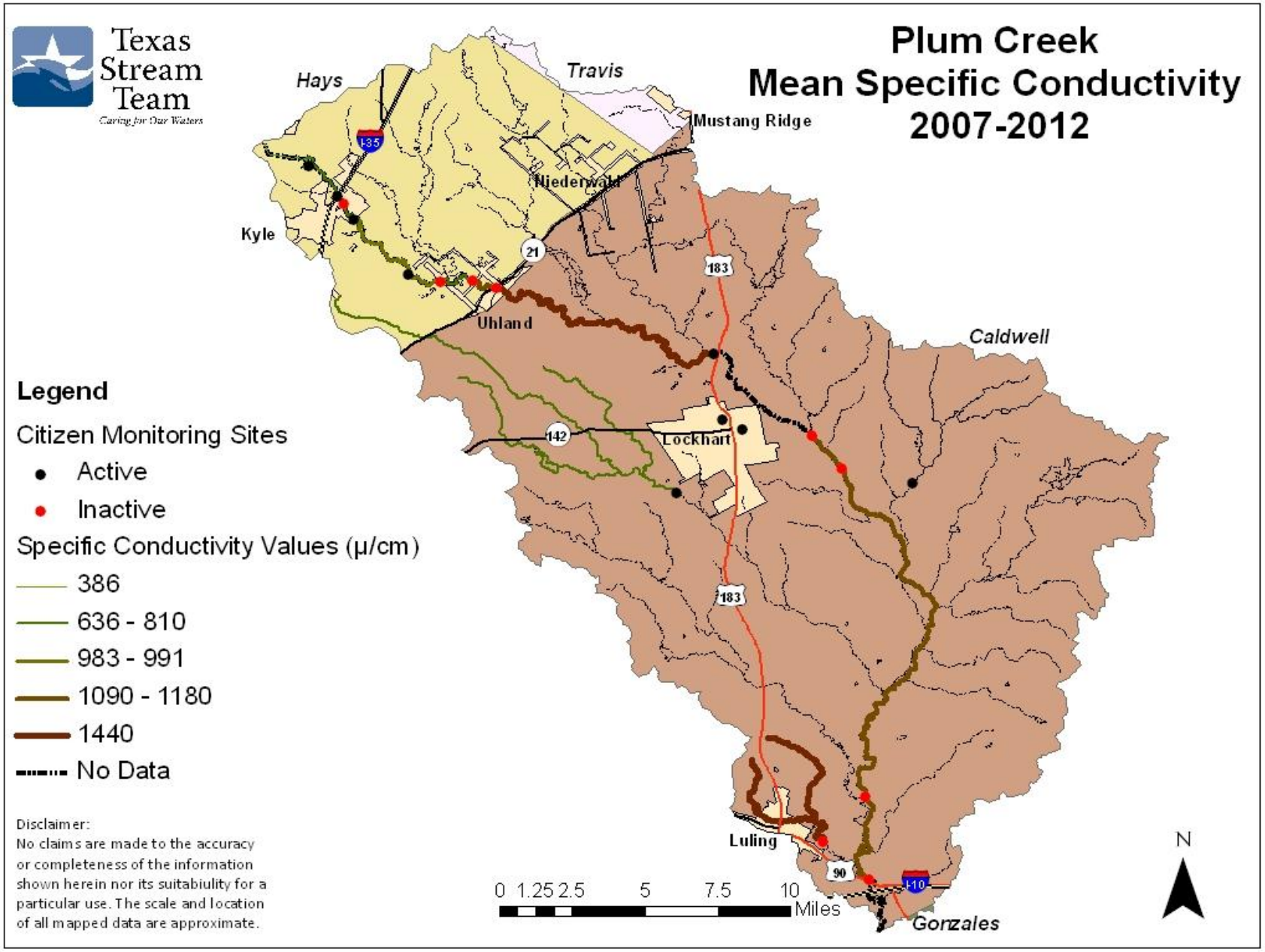
sampling period of 2007-2012 were applied to a clipped segment upstream of the monitoring site were the values were recorded. With each segment then containing a value, a graduated color map was created to visually represent the data. Additionally, a map was created to show the frequency of monitoring events on Plum Creek (Map 5). For this map, the number of samples taken per site over 2007-2012 was displayed using graduated symbols. Finally, a map was created as a reference for the site by site analysis, showing the locations of all active and inactive monitoring sites. For added reference points in all maps, layers showing active/inactive monitoring sites, cities, counties, and major highways were included. All shapefiles were downloaded from reliable federal, state, and local agencies.



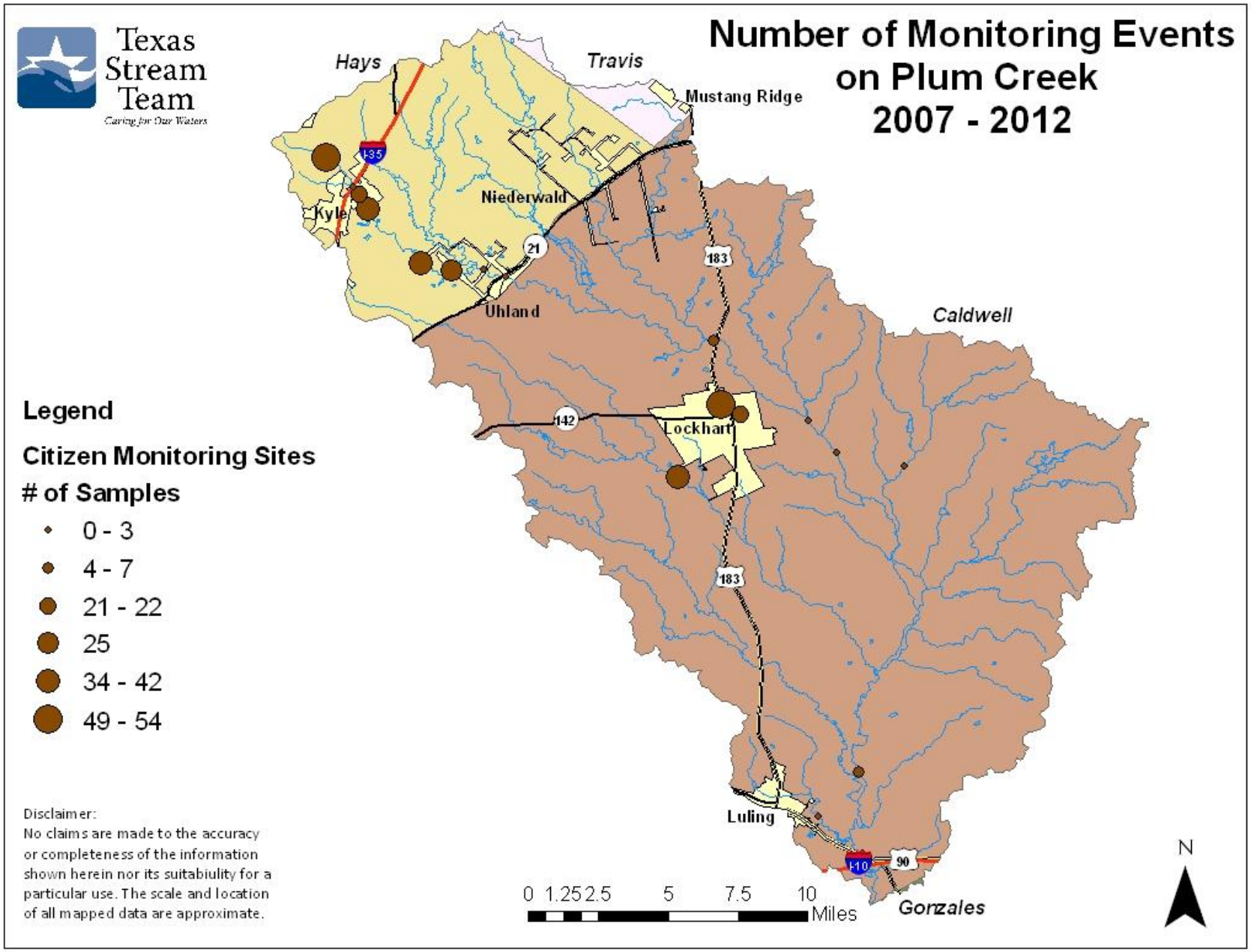
Map 2: Mean DO on Plum Creek
2007-2012



Map 3: Mean pH on Plum Creek 2007-2012



Map 4: Mean Specific Conductivity on Plum Creek 2007-2012



Map 5: Plum Creek Number of Monitoring Sites 2007-2012

Plum Creek Trends over Time

Sampling Trends over Time

Sampling along Plum Creek began in Feb 2007 and over 70% of the sampling events occurred during the years 2010-2012. Sampling occurred throughout the year, with no significant difference in the amount of sampling by month. Interestingly, the least sampled month was December (Figure 2). A majority of the sampling events took place in the morning, with few, to no samplings occurring in the dark hours.

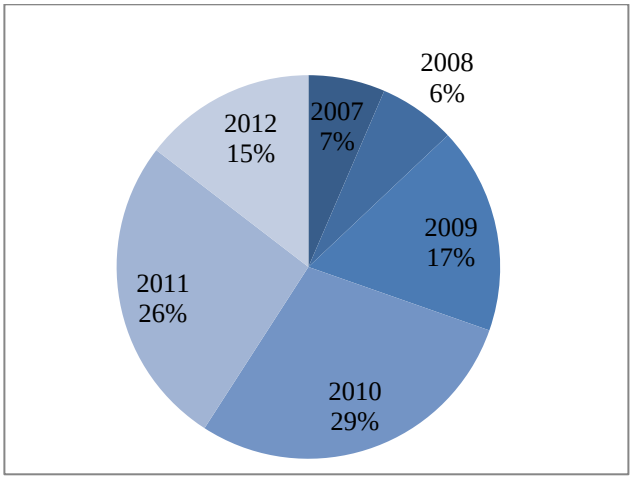


Figure 1: Samples by Year along Plum Creek

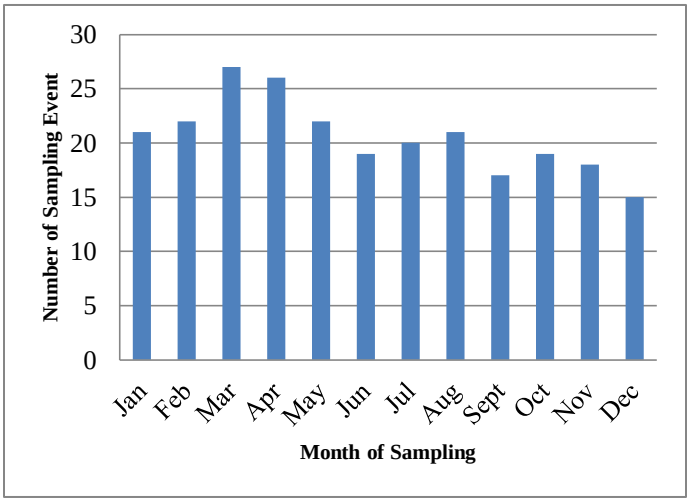


Figure 2: Breakdown of Sampling by Month

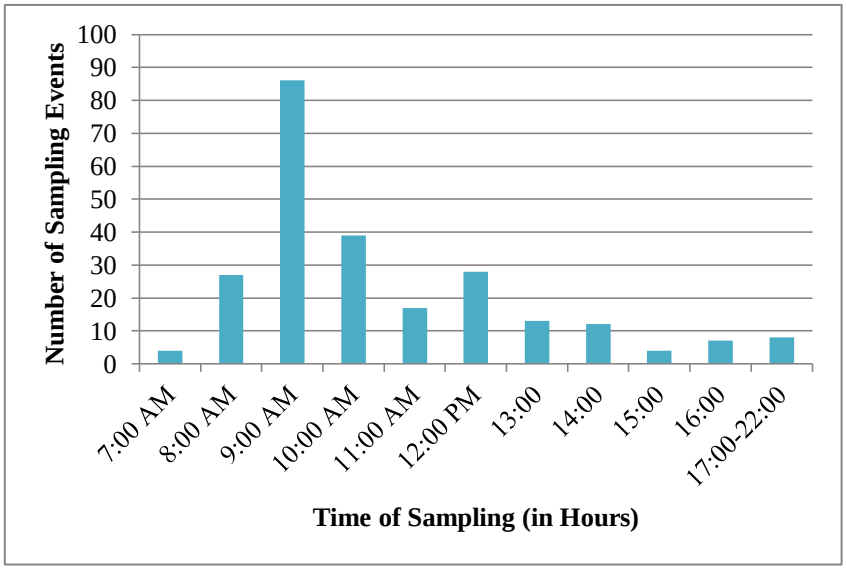


Figure 3: Breakdown of Time of Sampling on Plum Creek

Descriptive Parameters and Exceedances over time

Table 3: Descriptive parameters for all sites in the Plum Creek Watershed

Plum Creek February 2007-Oct 2012				
Parameter	% Complete	Mean ± Standard Deviation	Max	Min
Total Dissolved Solids (mg/L)	95.14%	541 ± 198.92	1440.5	21.44
Water Temperature (°C)	98.0%	20.22 ± 5.91	33	4
Dissolved Oxygen (mg/L)	93.9%	6.4 ± 2.15	14	0.1
pH	96.0%	7.59 ± 0.48	9.8	6.8
Secchi Disk Transparency (m)	90.0%	0.54 ± 0.38	2.5	0.01
Depth (m)	96.3%	0.61 ± 0.419	3.25	0
E. coli Bacteria (CFU/100 mL)	27.1%	22 ± 378	3100	0

*There were a total of 248 sampling events between 02/2007 and 10/2012. Mean, calculated in Microsoft Excel, is listed for all parameters except E. coli, where a geomean, calculated in Minitab v15, was used.

Trend Analysis over Time

Air and water temperature

A total of 247 air temperatures values and 242 water temperature values were collected within the Plum Creek Watershed between 2007 and 2012. Regression analysis (p=0.000) shows that variation in water temperature was significantly affected by time, with water temperature showing a slight increase over time.

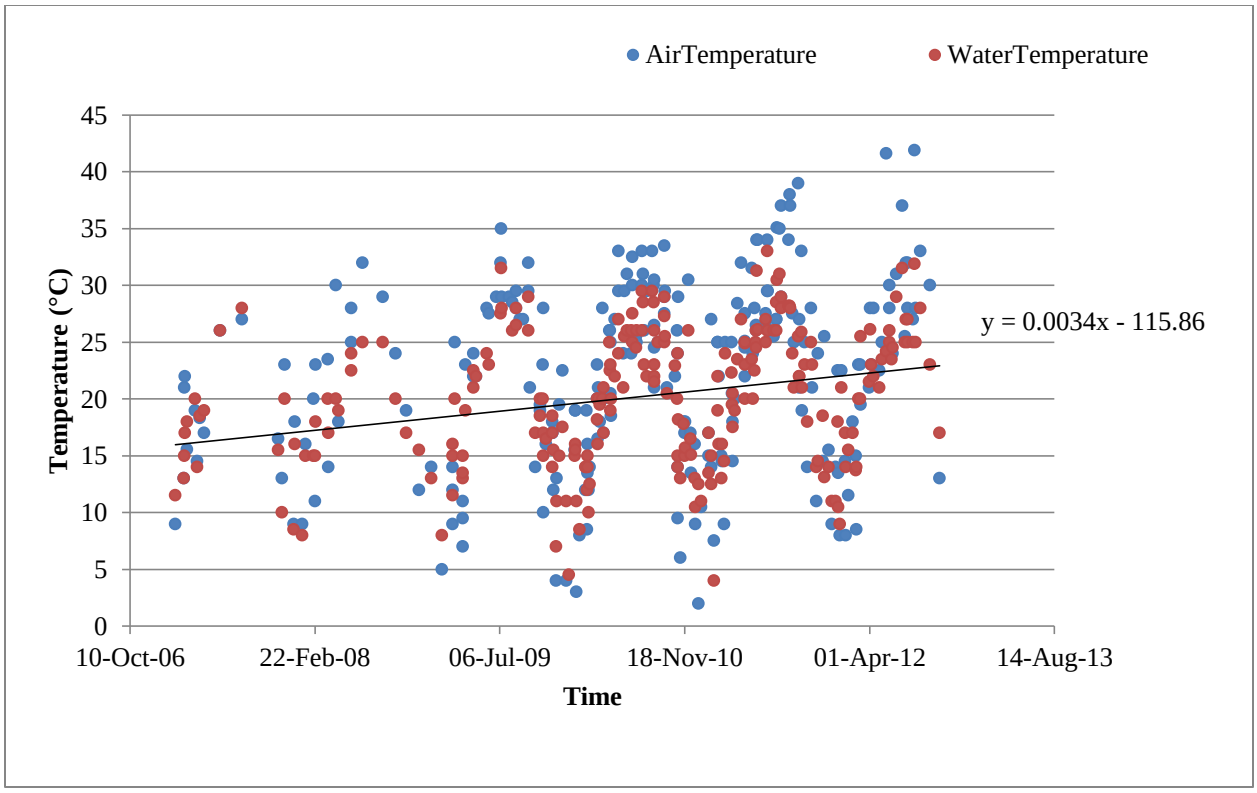


Figure 4: Air and water temperature over time at all sites within the Plum Creek Watershed

Total Dissolved Solids

Citizen scientists collected 235 TDS measurements within the watershed.. TDS did not significantly correlate to time, indicated with a regression analysis p-value of 0.871. TDS did appear to be affected by flow/water condition; TDS values were highest with low or normal flow and lowest during high or flood stage flow, as supported by previous studies.

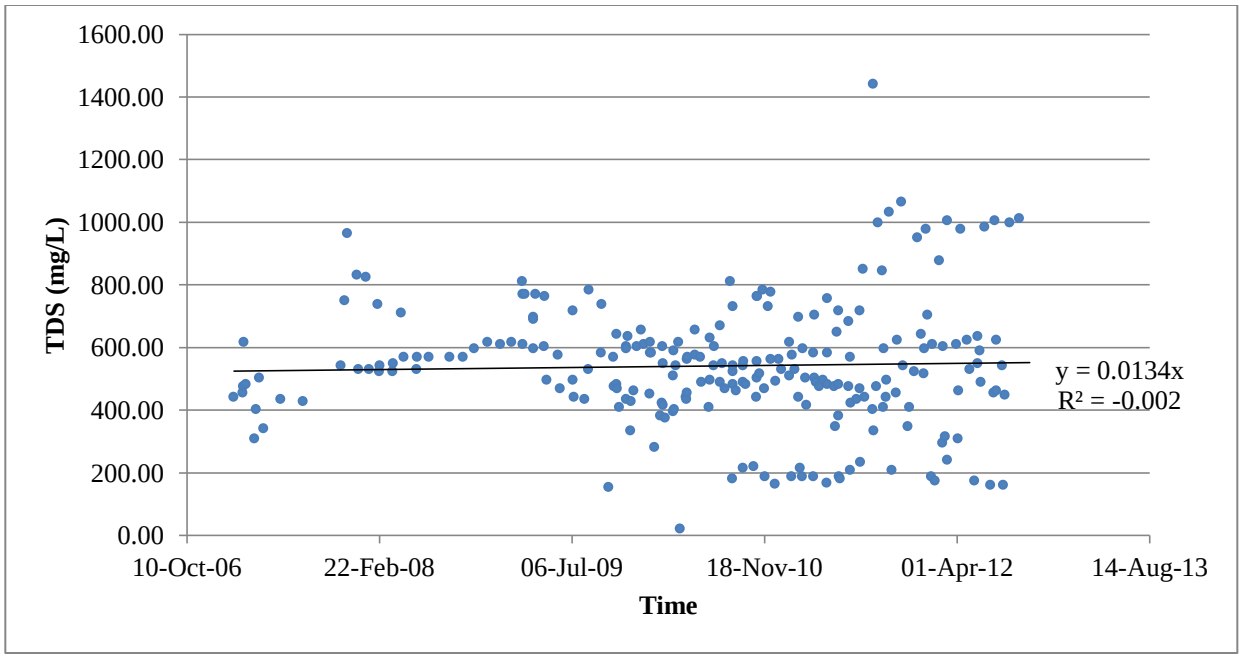


Figure 5: Total Dissolved Solids over time at all sites within the Plum Creek Watershed

Table 4: Average Total Dissolved Solids (mg/L) by flow for Plum Creek

Flow Level	Average	Standard Deviation
No Flow	438.25	148.99
Low Flow	556.37	200.46
Normal Flow	559.76	194.85
Flood	304.37	50.41

Dissolved Oxygen

Citizen scientists collected a total of 232 DO samples within the Plum Creek watershed. The DO values were significantly related to time (p=0.001), with DO decreasing over time during this sampling period within the watershed. Additionally, DO was affected by water temperature, rate of flow, season, and time of day that sampling occurred. As flow increased and the waters were mixed, DO levels rose, as shown in Table 6. The DO was also affected by water temperature, as shown in Figure 6. Cold water holds more oxygen than warm water; thus, DO was highest in the winter months. Additionally, plants and algae add a substantial amount of DO via photosynthesis, resulting in the pattern of high DO levels observed during the daylight hours, peaking in the late afternoon, and decreasing after dark. This pattern is shown in Table 6.

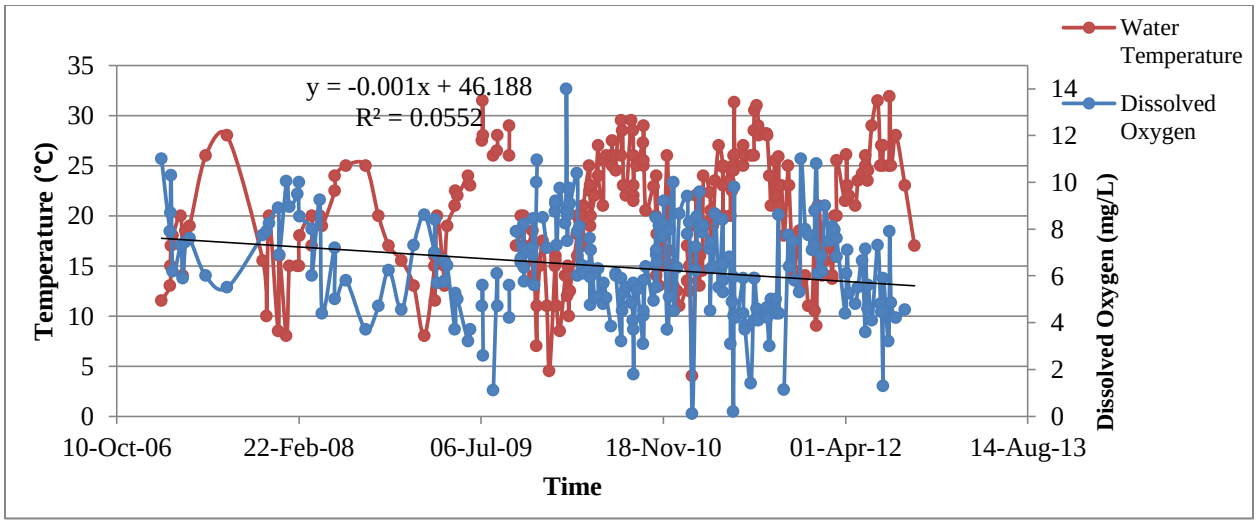


Figure 6: Dissolved Oxygen at all sites within the Plum Creek Watershed

Table 5: Average Dissolved Oxygen at five different flow levels along Plum Creek

Flow Level	Average DO	Standard Deviation
No Flow	4.22	3.00
Low Flow	6.04	1.83
Normal Flow	6.76	2.06
Flood	7.49	1.22
High	7.561	2.14

Table 6: Average Dissolved Oxygen values by Sampling Time within the Plum Creek Watershed

Time	Average DO	Standard Deviation
7:00	3.08	2.27
8:00	5.95	2.14
9:00	5.86	1.86
10:00	6.588	2.10
11:00	6.13	2.00
12:00	7.19	1.94
13:00	7.50	1.86
14:00	8.05	2.52
15:00	7.92	1.96
16:00	8.53	1.39
17:00-22:00	6.19	1.65

pH

The pH mean was 7.6, which is within the standard range for Plum Creek set by TCEQ. The pH was sampled 239 times, with four individual values exceeding the TCEQ-defined standards of less than 6.5 or greater than 9. Regression analysis showed that time could be a statistically valid predictor of pH ($p=0.001$) within the watershed, with pH decreasing slightly over time. The pH was not affected by any of the field conditions noted on the citizen science monitoring form.

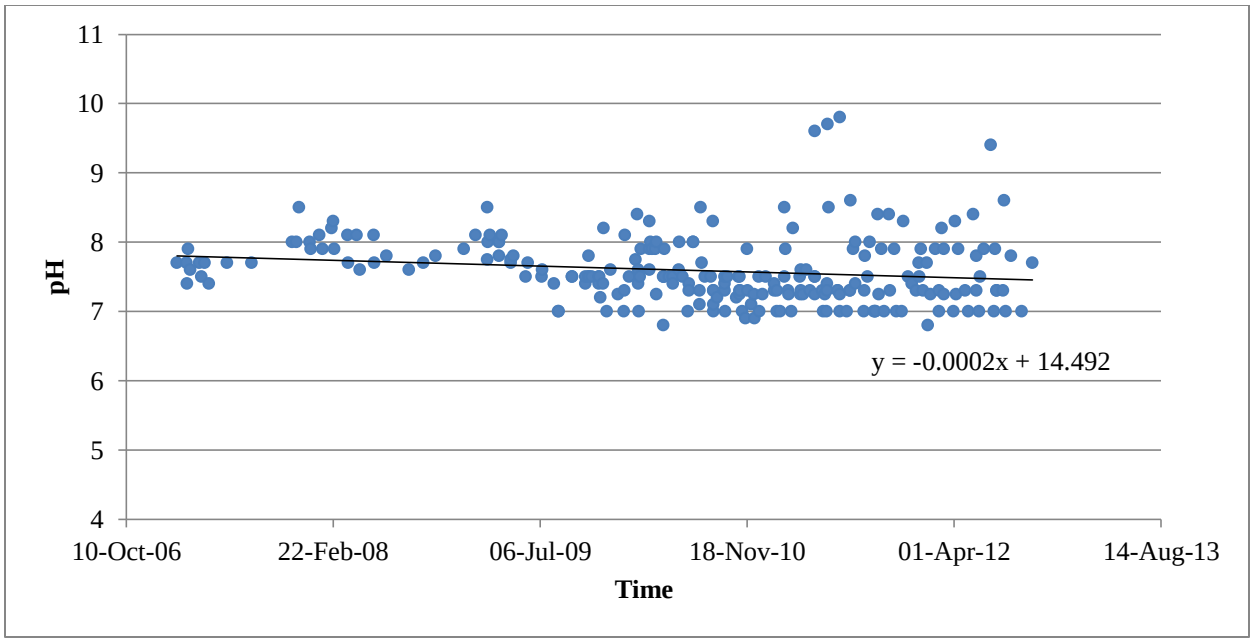


Figure 7: Changes in pH over time at all sites within the Plum Creek Watershed

Secchi disk and total depth

Total depth was measured 238 times and Secchi disk values were collected 222 times within the watershed during the sampling period. Secchi disk was significantly increased over time (P = 0.02). One high total depth measurement, found in early 2012, appears to be associated with a flood event in February 2012.

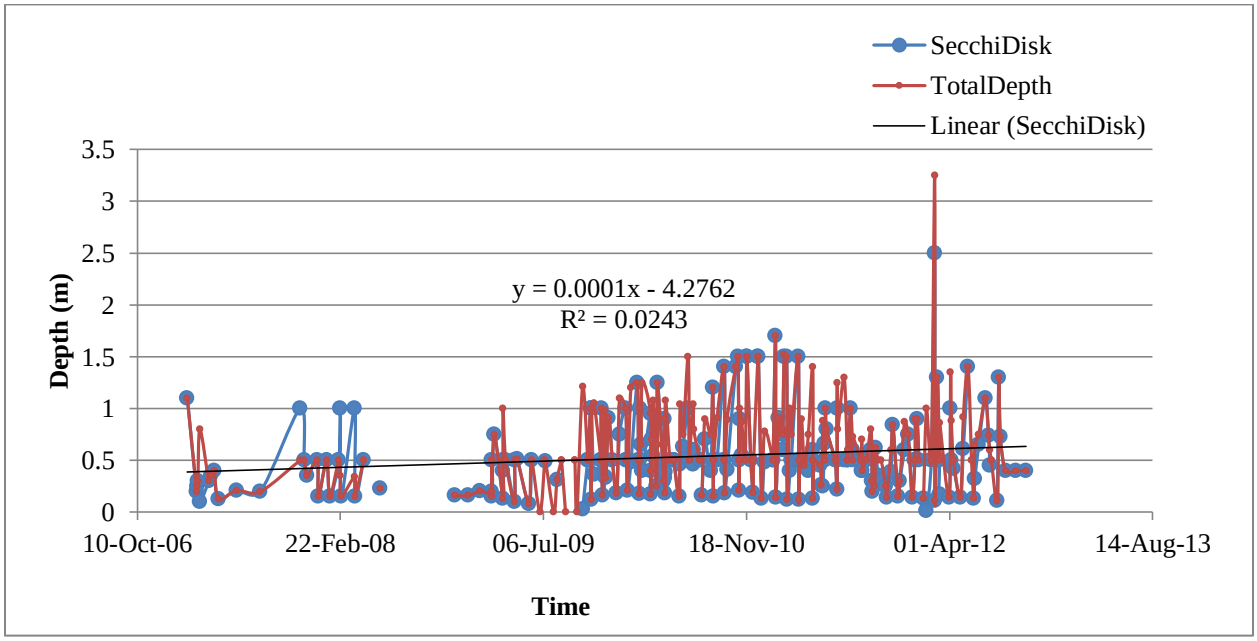


Figure 8: Total depth and Secchi disk over time within the Plum Creek Watershed

Field Observations

Rainfall events of over two inches occurred in Jan 2007, Oct 2009, Jan 2012, and May 2012. Additionally, analyses show that water conditions moved from ripples to calm water over the course of the study and water odor changed from 'oily' to 'no odor' over the course of the study.

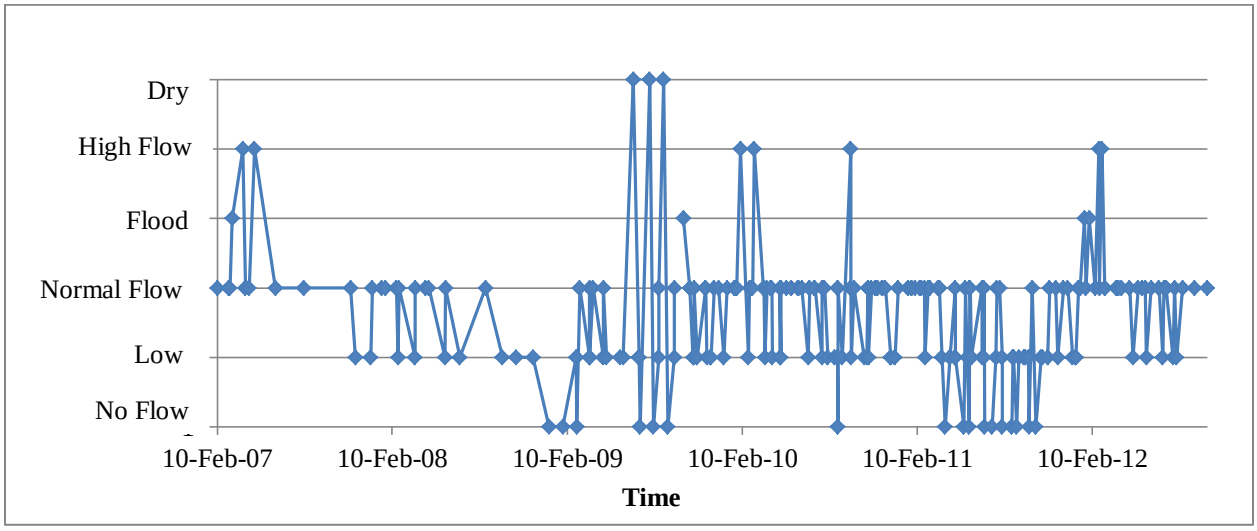


Figure 9: Flow over time at all sites within the Plum Creek Watershed

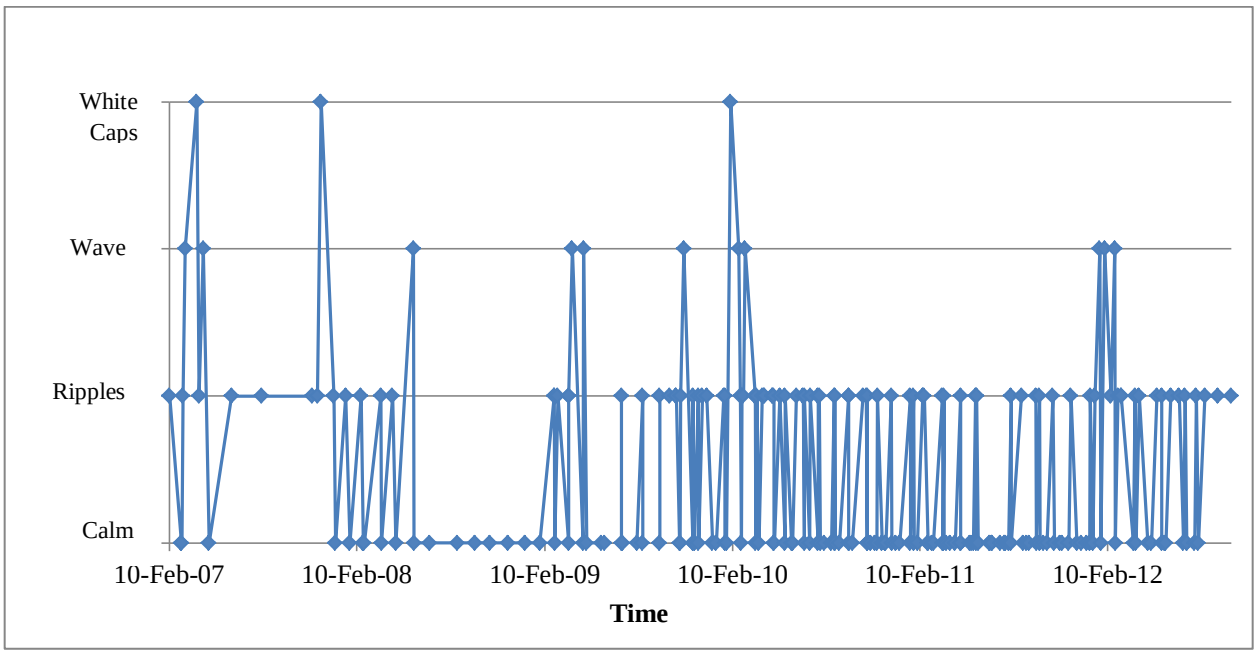


Figure 10: Water conditions over time at all sites within the Plum Creek Watershed

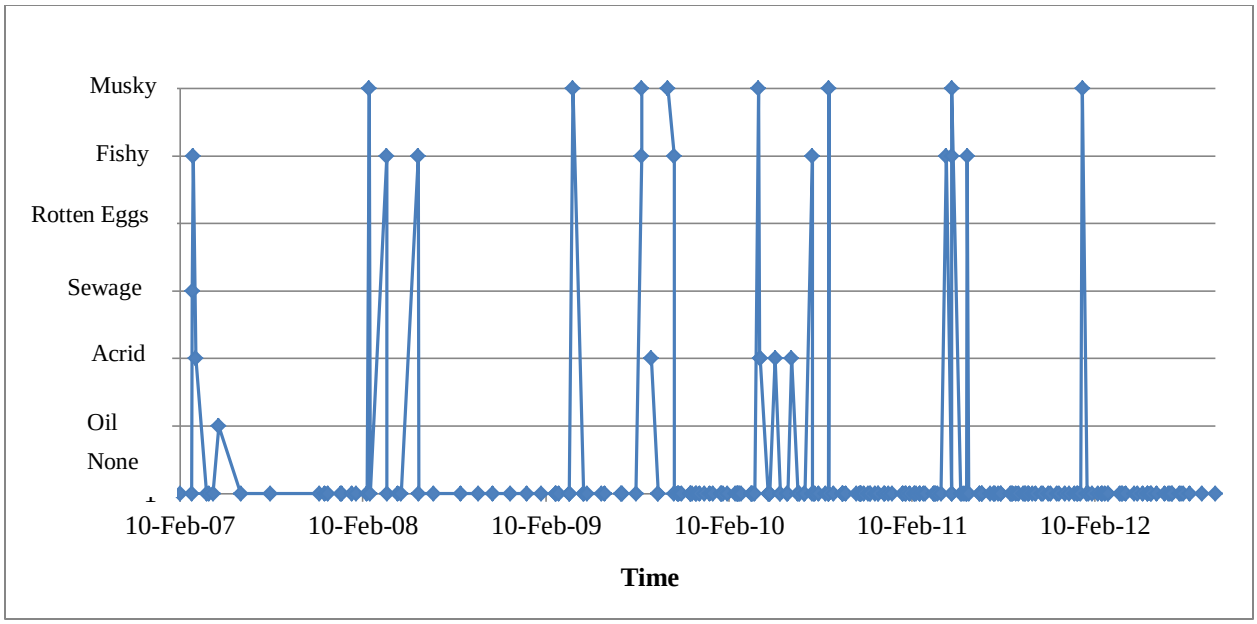


Figure 11: Water odor over time at all sites within the Plum Creek Watershed

E.coli Bacteria

Regression analysis (p = 0.263) of volunteer data suggests no significant correlation between E. coli levels and time for the duration of this study. A total of 68 samples were collected.

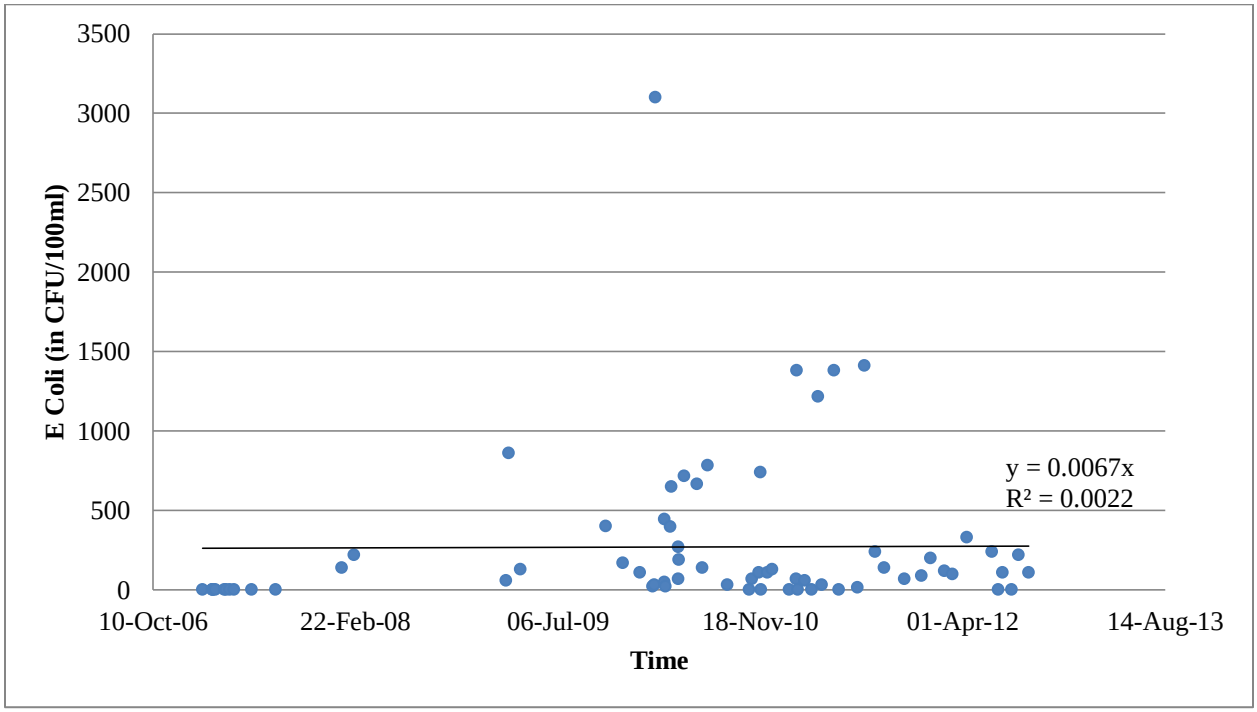


Figure 12: E. coli counts over time at all sites within the Plum Creek Watershed

Plum Creek Upstream and Downstream Trends

Air and water temperature

Water temperature was shown to have a significant correlation (p=0.001) with distance along Plum Creek in this study, with water temperature decreasing as distance from headwaters increased. Air temperature was not reviewed with a regression analysis.

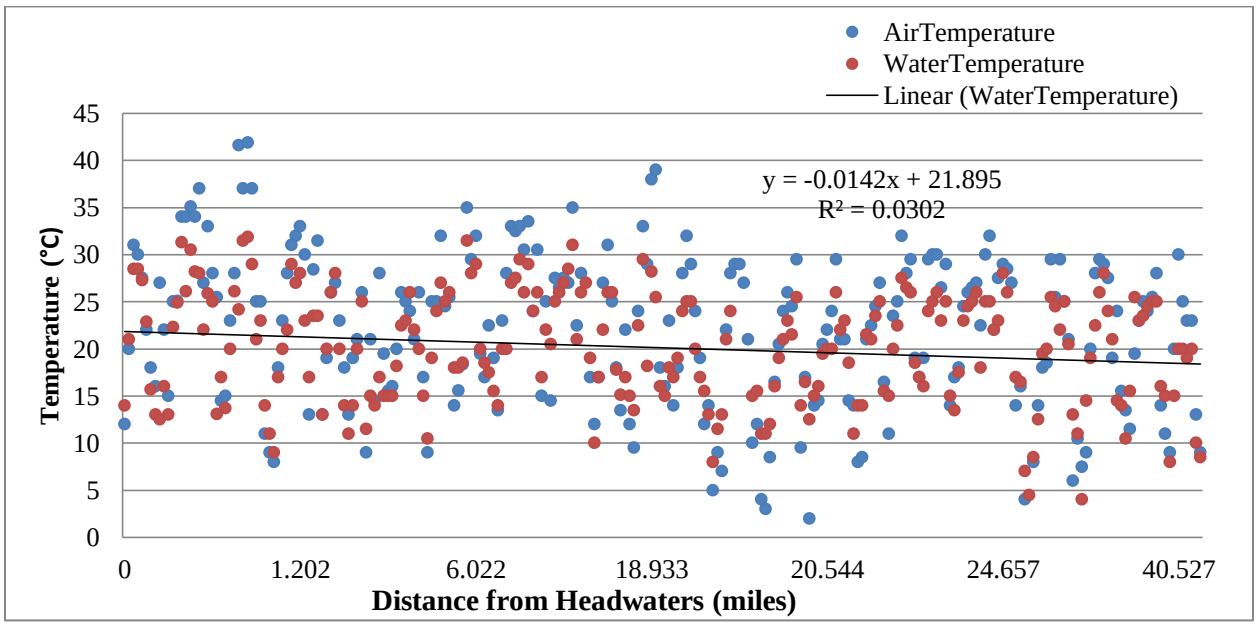


Figure 13: Air and water temperature over distance from headwaters at all sites within the Plum Creek Watershed

Total Dissolved Solids

The TDS concentration had a significant correlation (p=0.002) with distance along Plum Creek in this study, with TDS increasing with distance from headwaters.

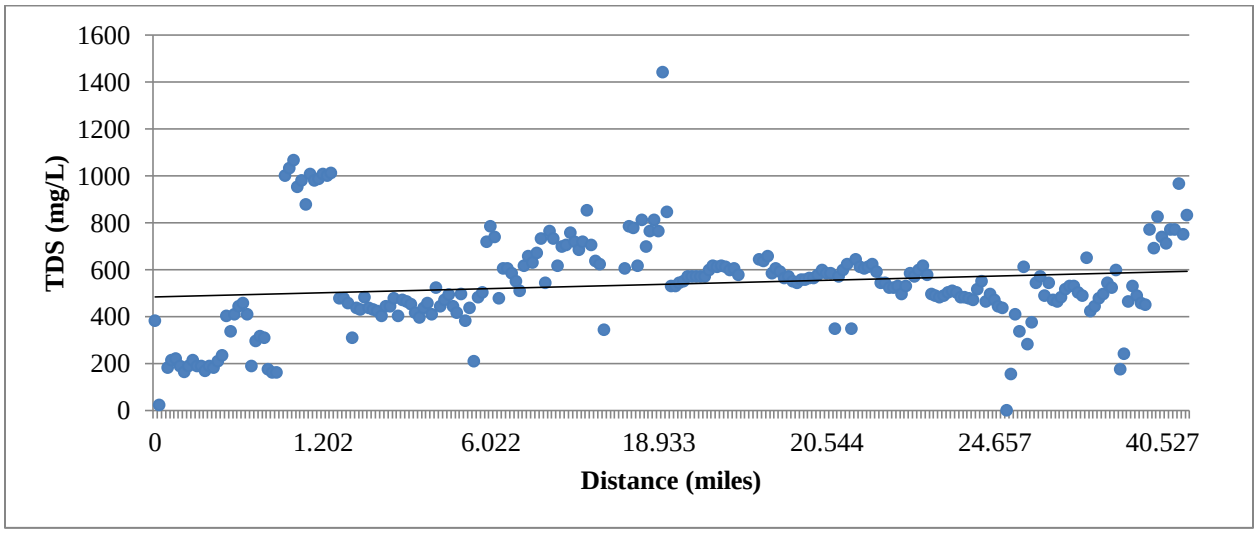


Figure 14: Total Dissolved Solids over distance from headwaters at all sites within the Plum Creek Watershed

Dissolved Oxygen

Distance from headwaters was not a significant predictor (p=0.0763) of DO along Plum Creek during this study.

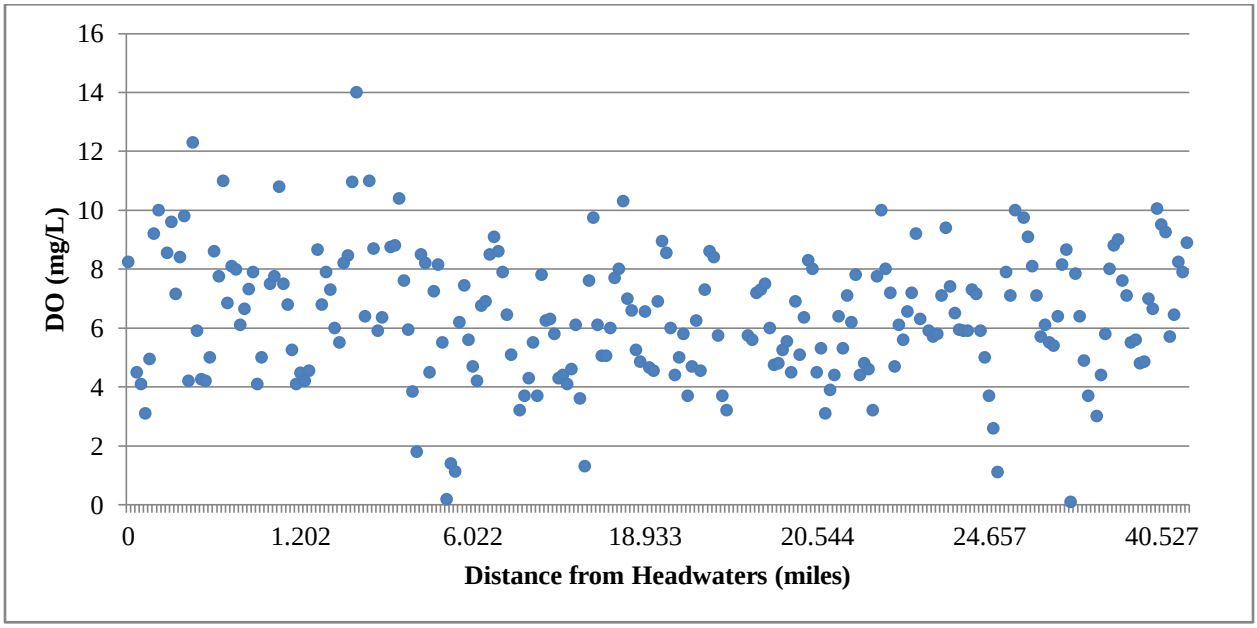


Figure 15: Dissolved Oxygen over distance from headwaters at all sites within the Plum Creek Watershed

pH

Distance from headwaters was a significant predictor (p=0.02) of pH along Plum Creek, with pH decreasing slightly as distance from headwaters increased.

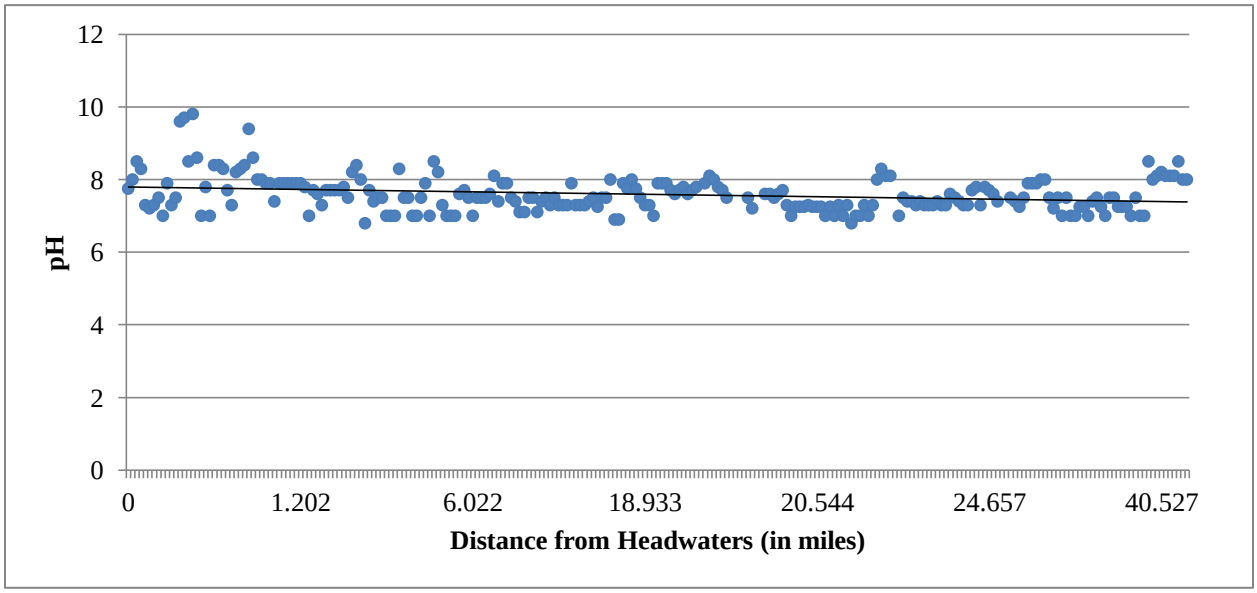


Figure 16: The pH over distance from headwaters at all sites within Plum Creek Watershed

Secchi disk and total depth

Secchi disk values show a significant decrease over distance from headwaters (p=0.000).

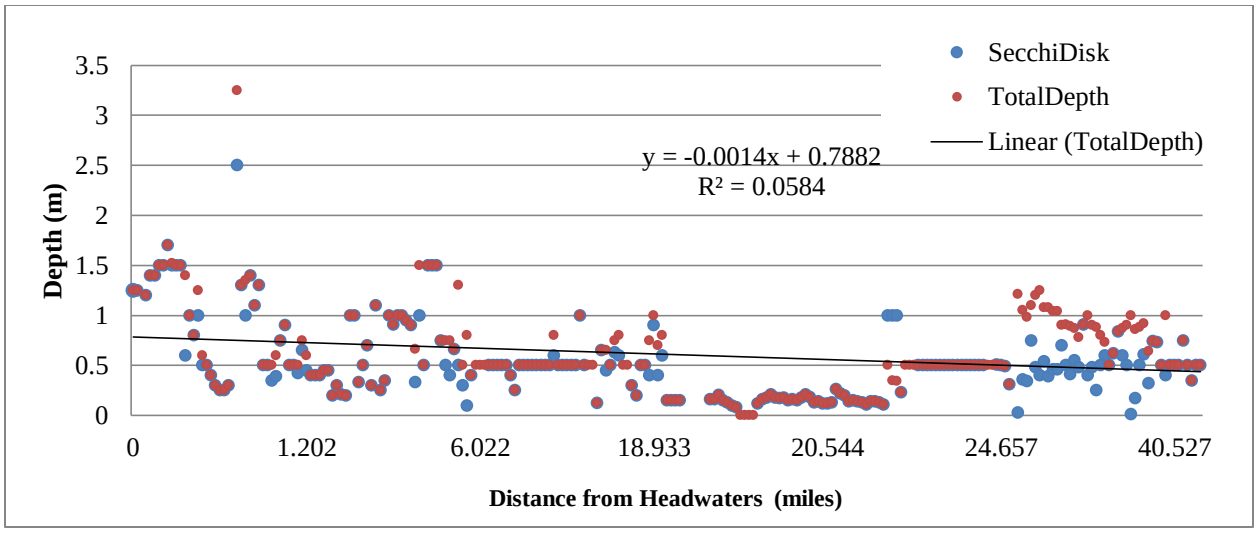


Figure 17: Secchi disk and total depth over distance from headwaters at all sites within Plum Creek Watershed

Field Observations

Among the Field Observations, algae cover, increased with distance along Plum Creek (p = 0.000). Water color, clarity, and conditions were also plotted along the distance from the Plume Creek Headwaters.

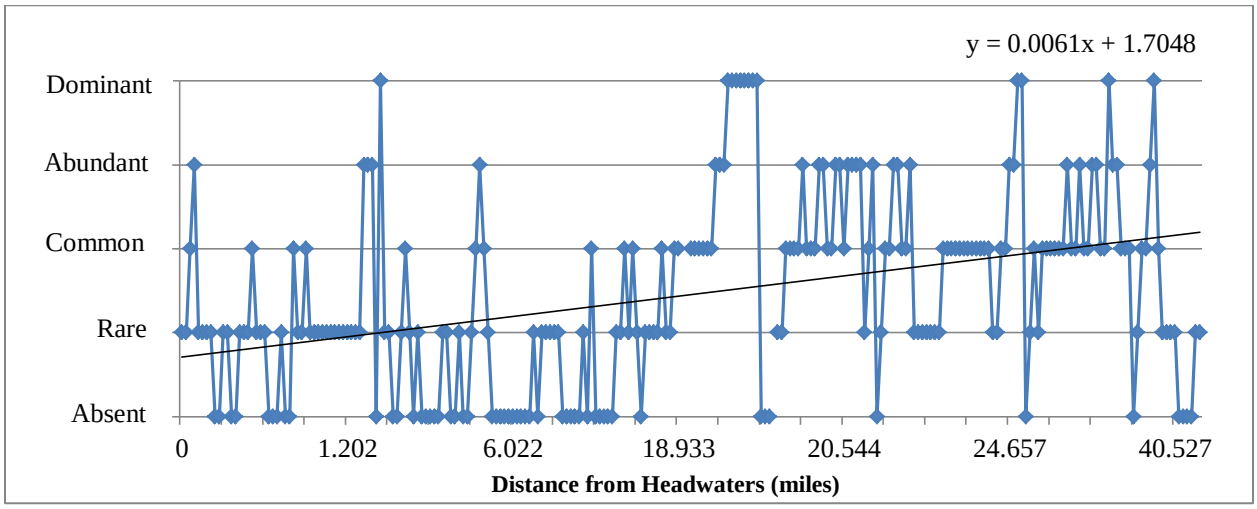


Figure 18: Algae cover over distance from headwaters at all sites within Plum Creek Watershed

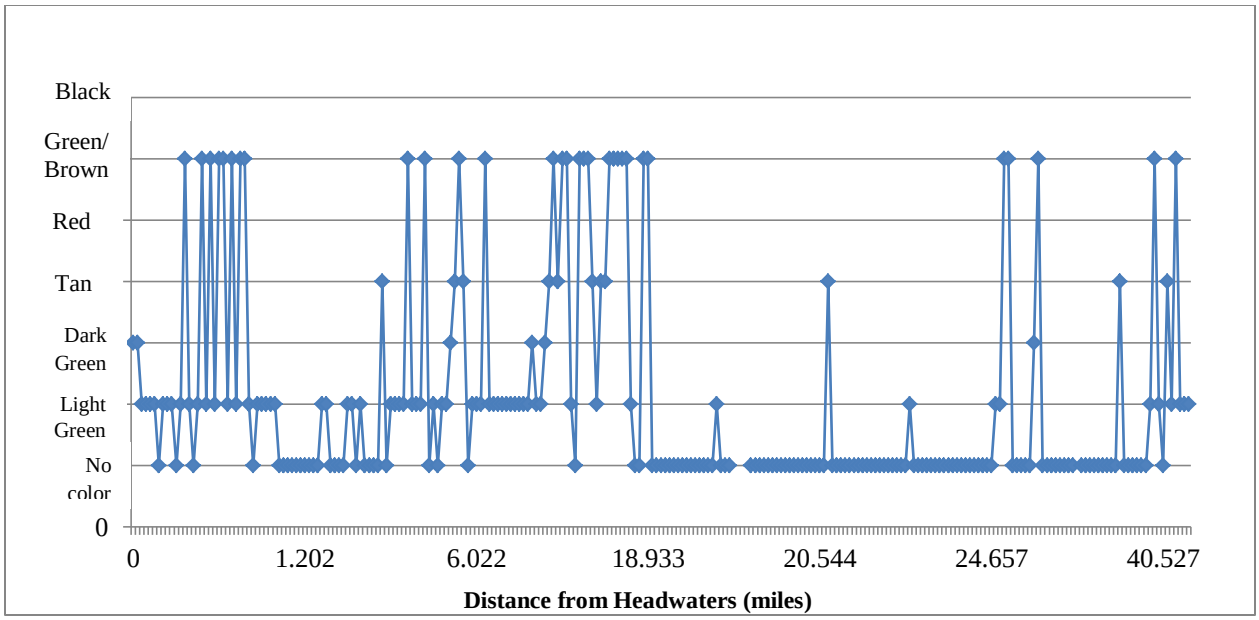


Figure 19: Water color over distance from headwaters at all sites within Plum Creek Watershed

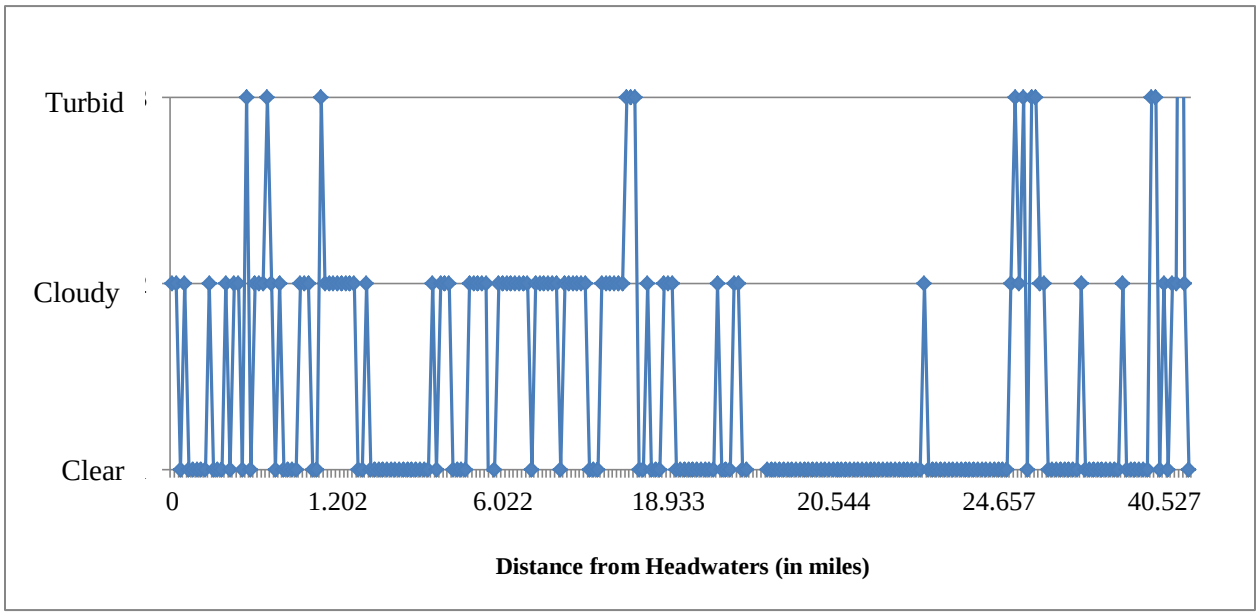


Figure 20: Water clarity over distance from headwaters at all sites within the Plum Creek Watershed

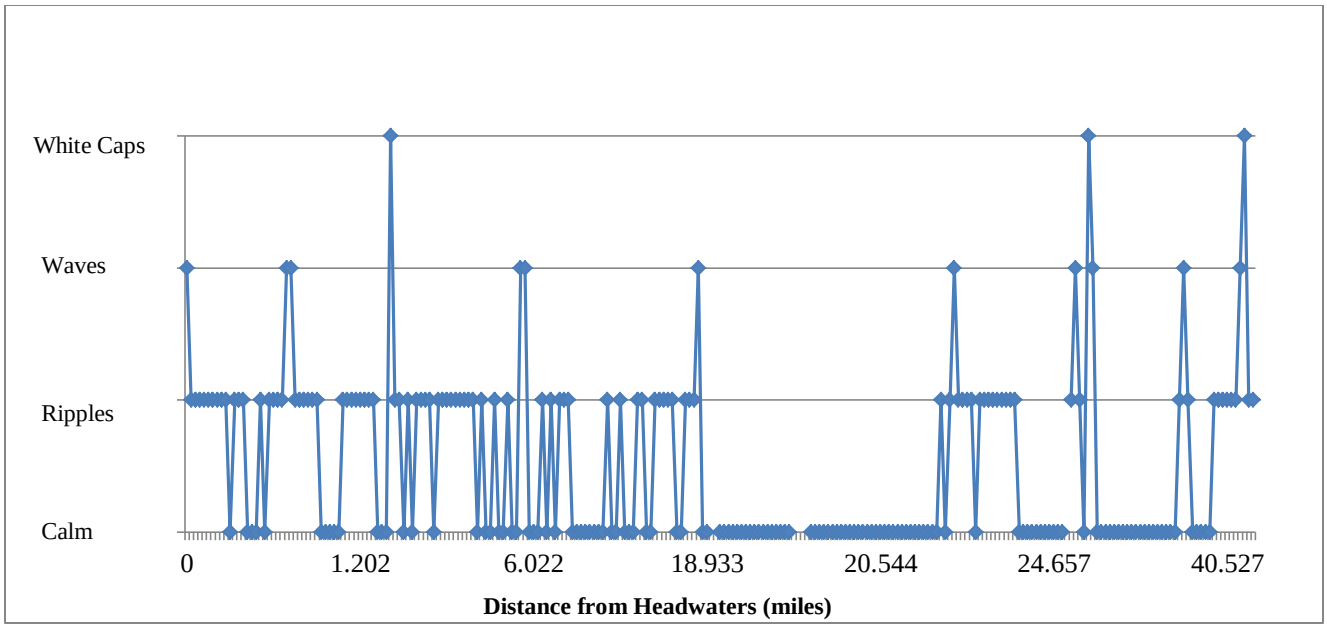


Figure 21: Water conditions over distance from headwaters at all sites within the Plum Creek Watershed

E.coli Bacteria

Regression analysis suggests that distance was not a predictor of E. coli levels along Plum Creek in this study.

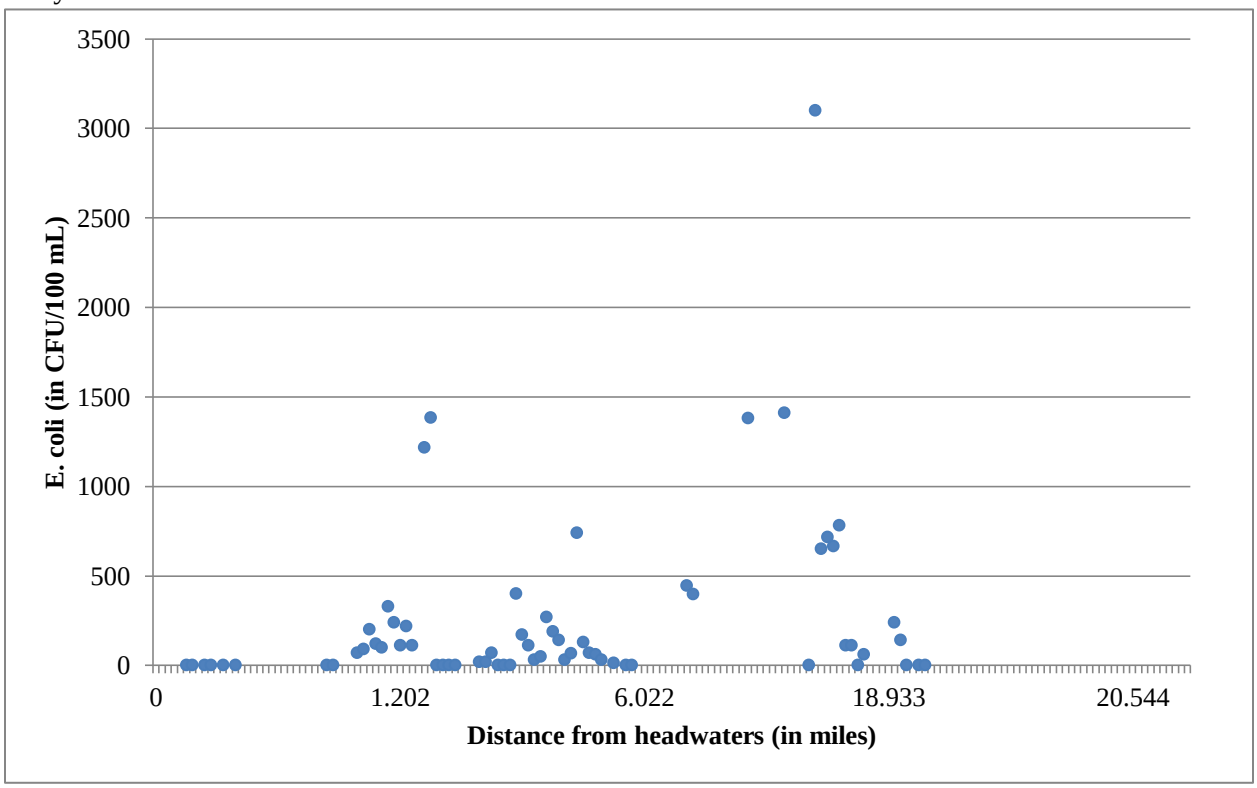


Figure 22: E. coli counts over distance from headwaters at all sites within the Plum Creek Watershed

Texas Stream Team
Caring for Our Waters

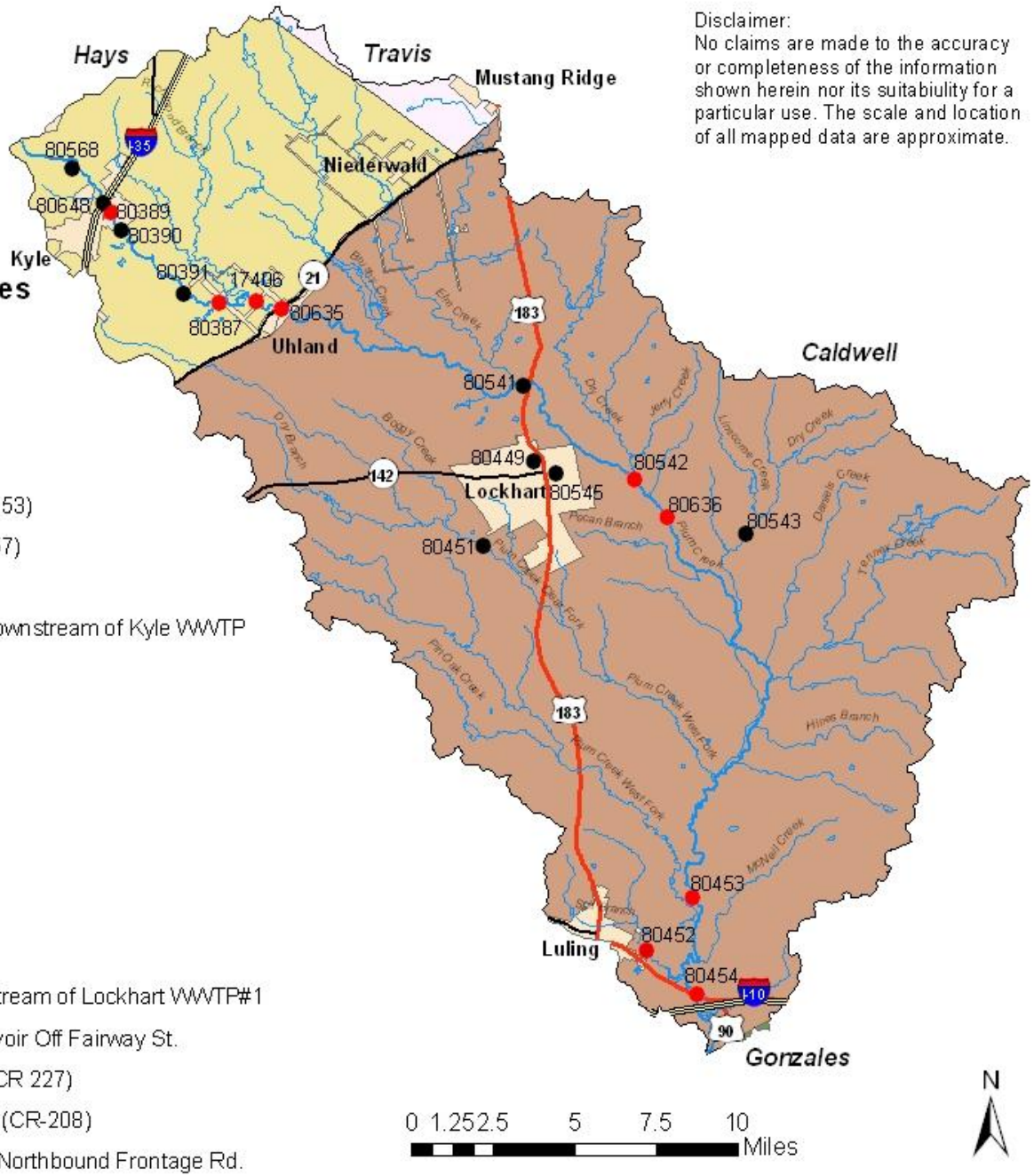
Plum Creek Watershed

Texas Stream Team Monitoring Sites

- Active Texas Stream Team Sites
- Inactive Texas Stream Team Sites

Site ID

- 17406 - Plum Creek @ Plum Creek Rd
- 80387 - Plum Creek @ Grist Mill Rd. (CR-153)
- 80389 - Plum Creek @ Goforth Rd. (CR-157)
- 80390 - Plum Creek @ Lehman Rd.
- 80391 - Plumc Creek @ Heidenreich Ln Downstream of Kyle WWTP
- 80449 - Town Branch @ N. Blanco St.
- 80451 - Clear Fork @ Lockhart State Park
- 80452 - Salt Creek @ FM 1322
- 80453 - Plum Creek @ CR131 Bridge
- 80454 - Plum Creek @ 135
- 80541 - Plum Creek Upstream of US 183
- 80542 - Salt Creek @ FM 1322
- 80543 - Dry Creek @ FM 713
- 80545 - Town Branch @ E. Market St. Upstream of Lockhart WWTP#1
- 80568 - Plum Creek @ Golf Course Reservoir Off Fairway St.
- 80635 - Plum Creek @ Old Spanish Trail (CR 227)
- 80636 - Plum Creek @ Old McMahan Trail (CR-208)
- 80648 - Plum Creek Downstream of IH-35 Northbound Frontage Rd.



Disclaimer:
No claims are made to the accuracy or completeness of the information shown herein nor its suitabiulity for a particular use. The scale and location of all mapped data are approximate.

Plum Creek 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 7, on the following page, for a quick overview of the average results.

Total Dissolved Solids 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 12538, Andrews Branch at Andrew's Crossing (CR-131), had the highest overall average for TDS, with a result of 990.48± 45.6 mg/L. Site 80568, Plum Creek at Golf Course Reservoir off Fairway St. had the lowest average TDS, with a result of 355.08 ± 154.84 mg/L.

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. 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. Site 80541, Plum Creek Upstream of US 183, had the lowest DO reading, with a result of 5.15 ± 0.94 mg/L. Sites 80452, 80453, and 80454 combined had the highest average DO with 16.59 ± 5.5 mg/L.

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. The lowest average pH observed was for site 80541, Plum Creek Upstream of US 183, with an average pH of 7.28± 0.21. Sites 80452, 80453, and 80454 combined had the highest average combined pH with a result of 8.28 ± 1.52.

E. coli bacteria originate in the digestive tract of endothermic organisms. The EPA has determined E. coli to be the best indicator of the degree of pathogens in a water body, which are far too numerous to be tested for directly, considering the amount of water bodies tested. A pathogen is a biological agent that causes disease. The highest E.coli geomean was 242.24± 2.4 CFU/100 mL from combined samples from Sites 80452, 80453, and 80454. The lowest E. coli geomean was 0.18 ± 1986 from combined samples from Sites 80648 and 80389.

It is 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 7: Average Values for all Plum Creek Sites

Site Number	TDS (mg/L)	DO (mg/L)	pH	E. coli (CFU/100 mL)
80568	355.08 ± 154.84 (min.)	7.15 ± 2.14	8.11 ± 0.73	N/A
80648 and 80389	432.71 ± 46.11	8.20 ± 2.44	7.7 ± 0.411	0.18 ± 1986 (min.)
80390	434.22 ± 62.79	6.20 ± 3.16	7.4 ± 0.47	10.55 ± 187.95
80391	653.03 ± 94.68	5.6 ± 1.84	7.46 ± 0.26	8.47 ± 2361.28
80387, 17046, 80635	674.2 ± 155.28	7.03 ± 1.73	7.53 ± 0.37	14.92 ± 1103.02
80541	964.8 ± 318.84	5.15 ± 0.94 (min.)	7.28 ± 0.21 (min.)	185.51 ± 1.31
80449	575.34 ± 57.11	5.77 ± 1.57	7.44 ± 0.33	N/A
80450 and 80545	519.65 ± 41.93	6.58 ± 1.87	7.51 ± 0.32	N/A
80636	730.3 ± 56.85	6.82 ± 0.25	8.25 ± 0.35	N/A
80451	461.58 ± 108.27	6.80 ± 4.6	7.40 ± 0.31	N/A
12538	990.48 ± 45.6 (max.)	6.09 ± 2.01	7.78 ± 0.29	141.367 ± 1.65
80452, 80453, and 80454	794.78 ± 79.91	16.59 ± 5.5 (max.)	8.28 ± 1.52 (max.)	242.24 ± 2.4 (max.)

Site 80568 – Plum Creek at Golf Course Reservoir off Fairway St.

Site Description

This site is located on Plum Creek at the Plum Creek Golf Course Reservoir off Fairway St. This site contains a limited riparian zone, with no trees or shade nearby, and the land next to the site is cleared and mowed. This site had the lowest mean TDS value of all of the Plum Creek Sites.

Sampling Information

This is a currently active site sampled from 2/22/2010 to 7/31/2012 by the following groups: Plum Creek Partnership (3C), American YouthWorks (YW), and TST Guadalupe River Basin (4K). This site has been sampled by Matt Liesse (2010), Kristy Reeves (2010-2011), Jessica Uramkin (2011-current), Frank Aguirre (2011), and Trevor Brue (2012). Sampling has occurred on average 8.6 times a year, typically during the latter part of the month and morning hours, although variation in date and time of sampling did occur. Since Jan. 2010, monitors spent a total of 69 hours and 4 minutes and traveled 1,377.5 miles while sampling this site, with an average of 139.8 minutes spent and 45.9 miles traveled during each sampling event.

Table 8: Descriptive parameters for Site 80568

Parameter	% Complete	Mean ± Standard Deviation	Max	Min
Total Dissolved Solids (mg/L)	96%	355.08 ± 154.84	680	32
Water Temperature (°C)	100%	22.61 ± 6.61	31.9	12.5
Dissolved Oxygen (mg/L)	96.20%	7.15 ± 2.14	11	3.1
pH	100%	8.11 ± 0.73	9.7	7
Secchi Disk Transparency (m)	96.20%	1.12 ± 0.54	2.5	0.25
Depth (m)	92.30%	1.2 ± 0.62	3.25	0.25
E. coli Bacteria (CFU/100 mL)	0%	NA	NA	NA

*Site was sampled 26 times between 2/2/2010 and 7/31/2012.

Air and water temperature

Water and air temperatures were sampled 30 times at site 80568. Temperatures fluctuated in an expected seasonal pattern, with maximum temperatures in the summers of 2011 and 2012. Water temperature remained below air temperature, except during two cold spells in 2010 and 2012.

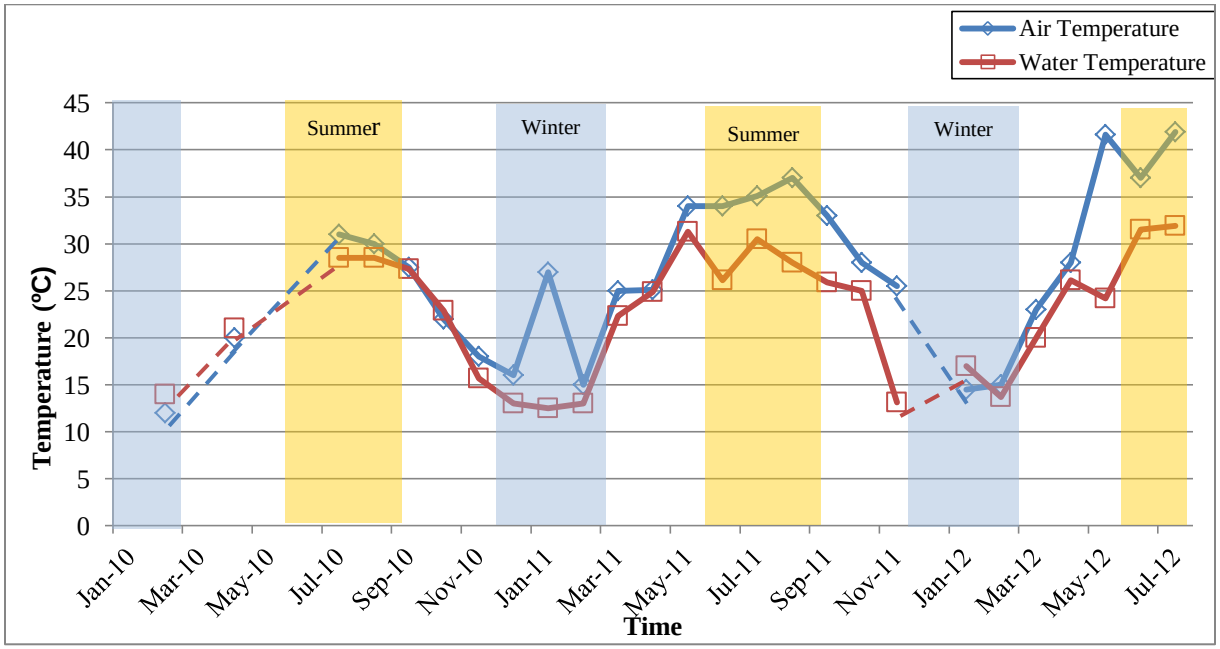


Figure 23: Air and water temperature at Site 80568

Total Dissolved Solids

Citizen scientists sampled TDS at this site 25 times. As shown in Figure 24, this time period also recorded the lowest depth for this site, which could have had an impact on TDS.

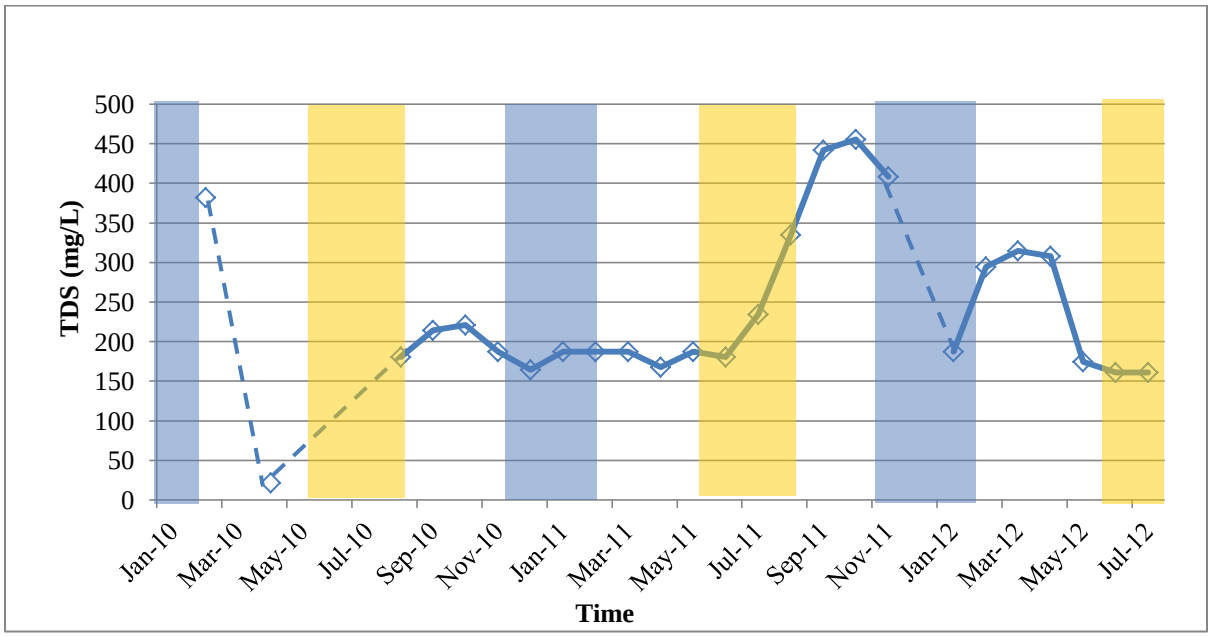


Figure 24: Total Dissolved Solids at Site 80568

Dissolved Oxygen

Dissolved oxygen followed a normal seasonal trend, rising in the winter when the water temperature was low and decreasing in the summer when the water temperature was high. Individual DO sampling event readings dropped below the standard of 5mg/L on six occasions.

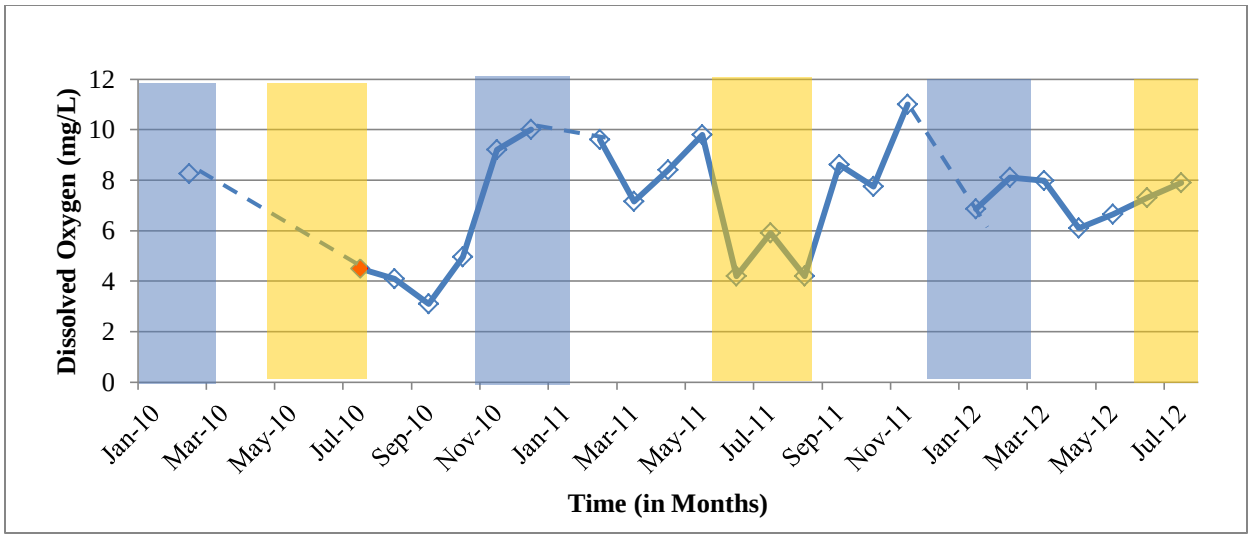


Figure 25: Dissolved Oxygen at Site 80568
Bright red data points on the graph show sampling events where DO measurements failed the quality assurance standards of the Texas Stream Team QAPP.

pH

The pH values at Site 80568 remained relatively constant with a slightly alkaline average of 8.1, which is expected for a stream originating in areas predominated by limestone.

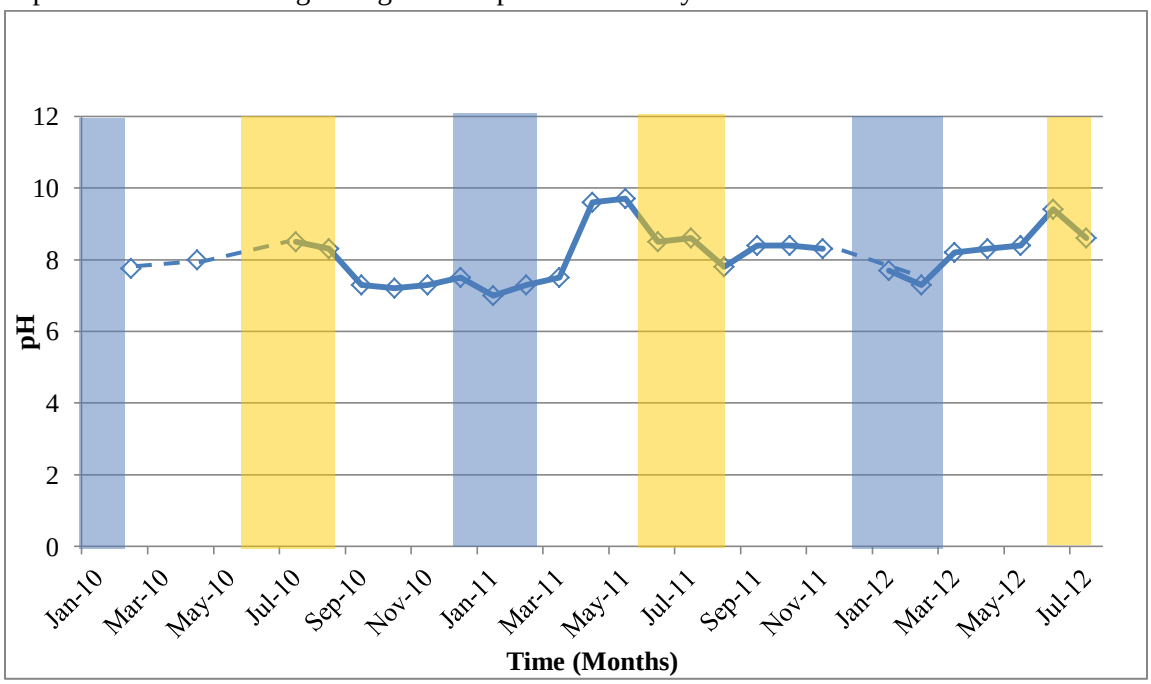


Figure 26: pH at Site 80568

Secchi disk and total depth

Secchi disk depth and total depth were similar for most of the sampling events, showing that the water had a high level of clarity and monitors could usually see to the bottom at their sampling site. However, on

four instances, Secchi disk depth was noted to be lower than total depth. These instances were noted in the spring of 2011 and 2012, where water was also observed to be green in color.

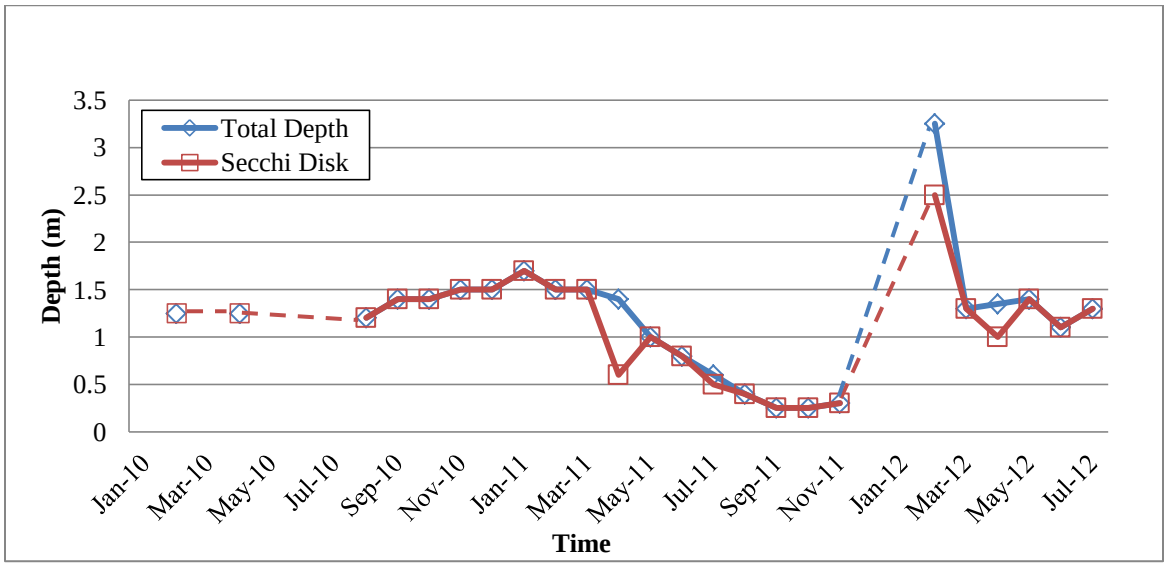


Figure 27: Total depth and Secchi disk depth at Sites 80568

Field Observations

At Site 80568, field observations recorded during sampling events indicated that water had low algal growth, was mostly clear or cloudy, and was light green, rippled, and odorless. Weather was noted to be clear at the time of sampling. Rainfall events of 0.3 in.-1 in. and 1in.-2 in. occurred near sampling in April, 2011 and May, 2012, respectively. One rainfall event of over 2 in. was noted and is mentioned below. Of the sampling events occurring at site 80568, 38.5% occurred during "Low Flow", 46.2% occurred during "Normal Flow", and 11.4% occurred during "High Flow." One sampling event, on January 25th 2012, occurred while the river was in a "Flood Stage," the monitor noted 5.81 in. of rain on the day of sampling.

Site 80648 and 80389 – Plum Creek immediately downstream of IH-35 & Plum Creek at Goforth Road.

Site Description

Site 80648 is on Plum Creek immediately downstream of IH-35 northbound frontage road, where the creek exits a culvert and descends into a small pool. Beyond the riparian zone the land use is suburban homes and some businesses. These sites collectively had the lowest (albeit extremely variable) E. coli geomean of all of the Plum Creek sites.

Site 80389, Plum Creek at Goforth Road (CR-157) is to the south of a small overpass on Goforth Rd. and next to business center, in Kyle, Texas. Beyond the riparian zone, land is primarily covered with suburban homes and business areas.

Site and Sampling Information

Site 80648 was sampled twice in 2011 by Kevin Kyte of the TST Plum Creek Watershed Group. These sampling events occurred between the early afternoon time (12:35 – 13:30) on the 9th and 18th of the

months of April and May. Because only limited sampling was done at this site and the similarity in location and riparian environments, data was combined with Site 80389 for the purposes of this report.

Data from site 80389 for this report was collected between 3/5/2007 and 4/29/2010 by monitors Tara Noah, Monica Gomez, Kevin Kemp, James Elkins, and Kevin Allen from the Group TST Plum Creek Watershed. There was no standard time of day or month that sampling occurred and samples were collected on average only 3 months of the year.

Table 9: Descriptive parameters for Site 80648 and Site 80389

Parameter	% Complete	Mean ± Standard Deviation	Maximum Value	Minimum Value
Total Dissolved Solids (mg/L)	100%	432.71 ± 46.11	482.4	308.2
Water Temperature (°C)	100%	19.83 ± 5.65	28	11
Dissolved Oxygen (mg/L)	91.7%	8.20 ± 2.44	14	5.5
pH	91.7%	7.7 ± 0.411	8.4	6.8
Secchi Disk Transparency (m)	100.0%	0.47 ± 0.29	1	0.2
Depth (m)	100.0%	0.47± 0.29	1	0.2
E. coli Bacteria (CFU/100 mL)	50%	0.18 ± 1986*	1382	20

~Sites were sampled 12 times between 3/5/2007 and 5/18/2011. * Geomean and Geometric Standard Deviation

Air and water temperature

Air and water temperature mirrored each other, with water temperature being slightly lower than air temperature. Both temperatures show a seasonal trend, which suggests that no other factors were affecting water temperatures at these sites. Additionally, the highest air temperature recorded at this site occurred in May, 2011, at the beginning of the hottest summer on record for Texas. The water temperature standard for Plum Creek, as defined in the Texas Surface Water Quality Standards 2010, is 32.2 ºC. While air temperature exceeded this standard water temperature did not, as shown in Figure 28.

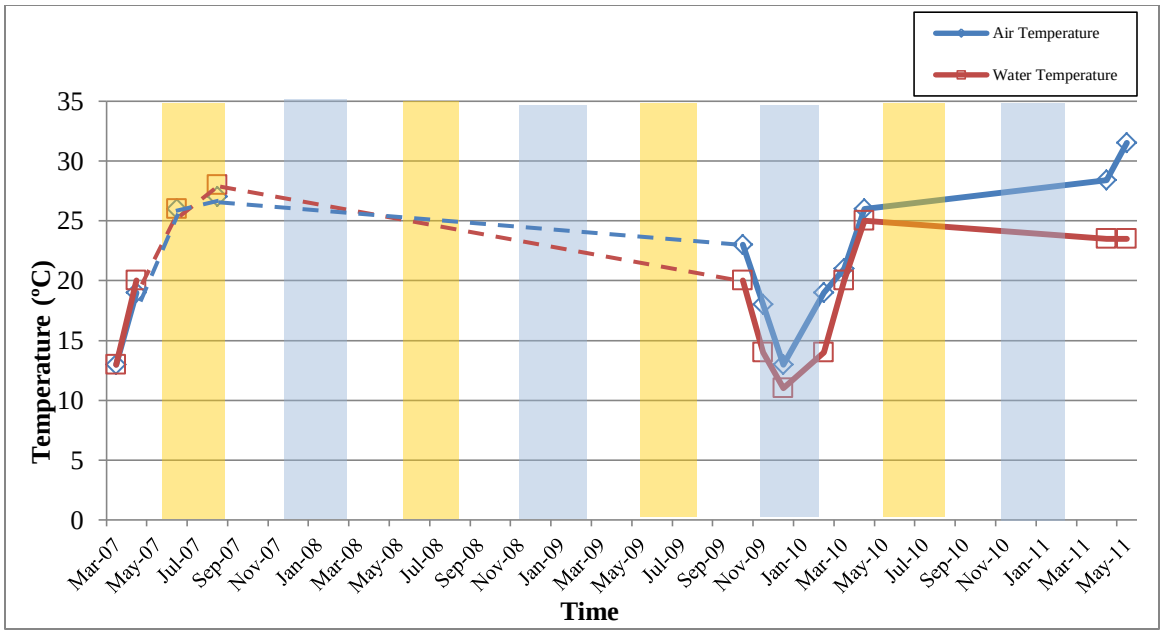


Figure 28: Air and water temperature at Sites 80648 and 80389

Total Dissolved Solids

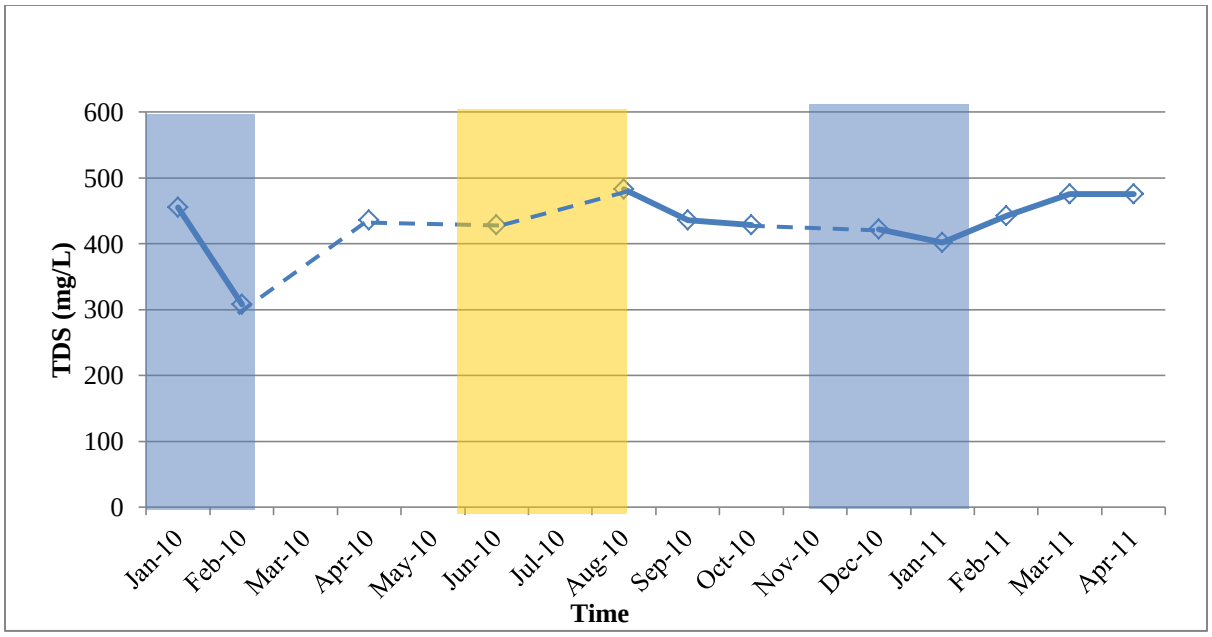


Figure 29: Total Dissolved Solids at Sites 80648 and 80389

Dissolved Oxygen

The DO values remain above the defined standard set for Plum Creek, with levels rising in the winter. The rise in March 2011, as seen on the far right side of Figure 30, was not explained by temperature, which would suggest that DO should begin decreasing at this time; however, no other factors could be found that explain this result.

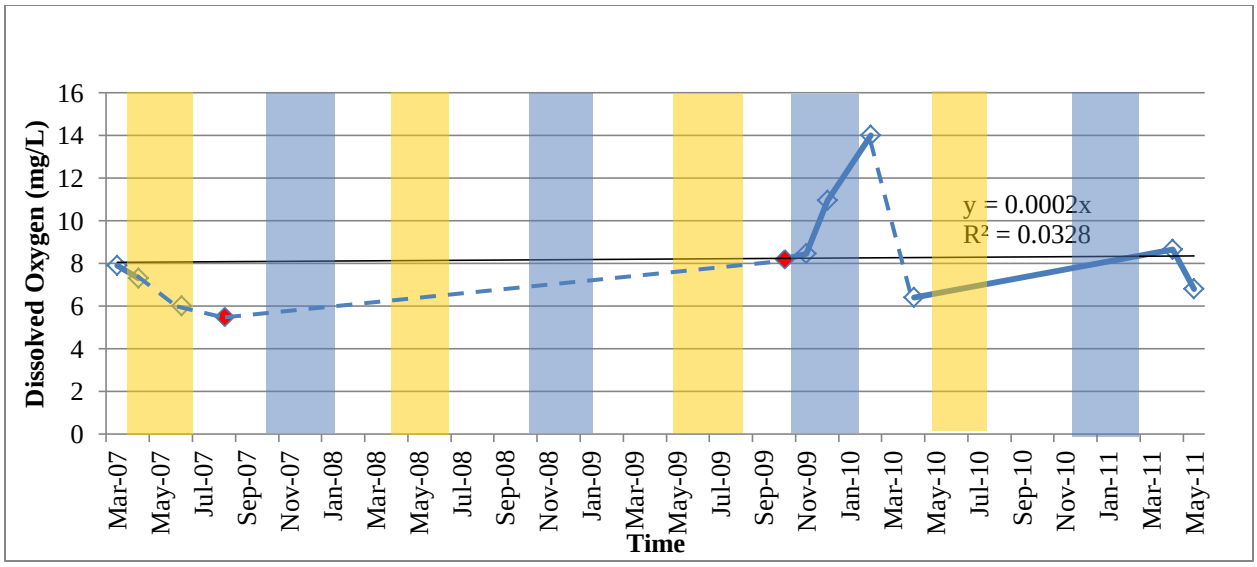


Figure 30: Dissolved Oxygen at Sites 80648 and 80398
Bright red symbols on the graph show sampling events where DO measurements failed the quality assurance standards of the Texas Stream Team QAPP.

Sampling at the site showed that pH remained relatively constant over time with an average of 7.7.

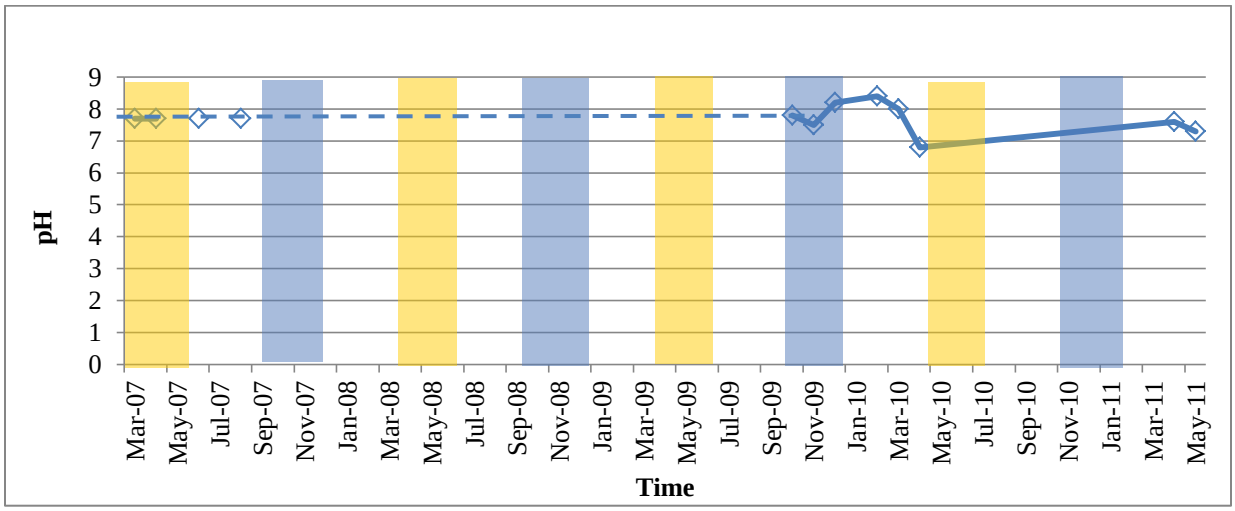


Figure 31: pH at Sites 80648 and 80398

Secchi disk and total depth

Secchi disk measurements were equal to total depth at all sampling events at this site, suggesting that the clarity of this water was high, expected of the headwaters of the Texas creek.

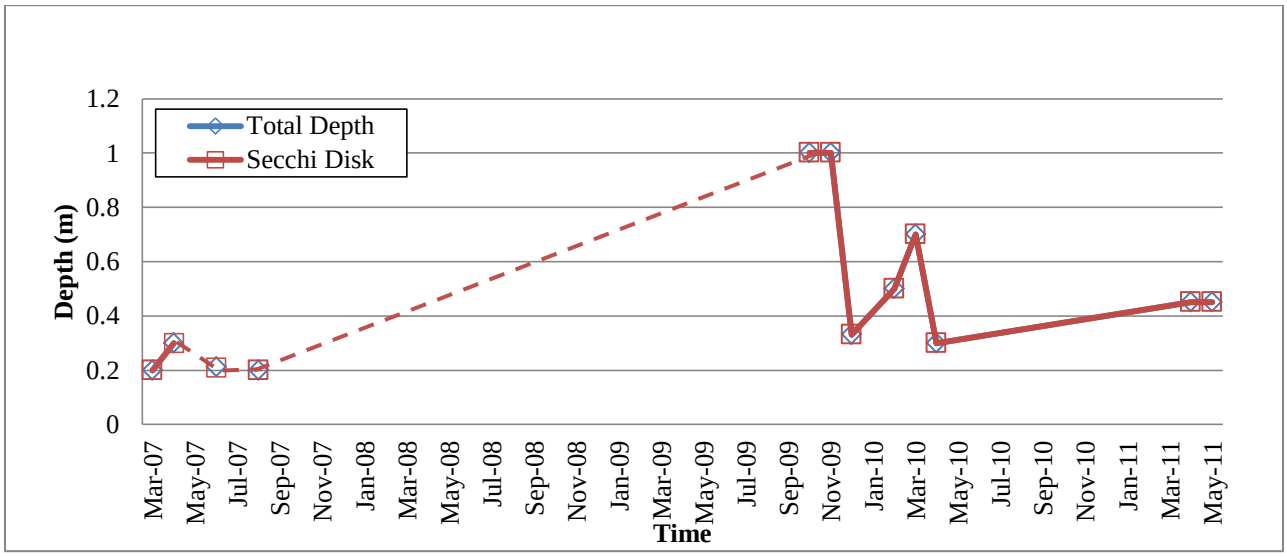


Figure 32: Total depth and Secchi disk depth at Sites 80684 and 80389

Field Observations

At site 80389, field observations indicate that the water commonly had low or normal flow, was rarely covered with algae, but was covered with scum, and contained no color. Water was clear, odorless and with a clear surface greater than70% of the time. The weather was commonly clear or calm at the time of sampling.

At site 80648, field observations indicated that water predominantly had “no flow”, with abundant algal growth, was covered with scum, and was light green in color. The site was also reported to be calm and odorless and could be clear or cloudy. The weather was noted to be either cloudy or overcast during the majority of sampling.

E.coli Bacteria

Bacteria sampling results showed no presence of E.coli in 2007, however in 2011 there were two individual sampling events where the E. coli count was 1216 CFU/100 mL and 1386 CFU/100 mL. It was noted that these two measurements took place during “No Flow” conditions.

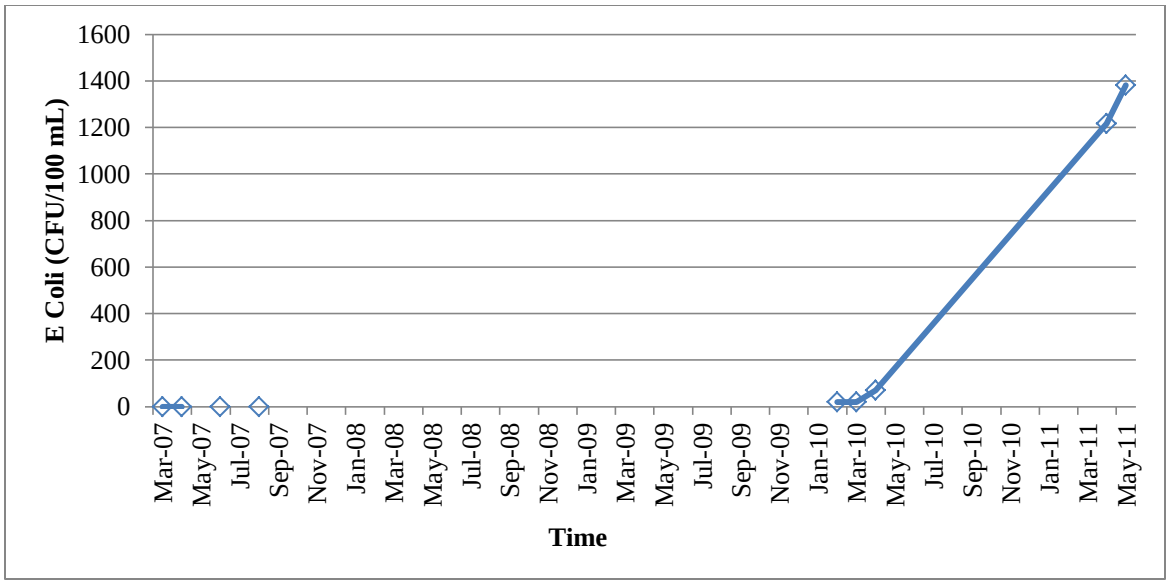


Figure 33: E. coli counts at Sites 80684 and 80389

Site 80390 - Plum Creek at Lehman Dr.

Site Description

Site 80390, Plum Creek at Lehman Dr. (CR-204), is on the south side of the Lehman Road, where the water exits a culvert into a section of creek with small ripples. The area around this site is a suburban landscape with a large school complex located nearby and a mowed park directly upstream.

Site and Sampling Information

The site was sampled from 2/10/2007 to 4/9/2007 by Carolyn Renfro and Elizabeth Stockhorst, and then again from 11/1/2009 to 10/15/2012 by monitors Becky Patterson, Voileta Avina, Will Keirdorf, Kristy Nguyen, Linda McClure, Kleber Trigg, all members of the group TST Plum Creek Watershed. The site was sampled at various times during each month and day.

Table 10: Descriptive parameters for Site 80390

Parameter	% Complete	Mean ± Standard Deviation	Maximum Value	Minimum Value
Total Dissolved Solids (mg/L)	100%	434.22 ± 62.79	522.6	207.7
Water Temperature (°C)	100%	18.99 ± 5.00	27	10.5
Dissolved Oxygen (mg/L)	95%	6.20 ± 3.16	10.75	0.19
pH	100%	7.4 ± 0.47	8.5	7
Secchi disk transparency (m)	100.0%	0.78 ± 0.39	1.5	0.25
Depth (m)	100.0%	0.90 ± 0.38	1.5	0.25
E. coli Bacteria (CFU/100 mL)	80%	10.55 ± 187.95*	740	14

* Geomean and Geometric Standard Deviation, ~ Sites were sampled 12 times between 2/18/2007 and 10/15/2011.

Air and water temperature

Air and water temperature mirrored each other, with water temperature being slightly lower than air temperature in most circumstances. Both temperatures show a seasonal trend, which indicates that no other factors were affecting water temperatures at these sites.

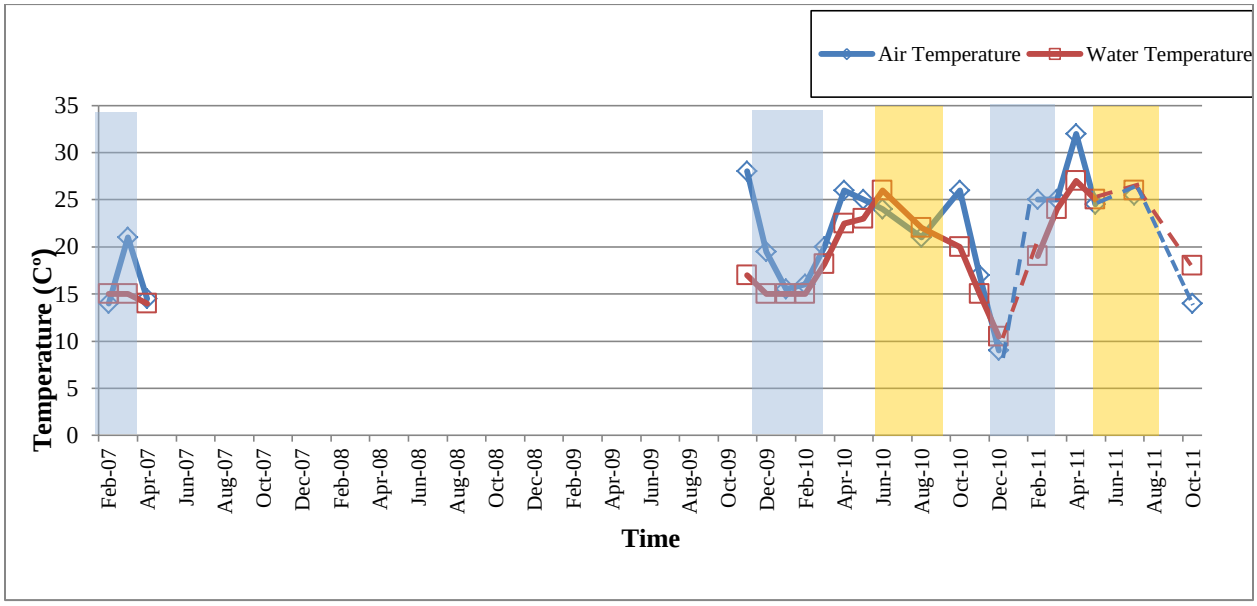


Figure 34: Air and water temperature at Site 80390

Total Dissolved Solids

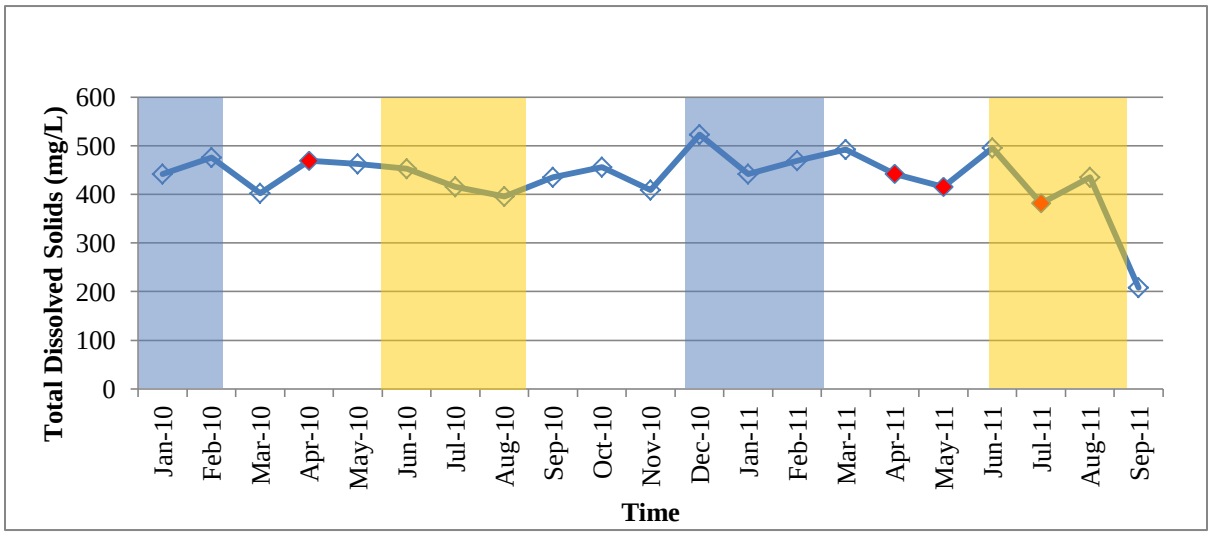


Figure 35: Total Dissolved Solids at Site 80390

Bright red data points on the graph show sampling events where DO measurements failed the quality assurance standards of the Texas Stream Team QAPP.

Dissolved Oxygen

The DO followed the usual season and temperature trend. At this site, times of "no flow" have an average DO level of 1.12, while "low flow" and "normal flow" had an average DO of 5.66, and 8.28, respectively.

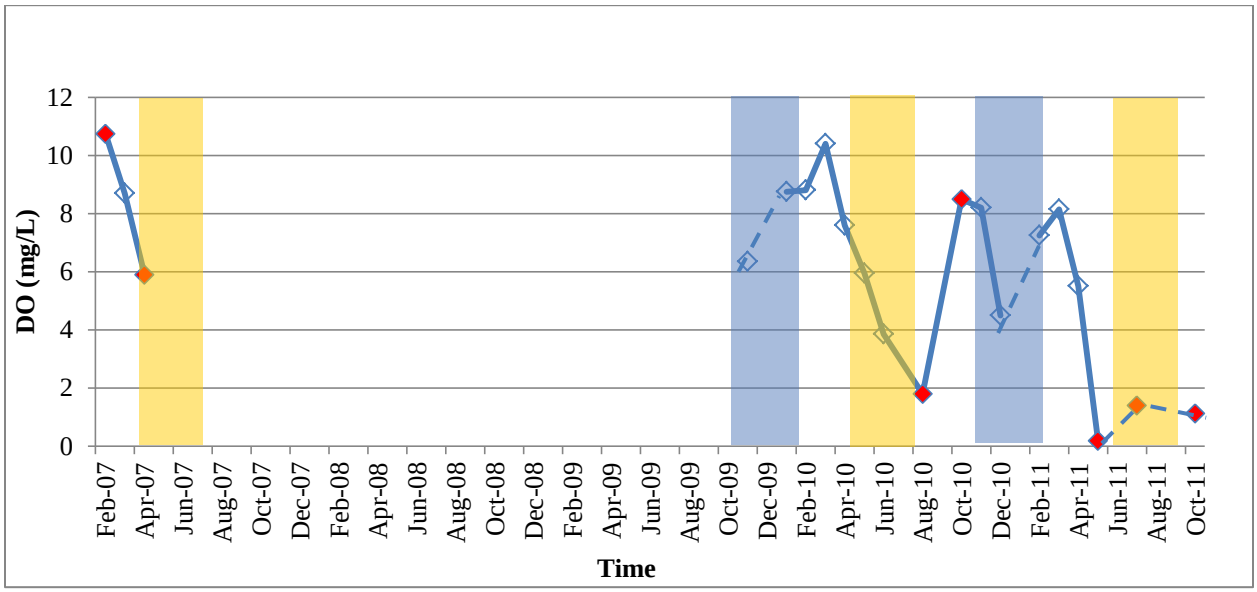


Figure 36: Dissolved Oxygen at Site 80390
Bright red data points on the graph show sampling events where DO measurements failed the quality assurance standards of the Texas Stream Team QAPP.

pH

The pH values remained fairly constant at this site with an average value of 7.4.

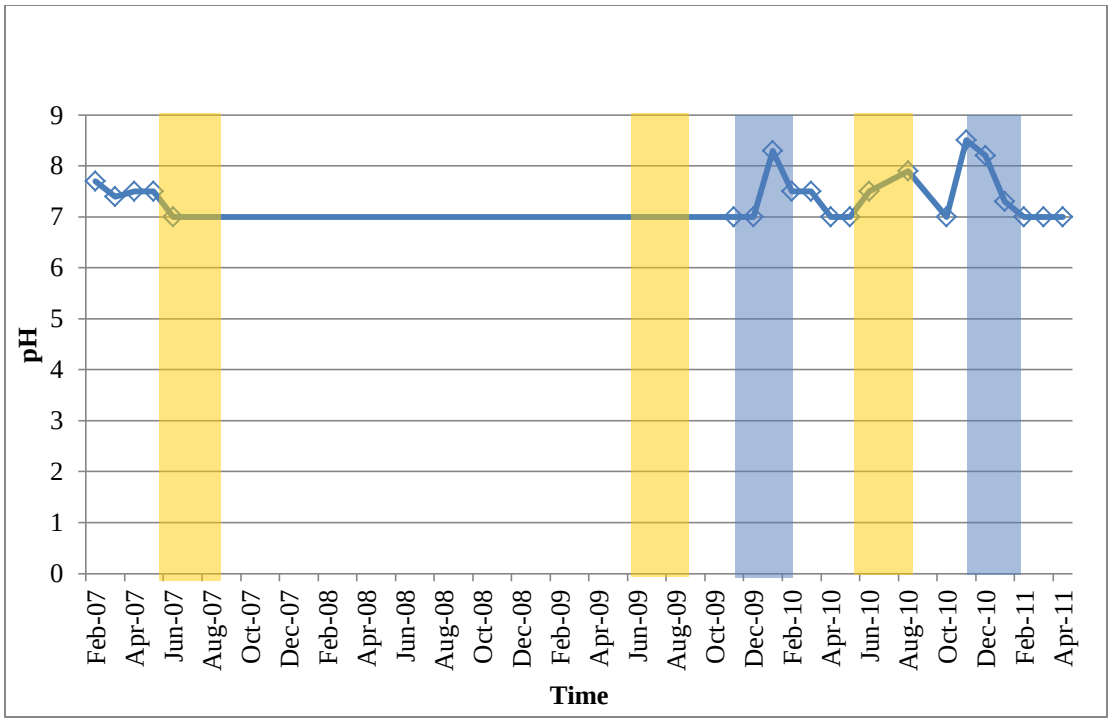


Figure 37: pH at Sites 80648 and 80398

Secchi disk and total depth

Secchi disk and total depth were equal during the winter months, while Secchi disk depth was lower than total depth during the summer months. This suggests that the water clarity was higher during the winter months, while the water was slightly more turbid during the summer months.

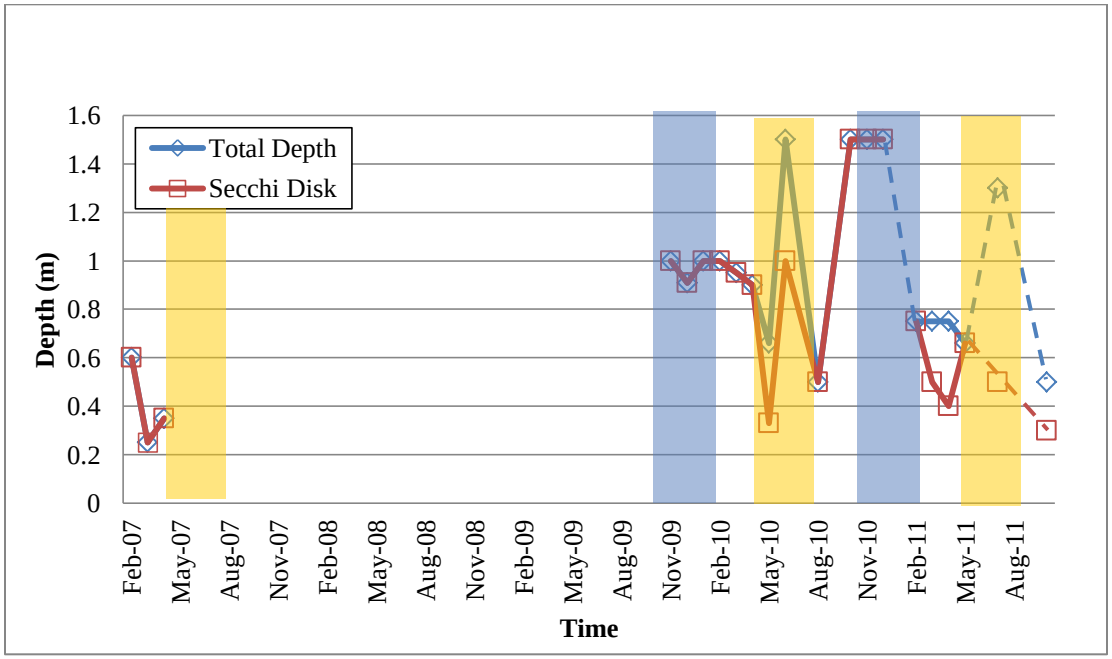


Figure 38: Total depth and Secchi disk depth at Site 80390

Field Observations

At site 80390, field observations recorded during sampling events indicated the water commonly had normal flow, had no algae cover, and was clear, rippled, and light green in color. Water was predominantly odorless, while weather was clear on 52.4%, cloudy on 38.1%, and overcast on 14.3% of sampling events.

E. coli Bacteria

This site displayed a very consistent presence of E.coli with two spikes in bacteria concentrations taking place from February 2007 to Aug 2011.

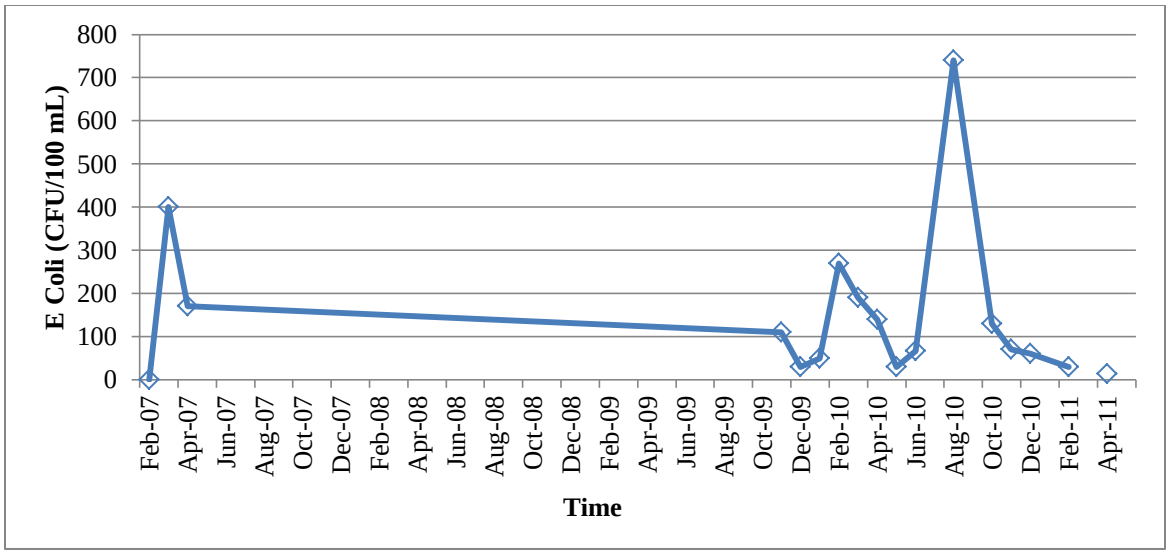


Figure 39: E Coli counts at Sites 80684 and 80389

Site 80391 - Plum Creek at Heidenreich Ln. (CR-152)

Site Description

Site 80391, Plum Creek at Heidenreich Ln., is on the south side of County Road 152, where Plum Creek passes under a bridge. The area around the creek is a thickly forested riparian zone with nearby range and crop land.

Site and Sampling Information

Site 80391 was created on 2/6/2007 and was sampled from 3/13/2007 to 7/13/2012. The site was sampled twice in in 2007, six times in 2009 (Aug-Dec), 11 times in 2010, eight times in 2011 (Sept – Dec) and three times in 2012. A majority of the sampling events were collected during the latter part of each month and 60% of the sampling events were collected in the afternoon hours. During 2007, the site was sampled by Angela Garrardo, while from 2009 to present the site has been sampled by Dustin Lawrence, Linda McClure, Devon Canady, Nicole Wallis, and Cathy Delwiche. All volunteers are members of the Plum Creek Partnership. Monitors spent a total of 72 hours and 14 minutes and traveled 664 miles sampling this site since March 2007, with an average of 144.47 minutes spent and 22.13 miles traveled during each sampling event.

Table 11: Descriptive parameters for Site 80391

Parameter	% Complete	Mean ± Standard Deviation	Maximum Value	Minimum Value
Total Dissolved Solids (mg/L)	64%	653.03 ± 94.68	850.9	475.7
Water Temperature (°C)	100%	23.68 ± 11.10	31.5	14
Dissolved Oxygen (mg/L)	100%	5.6 ± 1.84	9.1	1.3
pH	100%	7.46 ± 0.26	8.1	7.0
Secchi disk transparency (m)	77%	0.49 ± 0.144	1	0.1
Depth (m)	100%	0.52 ± 0.13	1	0.25
E. coli Bacteria (CFU/100 mL)	61.5%	8.47 ± 2361.28 *	1410	0

* Geomean and Geometric Standard Deviation, ~Site was sampled 29 times and between 3/13/2007 and 7/13/2012.

Air and water temperature

Air and water temperature followed the usual seasonal patterns, although the site shows considerable variation. Water temperature usually was cooler and more constant than air temperature. Major recorded rainfall events occurred in March 2007, when 4.46 in. fell, and in October 2009, when 1.11 in. fell.

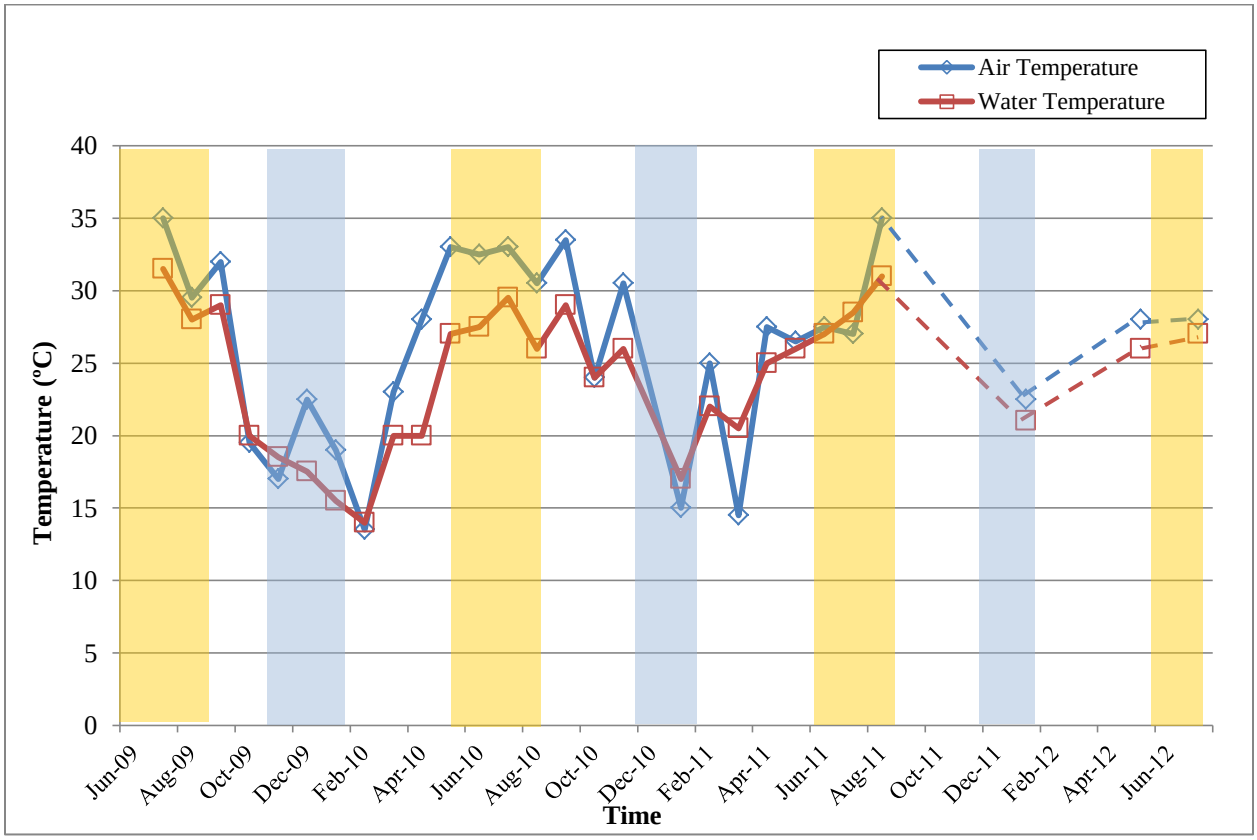


Figure 40: Air and water temperature at Sites 80391

Total Dissolved Solids

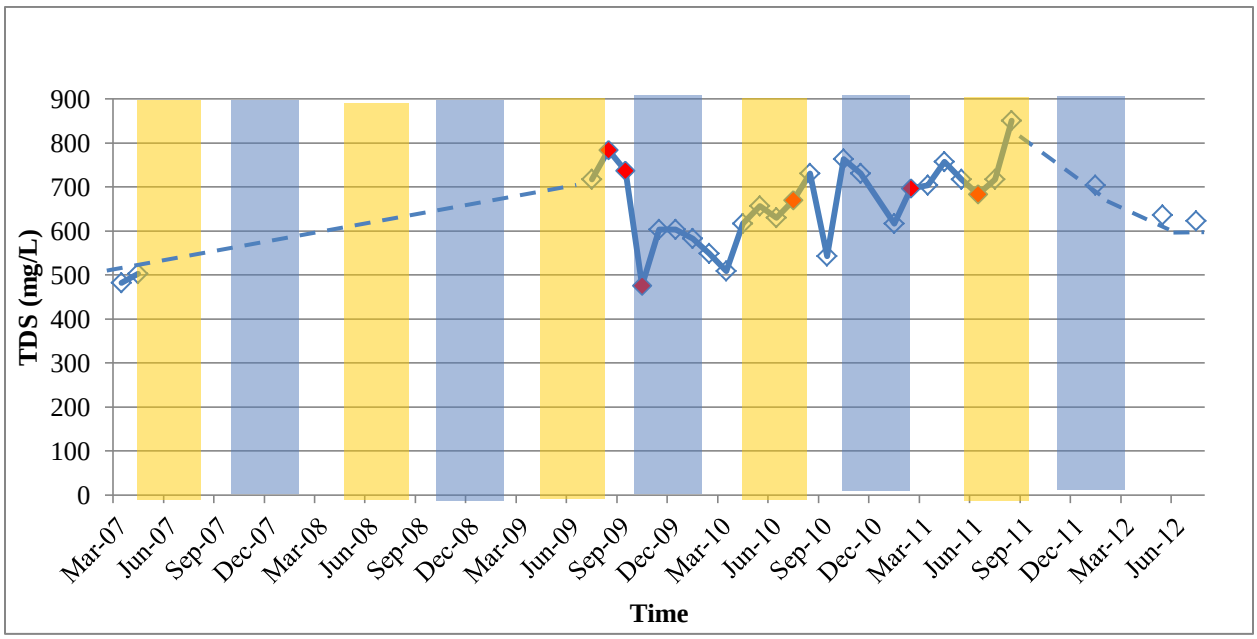


Figure 41: Total Dissolved Solids at Site 80390
Bright red data points on the graph show sampling events where DO measurements failed the quality assurance standards of the Texas Stream Team QAPP.

Dissolved Oxygen

The DO followed the usual seasonal patterns of high values in cooler months and lower values in warmer months.

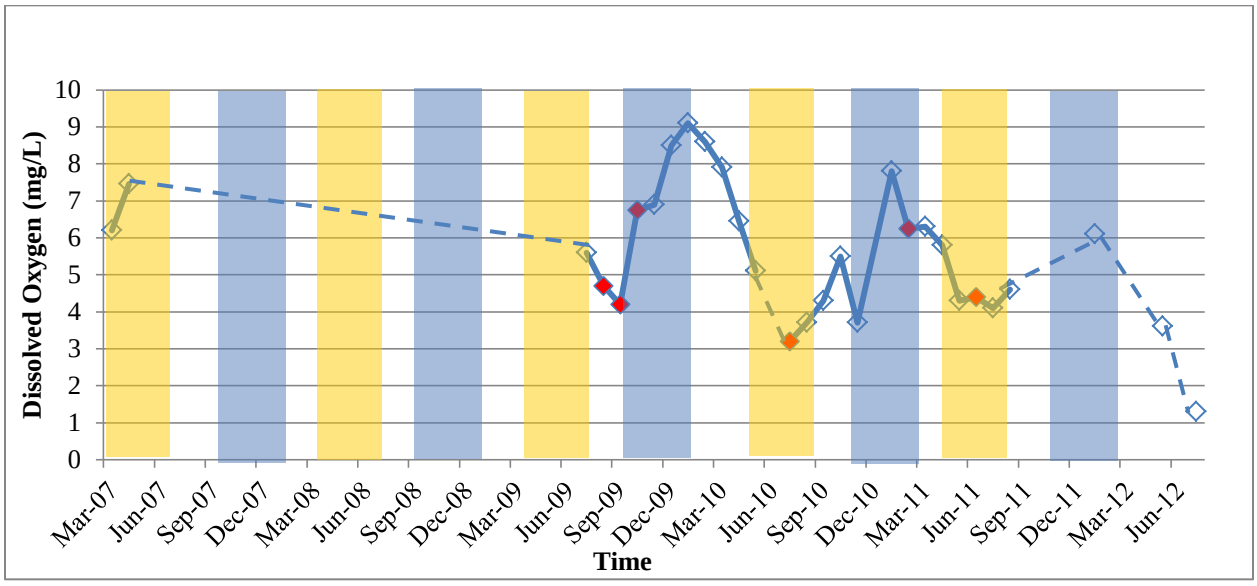


Figure 42: Dissolved Oxygen at Site 80390
Bright red data points on the graph show sampling events where DO measurements failed the quality assurance standards of the Texas Stream Team QAPP. Quality

pH

The pH remained fairly constant at this site, with an average value of 7.46, while there was a short peak in the winter and spring of 2010.

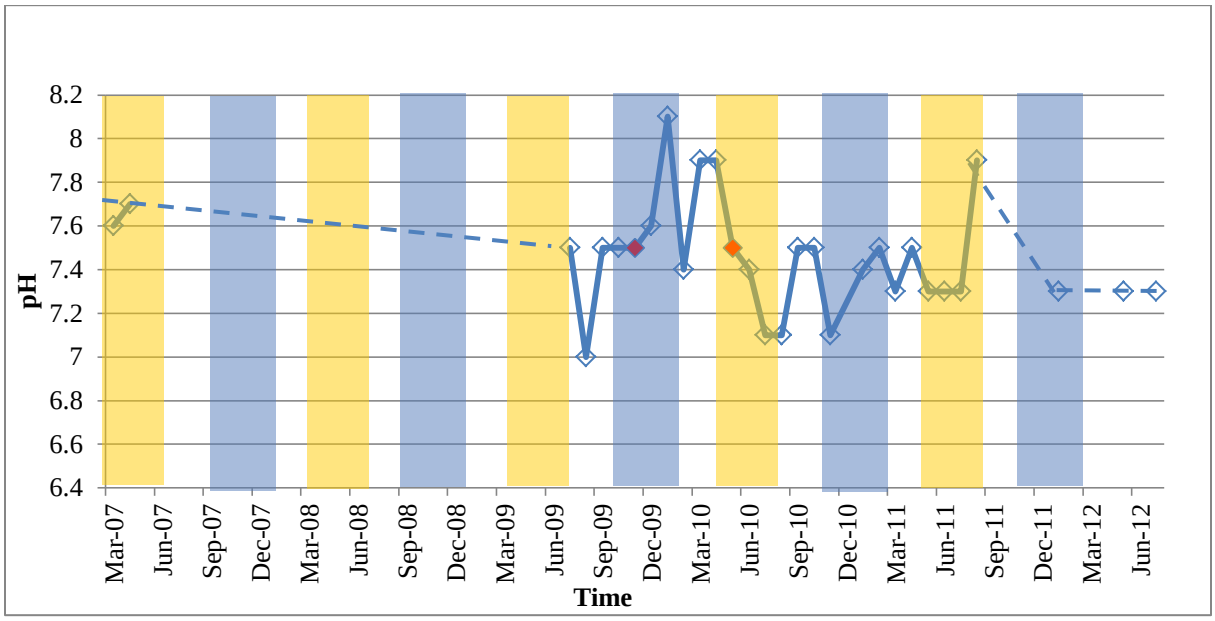


Figure 43: pH at Site 80391
Bright red symbols on the graph show sampling events where pH measurements failed the quality assurance standards of the Texas Stream Team QAPP.

Secchi disk and total depth

The majority of data for Secchi disk and total depth failed the quality assurance standards because of improper recording of data.

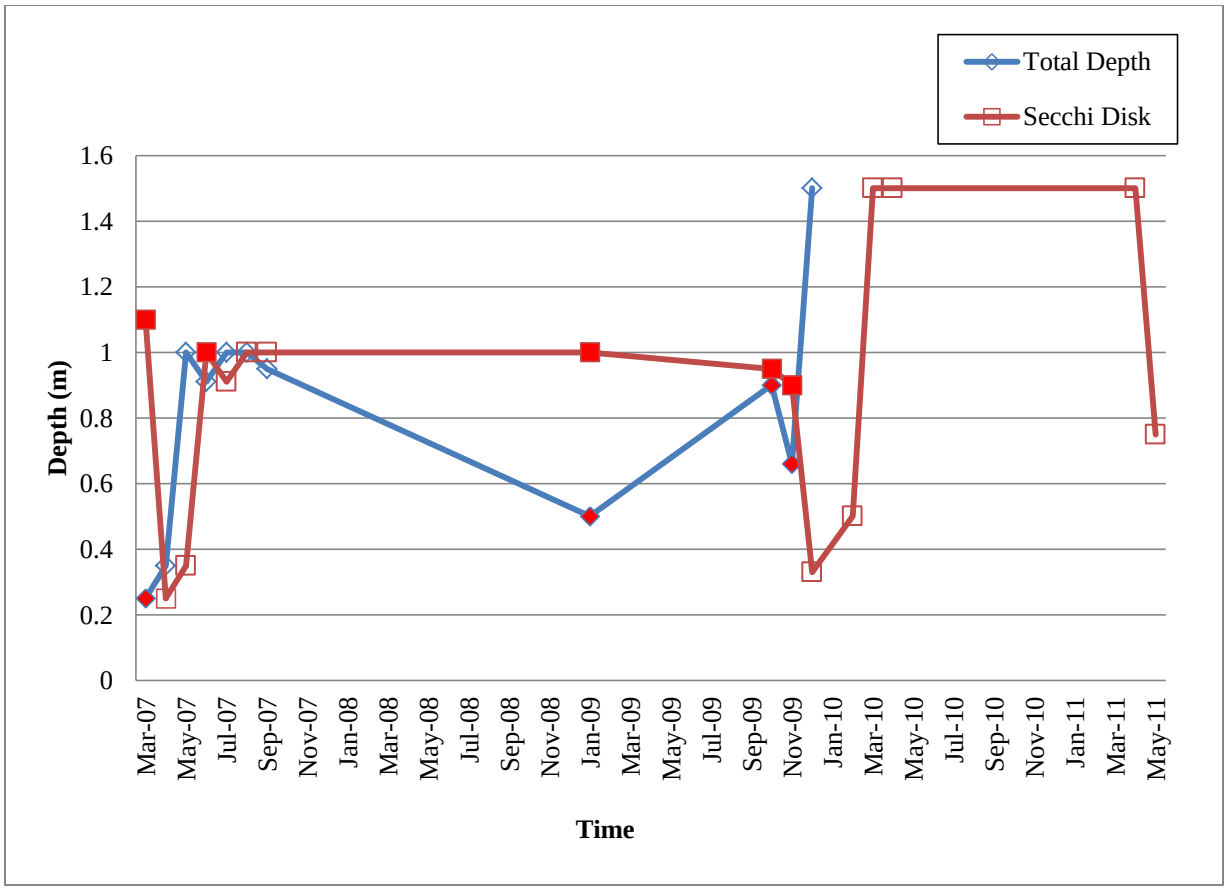


Figure 44: Total depth and Secchi disk depth at Sites 80391
Bright red symbols on the graph show sampling events where Secchi/total depth measurements failed the quality assurance standards of the Texas Stream Team QAPP.

Field Observation

At site 80391, field observations recorded during sampling events indicate that the water typically had no algae cover, had a clear (30% of the time) or scum (27% of the time) covered surface, and was calm and light green in color. Water was predominantly odorless, cloudy, and had normal flow during sampling events. Weather at the time of sampling events was clear 37% of the time, cloudy 43% of the time, and overcast during the remainder of the sampling events.

E.coli Bacteria

Elevated E. coli measurements in excess of 396 CFU/100 mL were observed at this site after March of 2010.

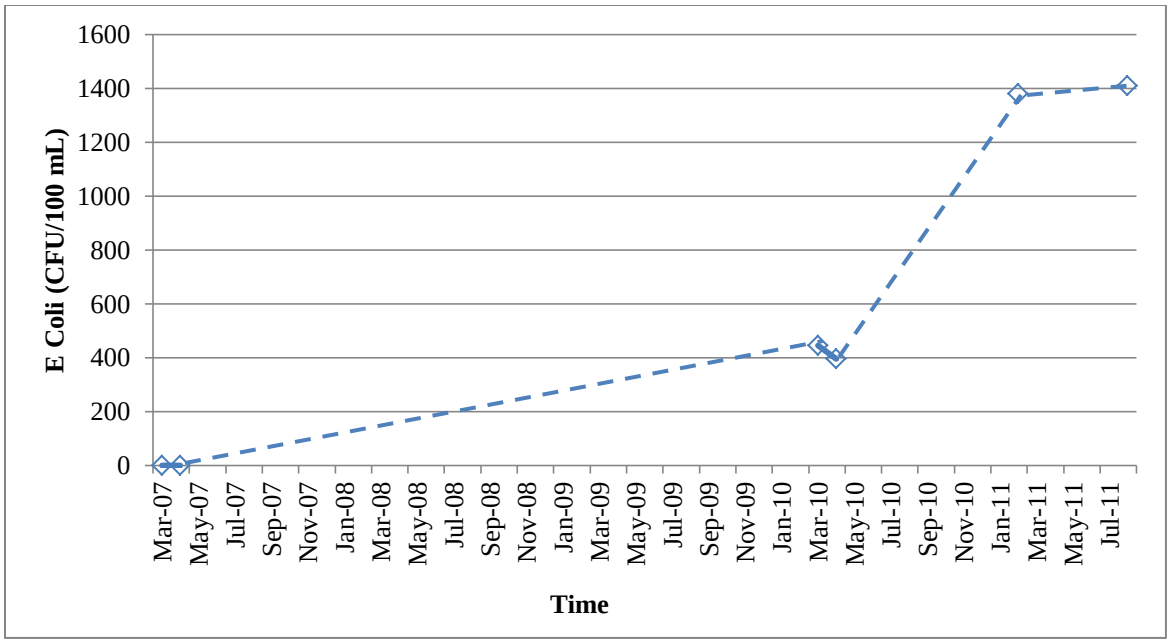


Figure 45: E coli counts at Site 80391

Site 80387, 17406, and 80635

80387 – Plum Creek at Gristmill Road (CR-153)
17406 – Plum Creek at Plum Creek Rd
80635 – Plum Creek at Old Spanish Trail (CR 227)

Site Description

Site 80387, Plum Creek at Gristmill Road, is on the east side of County Road 153, before the creek flows through a large culvert. The riparian zone is thickly forested upstream of the site, but only thinly forested downstream of the site. The surrounding area is dominated by croplands and isolated open rangeland.

Site 17406, Plum Creek at Plum Creek Rd, is upstream of the bridge on County Road 156. Cropland surrounds the thin riparian area around the creek at this site.

Site 80635, Plum Creek at Old Spanish Trail, is downstream of where both Hwy 21 and County Road 227 pass over Plum Creek. The creek runs directly west of the town of Uhland.

Site and Sampling Information

These three sites were close in distance and habitat type and each had so few sampling events that they were combined for the purpose of the site by site analysis. Site 17406 was sampled once in 2007, while Site 80387 was sampled once in 2007 and then eight times in 2010 (Mar-Dec). Site 80635 was sampled three times in 2009 (Feb – Apr). Sampling at 80635 in 2009 occurred mainly in the latter part of the month, in the mornings, while sampling at Site 80387 occurred mainly, but not always, during the first 15 days of the months between the hours of 09:00 and 15:00. Sampling at Site 80635 was completed by monitors Philip Aldridge, Julie Wilson, and Taylor Heard, members of the Plum Creek Partnership.

Sampling at Site 80387 was completed by Claire Parker, Casey Oldham, and Charles Sipes, members of the TST Guadalupe River Basin Group. Monitors spent a total of 18 hours and 20 minutes sampling these sites, with an average of one hour and 36 minutes spent at each sampling event and a total of 264 travelled miles.

Table 12: Descriptive parameters for Sites 80387, 17406, and 80635

Parameter	% Complete	Mean ± Standard Deviation	Maximum Value	Minimum Value
Total Dissolved Solids (mg/L)	69.2%	674.2 ± 155.28	810	341.7
Water Temperature (°C)	100%	18.41 ± 4.93	26	10
Dissolved Oxygen (mg/L)	100%	7.03 ± 1.73	10.3	5.05
pH	100%	7.53 ± 0.37	8	6.9
Secchi Disk Transparency (m)	77%	0.45 ± 0.18	0.65	0.126
Depth (m)	100%	0.50 ± 0.21	0.8	0.126
E. coli Bacteria (CFU/100 mL)	69.2%	14.92 ± 1103.02*	3100	0

* Geomean and Geometric Standard Deviation, Sites were sampled 12 times between 3/8/2007 and 12/5/2010. Note that standard deviation was higher than the Mean for E. coli bacteria, suggesting a high degree of variation in the results of these two parameters.

Air and water temperature

Air and water temperature seem to follow seasonal trends; however, due to the large gaps in time between sampling events it is hard to establish a baseline.

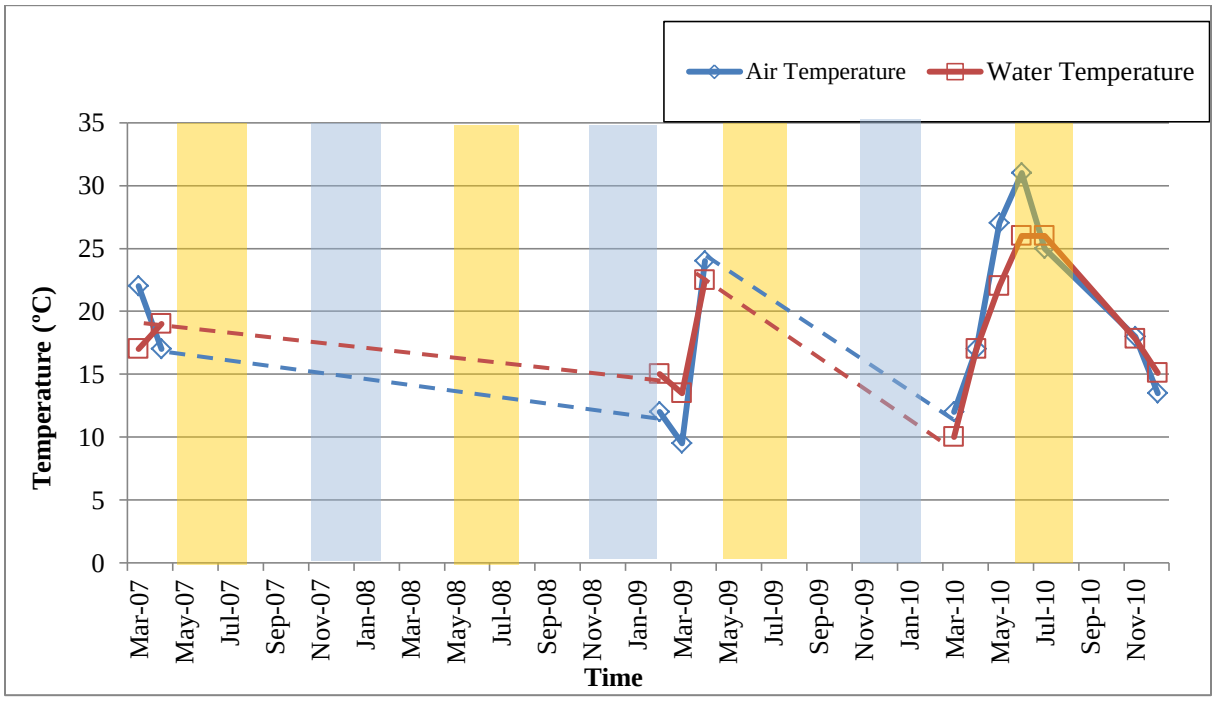


Figure 46: Air and water temperature at Sites 80379, 17406, and 80635

Total Dissolved Solids

The TDS values for these sites were below the defined standard, but a high in TDS was noted in the spring of 2009.The DO, pH, and TDS all show unusual results during the spring of 2009; however, no notes or field descriptions helped to indicate what could have caused such results.

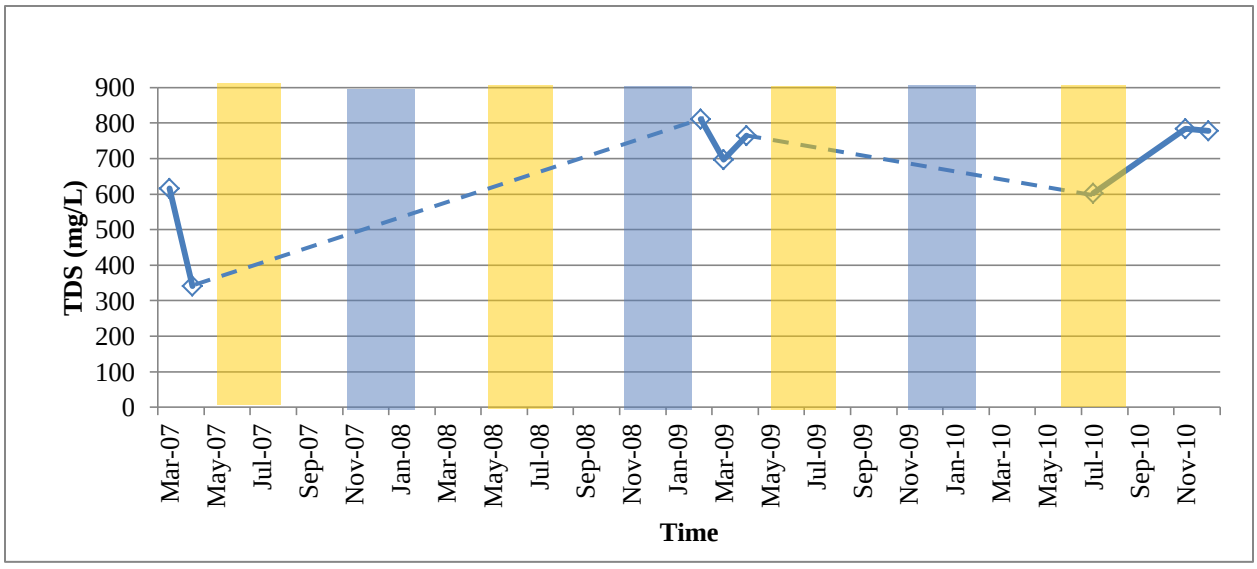


Figure 47: Total Dissolved Solids at Sites 80387, 17406, and 80635

Dissolved Oxygen

Due to large gaps between sampling events, it is hard to ascertain whether the DO values follow a normal seasonal trend.

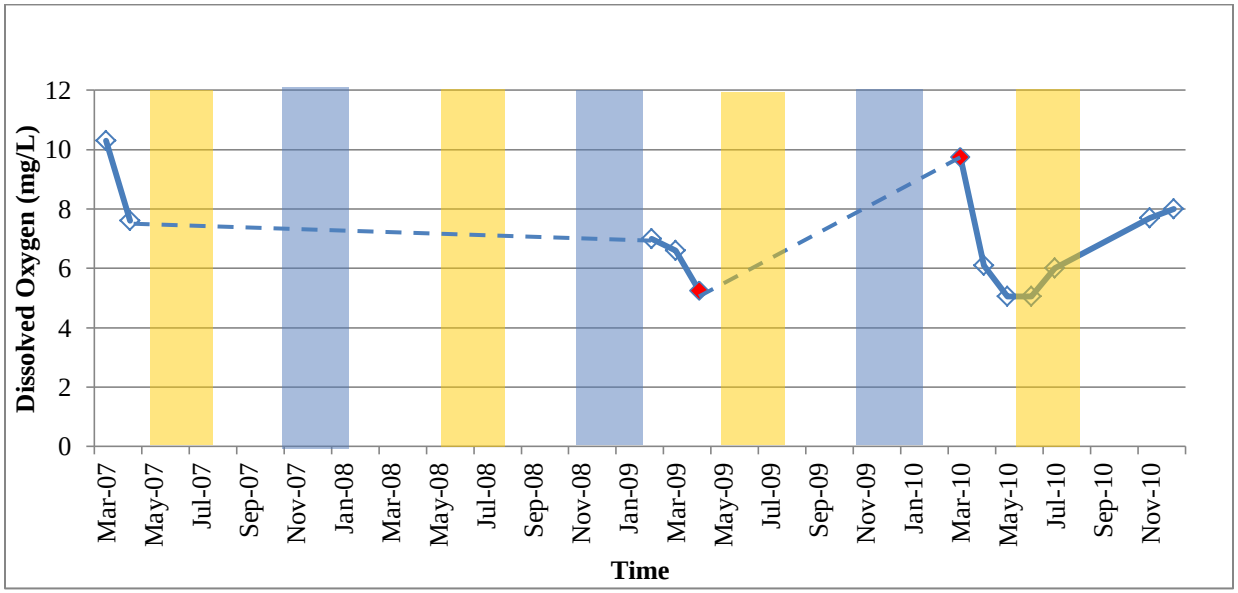


Figure 48: Dissolved Oxygen at Sites 80387, 17406, and 80635

Bright red data points on the graph show sampling events where DO measurements failed the quality assurance standards of the Texas Stream Team QAPP.

pH

There was a considerable amount of variation in pH values, with an overall average of 7.5.

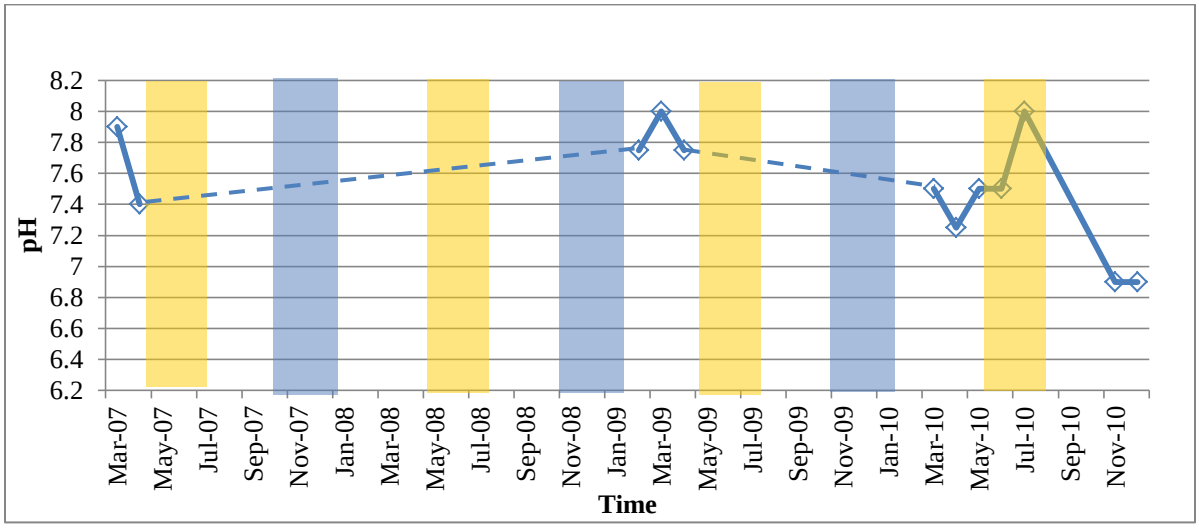


Figure 49: pH at Site 80387, 17406, and 80635

Secchi disk and total depth

Secchi disk and total depth measurements taken at these sites indicate high water clarity, with Secchi disk being greater than or equal to total depth at the majority of sampling events.

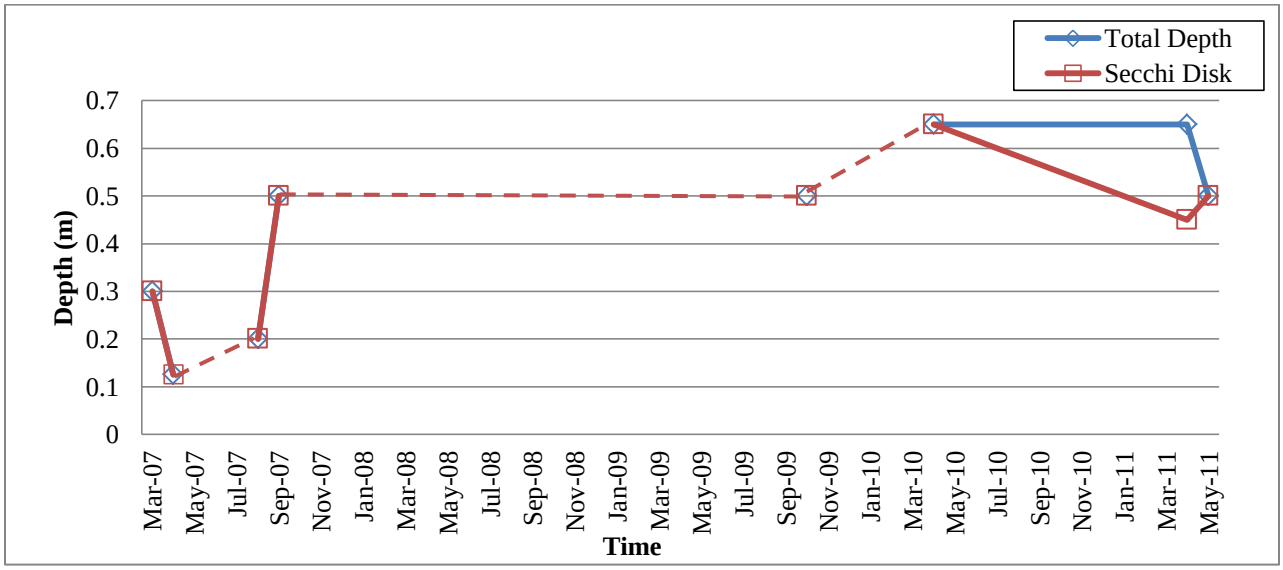


Figure 50: Total depth and Secchi disk depth at Sites 80387, 17406, and 80635

Field Observations

At sites 80387, 17406, and 80635 the field observations recorded during sampling events indicated that the water was rarely covered with algae, had ripples, and was clear, odorless, and green/brown in color. Water predominantly had normal flow during sampling events. Weather at the time of sampling events was clear 27% of the time, cloudy 45% of the time, and overcast during the remainder of the sampling events.

E.coli Bacteria

E.coli values tended to be high, with 50% of the sampling events being over 500 cfu/100 mL. The majority of these high recordings took place between February 2010 and July 2010.

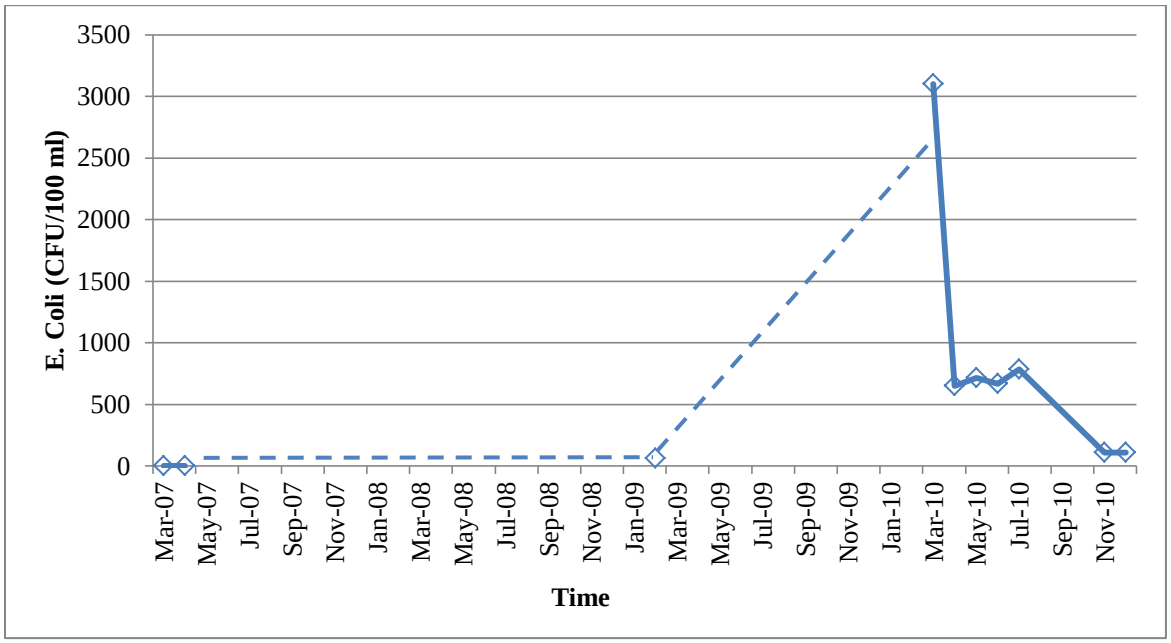


Figure 51: E coli counts at Sites 80387, 17406, and 80635

Site 80541 – Plum Creek Upstream of US 183

Site Description

Site 80541, Plum Creek upstream to US 183, has a thickly forested riparian zone and runs under the US Highway 183 bridge beside a small community of several homes and a church. The creek passes through rangeland and near several small reservoirs or retaining ponds upstream of the site. This site had the lowest average DO, and lowest average pH recorded of all of the Plum Creek sites.

Site and Sampling Information

Site 80541 was sampled twice in 2010 (Aug and Oct) and twice in 2011 (Aug and Sept), resulting in a sampling rate of 22% of the expected 9 samples per year. The sampling events were completed in the latter part of the month and between the hours of 12:00 and 1700. All samples were collected by monitor Josh Oyer, a member of the Plum Creek Partnership. Josh Oyer spent a total of 5 hours (an average of 75 minutes) sampling this site and traveled 70 miles (17.5 miles per sampling event) while sampling Site 80541.

Table 13: Descriptive parameters for Site 80541

Parameter	% Complete	Mean ± Standard Deviation	Maximum Value	Minimum Value
Total Dissolved Solids (mg/L)	100%	964.8 ± 318.84	1440.5	763.8
Water Temperature (°C)	100%	25.35 ± 5.05	29.5	18.2
Dissolved Oxygen (mg/L)	100%	5.15 ± 0.94	6.55	4.55
pH	100%	7.28 ± 0.21	7.5	7
Secchi Disk Transparency (m)	100%	0.58 ± 0.24	0.9	0.4
Depth (m)	100%	0.81 ± 0.13	1	0.7
E. coli Bacteria (CFU/100 mL)	50%	185.51 ± 1.31 *	240	140

* Geomean and Geometric Standard Deviation, Sites were sampled 4 times between 8/21/2010 and 9/20/2011

Air and water temperature

Air and water temperature followed seasonal trends, indicating that no other factors were influencing the values.

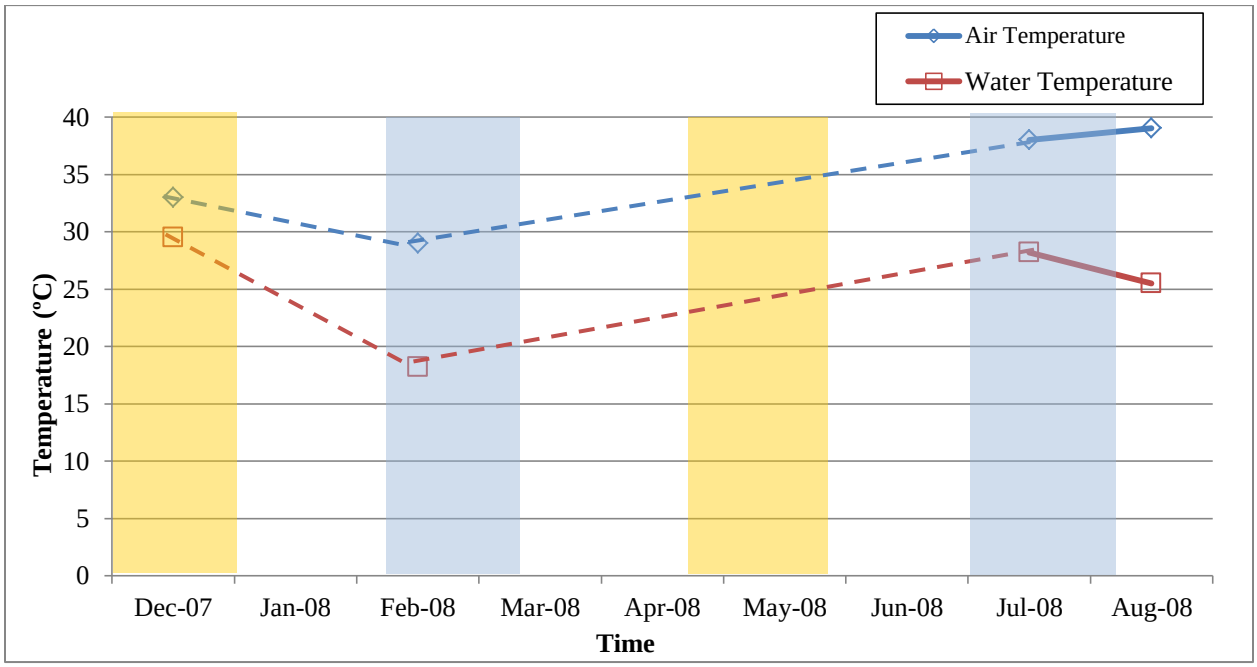


Figure 52: Air and water temperature at Site 80541

Total Dissolved Solids

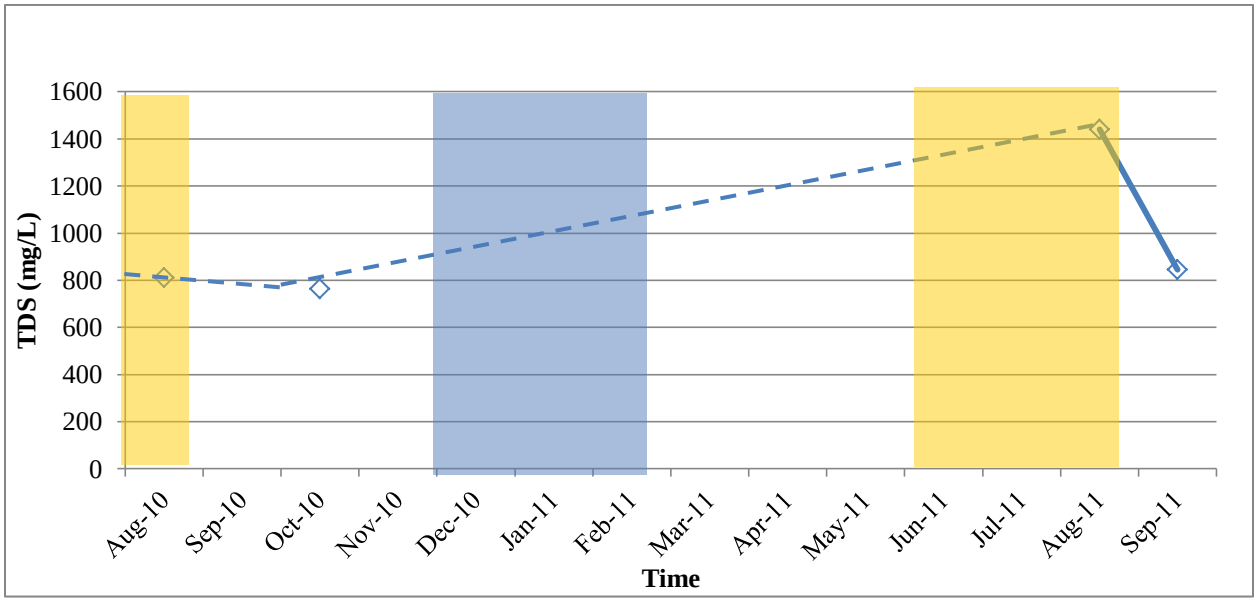


Figure 53: Total Dissolved Solids at Site 80541

Dissolved Oxygen

Due to the limited number of sampling events at this site it is difficult to identify a baseline for normal seasonal trends of DO values.

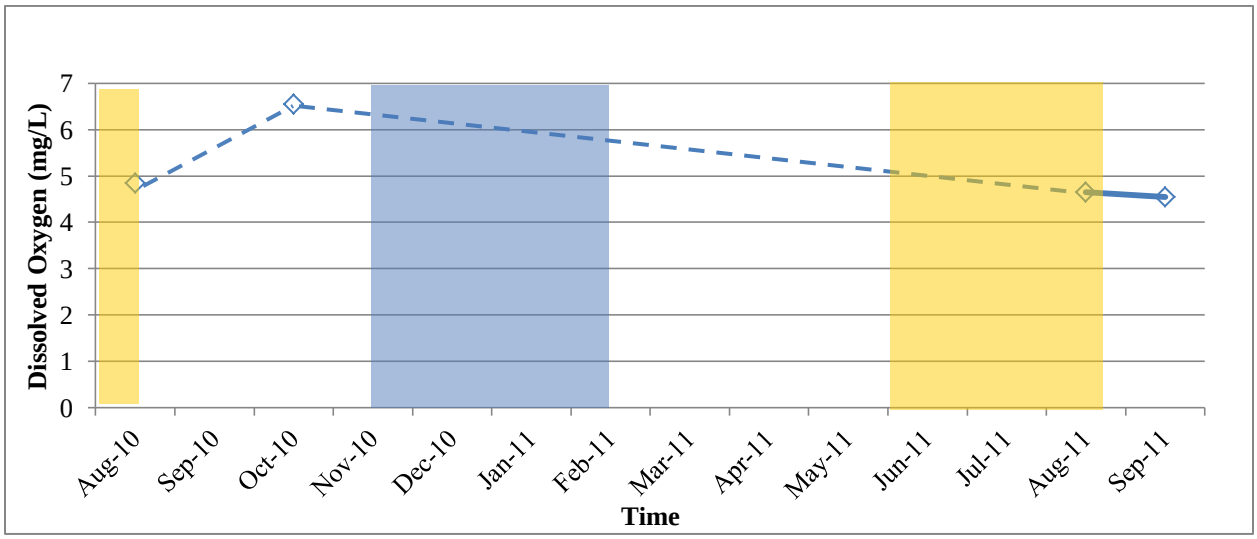


Figure 54: Dissolved Oxygen at Site 80541

pH

There was very little variation in pH values and, due to limited sampling events, it is difficult to discern any seasonal trends.

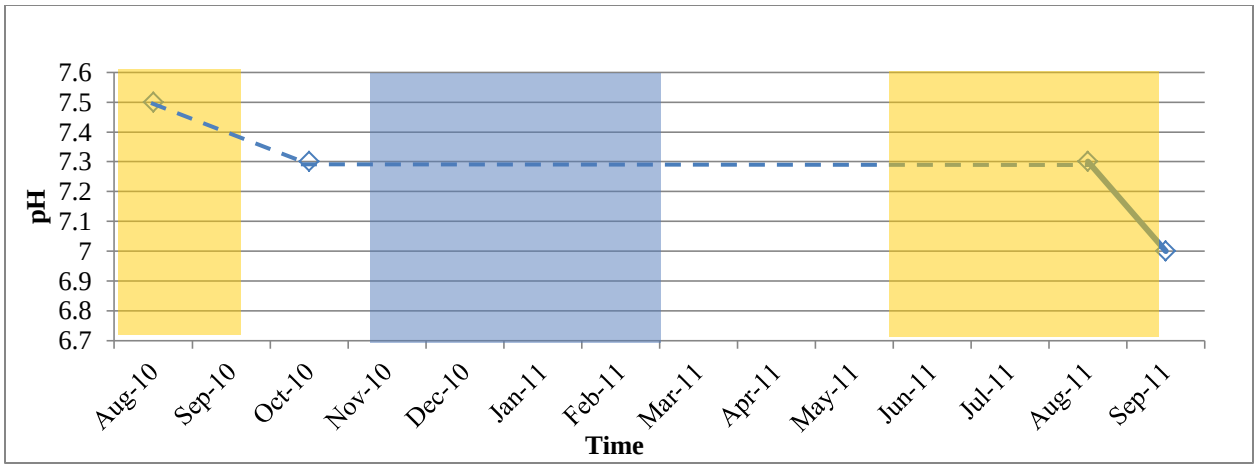


Figure 55: pH at Site 80541

Secchi disk and total depth

Secchi disk depth was consistently less than total depth, showing that the water was slightly turbid for most sampling events.

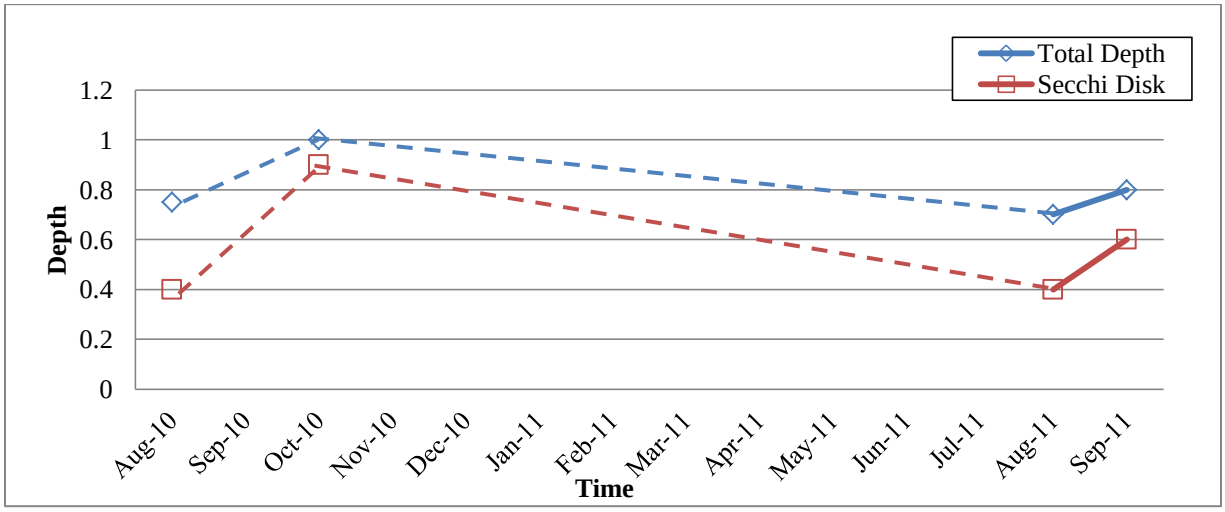


Figure 56: Total depth and Secchi disk depth at Sites 80541

Field Observations

At site 80541, field observations recorded during sampling events indicated that the water was commonly clear or green/brown in color, cloudy, calm, and had a clear surface with rare to common levels of algae. Water was predominantly recorded as “low flow” and was noted as odorless during sampling events. Weather at the time of sampling events was clear 25% of the time and cloudy 75% of the sampling events.

E.coli Bacteria

This site was sampled twice for E.coli. With limited data, it was difficult to spot any trends.

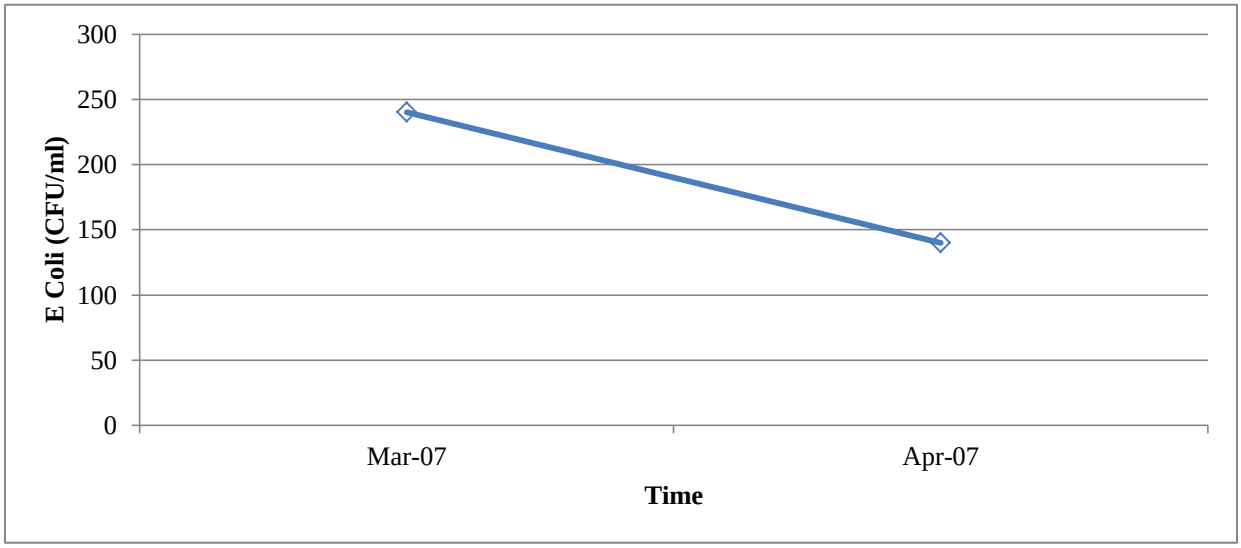


Figure 57: E. coli counts at Site 80541

Site 80449 – Town Branch at North Blanco St.

Site Description

Site 80449, Town Branch at North Blanco St., is on the upstream side of a where a tributary of Plum Creek passes under a bike trail in a Lockhart park. This tributary follows beside a railroad track that passes through town.

Site and Sampling Information

Sampling at site 80449 began in December 2007 and continued until July 2012. The site was sampled 11 times in 2008, 12 times in 2009, 11 times in 2010, 10 times in 2011, and six times in 2012. A majority of the samples were taken in the latter part of the month during the hours of 08:00 and 12:00. This site was the most consistently monitored site in this report. Monitoring was completed by Mary Magana, a member of the Plum Creek Partnership. Mary Magana spent a total of 93 hours and 20 minutes and 278 miles sampling site 80449, with an average sampling taking 105 minutes.

Table 14: Descriptive parameters for Site 80449

Parameter	% Complete	Mean ± Standard Deviation	Maximum Value	Minimum Value
Total Dissolved Solids (mg/L)	90.5%	575.34 ± 57.11	656.6	47
Water Temperature (°C)	90.5%	17.99 ± 4.69	26°	8°
Dissolved Oxygen (mg/L)	90.5%	5.77 ± 1.57	8.95	3.1
pH	90.5%	7.44 ± 0.33	8.1	6.8
Secchi Disk Transparency (m)	79.2%	0.15 ± 0.04	0.26	.08
Depth (m)	79.2%	0.14 ± 0.6	0.26	0
E. coli Bacteria (CFU/100 mL)	0%	NA	NA	NA

The site was sampled 51 times and between 12/30/2007 and 07/28/2012

Air and water temperature

Air and water temperature followed normal seasonal trends, indicating that no external factors influenced the values.

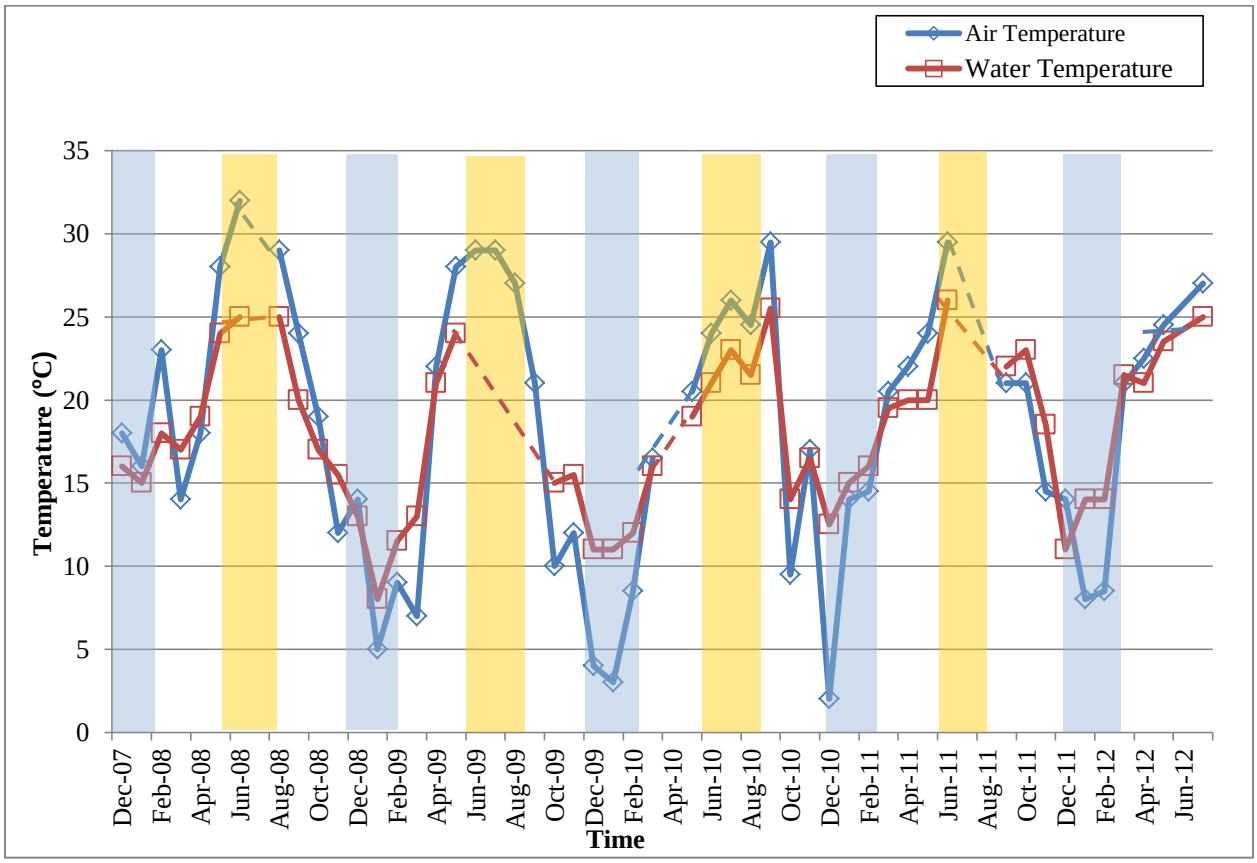


Figure 58: Air and water temperature at Site 80449

Total Dissolved Solids

The TDS showed drops in May and November 2011, but weather, field conditions, and monitor comments do not help to explain these drops in TDS.

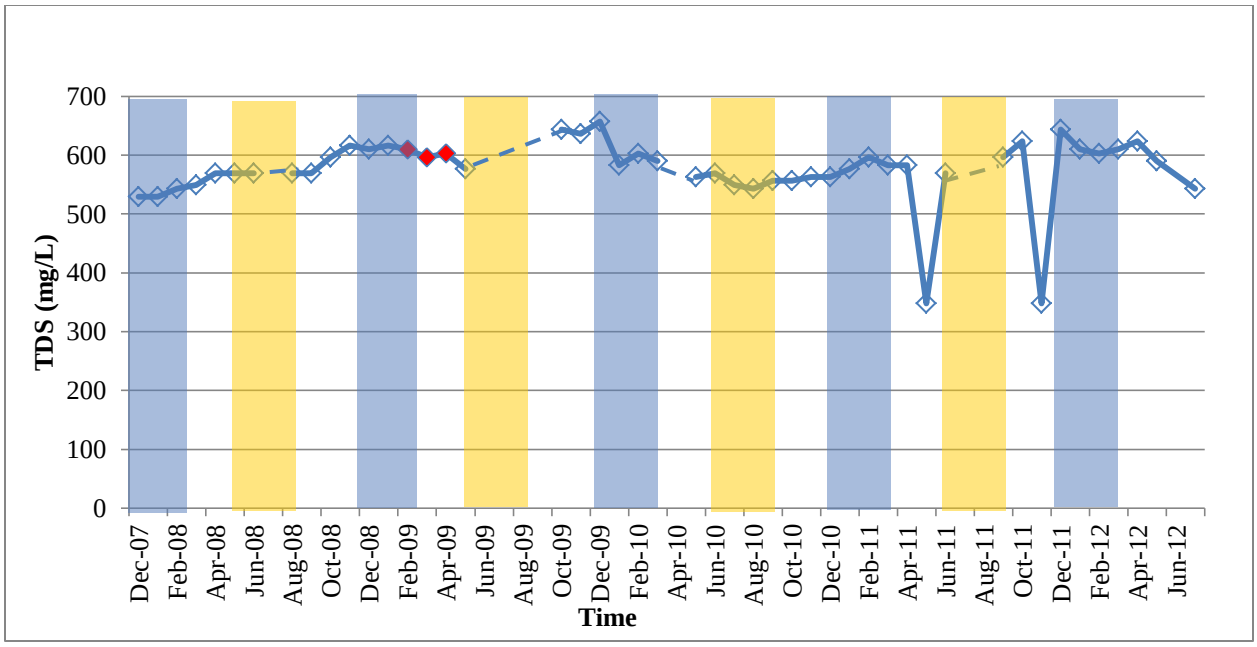


Figure 59: Total Dissolved Solids at Site 80449
Bright red data points on the graph show sampling events where DO measurements failed the quality assurance standards of the Texas Stream Team QAPP.

Dissolved Oxygen

The recorded DO values followed normal seasonal trends.

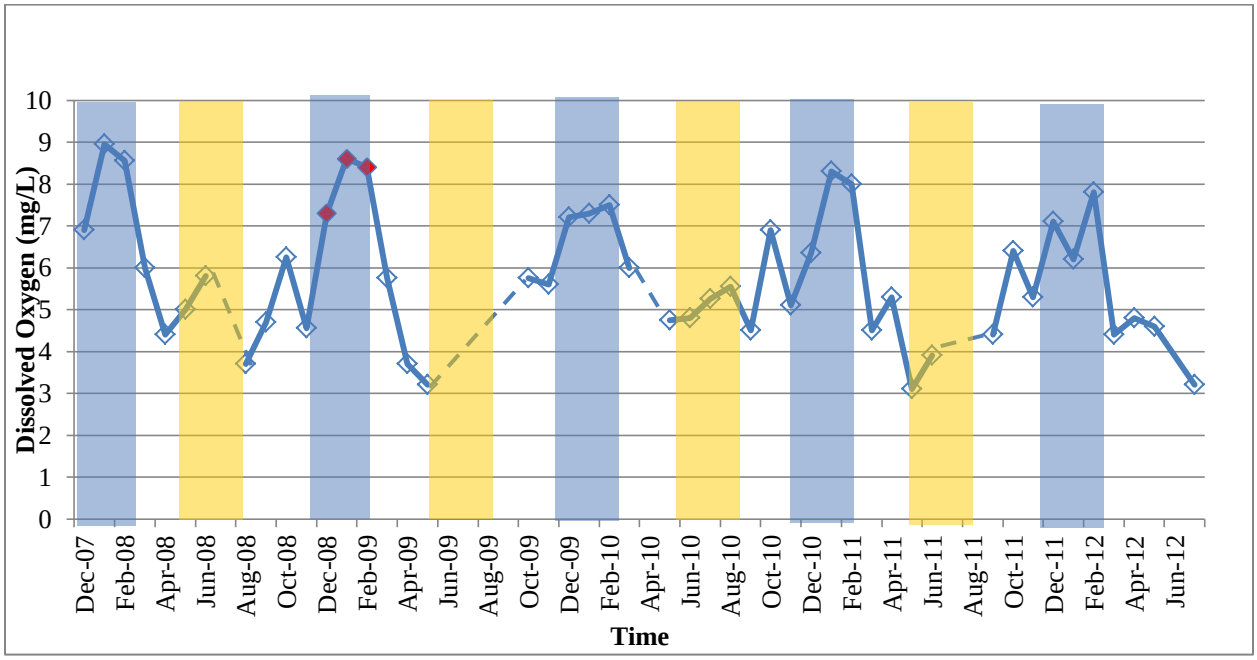


Figure 60: Dissolved Oxygen at Site 80449
Bright red data points on the graph show sampling events where DO measurements failed the quality assurance standards of the Texas Stream Team QAPP.

pH

The pH values at Site 80449 had a relatively significant (R^2= .71) downward trend over time.

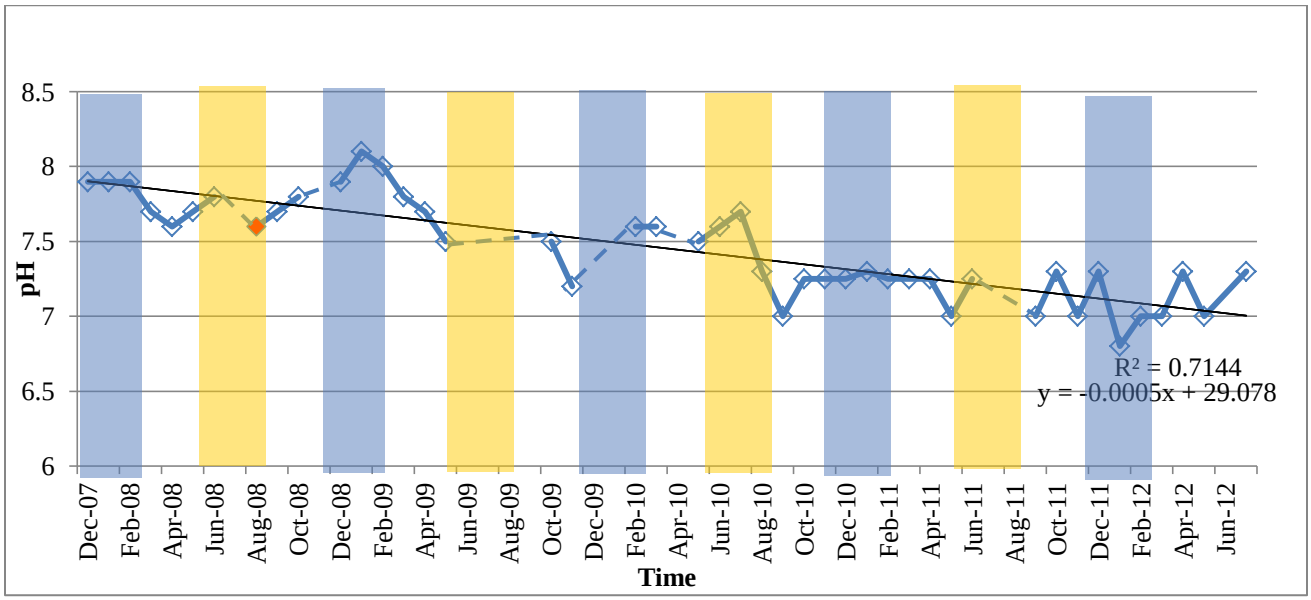


Figure 61: pH at Site 80449

Bright red symbols on the graph show sampling events where pH measurements failed the quality assurance standards of the Texas Stream Team QAPP.

Secchi disk and total depth

Secchi disk was consistently greater than or equal to total depth, indicating high water clarity. There were four sampling events between June 2009 and September 2009 were total depth was "0" due to "dry" conditions.

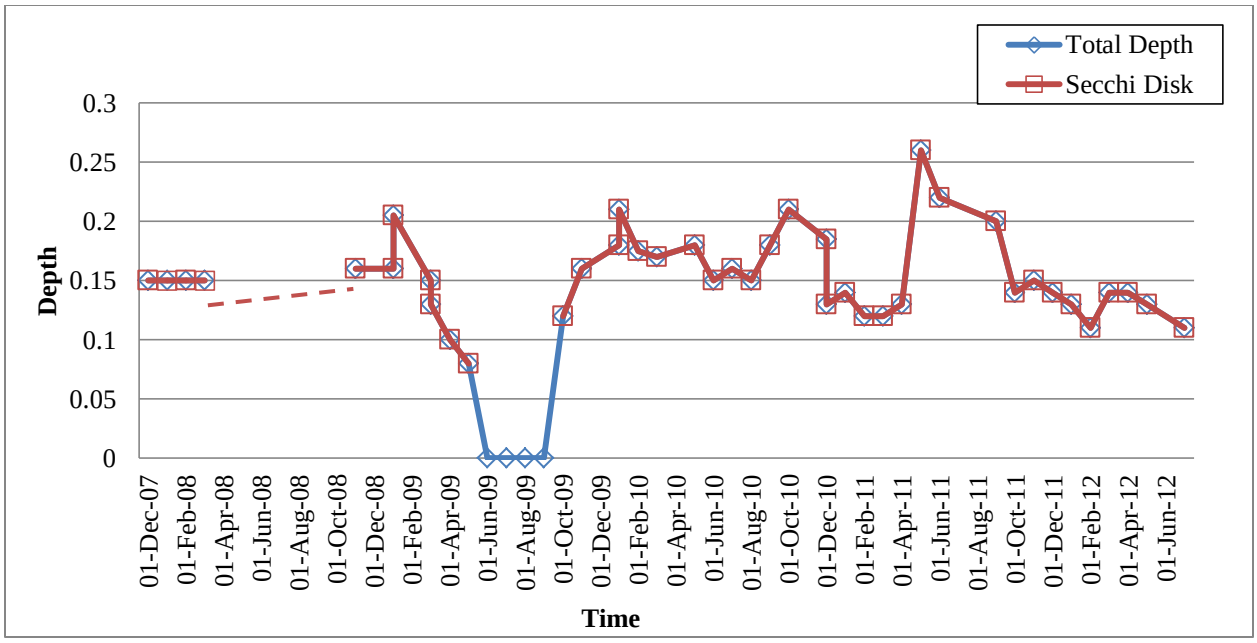


Figure 62: Total depth and Secchi disk depth at 80449

Field Observations

At site 80449, field observations recorded during sampling events indicate that the water had normal (48%), or low (40%) flow, common or abundant algae cover (30% and 38%), and a clear surface. Water was predominantly clear, calm, and odorless during sampling events. Weather at the time of sampling events was clear 55% of the time, cloudy 16% of the time, overcast 25% of the time, and raining 2% of the time for the recorded sampling events.

Site 80450 and 80545

80450 – Town Branch at City Park

80545 – Town Branch at E. Market St. (Upstream from Lockhart WWTP #1)

Site Description

Site 80450, Town Branch at City Park, is along the same tributary as site 80449, which flows through downtown Lockhart. The site is located along the railroad tracks in Lockhart City Park. Site 80545 is downstream of site 80450 and both are surrounded by urban and suburban areas.

Site and Sampling Information

Sites 80450 and 80545 were close in distance and habitat type, and each had few sampling events so they were combined for the purpose of the site by site analysis. Site 80450 was sampled four times between November 2007 and May 2008. Site 80545 was sampled from July 2009 to July 2012. Monitors sampled Site 80545 six times in 2009, seven times in 2010, six times in 2011, and three times in 2012. A majority of the sampling events at site 80545 occurred during the latter part of each month and between the hours 07:00 and 13:30. Sampling events at site 80450 had no consistent time of month, but all occurred during the 10:00 hour. Site 80450 was sampled by Jennifer Lickert, while site 80545 was sampled by monitors Cathy Delwiche and Dan Rivas, both members of the Plum Creek Partnership. Monitors spent a total of 46

hours and 56 minutes and travelled a total of 738 miles to sample at these two sites. On average, a sampling event took 112.6 minutes and required 29.5 miles of travel.

Table 15: Descriptive parameters for Sites 80450 and 80545

Parameter	% Complete	Mean ± Standard Deviation	Maximum Value	Minimum Value
Total Dissolved Solids (mg/L)	100%	519.65 ± 41.93	616.4	462.3
Water Temperature (°C)	100%	21.6 ± 4.46	27.5	13.5
Dissolved Oxygen (mg/L)	100%	6.58 ± 1.87	10	0
pH	96%	7.51 ± 0.32	8.3	7
Secchi Disk Transparency (m)	80%	0.56 ± 0.20	1	0.23
Depth (m)	100%	0.47 ± 0.23	0.23	0.23
E. coli Bacteria (CFU/100 mL)	0%	NA	NA	NA

Sites were sampled 25 times between 11/15/2007 and 07/13/2012.

Total Dissolved Solids

The TDS remained relatively consistent through time, with a slight peak occurring from July 2009 to May 2010. It is important to note that there were five sampling events that failed the quality assurance standards.

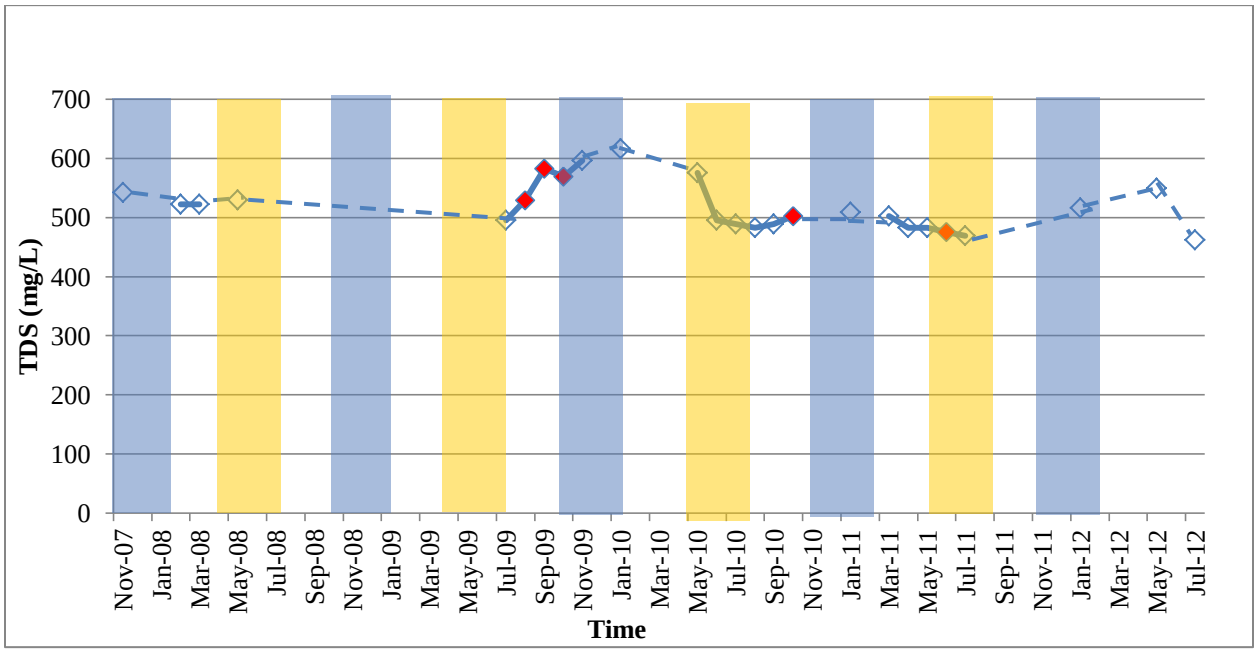


Figure 63: Total Dissolved Solids at Sites 80450 and 80545
Bright red data points show sampling events where TDS measurements failed the quality assurance standards of the Texas Stream Team QAPP. Summer and winter months are denoted by yellow and blue shading, respectively.

Air and water temperature

Air and water temperature followed normal seasonal trends, indicating that there were no other factors influencing the readings.

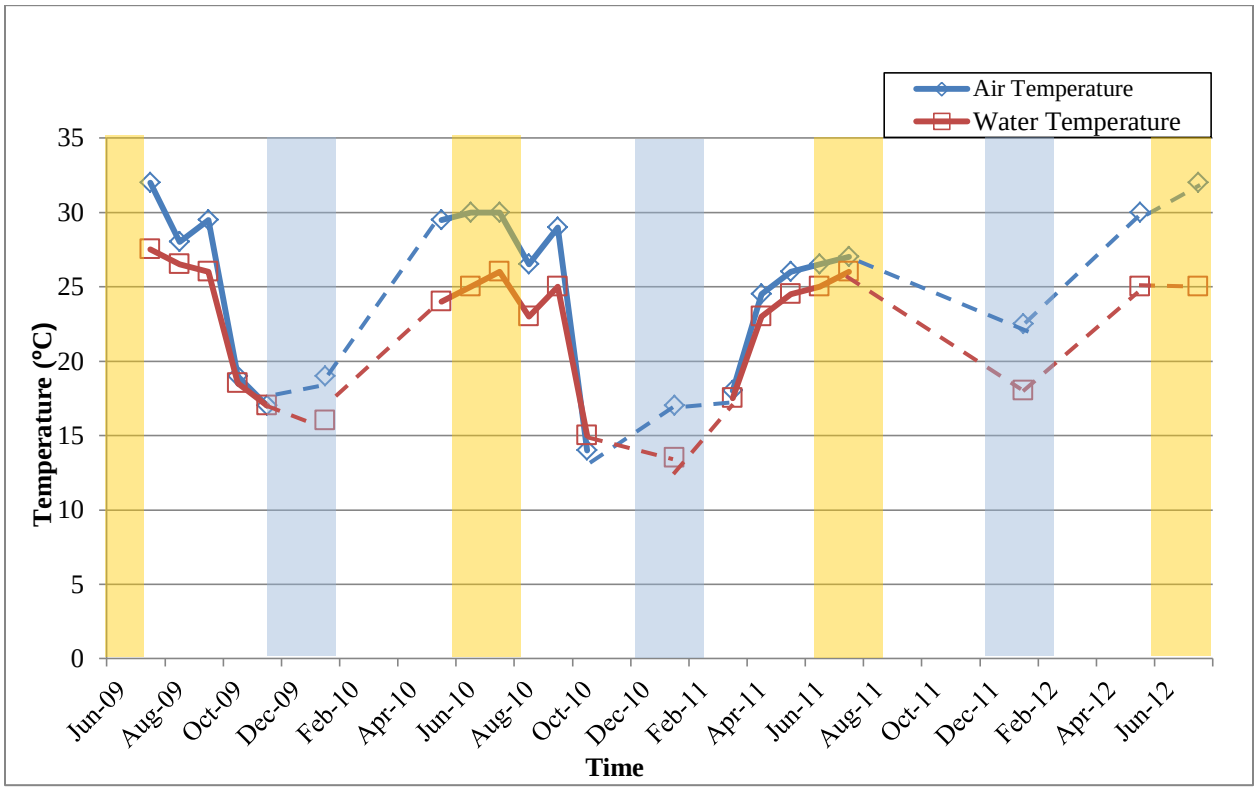


Figure 64: Air and water temperature at Site 80450 and 80545

Dissolved Oxygen

The DO values followed normal seasonal trends of higher readings in the cooler months and lower readings in the warmer months. It is also important to note that there were seven sampling events that failed their quality assurance standards, most due to improper titration readings.

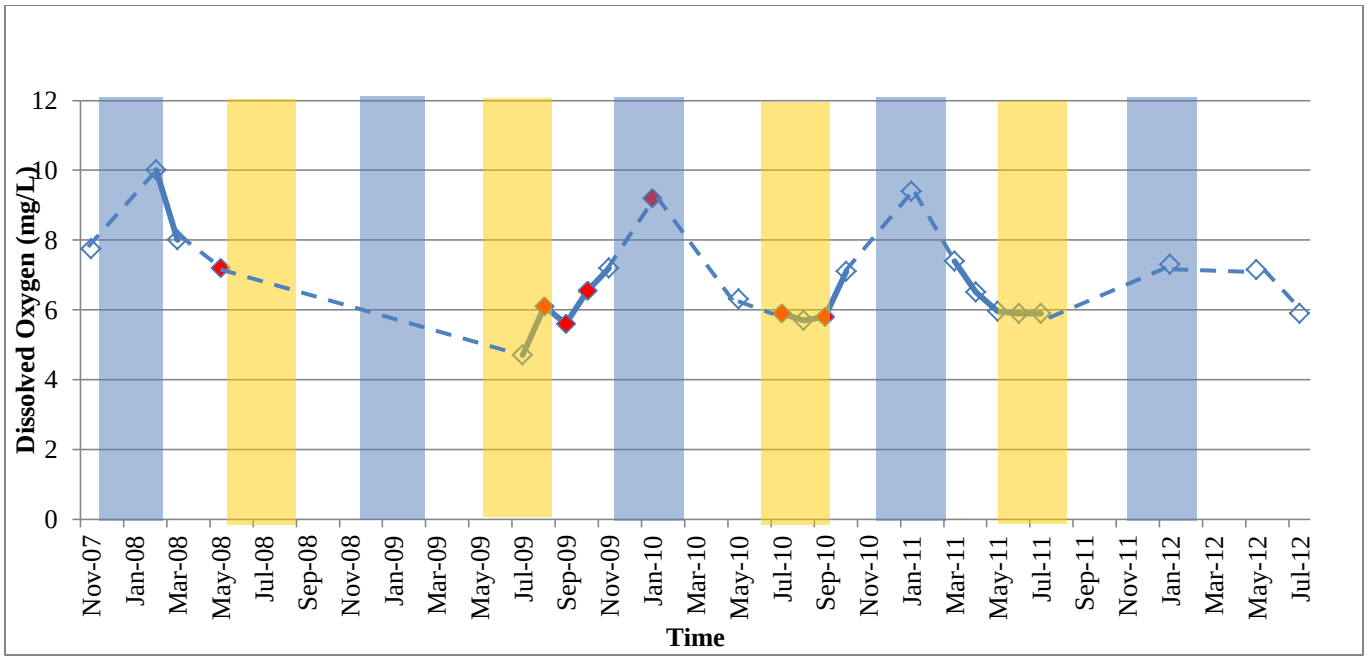


Figure 65: Dissolved Oxygen at Sites 80450 and 80545
Bright red data points on the graph show sampling events where DO measurements failed the quality assurance standards of the Texas Stream Team QAPP.

pH

The pH values recorded from November 2007 to May 2008 stayed consistently between 8.0 and 8.3. Sampling events occurred from 2009 to present. Site 80545 had pH values that remained fairly consistent with an average pH of 7.5.

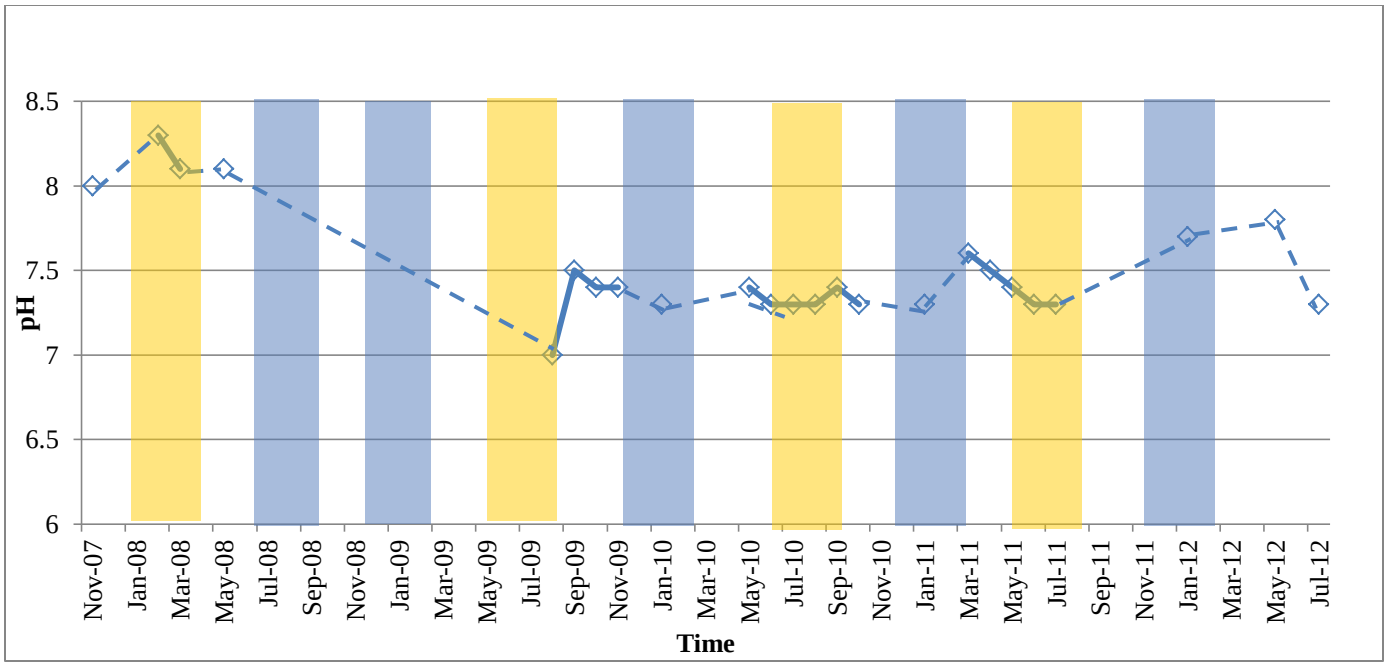


Figure 66: pH at Sites 80450 and 80545

Secchi disk and total depth

Secchi disk was consistently greater than or equal to total depth, indicating high water clarity. There were three sampling events that failed the quality assurance standards..

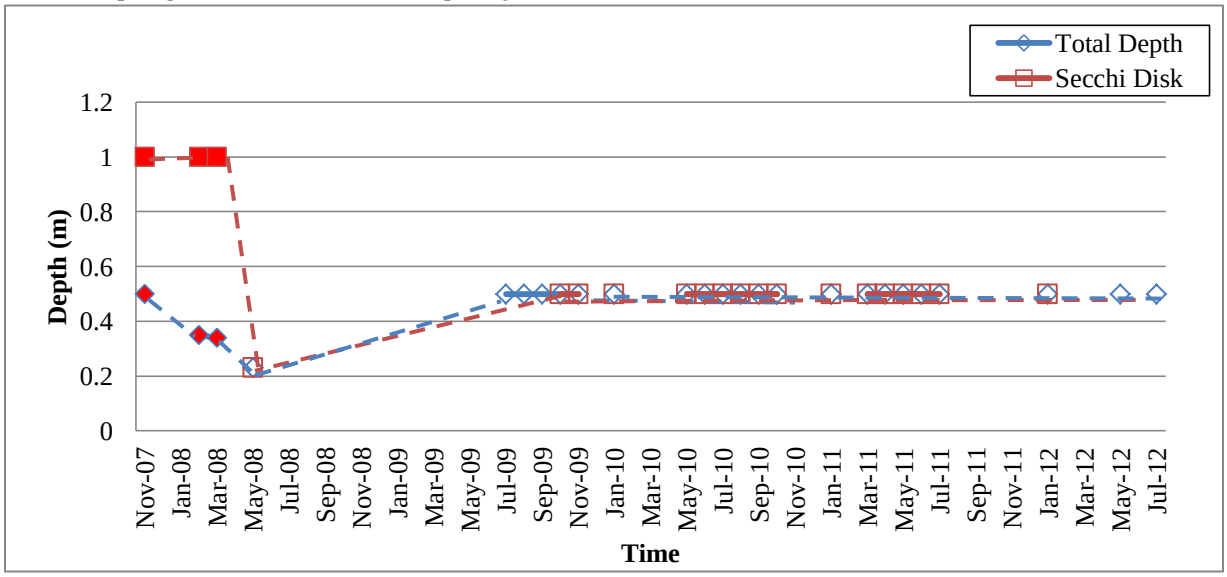


Figure 67: Total depth and Secchi disk depth at Sites 80450 and 80545
Bright red data points show sampling events where Secchi Disk measurements failed the quality assurance standard of the Texas Stream Team QAPP.

Field Observations

At both sites, field observations recorded during sampling events indicate that the water commonly had normal flow, ripples, had common levels of algae, and was odorless. Water was predominantly clear in

color, clarity, and surface during sampling events. Weather at the time of sampling events was clear 44% of the time, cloudy 44% of the time, and overcast during the remainder of the sampling events.

Site 80636 – Plum Creek at Old McMahan Trail (CR 208)

Site Description

Site 80636, Plum Creek at Old McMahan Trail, is located on the upstream side of where Plum Creek passes under the bridge of County Road 208. The site is surrounded by open rangeland.

Site and Sampling Information

Site 80391 was sampled from 2/28/2009 to 3/28/2009. The site was sampled twice in in 2009 (February and March). Both sampling events were collected on the 28th of each month and from 10:50-11:00. The site was sampled by Taylor Heard and Ryan Spencer, both members of the Plum Creek Partnership. Monitors spent a total of four hours and traveled 90 miles sampling this site, with an average of 120 minutes spent and 45 miles traveled during each sampling event.

Table 16: Descriptive parameters for Site 80636

Parameter	% Complete	Mean ± Standard Deviation	Maximum Value	Minimum Value
Total Dissolved Solids (mg/L)	100%	730.3 ± 56.85	770.5	690.1
Water Temperature (°C)	100%	15.5 ± 0.71	16	15
Dissolved Oxygen (mg/L)	100%	6.82 ± 0.25	7	6.65
pH	100%	8.25 ± 0.35	8.5	8
Secchi Disk Transparency (m)	100%	0.45 ± 0.07	0.5	0.4
Depth (m)	100%	0.75 ± 0.35	1	0.5
E. coli Bacteria (CFU/100 mL)	0%	NA	NA	NA

The site was sampled twice on 2/28/2009 and 3/28/2009.

Air and water temperature

No trends or baseline date were established due to small number of samples.

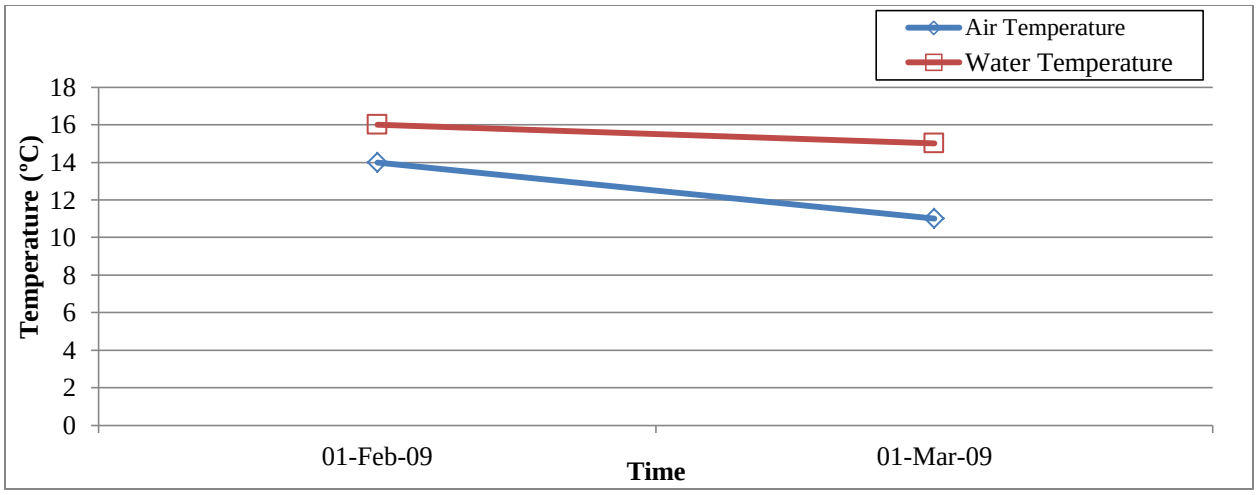


Figure 68: Air and water temperature at Site 80636

Total Dissolved Solids

Due to limited data it is hard to detect any trends or establish a baseline reading.

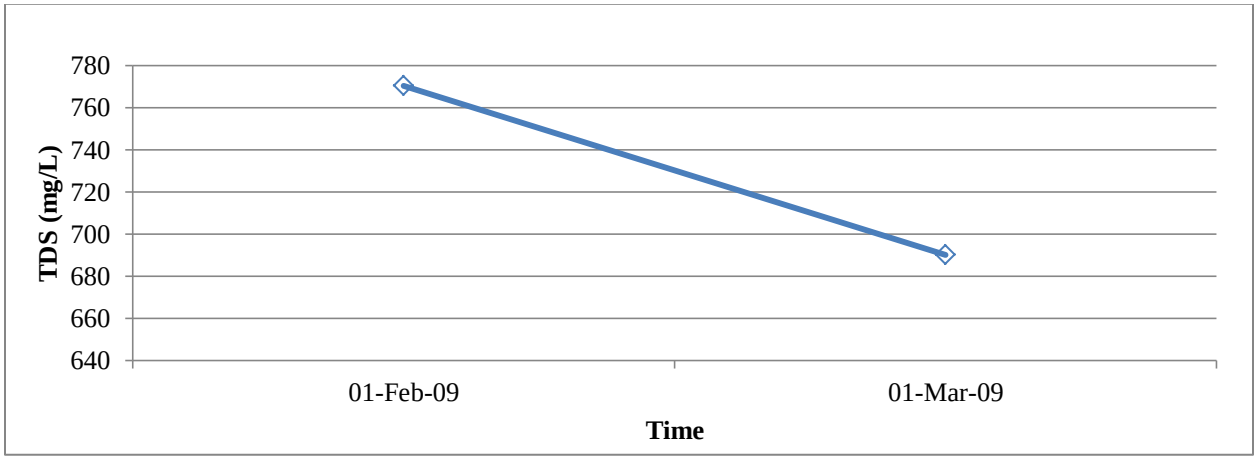


Figure 69: Total Dissolved Solids at Site 80636

Dissolved Oxygen

With so few sampling events it is impossible to see if values follow normal seasonal trends.

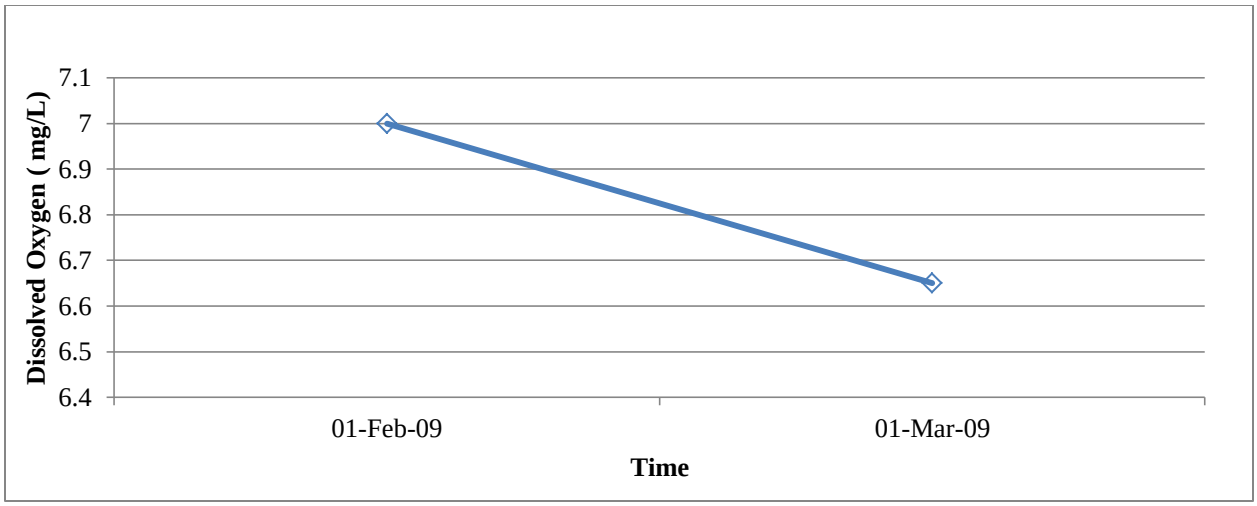


Figure 69: Dissolved Oxygen Site 80636

pH

pH values indicate that the water is slightly alkaline; however with so few sampling events it is hard to establish a baseline.

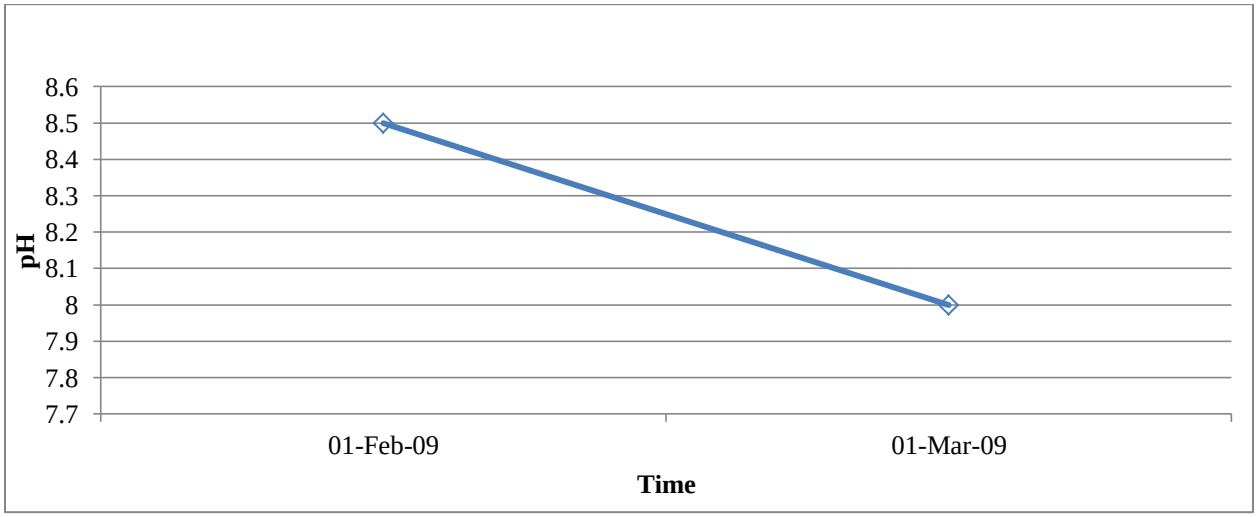


Figure 70: pH at Site 80636

Secchi disk and total depth

The April 2007 sampling event indicated some turbidity, however with limited data it is impossible to establish a baseline.

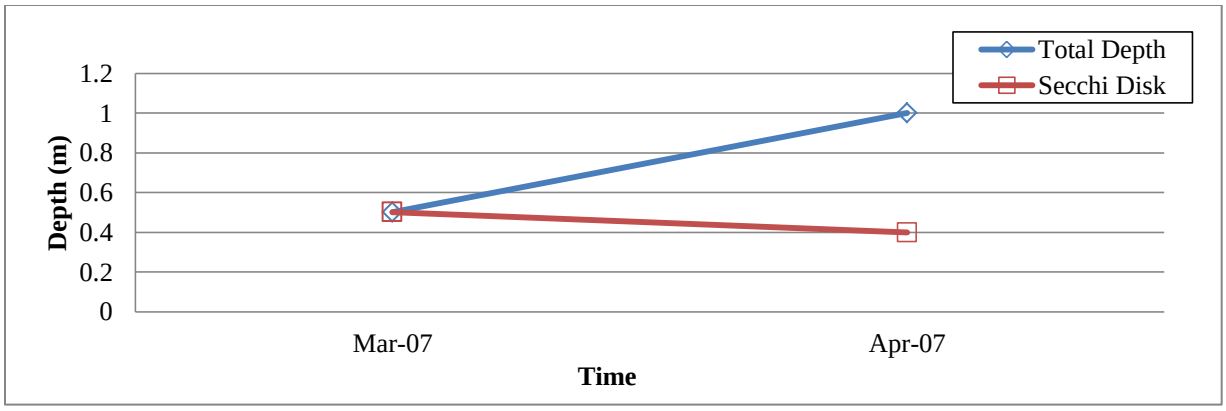


Figure 71: Total depth and Secchi disk depth at Site 80636

.

Field Observations

At site 80636, field observations recorded during sampling events indicate that the water commonly was either light green or green/brown in color. Water was predominantly recorded as "low flow", no odor, and rarely had algae during sampling events. It was also recorded as turbid, covered in debris, and rippled during the majority of sampling events. Weather was clear during both sampling events.

Site 80451 – Clear Fork at Lockhart State Park

Site Description

Site 80451, Clear Fork at Lockhart State Park, is located upstream of where the stream passes under a bridge on Park Road 10. The riparian area is heavily forested and the land around the creek is parkland (some of it manicured) and rangeland.

Site and Sampling Information

Site 80451 was created on 10/16/2007 and has been sampled since 5/2/2009. The site was sampled eight times in 2009 (May-December), 11 times in 2010 (January-November), 11 times in 2010, eight times in 2011 (September – December), and nine times in 2012. The majority of sampling events were collected during the earlier part of the month and all of the sampling events were collected in between 08:00 and 12:00. The site was sampled by Jesse Magana of the Plum Creek Partnership. Jesse spent a total of 76 hours and 45 minutes and traveled 469 miles sampling this site since October 2007, with an average of 121.18 minutes spent and 12.33 miles traveled during each sampling event.

Table 17: Descriptive parameters for Site 80451

Parameter	% Complete	Mean ± Standard Deviation	Maximum Value	Minimum Value
Total Dissolved Solids (mg/L)	97%	461.58 ± 108.27	649.9	154.1
Water Temperature (°C)	97%	19.1 ± 6.71	28	4
Dissolved Oxygen (mg/L)	94.7%	6.80 ± 4.6	30	0.1
pH	94.7%	7.40 ± 0.31	8	7
Secchi Disk Transparency (m)	97%	0.48 ± 0.19	0.91	0.01
Depth (m)	97%	0.86 ± 0.22	1.25	0.31
E. coli Bacteria (CFU/100 mL)	0%	NA	NA	NA

The site was sampled 38 times between 5/2/2009 and 8/04/2012.

Air and water temperature

Air and water temperature followed normal seasonal trends, indicating that no other factors influenced the values.

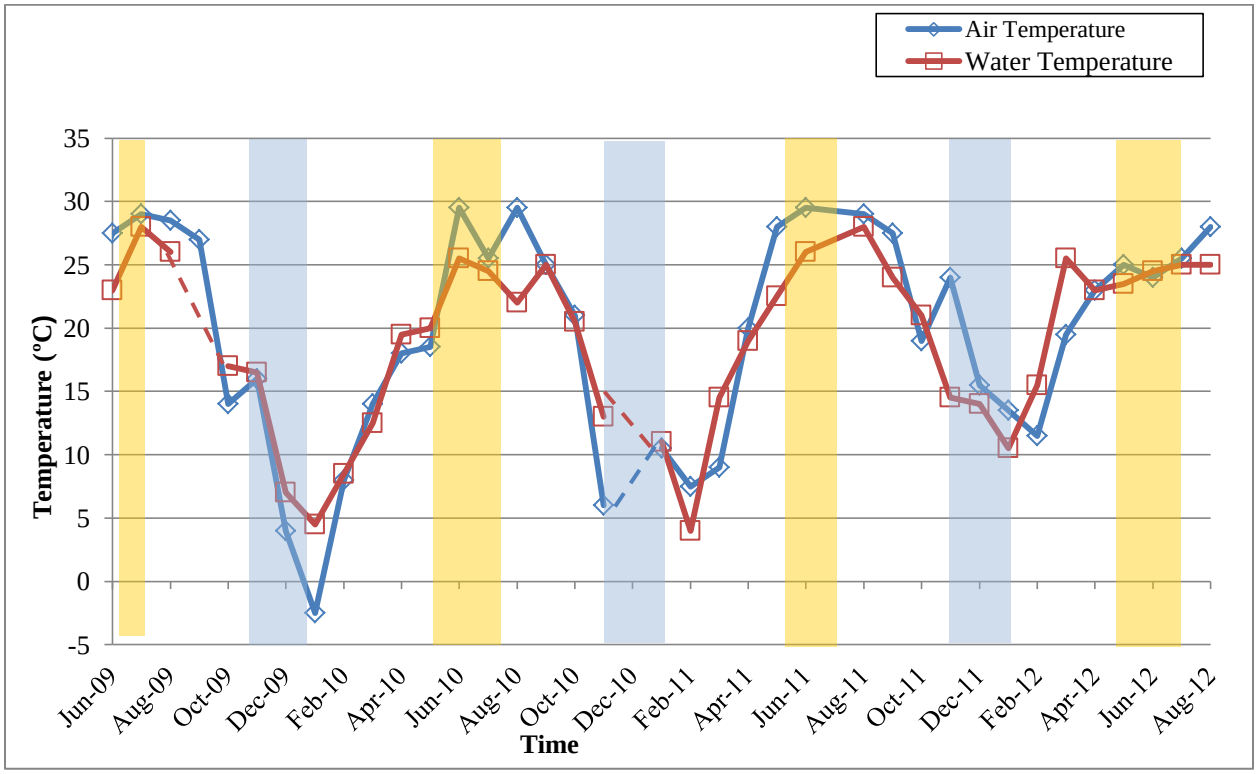


Figure 72: Air and water temperature at Site 80451

Total Dissolved Solids

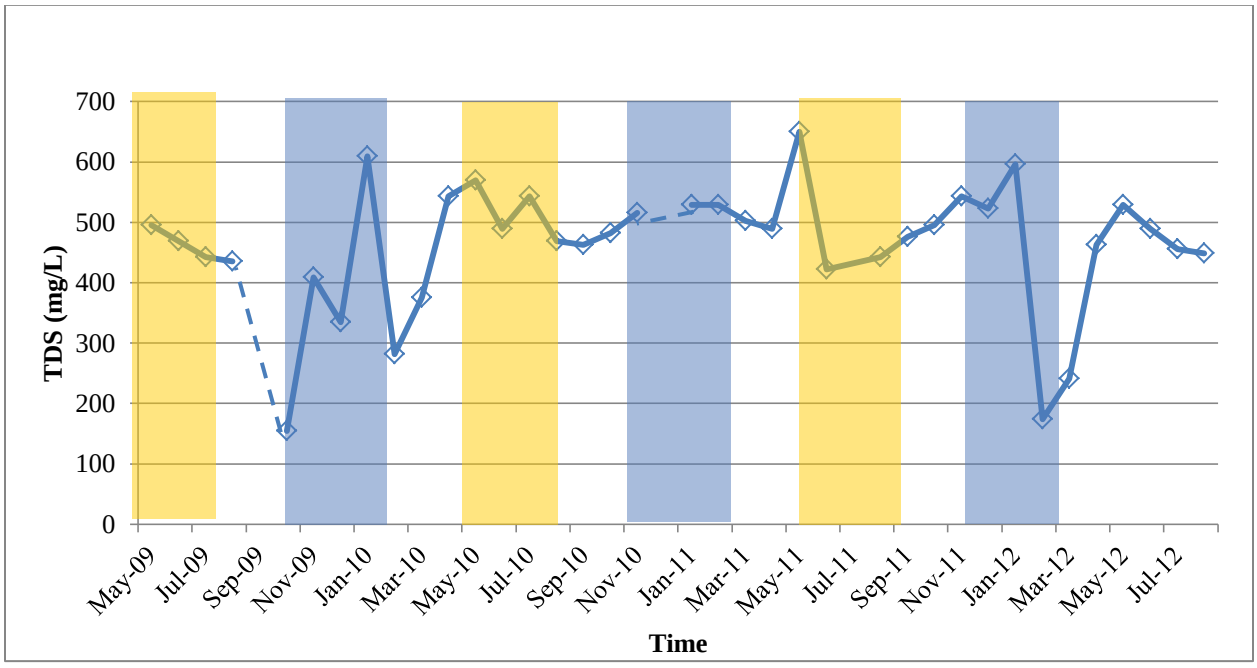


Figure 73: Total Dissolved Solids at Site 80451

Dissolved Oxygen

The DO values followed normal seasonal trends of high values in the winter and low values in the summer. It is also important to note that for the sampling events taking place in the summer of 2011, flow conditions were noted as "no flow" which could explain low DO readings.

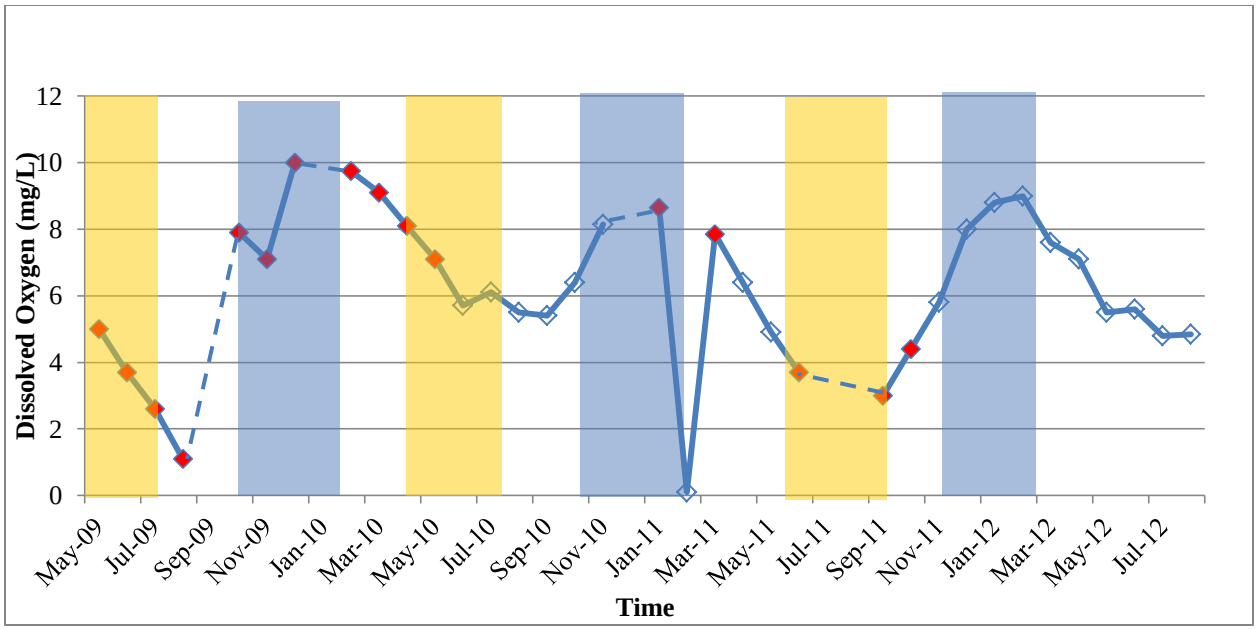


Figure 74: Dissolved Oxygen at Site 80541
Bright red data points on the graph show sampling events where DO measurements failed the quality assurance standards of the Texas Stream Team QAPP.

pH

The pH values remained fairly consistent with an average of 7.4. There was a peak of 7.9-8.0 from March 2010 to August of 2010 but the pH returned back to the average in September.

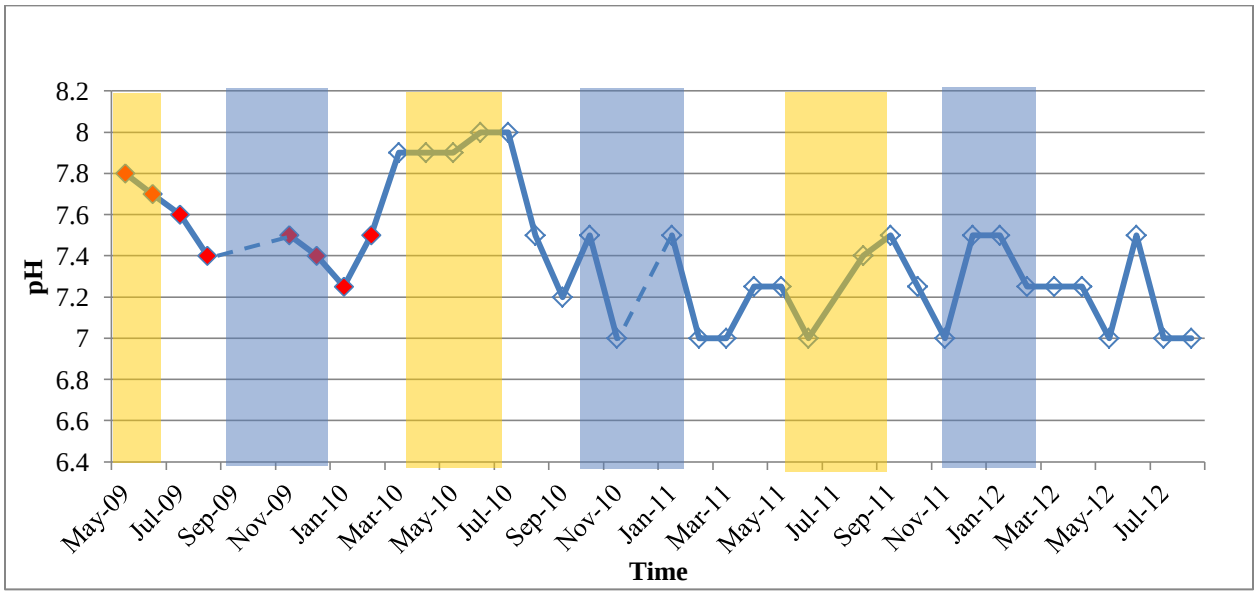


Figure 75: pH at Site 80451
Bright red symbols on the graph show sampling events where pH measurements failed the quality assurance standards of the Texas Stream Team QAPP.

Secchi disk and total depth

Secchi disk depth was consistently shallower than the total depth, indicating that the water was turbid for most sampling events.

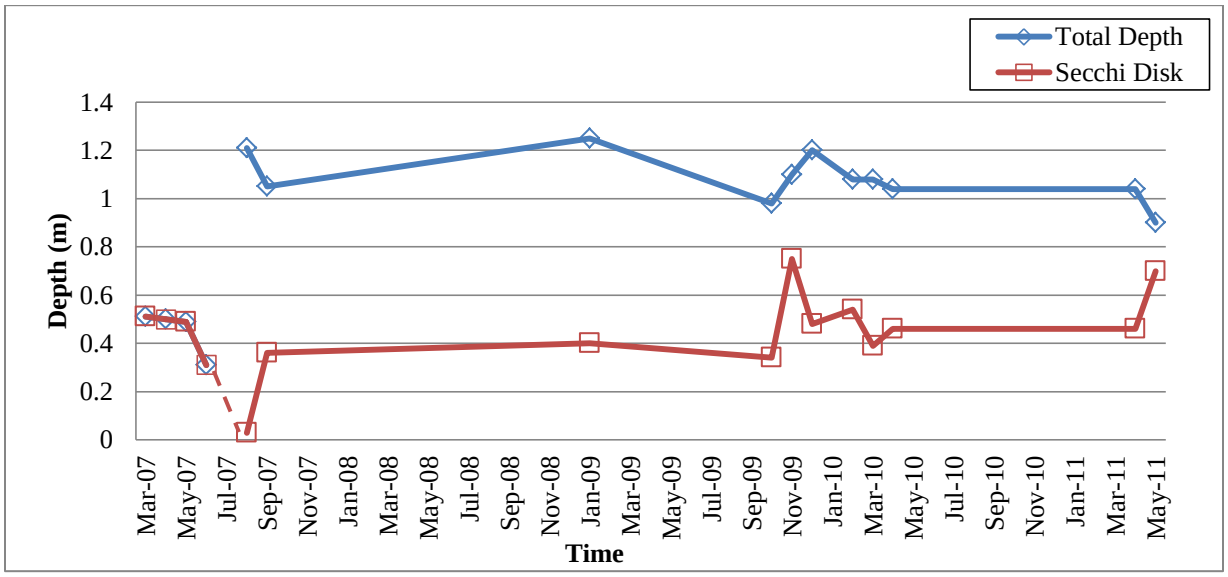


Figure 76: Total depth and Secchi disk depth at Site 80636

Field Observations

At site 80451, field observations recorded during sampling events indicate that the water commonly had normal flow, low levels of algae, and was clear in color, clarity, and surface cover. Water was predominantly calm during sampling events. Weather at the time of sampling events was clear 55% of the time, cloudy 32% of the time, overcast 8% of the time, and rainy during the remainder of the sampling events.

Site 12538 – Andrews Branch at Andrew's Crossing (CR-131)

Site Description

Site 12538, Andrews Branch at Andrew's Crossing, is upstream of where a tributary of Plum Creek passes under County Road 131, northeast of Kyle. The riparian zone is forested and surrounded by suburbs. This site had the highest average TDS recorded of all of the Plum Creek sites.

Site and Sampling Information

Site 12538 was created on 7/21/2011 and has been sampled since 8/6/2011. The site has been sampled 14 times since its creation. A majority of sampling events were collected during the earlier part of the month and all of the sampling events were collected in the morning hours between 09:00 and 11:30. The site continues to be monitored by Charles Sipes, of the TST Guadalupe River Basin Group. Monitoring events have required a total of 27 hours and 55 minutes and 500 miles of travel for sampling since August 2011, with an average of 119.64 minutes spent and 35.71 miles traveled during each sampling event.

Table 18: Descriptive parameters for Site 12538

Parameter	% Complete	Mean ± Standard Deviation	Maximum Value	Minimum Value
Total Dissolved Solids (mg/L)	85.7%	990.48 ± 45.6	1065.3	877.7
Water Temperature (°C)	100%	20.33 ± 6.48	29	9
Dissolved Oxygen (mg/L)	92.8%	6.09 ± 2.01	10.8	4.1
pH	100%	7.78 ± 0.29	8	7
Secchi Disk Transparency (m)	100%	0.51 ± 0.17	0.9	0.35
Depth (m)	100%	0.58 ± 0.15	0.9	0.4
E. coli Bacteria (CFU/100 mL)	76.9%	141.367 ± 1.65 *	330	70

* Geomean and Geometric Standard Deviation, The site was sampled 14 times and between 8/6/2011 and 10/7/2012

Air and water temperature

Air and water temperature followed normal seasonal trends indicating that no other factors influenced the values.

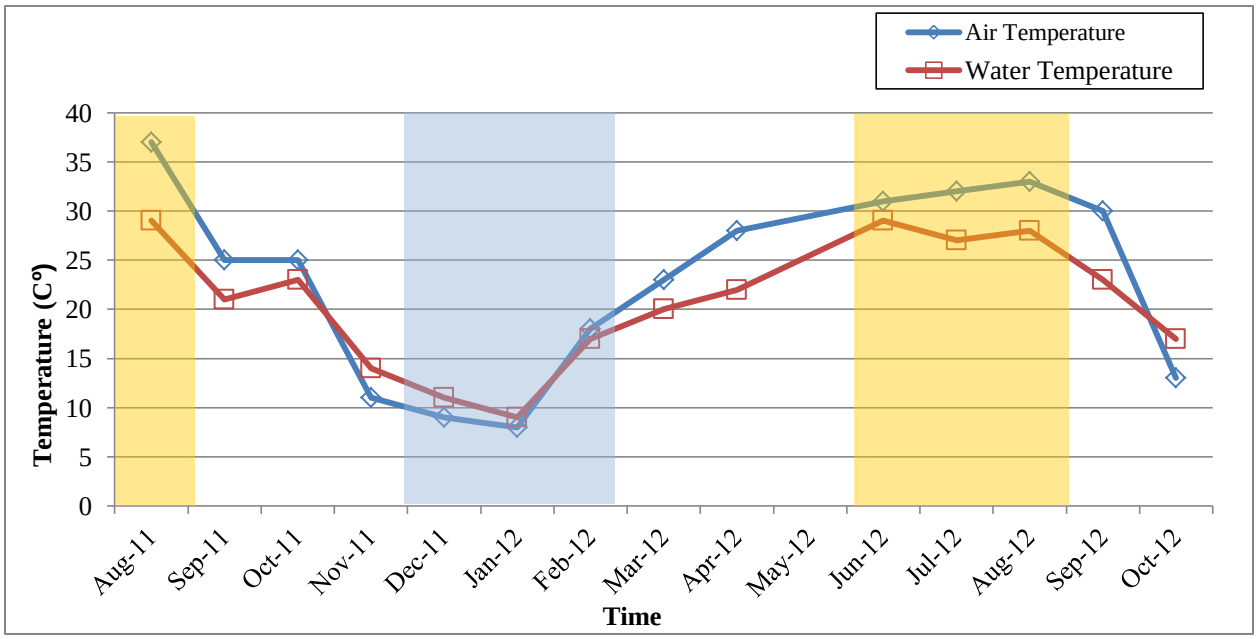


Figure 77: Air and water temperature at Site 12538

Total Dissolved Solids

The TDS values were very consistent. However, one sample in the winter of 2011 was 1065 mg/L, the second highest value recorded for Plum Creek.

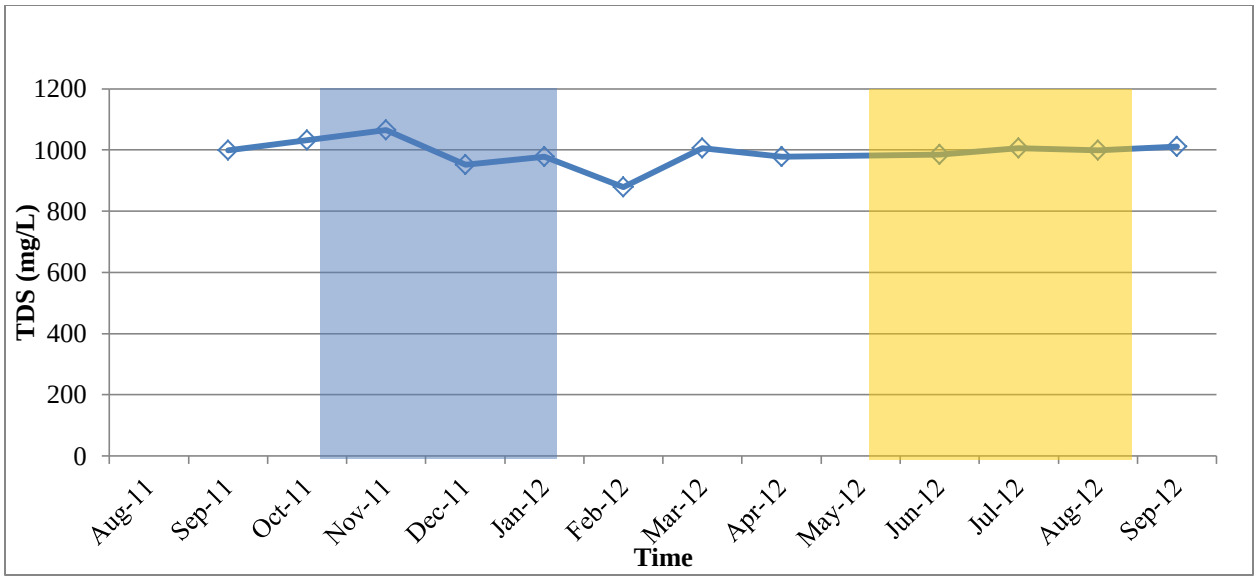


Figure 78: Total Dissolved Solids at Site 12538

Dissolved Oxygen

The DO values followed normal seasonal trends with higher values in the winter months and lower values in the summer months.

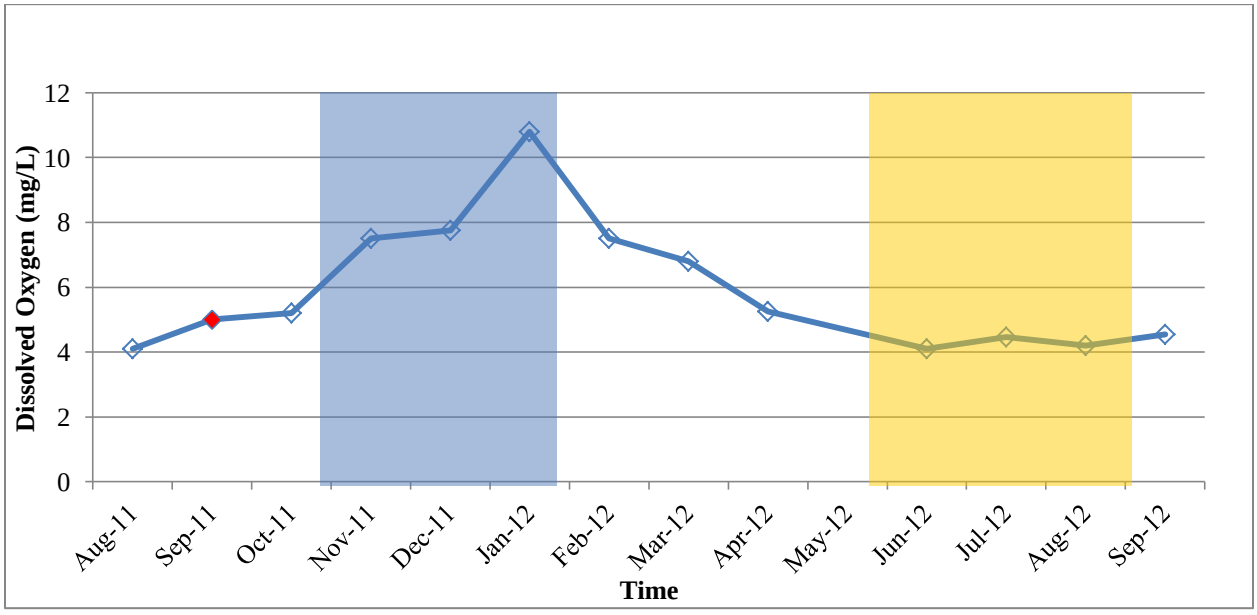


Figure 79: Dissolved Oxygen at Site 12538
Bright red data points on the graph show sampling events where DO measurements failed the quality assurance standards of the Texas Stream Team QAPP.

pH

The pH values were consistently 7.9-8.0, indicating slightly alkaline water. This is to be expected, since the water in Andrews Branch originates in limestone terrains. There were two sampling events where the

values dipped to 7.4 and 7.0 respectively; this could have been due to a rain event neutralizing the basic elements in the water.

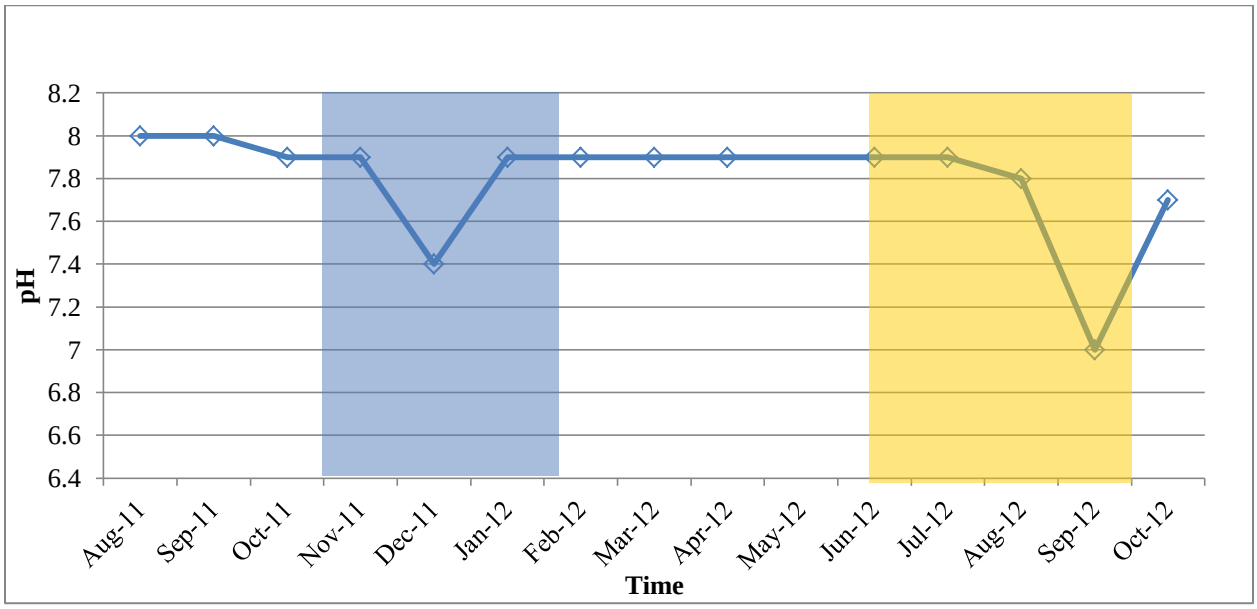


Figure 80: pH at Site 12538

Secchi disk and total depth

Secchi disk depth was typically greater than or equal to total depth, indicating high water clarity; however during some sampling events the Secchi disk depth was less than the total depth, indicating possible turbidity.

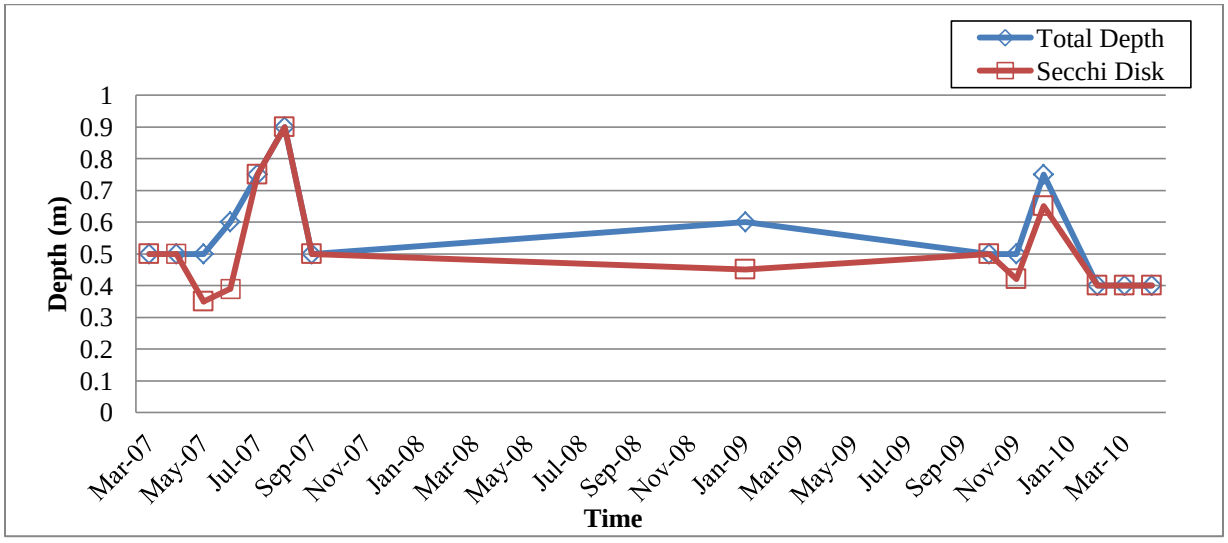


Figure 81: Total depth and Secchi disk depth at Site 12538
Note that when total depth and Secchi disk values are the same, water is clear and Secchi disk value should be greater than the total depth.

Field Observations

Field observations for this site indicated that the water was commonly calm, clear in color, and cloudy. Water was predominantly odorless and had a clear surface, with rare instances of algae, and normal flow during sampling events. Weather at the time of sampling events was clear 21% of the time, cloudy 36% of the time, and overcast during the remainder of the sampling events.

E.coli Bacteria

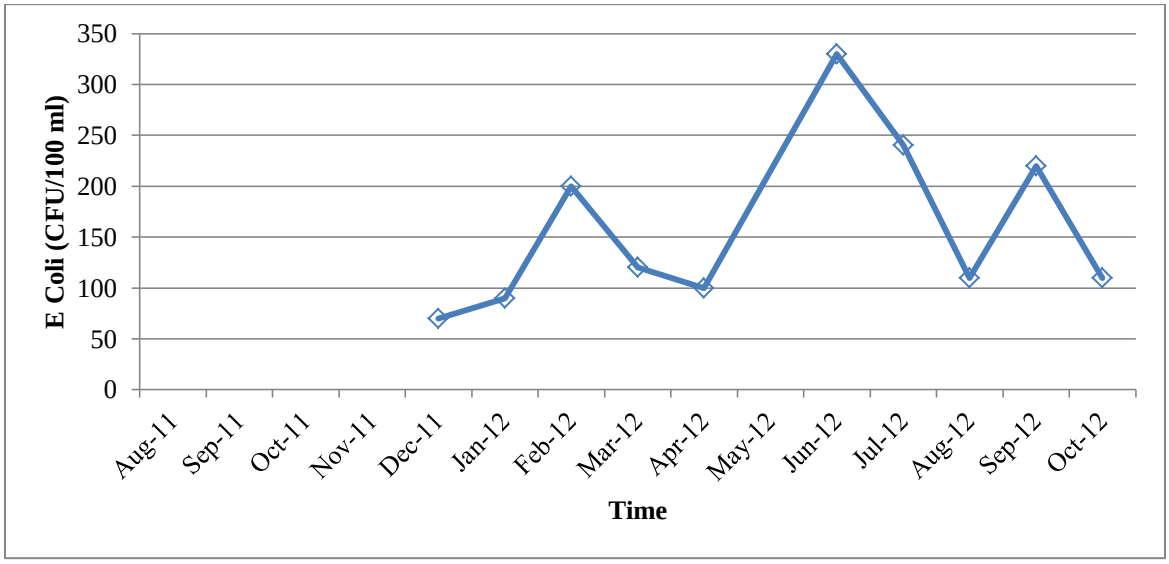


Figure 82: E Coli Counts at Sites 12538

Site 80452, 80453 and 80454

80454 – Plum Creek on 135
80453 – Plum Creek at CR 131 Bridge
80452 – Salt Creek at FM 1322

Site Description

Site 80454, Plum Creek on 135, is the last sampling site on Plum Creek before it merges with the San Marcos River. The site is located on the upstream side of the bridge on county road 135. The riparian zone is forested and the surrounding landscape is open rangeland, with some farmland. A creek runs along Highway 183 and passes under Interstate 10 close to this site.

Site 80453, Plum Creek at CR 131 Bridge, is on the upstream side of the bridge, east of the city of Luling. The surrounding landscape is primarily open rangeland, with some forested areas, which are found mainly along Plum Creek and its tributaries in the area.

Site 80452, Salt Creek on FM 1322, is located on a tributary of Plum Creek, and is located on the downstream site of the bridge on FM 1322, east of Luling. The creek is surrounded by open farmland, a large factory and a lush riparian zone.

These sites combined to have the highest average DO, highest average pH, and highest E. coli geomean of all of the Plum Creek sites.

Site and Sampling Information

Site 80454 was created on 10/16/2007 and was sampled twice on 11/25/2007 and 12/27/2007. Site 80453, Plum Creek at CR 131 Bridge was created on 10/16/2007, was sampled three times in 2008 (January-April) and two times in 2009 (March-April). Finally, Site 80452, Salt Creek at FM 1322, was created on 10/16/2007 and was sampled once on 12/2/2007. Sampling at the three sites did not occur with consistency in date or time of sampling. Sites 80542 and 80454 were monitored by Christina Chonka and Nicole Welch. Site 80453 was monitored by Heather Ann Brown, Bryan Ruiz, and Kathy Ruiz. Monitors spent a total of 30 hours and 5 minutes and traveled 347 miles sampling this site since November 2007, with an average of 257.87 minutes spent sampling and 49.6 miles traveled during each sampling event.

Table 19: Descriptive parameters for Sites 80452, 80453, and 80454, on the lower section of Plum Creek

Parameter	% Complete	Mean ± Standard Deviation	Maximum Value	Minimum Value
Total Dissolved Solids (mg/L)	100%	794.78 ± 79.91	964.8	710.2
Water Temperature (°C)	100%	18.63 ± 7.65	30	9
Dissolved Oxygen (mg/L)	100%	16.59 ± 5.5	20	8
pH	87.5%	8.28 ± 1.52	10.1	5.7
Secchi Disk Transparency (m)	100%	0.51 ± 0.11	0.75	0.35
Depth (m)	100%	0.59 ± 0.19	1	0.5
E. coli Bacteria (CFU/100 mL)	50%	242.24 ± 2.4 *	860	130

* Geomean and Geometric Standard Deviation, Sites were sampled 8 times between 11/13/2007 and 4/4/2009.

Air and water temperature

Due to limited data it is difficult to identify any seasonal trends for these sites.

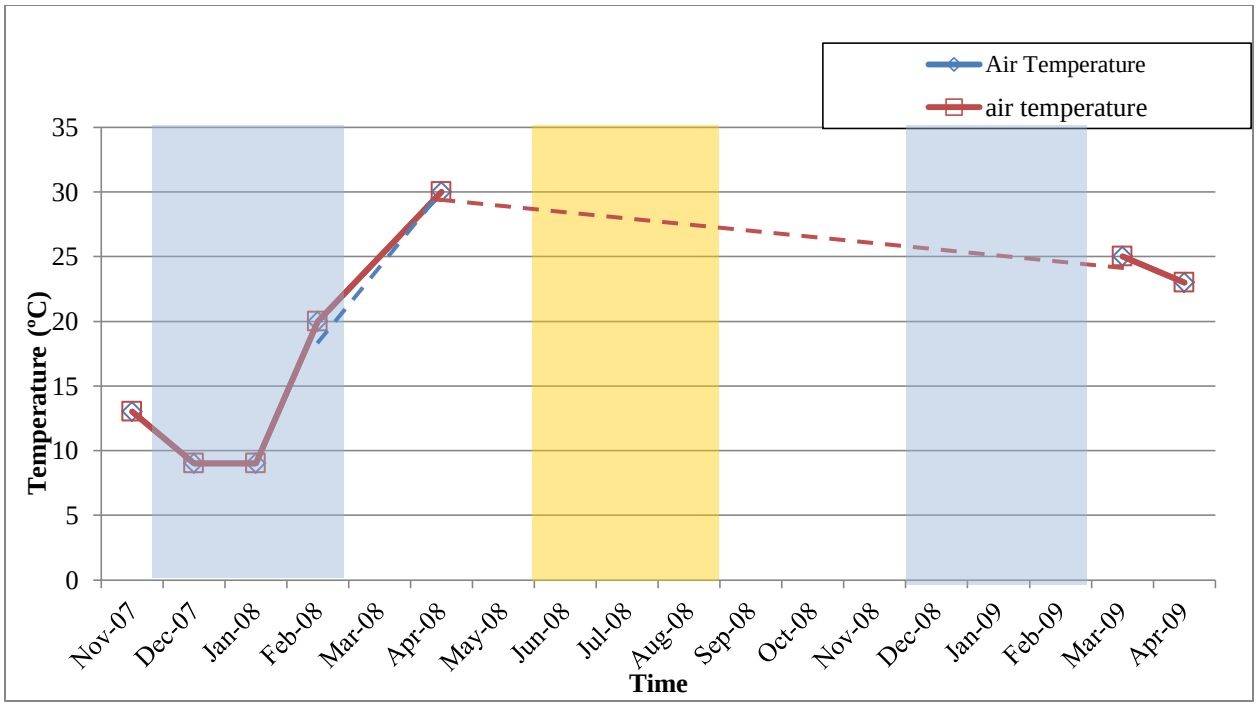


Figure 83: Air and water temperatures at Site 80452, 80453, and 80454

Total Dissolved Solids

The TDS values remained fairly consistent across sampling events. It is important to note that four out of the seven sampling events failed quality assurance standards.

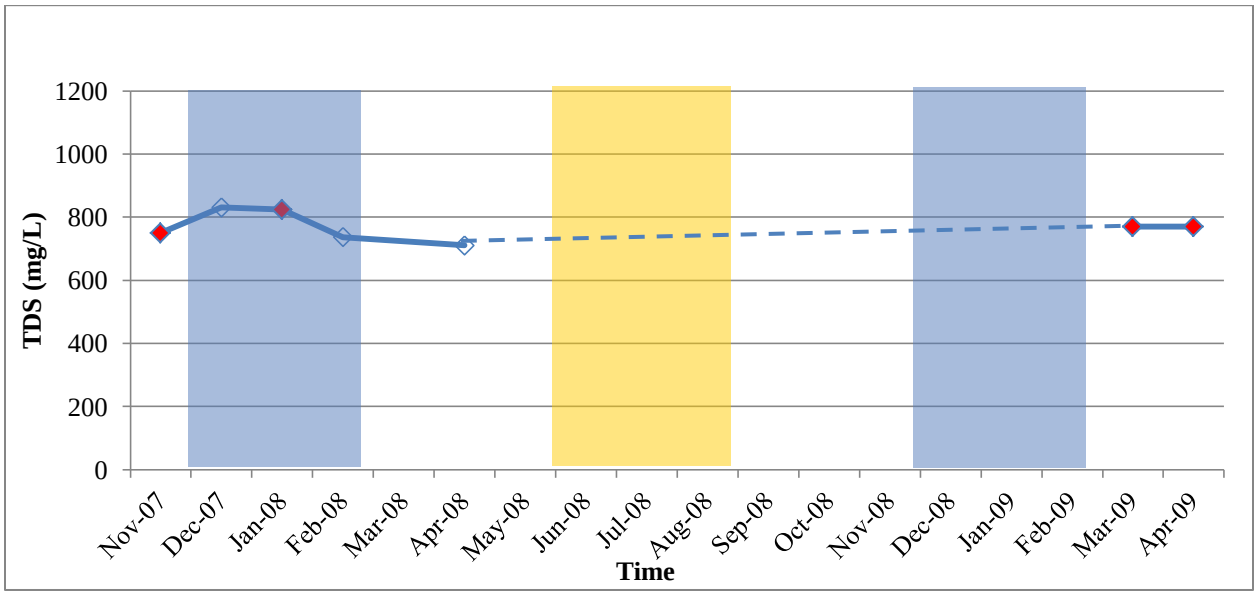


Figure 84: Total Dissolved Solids at Sites 80452, 80453, and 80454

Bright red data points on the graph show sampling events where TDS measurements failed the quality assurance standards of the Texas Stream Team QAPP.

Dissolved Oxygen

Due to limited data it is difficult to identify whether or not DO values followed the normal seasonal trends. It is important to note that the majority of sampling events failed the quality assurance standards. The majority of failures were due to expired reagents.

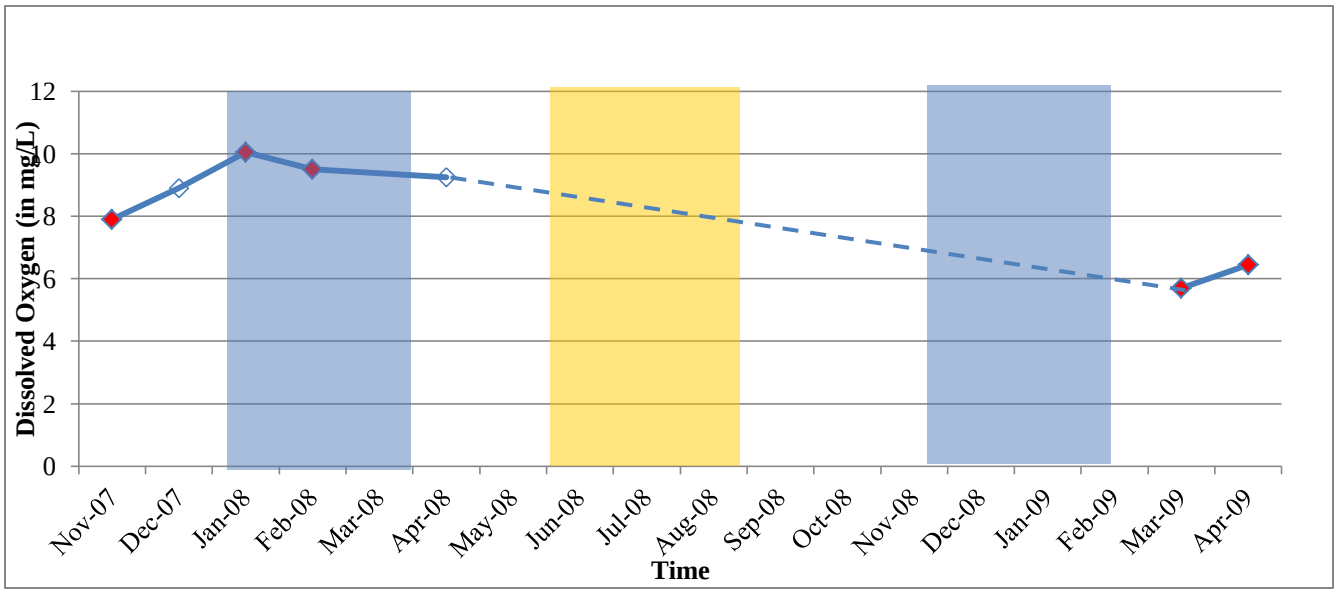


Figure 85: Dissolved Oxygen at Sites 80452, 80453, and 80454
Bright red data points on the graph show sampling events where DO measurements failed the quality assurance standards of the Texas Stream Team QAPP.

pH

The pH values were highly variable at these sites.

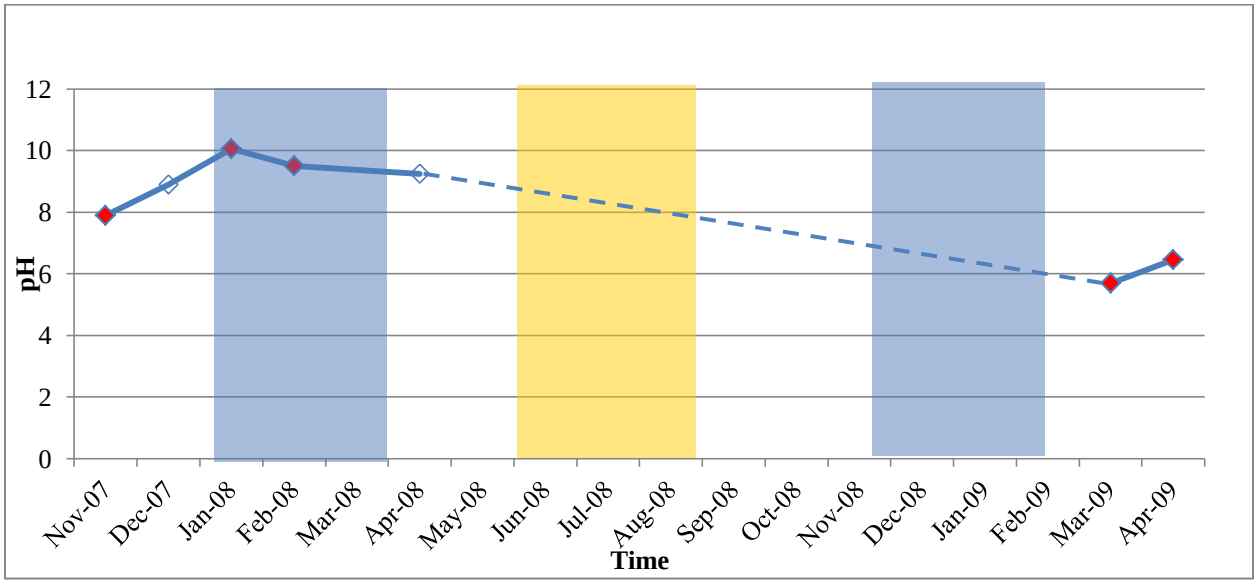


Figure 86: pH at Sites 80452, 80453, and 80454
Bright red symbols on the graph show sampling events where pH measurements failed the quality assurance standards of the Texas Stream Team QAPP.

Secchi disk and total depth

Secchi disk depth was consistently greater than or equal to total depth, indicating a high degree of water clarity.

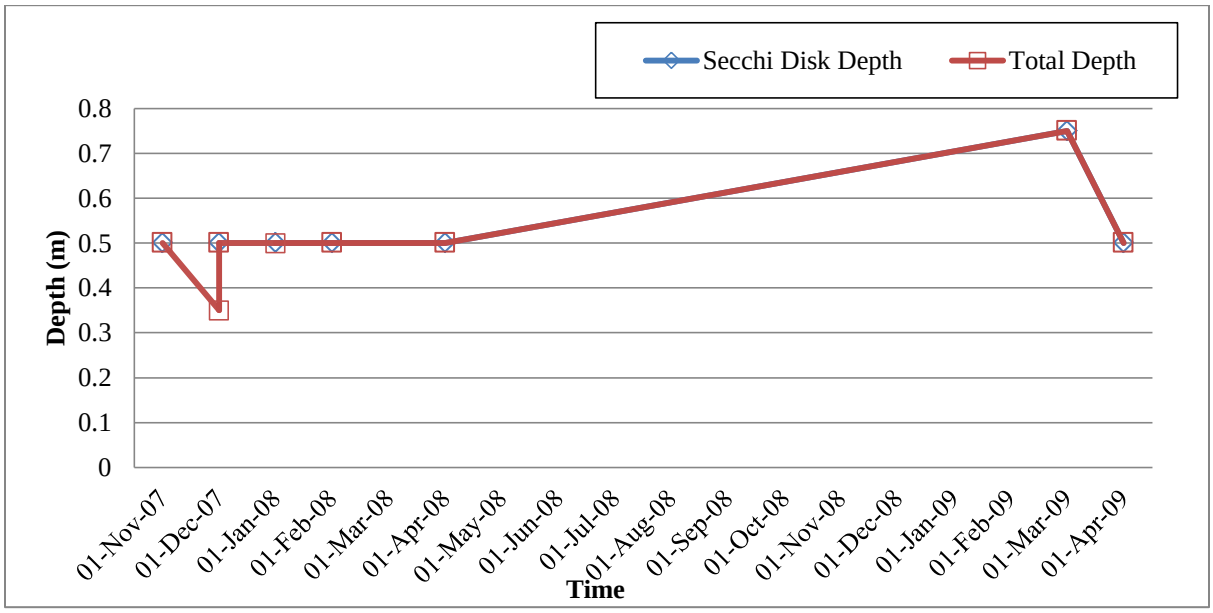


Figure 87: Total depth and Secchi disk depth at Sites 80452, 80453, and 80454

.

Field Observations

At sites 80452, 80453, and 80454, field observations recorded during sampling events indicate that the water commonly had normal flow, rare occurrences of algae, and was light green and cloudy. For the majority of sampling events, the site had no odor, a clear surface, and ripples. Weather at the time of sampling events was clear 57% of the time, cloudy 29% of the time, and overcast during the remainder of the sampling events.

E.coli Bacteria

Four E. coli measurements were taken at this site of which one sample had a value of 860 CFU/100 mL.

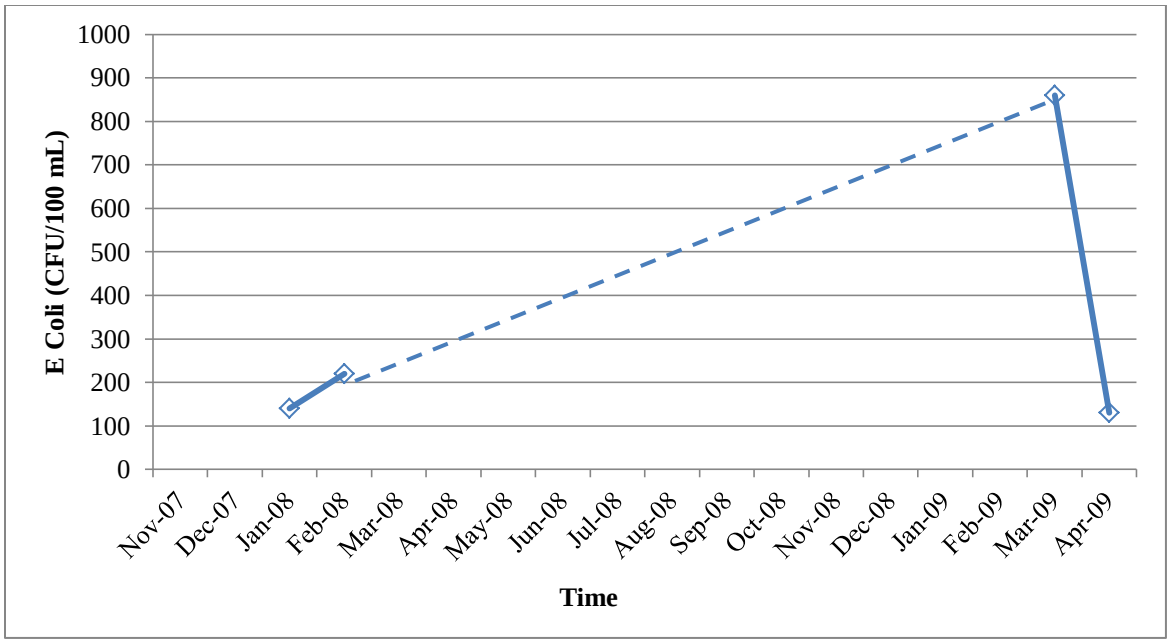


Figure 88: E. coli counts at Sites 12538

Get Involved with Texas Stream Team!

Once trained, citizen monitors 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 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.

Appendix A- List of Maps, Tables, and Figures

Maps

Tables

Figures