2012 MARK TWAIN LAKE WATER QUALITY REPORT



U.S. ARMY CORPS OF ENGINEERS, ST. LOUIS DISTRICT ENVIRONMENTAL QUALITY SECTION – WATER QUALITY

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Executive Summary

The purpose of this report is to provide an annual analysis of the water quality in the lake for the past year. Mark Twain Lake is located in northeastern Missouri in the Salt River Basin on the Salt River. Clarence Cannon Dam and the Reregulation Dam are located in Ralls County at Salt River miles 63.0 and 53.5, respectively. The purpose of this project was to provide flood control, hydroelectric power generation, water supply, fish and wildlife conservation, recreation and water quality enhancement. The Mark Twain watershed comprises 2,318 square miles, with an additional 29 square miles draining into the Reregulation Pool. Major tributaries are the North Fork, Middle Fork, Elk Fork, and South Fork. The watershed consists of a gently rolling plain in the upstream portion and more hilly in the downstream reaches. High rock bluffs border the stream and lake at various locations. Hickory and oak forests are scattered among crop and grazing lands.

The water of Mark Twain Lake and the downstream river channel is generally good. The lake is a medium depth reservoir nestled in the Salt River Basin. The lake tends to stratify during the summer months.

All sampling sites met the appropriate state standards during 2012 except the phosphorous levels. Phosphorous levels have exceeded the state standard on a routine basis. Generally the tailwater levels are lower than the incoming tributary flows, which indicates that the lake is sinking the phosphorous. This is also occurring with nitrogen. The project area has little pollution potentials at present time, no major form of degradation to the lake or streams is apparent. Constant water quality monitoring will continue to check future degradation of the watershed.

WATER QUALITY MONITORING PROGRAM

1.0 GENERAL OVERVIEW

This report summarizes water quality activities of the St. Louis District for Fiscal Year 2012 in accordance with ER 1110-2-8154 Water Quality & Environmental management for Corps Civil Works Projects and ETL 1110-2-362 Environmental Engineering Initiatives for Water Management. According to the U.S. Environmental Protection Agency (USEPA) poor lakeshore habitat is the biggest problem in our nation's lakes, followed by nutrients. Shoreline vegetation provides shelter for aquatic wildlife, reduces sediment and nutrient movement. The biology of a lake is characterized by the diversity if it's organisms. The number and kinds of plant and animal species present is a direct measure of a lake's well-being. Water quality at Mark Twain Lake is directly assessed using stream and river data from 10 site locations.

Water quality monitoring remains one of the Sections major responsibilities. The objective is to maintain a reasonable environmental monitoring program for the Mississippi River and the 5 lakes under the St. Louis District's control. The District's reservoirs consist of Mark Twain and Wappapello Lakes in Missouri, and Shelbyville, Carlyle and Rend Lakes in Illinois. Water quality sampling is conducted within the lakes and their tributaries to establish trend analysis and maintain water quality at or above state and federal regulations.

The main objective is to provide technical expertise of an environmental nature to all Corps elements requesting assistance in accordance with ER 1110-2-8154. This would include updating the water quality management priorities for the district's projects to ensure water quality meets the state and federal regulations, for protection of human health and the environment, and for the safety and economic welfare of those at Corps projects. Ongoing goals include ensuring that downstream water quality meets all state and federal regulations, is suitable for aquatic and human life, and continue to evaluate trend analysis in relation to baseline conditions at all projects.

Water quality data is provided to the Missouri Department of Natural Resources (MDNR) to be used as a screening mechanism for the Missouri Water Quality Report which is required every two years by the Clean Water Act Sections 303(d) and 305(b). MDNR does not routinely monitor Mark Twain Lake, however the Lakes of Missouri Volunteer Program (LMVP) through the University of Missouri-Columbia has been taking samples at 3 sites 4 times a year since 1989. The LMVP only analyze for Nutrients and Chlorophyll.

The National Water Quality Inventory Report to Congress (305(b) report) is the primary vehicle for informing Congress and the public about general water quality conditions in the United States. This document characterizes our water quality, identifies widespread water quality problems of national significance, and describes various programs implemented to restore and protect our waters.

Under Section 303(d) of the 1972 Clean Water Act, states, territories and authorized tribes are required to develop a list of water quality limited segments. These waters on the list do not meet water quality standards, even after point sources of pollution have installed the minimum required levels of pollution control technology. The law requires that these jurisdictions establish priority rankings for water on the lists and develop action plans, called as Total Maximum Daily Loads (TMDL), to improve water quality.

The 2010 water quality report compiled by the Missouri Department of Natural Resources has listed the Salt River below the Cannon Dam and Mark Twain Lake as impaired. The Salt River is impaired by low Dissolved Oxygen and Mercury. Mark Twain Lake is impaired by Mercury. Mark Twain Lake is listed as eutrophic. Continued monitoring of the lake and its tributaries is vital in assisting the future assessment of the lake for these and other possible impairments. The water quality monitoring program represents the single metric that encompasses the overall health of the watershed as it is a direct measure of how well the environmental stewardship programs are working.

1.1 INTRODUCTION

Mark Twain Lake is located in northeast Missouri. The land surrounding the lake is used predominately for agriculture. The main agricultural contaminants into the watershed include pesticides and fertilizers. Also a concern is the high sediment loading into the lake and the colloidal characteristic of the sediments as well as low dissolved oxygen levels related to turbine generation. The lake is also susceptible to fish kills due to algal decay in the lake arms.

The operating purposes for Mark Twain Lake are fish/wildlife, hydroelectric power, flood control, recreation, navigation and water supply. The water quality management program for the lake includes monitoring of baseline parameters, ecological trends and investigation of problem areas to keep the lake within state and federal standards.

Water quality monitoring was conducted during 2012 to assure safe conditions for human recreation, wildlife and aquatic life as maintained and managed within the lake system. The 2012 water quality monitoring program was funded to conduct three sampling events. During the sampling event one site was selected for quality control duplication and denoted as MTL-15. The locations of the ten sampling sites are depicted on the lake map in Figure 1.

As mentioned above, LMVP collects samples at Mark Twain Lake. This year they conducted 8 sampling events at 3 sites. Their data is in Appendix D. We have also included data from the United Water Services Clarence Cannon WTP in Appendix E.

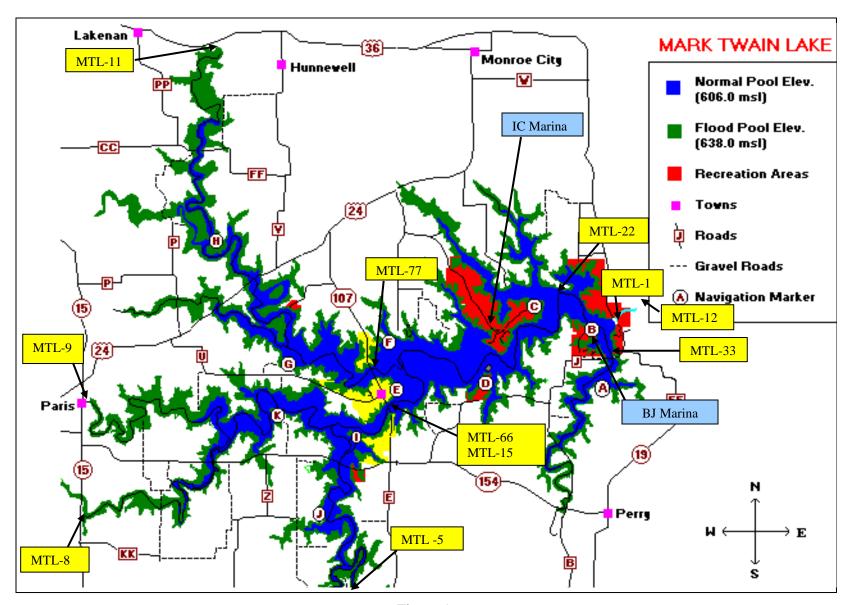


Figure 1 Location of sample sites

2.0 WATER QUALITY ASSESSMENT CRITERIA

2.1 Water Quality

The water quality assessment criteria were based upon the State of Missouri regulatory limits for certain contaminants, which has been generally accepted criteria for sustaining adequate aquatic plant and animal growth. The samplings and analysis which were conducted at the Mark Twain Lake sites reflect the minimal set of parameters needed to analyze the current status of water quality for the Mark Twain Lake system.

The following parameters were analyzed in the Fiscal Year 2012 samplings at Mark Twain Lake: Total Organic Carbon (TOC), iron, manganese, ammonia-nitrogen, nitrate-nitrogen, orthophosphate, total phosphate, Total Suspended Solids (TSS), Total Volatile Suspended Solids (TVSS), fecal coliform, pH, temperature, dissolved oxygen, specific conductance, oxidation-reduction potential (ORP), chlorophyll, pheophytin-a, atrazine and alachlor,

The Missouri Department of Natural Resources, Code of State Regulations, Division 20, Chapter 7 classifies water quality criteria based on designated usage. These standards are used to determine the aquatic water quality of the lake. Table 2.1 provides a listing of the regulatory limits for the parameters analyzed where a limit has been established.

TABLE 2.1 State of Missouri Water Quality Standards				
PARAMETER	LIMIT			
Temperature	20.5°C - 33°C (68°F - 90°F)			
Ammonia Nitrogen	< 15 mg/L			
Nitrate Nitrogen	10 mg/L			
Iron	1.0 mg/L (Aquatic Life)			
Manganese	0.05 mg/L (Drinking Water & GW)			
Phosphorous as Phosphate	0.05 mg/L			
E. Coli	Missouri standard is 235 E. coli per 100ml for single sample or 126 for geometric mean			
pH	Range: 6.5 to 9.0			
DO	> 5.0 mg/L			
Atrazine	> 5.0 mg/L 3ug/L ¹ , 82ug/L ² , 9ug/L ³			
Alachlor	$2ug/L^1$			
Conductivity	1,700 <i>u</i> S/cm≈TDS of 1,000 mg/L			
Total Suspended Solids (TSS)	116mg/L (streams); ≥12mg/L Lakes			
Chlorpyrifos	10ug/L^1			
Cyanazine	370ug/L ² ; 30ug/L ³			
Metolachlor	1.7mg/L^2			
Metribuzin	200ug/L ¹ 91ug/L HRL			
Pendmethalin (PROWL)	70ug/L HBSL, 20ug/L ¹			
Simazine	4.0ug/L ¹			

Trifluralin	26ug/L ² ; 1.1ug/L ³

¹ Drinking Water

Health Based Sreening Level (HBSL)

Health Reference Level (HRL)

Nitrogen is an essential component of proteins, genetic material, chlorophyll, and other key organic molecules. All organisms require nitrogen in order to survive. Nitrogen exists in several forms. These forms include gaseous nitrogen (N₂), nitrites (NO₂), nitrate (NO₃), ammonia nitrogen (NH₃-N), and ammonium (NH₄). Ammonia can be toxic to fish and other aquatic organisms at certain levels. Unlike ammonia, ammonium (NH4) is not toxic to aquatic organisms and is readily available for uptake by plankton and macrophytes. Nitrogen levels have increased as human activities have accelerated the rate of fixed nitrogen being put into circulation. High nitrogen levels can cause eutrophication. Eutrophication increases biomass of phytoplankton, decrease water transparency, and causes oxygen depletion. Ammonia nitrogen is monitored so that the effects on fish spawning, hatching, growth rate and pathologic changes in gills, liver and kidney tissue can be related to the detected levels of ammonia nitrogen. Nitratenitrogen degrades to nitrite or produces ammonia which has a detrimental effect on aquatic life and, therefore, has been monitored to assure levels are below the regulatory "safe" limit.

Phosphate has been analyzed as phosphorus and has been monitored due to the potential for uptake by nuisance algae. Levels of phosphate can indicate the potential for rapid growth of algae (algae bloom) which can cause serious oxygen depletion during the algae decay process. Phosphorous is typically the limiting nutrient in a water body. Therefore, addition of phosphorous to the ecosystem stimulates the growth of plants and algae. Phosphorous is delivered to lakes and streams by way of storm water runoff from agricultural fields, residential property, and construction sites. Other sources of phosphorous are anaerobic decomposition of organic matter, leaking sewer systems, waterfowl, and point source pollution. The general standard for phosphorous in lake water is $0.05 \, \text{mg/L}$. Dissolved phosphorous also called orthophosphorous is generally found in much smaller concentrations than total phosphorous and is readily available for uptake. For this reason dissolved phosphorous concentrations are variable and difficult to use as an indicator of nutrient availability.

The metals manganese and iron are nutrients for both plants and animals. Living organisms require trace amounts of metals. However, excessive amounts can be harmful to the organism. Heavy metals exist in surface waters in three forms, colloidal, particulate, and dissolved. Water chemistry determines the rate of adsorption and desorption of metals to and from sediment. Metals are desorbed from the sediment if the water experiences increases in salinity, decreases in redox potential, or decreases in pH. Metals in surface waters can be from natural or human sources. Currently human sources contribute more metals than natural sources. Metals levels in surface water may pose a health risk to humans and the environment.

Photosynthetic activity can be hindered by the levels of total suspended solids. Total suspended solids concentrations, which cause the photosynthetic activity to be reduced by more than 10% from the seasonably established norm, can have a detrimental effect on aquatic life.

² Acute

³ Chronic

Soil particles, organic material, and other debris comprise suspended solids in the water column. Secchi disk measurements are inverse to suspended solid measurements. As the total suspended solids (TSS) increase, the secchi disk depth or water transparency decreases. Total suspended solids can be an important indicator of the type and degree of turbidity. TSS measurements represent a combination volatile suspended solids (VSS) which is comprised of organic material and nonvolatile suspended solids (NVSS) which is comprised of inorganic mineral particles in the water. In order to more accurately determine the types and amounts of suspended solids, volatile suspended solids (VSS) are analyzed. VSS concentration represents the organic portion of the total suspended solids. Organic material often includes plankton and additional plant and animal debris that is present in water. Total volatile solids indicate the presence of organics in suspension and, therefore, show additional demand levels of oxygen. Missouri does not currently have a standard for TSS or TVSS. However, literature suggests that NVSS above 15mg/L could highly impair recreational lake use and a NVSS of 3 to 7mg/L might cause slight impairment.

Chlorophyll and pheophytin-a are monitored to provide indicators of algae growth and, therefore, potential oxygen depletion activity. Chlorophyll is measured in lakes to estimate the type and amount of algal productivity in the water column. Chlorophyll \underline{a} is present in green algae, blue-green algae, and in diatoms. Chlorophyll \underline{a} is often used to indicate the degree of eutrophication. Chlorophyll \underline{b} and \underline{c} are used to estimate the extent of algal diversity and productivity. Chlorophyll \underline{b} is common in green algae and is used as an auxiliary pigment for photosynthesis. Chlorophyll \underline{c} is most common in diatom species and serves as an auxiliary pigment. Algal productivity and diversity can be determined by the concentrations of the individual pigments. For example high concentrations of chlorophyll \underline{a} and \underline{b} would indicate that green algae is abundant. High concentrations of chlorophyll \underline{a} would indicate abundance of bluegreen algae and concentrations of chlorophyll \underline{a} and \underline{c} would indicate diatoms are the dominant species. Chlorophyll production is currently being connected with hypoxia.

Fecal coliform bacteria is monitored for the protection of human health as it relates to full body contact of recreational waters. People can be exposed to disease-causing organisms, such as bacteria, viruses and protozoa in beach and recreational waters mainly through accidental ingestion of contaminated water or through skin contact. These organisms, called pathogens, usually come from the feces of humans and other warm-blooded animals. If taken into the body, pathogens can cause various illnesses and on rare occasions, even death. Waterborne illnesses include diseases resulting from bacteria infection such as cholera, salmonellosis, and gastroenteritis, viral infections such as hepatitis, gastroenteritis, and intestinal diseases, and protozoan infections such as ameobic dysentery and giardiasis. The most commonly monitored recreational water indicator organisms are fecal coliform, Escherichia coli, (E. coli) and enterococci. Fecal coliform are bacteria that live in the intestinal tracts of warm-blooded animals. The Missouri standard for fecal coliform is less than 200 colonies per 100ml of sample water calculated as a geometric mean. Fecal coliform was originally recommended in 1968 by the Federal Water Pollution Control Administration (predecessor to EPA) as an effective water quality indicator organism for recreational waters. Recent studies indicate that fecal coliform show less correlation to illness than other indicator organisms such as E. coli and enterococci. The Environmental Protection Agency (EPA) currently recommends E. coli or enterococci as an indicator organism for fresh waters. Since 2009 the St. Louis District has been using E. coli as

the standard indicator.

Atrazine and Alachlor herbicides are commonly used agricultural chemicals which can be readily transported by rainfall runoff. Both compounds are suspected of causing cancer and, therefore, were monitored for the protection of human and aquatic health. Organic compounds include many pesticides. A pesticide can be any substance that is intended to prevent, destroy, repel, or mitigate any pest. This includes insecticides, herbicides, fungicides, fumigants, algaecides and other substances. Herbicides which are pesticides used to kill vegetation are the most widely used and sampled. Ten of the most frequently used herbicides and detected in water are Atrazine, Metolachlor, Alachlor, 2,4-D, Trifluralin, Glyphosate, Dicamba, Cyanazine, Simazine, and 2,4,5-T. Two of the most widely used pesticides are Atrazine and Alachlor. Atrazine is a preemergence or postemergence herbicide use to control broadleaf weeds and annual grasses. Atrazine is most commonly detected in ground and surface water due to its wide use, and its ability to persist in soil and move in water. Alachlor is a Restricted Use Pesticide (RUP) due to the potential to contaminate groundwater. The drinking water standard for Atrazine is 0.003mg/L and 0.002 mg/L for Alachlor.

Temperature, dissolved oxygen and pH are monitored for the protection of aquatic life. Temperature is important because it controls several aspects of water quality. Colder water hold more dissolved oxygen which is required by aquatic organisms. Plants grow more rapidly and use more oxygen in warmer water. Decomposition of organic matter which uses oxygen is accelerated in warmer water. Temperature can also determine the availability of toxic compounds such as ammonia. Since aquatic organisms are cold blooded, water temperature regulates their metabolism and ability to survive. The number and kinds of organisms that are found in streams or lakes is directly related to temperature. Certain organisms require a specific temperature range, such as trout, which require water temperatures below 20°C. Most aquatic organisms require a minimum concentration of dissolved oxygen to survive. In spring, surface waters of the lake mix with the water below through wind and thermal action. This mixing diminishes as the upper layer of water becomes warmer and less dense. Solar insulation during the summer months stratifies the lake into three zones. The upper warmer water zone is called the epilimnion and the lower cooler water zone is called the hypolimnion. The epilimnion and the hypolimnion zones are divided by a transition zone known as the metalimnion. The thermocline located within the metalimnion exhibits a rapid change in water temperature. During the summer months the hypolimnion may become anaerobic. In this anaerobic zone, chemical reduction of iron and manganese, or the production of methane and sulfides can occur. Iron rapidly oxidizes in aerobic environments, but manganese oxidizes slowly and can remain in the reduced state for long distances down stream even in aerobic environments. The degree of acidity of water is measured by a logarithmetic scale ranging from 0 to 14 and is known as the pH scale. A reading of 7 indicates neutrality and readings below seven are acidic and above are alkaline. Most Illinois lakes range from 6 to 9 on the pH scale. The buffering capacity of water is the ability to neutralize acid better known as alkalinity. A high alkalinity concentration indicates an increased ability to neutralize pH and resist changes, whereas a low alkalinity concentration indicates that a water body is vulnerable to changes in pH.

Conductivity is a measure of a water's ability to conduct an electrical current. The ability to carry a current is often driven by the dissolved materials present in a water column. These

materials can include dissolved ions and other materials in the water and thus are directly proportional to the concentration of total dissolved solids (TDS) present in the water column. Typically TDS concentrations represent 50-60% of the conductivity measurements. Conductivity is also affected by water temperature. The warmer the water, the higher the conductivity. Conductivity in streams and rivers is affected by the geology of the area. Streams running through granite areas tend to have lower conductivity due to granite being composed of inert material, materials that do not ionize or dissolve into ionic compounds in water. On the other hand streams that run through areas of limestone or clay soils tend to have higher conductivity readings because of the presence of materials that ionize. Conductivity is useful as a general measure of water quality. A stream tends to have a relatively constant range of conductivity that once establish can be used as a baseline. Significant changes either high or low might indicate a source of pollution has been introduced into the water. The pollution source could be a treatment plant which raises the conductivity or an oil spill which would lower the conductivity.

Redox or Oxidation-Reduction Potential (ORP) is a measure of a water system's capacity to either release or gain electrons. Oxidation involves an exchange of electrons between 2 atoms. The atom that loses an electron is oxidized and the one that gains an electron is reduced. ORP sensors measure the electrochemical potential between the solution and a reference electrode. Readings are expressed in millivolts with positive readings indicating increased oxidizing potential and negative readings being increased reduction. The ORP probe is essentially a millivolt meter, measuring the voltage across 2 electrodes with the water in between. ORP values are used much like pH values to determine water quality. While pH readings characterize the state of a system relative to the receiving or donating hydrogen ions (base or acid), ORP readings characterize the relative state of losing or gaining electrons. The conversion of ammonia (NH₃) requires an oxidating environment to convert it into nitrites (NO₂) and nitrates (NO₃). Ammonia levels as low as 0.002mg/L can be harmful to fish. Generally ORP readings above 400mV are harmful to aquatic life. However, ORP is a non-specific measurement which is a reflection of a combination of effects of all the dissolved materials in the water. Therefore, the measurement of ORP in relatively clean water has only limited utility unless a predominant redox-active material is known to be present.

Water clarity is intuitively used by the public to judge water quality. Secchi depth has been used for many years as a limnological characterization tool for characterizing water clarity. Secchi depth is a measure of light penetration into a waterbody and is a function of the absorption and scattering of light in the water. There are three characteristics of water which affect the penetration of light. The three factors are the color of water, amount of phytoplankton in the water column, and amount of inorganic material in the water column. Secchi depth integrates the combined impacts of all the factors which influence water clarity. Water transparency was measured using a Secchi disk. Secchi disk readings were taken at all lake sites.

2.2 Sediment

In accordance with EM-1110-2-1201, sediment samples should be taken to monitor and assess potential impacts to aquatic and human health. To assess ecological risk, sample values were compared against toxicity information published in the National Oceanic Atmospheric Administrations (NOAA) Screening Quick Reference Tables (SQRT) or similar references for

ecological receptors in freshwater sediment. Without standards or other widely applicable numerical tools, NOAA scientists found it difficult to estimate the possible toxicological significance of chemical concentrations in sediment. Therefore, numerical sediment quality guidelines (SQG's) were developed as informal, interpretive tools. The SQGs were not promulgated as regulatory standards, but rather as informal, non-regulatory guidelines for interpreting chemical data from analyses of sediments. For potential ecological risk from inorganic contaminants, seven metals are typically of "most concern" with regards to fish and wildlife: Arsenic, Copper, Cadmium, Selenium, Mercury, Lead, and Zinc. Avian species are thought to be particularly sensitive to arsenic, but is also considered a carcinogenic, mutagenic, and teratogenic contaminant in a variety of species in elevated doses over time. Avian species are also known to be particularly sensitive to lead in the environment with effects ranging from mortality, reduced growth and reproductive output, behavior changes, blood chemistry alterations, and lesions of major organs. Finally, the embryo stages in fish and avian species are known to be the most sensitive life stage to selenium effecting reproductive success.

It is recommended that the next round of sediment samples focus on organochlorines in freshwater sediment to assess potential chronic aquatic impacts (e.g. aldrin, chlordane, endrin, endosulfan, DDT, methoxychlor).

For potential human health risk, there are no known values in Missouri for sediments. While not a direct correlation, sample results are compared against Missouri Risk Based Corrective Action (MRBCA) lowest default target levels for all soil types and exposure pathways for soils.

3.0 SUMMARY OF MONITORING RESULTS

3.1 Water Quality Summary

The monitoring program for Mark Twain Lake during Fiscal Year 2012 revealed good water quality when compared to limits established by the Missouri Department of Natural Resources for general use, secondary contact, and indigenous aquatic life. Agricultural nutrient runoffs were primary concerns for the lake's water quality. Better land management practices, erosion control and buffering zones are methods used to reduce such contaminants from entering the lake. The St. Louis District personnel are available to work with lake personnel, area communities, and other agencies in the implementation of educational programs and planning to bring about the use of better management techniques to improve the lake's water quality.

E. coli were sampled at the marinas to ensure that the marina areas are not being contaminated by boats with restroom facilities. Bacteria levels for both marinas were well below the Missouri standard of 235. We currently do not take enough samples in a month to calculate a geometric mean, so we mainly look at a high reading of 235/100ml of sample to trigger additional investigations. E. coli beach sample results for the Corps beaches were received from the project office, and data for the state beach was received from MDNR were incorporated into this report. Beach samples were taken weekly during the recreation season. No samples were above the Missouri standard for beaches.

Total iron and total manganese are sampled above the dam near the bottom of the channel (MTL-22-15), below the re-regulation dam (MTL-12), and in the spillway area (MTL-1). As was previously stated living organisms require trace amounts of metals, however excessive amounts can be harmful to the organism. Iron cycling is a function of oxidation-reduction processes. This elevated level of manganese is not detrimental to the overall lake system at this time. Iron oxidizes relatively rapidly (minutes to hours); therefore any iron released through the spillway will normally be oxidized in a short period of time. Manganese oxidizes slower and can persist in the reduced state long distances downstream even in aerobic environments. Missouri's standard for manganese is for drinking water and groundwater. Missouri does not have a manganese standard for aquatic life.

Nitrogen and phosphates are sampled at all sites. All lake sites exceeded the total phosphorous 0.05 mg/l standard at least once during the sampling period. Phosphorous levels were higher in the upper reaches of the lake (sites 66 &77, 15 is a duplicate of 66). Phosphorous levels are lowest near and below the dam. Total Phosphates are used or locked up as water travels down the lake. Because phosphorous in water is not considered directly toxic to humans and animals no drinking water standards have been established for phosphorous. However, phosphorous can cause health threats through the stimulation of toxic algal blooms and the resulting oxygen depletion. Nitrates can pose a threat to human and animal health. Nitrate in water is toxic at high levels and has been linked to toxic effects of livestock and to blue baby disease (methemoglobinemia) in infants. The Maximum Contaminant Level (MCL) for nitrate-N in drinking water is 10mg/L to protect babies 3 to 6 months of age. The Missouri Water Quality Standard for ammonia nitrogen (NH₃-N) is 15mg/L. Nitrate-Nitrogen did not exceed the 10mg/L standard at any site. The highest value recorded was 1.3mg/L at site 77 (North Fork Arm). Ammonia-Nitrogen tends to be constant throughout the lake. The increased levels of phosphate in combination with nitrogen and other lake conditions, such as temperature, pH and stagnant lake conditions, can lead to increased algae growth. Eutrophication is currently the most widespread water quality problem in the U.S. and many other countries. Restoration of eutrophic waters requires the reduction of nonpoint inputs of phosphorous and nitrogen. The resulting detrimental effects of algae toxins and oxygen depletion could result in health problems for fish and other aquatic species as well as land animals utilizing the water supply. There were no signs of any of these effects during the site visits in 2012.

Chlorophyll *a* was sampled at 4 sites, MTL-22, MTL-33, MTL-66 and MTL-77. MTL-15 is a duplicate sample of MTL-66. Chlorophyll a is a green pigment found in plants. Missouri does not currently have a standard for chlorophyll. Chlorophyll *a* concentrations are an indicator of phytoplankton abundance and biomass. They can be an effective measure of trophic status, and used as a measure of water quality. High levels often indicate poor water quality and low levels suggest good conditions. However, elevated levels are not necessarily bad. It is the long term persistence of elevated levels that is the problem. It is natural for chlorophyll *a* levels to fluctuate over time. Chlorophyll *a* tends to be higher after storm events and during the summer months when water temperatures and light levels are elevated. Chlorophyll can reduce the clarity of the water and the amount of oxygen available to other organisms. Chlorophyll concentrations and cyanobacteria cell counts serve as proxies for the actual presence of algal toxins. Exposure to cyanobacteria or their toxins may produce allergic reactions such as skin rashes, eye irritations, respiratory symptoms, and in some cases more severe health effects.

Microcystin is currently believed to be the most common cyanotoxin in lakes. While EPA does not currently have water quality criteria for algal toxins, the World Health Organization (WHO) has established recreational exposure guidelines for Chlorophyll-a, cyanobacterial cell counts, and microcystin. Mark Twain lake was in the moderate risk of exposure category for chlorophyll.

Seventy percent of the Mark Twain Lake watershed is used for agriculture and 50% of this is used for cropland. Atrazine and Alachlor are pesticides that were sampled at all sites. These chemicals are herbicides used to control weed growth. All sites were below the Missouri alachlor and atrazine standard. However, site 11 (North Fork near Hunnewell) had a reading of 2.7ug/L on June 27. These substances can enter water bodies as a result of drift during spraying, surface runoff, and leaching through soil. Cyanizine, Metolachlor, Trifluralin and Simazine are also analyzed as part of the pesticide screening. In order to eliminate pesticide contamination of waters it is important for the public to be educated and institute best manage practices when using these chemicals.

Total Suspended Solids (TSS) and Total Volatile Suspended Solids (TVSS) samples are collected at all sites. Solids can affect water quality by increasing temperature through the absorption of sunlight by the particles in the water, which also affects the clarity of the water. This can then affect the amount of oxygen in the water. Total Suspended Solids are highest at sites MTL-5 (South Fork), MTL-9 (Middle Fork) and MTL-11 (North Fork), and lowest near sites near the dam. Missouri does not currently have a standard for TSS or TVSS. However, literature suggests that Nonvolatile Suspended Solids (NVSS) which is a subdivision of TSS above 15mg/L could highly impair recreational lake use and a NVSS of 3 to 7mg/L might cause slight impairment.

Total Organic Carbon (TOC) is collected at all sites. TOC is an indicator of the organic character of water. The larger the carbon or organic content, the more oxygen is consumed. TOC tends to be higher in the summer months which may be a result of plant material, which had grown all summer and begins to decay. Missouri does not currently have a standard for TOC.

Temperature and dissolved oxygen levels were taken at all sites. Measurements were taken at 1 meter intervals at the lake sites. During the summer months the lake stratifies and a boundary is formed between the upper warmer water and the lower cooler water. This transition area is known as the thermocline, the area where the temperature drops significantly. Oxygen levels can also change drastically as a function of depth. This area where the oxygen level significantly drops is called the oxycline. The depth of the thermocline and oxycline can have an effect on the aquatic organisms. Occasionally the thermocline and oxycline are at or near the same depth.

pH is taken at all sites and at 1 meter intervals at lake sites. All sites were within the 6 to 9 pH range except site 5 on 28 August. Variances in pH can be caused by a rainfall event. There was a 2 inch rain event on 26 August.

Conductivity and redox are taken at all sites and at 1 meter intervals at lake sites.

Recommended standard for conductivity is 1,700*u*S/cm. Missouri does not currently have a standard for redox.

Seechi disk readings at sites 22 (above dam) and 33 (Lick Creek Arm near Hwy J) indicate that these sites tend to have better water clarity than the rest of the lake. This would seem to be reasonable since these sites are located closer to the dam which allows solids time to settle out of the water column.

3.2 Sediment Summary

Sediment sampling was not conducted in 2012. Sediment sampling is normally conducted every 5 years if funding is available. Sediment sampling was last conducted in 2007.

4.0 PLANNED 2013 STUDIES

The Mark Twain Lake water quality monitoring will continue in Fiscal Year 2012. Because of budgetary constraints the number of sampling events will remain at 3 for 2012. A restored number of sampling events would provide the ability to better evaluate water quality trends, better defend project operations (lake levels, releases, maintenance projects, construction projects, etc.), to better confirm that we meet state water quality standards, and to better confirm that human health and safety are adequately protected. The sampling events are planned to be conducted between April and August in 2013. Mark Twain Lake provides drinking fwater to many communities and is a high usage recreational lake. The monitoring of water quality is imperative to assure the water quality is within acceptable limits for the designated usage.

The sampling sites include the following: Site 1 MTL-1 Spillway, Site 5 MTL-5 South Fork at Hwy D, Site 8 Elk Fork at Hwy 15, Site 9 Middle Fork at Hwy 15, Site 11 North Fork at Hwy 36, Site 12 below re-regulation dam, Site 22 MTL-22 old river channel 1mile up lake from dam, Site 33 Lick Creek at Hwy J, Site 66 South Fork at Hwy 107 bridge, and Site 77 North Fork at Hwy 107 bridge. This combination of sites effectively represents the incoming contaminants and their effects on the lake.

A remote sensor was installed several years ago in the spillway to allow the project as well as water quality personnel to remotely monitor temperature and oxygen readings to avoid fish kills. During low flow, water is discharged through the after bay. This water is low in oxygen and can create a low oxygen area below the dam. The sensor will allow the project to track oxygen levels below the dam and make appropriate adjustments to avoid a possible fish kill. Normally allowing water to spill through the tainter gates will alleviate low oxygen levels below the dam. In 2009 a remote sensor was installed in the re-reg pool near the re-reg dam to monitor the lower portion of the re-reg pool. Water quality personnel will continue to maintain and monitor these probes.

APPENDIX A

DATA

LAB DATA

Site	Date	Result	Qualifier	Units	Parameter
MTL-1	5/24/12	0.20	<	UG/L	Alachlor
MTL-1	6/27/12	0.20	<	UG/L	Alachlor
MTL-1	8/28/12	0.20	<	UG/L	Alachlor
MTL-11	5/24/12	0.20	<	UG/L	Alachlor
MTL-11	6/27/12	0.20	<	UG/L	Alachlor
MTL-11	8/28/12	0.20	<	UG/L	Alachlor
MTL-12	5/24/12	0.20	<	UG/L	Alachlor
MTL-12	6/27/12	0.20	<	UG/L	Alachlor
MTL-15	5/24/12	0.20	<	UG/L	Alachlor
MTL-15	6/27/12	0.20	<	UG/L	Alachlor
MTL-15	8/28/12	0.20	<	UG/L	Alachlor
MTL-22	5/24/12	0.20	<	UG/L	Alachlor
MTL-22	6/27/12	0.20	<	UG/L	Alachlor
MTL-22	8/28/12	0.20	<	UG/L	Alachlor
MTL-33	5/24/12	0.20	<	UG/L	Alachlor
MTL-33	6/27/12	0.20	<	UG/L	Alachlor
MTL-33	8/28/12	0.20	<	UG/L	Alachlor
MTL-5	5/24/12	0.20	<	UG/L	Alachlor
MTL-5	6/27/12	0.20	<	UG/L	Alachlor
MTL-5	8/28/12	0.20	<	UG/L	Alachlor
MTL-66	5/24/12	0.20	<	UG/L	Alachlor
MTL-66	6/27/12	0.20	<	UG/L	Alachlor
MTL-66	8/28/12	0.20	<	UG/L	Alachlor
MTL-77	5/24/12	0.20	<	UG/L	Alachlor
MTL-77	6/27/12	0.20	<	UG/L	Alachlor
MTL-77	8/28/12	0.20	<	UG/L	Alachlor
MTL-8	5/24/12	0.20	<	UG/L	Alachlor
MTL-8	6/27/12	0.20	<	UG/L	Alachlor
MTL-8	8/28/12	0.20	<	UG/L	Alachlor
MTL-9	5/24/12	0.20	<	UG/L	Alachlor
MTL-9	6/27/12	0.20	<	UG/L	Alachlor
MTL-9	8/28/12	0.20	<	UG/L	Alachlor
MTL-1	5/24/12	0.051		MG/L	Ammonia Nitrogen
MTL-1	6/27/12	0.041		MG/L	Ammonia Nitrogen
MTL-1	8/28/12	0.13		MG/L	Ammonia Nitrogen
MTL-11	5/24/12	0.089		MG/L	Ammonia Nitrogen
MTL-11	6/27/12	0.030	<	MG/L	Ammonia Nitrogen
MTL-11	8/28/12	0.030	<	MG/L	Ammonia Nitrogen
MTL-12	5/24/12	0.037		MG/L	Ammonia Nitrogen
MTL-12	6/27/12	0.030	<	MG/L	Ammonia Nitrogen
MTL-15	5/24/12	0.030	<	MG/L	Ammonia Nitrogen
MTL-15	6/27/12	0.030	<	MG/L	Ammonia Nitrogen
MTL-15	8/28/12	0.030	<	MG/L	Ammonia Nitrogen
MTL-22	5/24/12	0.030	<	MG/L	Ammonia Nitrogen
MTL-22	6/27/12	0.052		MG/L	Ammonia Nitrogen
MTL-22	8/28/12	0.030	<	MG/L	Ammonia Nitrogen
MTL-22-15	5/24/12	0.030	<	MG/L	Ammonia Nitrogen
MTL-22-15	6/27/12	0.030	<	MG/L	Ammonia Nitrogen
MTL-22-15	8/28/12	0.030	<	MG/L	Ammonia Nitrogen
MTL-33	5/24/12	0.030	<	MG/L	Ammonia Nitrogen
MTL-33	6/27/12	0.030	<	MG/L	Ammonia Nitrogen
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Site	Date	Result	Qualifier	Units	Parameter
MTL-33	8/28/12	0.030	<	MG/L	Ammonia Nitrogen
MTL-5	5/24/12	0.045	•	MG/L	Ammonia Nitrogen
MTL-5	6/27/12	0.030	<	MG/L	Ammonia Nitrogen
MTL-5	8/28/12	0.030	<	MG/L	Ammonia Nitrogen
MTL-66	5/24/12	0.030	<	MG/L	Ammonia Nitrogen
MTL-66	6/27/12	0.030	<	MG/L	Ammonia Nitrogen
MTL-66	8/28/12	0.030	<	MG/L	Ammonia Nitrogen
MTL-77	5/24/12	0.030	<	MG/L	Ammonia Nitrogen
MTL-77	6/27/12	0.030	<	MG/L	Ammonia Nitrogen
MTL-77	8/28/12	0.030		MG/L	Ammonia Nitrogen
MTL-8	5/24/12	0.038	<	MG/L	•
MTL-8	6/27/12	0.030	_	MG/L	Ammonia Nitrogen
MTL-8	8/28/12	0.030	<	MG/L MG/L	Ammonia Nitrogen
					Ammonia Nitrogen
MTL-9	5/24/12	1.0		MG/L	Ammonia Nitrogen
MTL-9	6/27/12	0.030	<	MG/L	Ammonia Nitrogen
MTL-9	8/28/12	0.030	<	MG/L	Ammonia Nitrogen
MTL-1	5/24/12	0.20	<	UG/L	Atrazine
MTL-1	6/27/12	0.20	<	UG/L	Atrazine
MTL-1	8/28/12	0.20	<	UG/L	Atrazine
MTL-11	5/24/12	0.70		UG/L	Atrazine
MTL-11	6/27/12	2.7		UG/L	Atrazine
MTL-11	8/28/12	0.20	<	UG/L	Atrazine
MTL-12	5/24/12	0.20	<	UG/L	Atrazine
MTL-12	6/27/12	0.20	<	UG/L	Atrazine
MTL-15	5/24/12	0.20	<	UG/L	Atrazine
MTL-15	6/27/12	0.20	<	UG/L	Atrazine
MTL-15	8/28/12	0.20	<	UG/L	Atrazine
MTL-22	5/24/12	0.20	<	UG/L	Atrazine
MTL-22	6/27/12	0.20	<	UG/L	Atrazine
MTL-22	8/28/12	0.20	<	UG/L	Atrazine
MTL-33	5/24/12	0.20	<	UG/L	Atrazine
MTL-33	6/27/12	0.20	<	UG/L	Atrazine
MTL-33	8/28/12	0.20	<	UG/L	Atrazine
MTL-5	5/24/12	0.69		UG/L	Atrazine
MTL-5	6/27/12	0.87		UG/L	Atrazine
MTL-5	8/28/12	0.20	<	UG/L	Atrazine
MTL-66	5/24/12	0.20	<	UG/L	Atrazine
MTL-66	6/27/12	0.20	<	UG/L	Atrazine
MTL-66	8/28/12	0.20	<	UG/L	Atrazine
MTL-77	5/24/12	0.20	<	UG/L	Atrazine
MTL-77	6/27/12	0.20	<	UG/L	Atrazine
MTL-77	8/28/12	0.20	<	UG/L	Atrazine
MTL-8	5/24/12	1.6		UG/L	Atrazine
MTL-8	6/27/12	0.52		UG/L	Atrazine
MTL-8	8/28/12	0.53		UG/L	Atrazine
MTL-9	5/24/12	0.75		UG/L	Atrazine
MTL-9	6/27/12	0.20	<	UG/L	Atrazine
MTL-9	8/28/12	0.20	<	UG/L	Atrazine
MTL-15	5/24/12	8.7		MG/CU.M.	Chlorophyll a
MTL-15	6/27/12	22.7		MG/CU.M.	Chlorophyll a
MTL-15	8/28/12	3.4		MG/CU.M.	Chlorophyll a
MTL-22	5/24/12	14.0		MG/CU.M.	Chlorophyll a
MTL-22	6/27/12	12.7		MG/CU.M.	Chlorophyll a
MTL-22	8/28/12	2.0	<	MG/CU.M.	Chlorophyll a
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Site	Date	Result	Qualifier	Units	Parameter
MTL-33	5/24/12	7.6		MG/CU.M.	Chlorophyll a
MTL-33	6/27/12	13.9		MG/CU.M.	Chlorophyll a
MTL-33	8/28/12	2.0	<	MG/CU.M.	Chlorophyll a
MTL-66	5/24/12	7.6		MG/CU.M.	Chlorophyll a
MTL-66	6/27/12	25.5		MG/CU.M.	Chlorophyll a
MTL-66	8/28/12	2.6		MG/CU.M.	Chlorophyll a
MTL-77	5/24/12	3.2		MG/CU.M.	Chlorophyll a
MTL-77	6/27/12	13.6		MG/CU.M.	Chlorophyll a
MTL-77	8/28/12	3.1		MG/CU.M.	Chlorophyll a
MTL-1	5/24/12	0.20	<	UG/L	Chloropyrifos
MTL-1	6/27/12	0.20	<	UG/L	Chloropyrifos
MTL-1	8/28/12	0.20	<	UG/L	Chloropyrifos
MTL-11	5/24/12	0.20	<	UG/L	Chloropyrifos
MTL-11	6/27/12	0.20	<	UG/L	Chloropyrifos
MTL-11	8/28/12	0.20	<	UG/L	Chloropyrifos
MTL-12	5/24/12	0.20	<	UG/L	Chloropyrifos
MTL-12	6/27/12	0.20	<	UG/L	Chloropyrifos
MTL-15	5/24/12	0.20	<	UG/L	Chloropyrifos
MTL-15	6/27/12	0.20	<	UG/L	Chloropyrifos
MTL-15	8/28/12	0.20	<	UG/L	Chloropyrifos
MTL-22	5/24/12	0.20	<	UG/L	Chloropyrifos
MTL-22	6/27/12	0.20	<	UG/L	Chloropyrifos
MTL-22	8/28/12	0.20	<	UG/L	Chloropyrifos
MTL-33	5/24/12	0.20	<	UG/L	Chloropyrifos
MTL-33	6/27/12	0.20	<	UG/L	Chloropyrifos
MTL-33	8/28/12	0.20	<	UG/L	Chloropyrifos
MTL-5	5/24/12	0.20	<	UG/L	Chloropyrifos
MTL-5	6/27/12	0.20	<	UG/L	Chloropyrifos
MTL-5	8/28/12	0.20	<	UG/L	Chloropyrifos
MTL-66	5/24/12	0.20	<	UG/L	Chloropyrifos
MTL-66	6/27/12	0.20	<	UG/L	Chloropyrifos
MTL-66	8/28/12	0.20	<	UG/L	Chloropyrifos
MTL-77	5/24/12	0.20	<	UG/L	Chloropyrifos
MTL-77	6/27/12	0.20	<	UG/L	Chloropyrifos
MTL-77	8/28/12	0.20	<	UG/L	Chloropyrifos
MTL-8	5/24/12	0.20	<	UG/L	Chloropyrifos
MTL-8	6/27/12	0.20	<	UG/L	Chloropyrifos
MTL-8	8/28/12	0.20	<	UG/L	Chloropyrifos
MTL-9	5/24/12	0.20	<	UG/L	Chloropyrifos
MTL-9	6/27/12	0.20	<	UG/L	Chloropyrifos
MTL-9	8/28/12	0.20	<	UG/L	Chloropyrifos
MTL-1	5/24/12	0.20	<	UG/L	Cyanazine
MTL-1	6/27/12	0.20	<	UG/L	Cyanazine
MTL-1	8/28/12	0.20	<	UG/L	Cyanazine
MTL-11	5/24/12	0.20	<	UG/L	Cyanazine
MTL-11	6/27/12	0.20	<	UG/L	Cyanazine
MTL-11	8/28/12	0.20	<	UG/L	Cyanazine
MTL-12	5/24/12	0.20	<	UG/L	Cyanazine
MTL-12	6/27/12	0.20	<	UG/L	Cyanazine
MTL-15	5/24/12	0.20	<	UG/L	Cyanazine
MTL-15	6/27/12	0.20	<	UG/L	Cyanazine
MTL-15	8/28/12	0.20	<	UG/L	Cyanazine
MTL-22	5/24/12	0.20	<	UG/L	Cyanazine
MTL-22	6/27/12	0.20	<	UG/L	Cyanazine

Site	Date	Result	Qualifier	Units	Parameter
MTL-22	8/28/12	0.20	<	UG/L	Cyanazine
MTL-33	5/24/12	0.20	<	UG/L	Cyanazine
MTL-33	6/27/12	0.20	<	UG/L	Cyanazine
MTL-33	8/28/12	0.20	<	UG/L	Cyanazine
MTL-5	5/24/12	0.20	<	UG/L	Cyanazine
MTL-5	6/27/12	0.20	<	UG/L	Cyanazine
MTL-5	8/28/12	0.20	<	UG/L	Cyanazine
MTL-66	5/24/12	0.20	<	UG/L	Cyanazine
MTL-66	6/27/12	0.20	<	UG/L	Cyanazine
MTL-66	8/28/12	0.20	<	UG/L	Cyanazine
MTL-77	5/24/12	0.20	<	UG/L	Cyanazine
MTL-77	6/27/12	0.20	<	UG/L	Cyanazine
MTL-77	8/28/12	0.20	<	UG/L	Cyanazine
MTL-8	5/24/12	0.20	<	UG/L	Cyanazine
MTL-8	6/27/12	0.20	<	UG/L	Cyanazine
MTL-8	8/28/12	0.20	<	UG/L	Cyanazine
MTL-9	5/24/12	0.20	<	UG/L	Cyanazine
MTL-9	6/27/12	0.20		UG/L	•
MTL-9	8/28/12	0.20	<	UG/L	Cyanazine
MTL-1	5/24/12	0.43	<	MG/L	Cyanazine Iron
MTL-1	6/27/12	0.42		MG/L	Iron
	8/28/12	0.066		MG/L	-
MTL-1 MTL-12	5/24/12	0.000		MG/L	Iron Iron
MTL-12	6/27/12	0.20		MG/L	
MTL-12	5/24/12	0.18		MG/L	Iron
MTL-22-15	6/27/12	0.44		MG/L	Iron
MTL-22-15	8/28/12			MG/L	Iron
MTL-1	5/24/12	0.050 0.020	<	MG/L	Iron
MTL-1	6/27/12	0.020		MG/L	Manganese
MTL-1	8/28/12	0.054		MG/L	Manganese
MTL-12	5/24/12	0.038		MG/L	Manganese
MTL-12	6/27/12	0.084		MG/L	Manganese
MTL-12	5/24/12	0.015		MG/L	Manganese
MTL-22-15	6/27/12	0.013		MG/L	Manganese Manganese
MTL-22-15	8/28/12	0.020		MG/L	Manganese
MTL-1	5/24/12	0.63		UG/L	Metolachlor
MTL-1	6/27/12	0.49		UG/L	Metolachlor
MTL-1	8/28/12	0.49		UG/L	Metolachlor
MTL-11	5/24/12	0.20	_	UG/L	Metolachlor
MTL-11	6/27/12	4.5	<	UG/L	Metolachlor
MTL-11	8/28/12	0.20	<	UG/L	Metolachlor
MTL-12	5/24/12	0.20	<	UG/L	Metolachlor
MTL-12	6/27/12	0.20	<	UG/L	Metolachlor
MTL-12	5/24/12	0.20	<	UG/L	Metolachlor
MTL-15	6/27/12	0.76		UG/L	Metolachlor
MTL-15	8/28/12	0.20	<	UG/L	Metolachlor
MTL-13	5/24/12	0.20	<	UG/L	Metolachlor
MTL-22	6/27/12	0.51		UG/L	Metolachlor
MTL-22	8/28/12	0.20	<	UG/L	Metolachlor
MTL-33	5/24/12	0.20	`	UG/L	Metolachlor
MTL-33	6/27/12	0.65		UG/L	Metolachlor
MTL-33	8/28/12	0.20	<	UG/L	Metolachlor
MTL-55	5/24/12	1.1	`	UG/L	Metolachlor
MTL-5	6/27/12	2.1		UG/L	Metolachlor
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Site	Date	Result	Qualifier	Units	Parameter
MTL-5	8/28/12	0.20	<	UG/L	Metolachlor
MTL-66	5/24/12	0.62		UG/L	Metolachlor
MTL-66	6/27/12	0.76		UG/L	Metolachlor
MTL-66	8/28/12	0.20	<	UG/L	Metolachlor
MTL-77	5/24/12	0.20	<	UG/L	Metolachlor
MTL-77	6/27/12	0.65		UG/L	Metolachlor
MTL-77	8/28/12	0.03		UG/L	Metolachlor
MTL-8	5/24/12	0.20	<	UG/L	Metolachlor
MTL-8	6/27/12	0.20	<	UG/L	
MTL-8	8/28/12	0.20	<	UG/L UG/L	Metolachlor
MTL-9	5/24/12	0.20	<	UG/L UG/L	Metolachlor Metolachlor
MTL-9	6/27/12	0.20	<	UG/L UG/L	
			<		Metolachlor
MTL-9	8/28/12	0.20	<	UG/L	Metolachlor
MTL-1	5/24/12	0.20	<	UG/L	Metribuzin
MTL-1	6/27/12	0.20	<	UG/L	Metribuzin
MTL-1	8/28/12	0.20	<	UG/L	Metribuzin
MTL-11	5/24/12	0.20	<	UG/L	Metribuzin
MTL-11	6/27/12	0.20	<	UG/L	Metribuzin
MTL-11	8/28/12	0.20	<	UG/L	Metribuzin
MTL-12	5/24/12	0.20	<	UG/L	Metribuzin
MTL-12	6/27/12	0.20	<	UG/L	Metribuzin
MTL-15	5/24/12	0.20	<	UG/L	Metribuzin
MTL-15	6/27/12	0.20	<	UG/L	Metribuzin
MTL-15	8/28/12	0.20	<	UG/L	Metribuzin
MTL-22	5/24/12	0.20	<	UG/L	Metribuzin
MTL-22	6/27/12	0.20	<	UG/L	Metribuzin
MTL-22	8/28/12	0.20	<	UG/L	Metribuzin
MTL-33	5/24/12	0.20	<	UG/L	Metribuzin
MTL-33	6/27/12	0.20	<	UG/L	Metribuzin
MTL-33	8/28/12	0.20	<	UG/L	Metribuzin
MTL-5	5/24/12	0.20	<	UG/L	Metribuzin
MTL-5	6/27/12	0.20	<	UG/L	Metribuzin
MTL-5	8/28/12	0.20	<	UG/L	Metribuzin
MTL-66	5/24/12	0.20	<	UG/L	Metribuzin
MTL-66	6/27/12	0.20	<	UG/L	Metribuzin
MTL-66	8/28/12	0.20	<	UG/L	Metribuzin
MTL-77	5/24/12	0.20	<	UG/L	Metribuzin
MTL-77	6/27/12	0.20		UG/L	Metribuzin
MTL-77	8/28/12	0.20	<	UG/L	Metribuzin
MTL-8	5/24/12	0.20	<	UG/L	Metribuzin
MTL-8	6/27/12	0.20	<	UG/L	Metribuzin
			<		
MTL-8	8/28/12	0.20	<	UG/L	Metribuzin
MTL-9	5/24/12	0.20	<	UG/L	Metribuzin
MTL-9	6/27/12	0.20	<	UG/L	Metribuzin
MTL-9	8/28/12	0.20	<	UG/L	Metribuzin
MTL-1	5/24/12	0.77		MG/L	Nitrate as Nitrogen
MTL-1	6/27/12	0.65		MG/L	Nitrate as Nitrogen
MTL-1	8/28/12	0.10		MG/L	Nitrate as Nitrogen
MTL-11	5/24/12	0.033		MG/L	Nitrate as Nitrogen
MTL-11	6/27/12	0.020	<	MG/L	Nitrate as Nitrogen
MTL-11	8/28/12	0.022		MG/L	Nitrate as Nitrogen
MTL-12	5/24/12	0.68		MG/L	Nitrate as Nitrogen
MTL-12	6/27/12	0.40		MG/L	Nitrate as Nitrogen
MTL-15	5/24/12	1.2		MG/L	Nitrate as Nitrogen

Site	Date	Result	Qualifier	Units	Parameter
MTL-15	6/27/12	0.62		MG/L	Nitrate as Nitrogen
MTL-15	8/28/12	0.020	<	MG/L	Nitrate as Nitrogen
MTL-22	5/24/12	0.71		MG/L	Nitrate as Nitrogen
MTL-22	6/27/12	0.57		MG/L	Nitrate as Nitrogen
MTL-22	8/28/12	0.020	<	MG/L	Nitrate as Nitrogen
MTL-22-15	5/24/12	0.73		MG/L	Nitrate as Nitrogen
MTL-22-15	6/27/12	0.73		MG/L	Nitrate as Nitrogen
MTL-22-15	8/28/12	0.044		MG/L	Nitrate as Nitrogen
MTL-33	5/24/12	0.70		MG/L	Nitrate as Nitrogen
MTL-33	6/27/12	0.52		MG/L	Nitrate as Nitrogen
MTL-33	8/28/12	0.028		MG/L	Nitrate as Nitrogen
MTL-5	5/24/12	0.020	<	MG/L	Nitrate as Nitrogen
MTL-5	6/27/12	0.20		MG/L	Nitrate as Nitrogen
MTL-5	8/28/12	0.032		MG/L	Nitrate as Nitrogen
MTL-66	5/24/12	1.1		MG/L	Nitrate as Nitrogen
MTL-66	6/27/12	0.60		MG/L	Nitrate as Nitrogen
MTL-66	8/28/12	0.020	<	MG/L	Nitrate as Nitrogen
MTL-77	5/24/12	1.3		MG/L	Nitrate as Nitrogen
MTL-77	6/27/12	0.58		MG/L	Nitrate as Nitrogen
MTL-77	8/28/12	0.040		MG/L	Nitrate as Nitrogen
MTL-8	5/24/12	0.020	<	MG/L	Nitrate as Nitrogen
MTL-8	6/27/12	0.020	<	MG/L	Nitrate as Nitrogen
MTL-8	8/28/12	0.028		MG/L	Nitrate as Nitrogen
MTL-9	5/24/12	0.020	<	MG/L	Nitrate as Nitrogen
MTL-9	6/27/12	0.020	<	MG/L	Nitrate as Nitrogen
MTL-9	8/28/12	0.023		MG/L	Nitrate as Nitrogen
MTL-1	5/24/12	0.20	<	UG/L	Pendimethalin
MTL-1	6/27/12	0.20	<	UG/L	Pendimethalin
MTL-1	8/28/12	0.20	<	UG/L	Pendimethalin
MTL-11	5/24/12	0.20	<	UG/L	Pendimethalin
MTL-11	6/27/12	0.20	<	UG/L	Pendimethalin
MTL-11	8/28/12	0.20	<	UG/L	Pendimethalin
MTL-12	5/24/12	0.20	<	UG/L	Pendimethalin
MTL-12	6/27/12	0.20	<	UG/L	Pendimethalin
MTL-15	5/24/12	0.20	<	UG/L	Pendimethalin
MTL-15	6/27/12	0.20	<	UG/L	Pendimethalin
MTL-15	8/28/12	0.20	<	UG/L	Pendimethalin
MTL-22	5/24/12	0.20	<	UG/L	Pendimethalin
MTL-22	6/27/12	0.20	<	UG/L	Pendimethalin
MTL-22	8/28/12	0.20	<	UG/L	Pendimethalin
MTL-33	5/24/12	0.20	<	UG/L	Pendimethalin
MTL-33	6/27/12	0.20	<	UG/L	Pendimethalin
MTL-33	8/28/12	0.20	<	UG/L	Pendimethalin
MTL-5	5/24/12	0.20	<	UG/L	Pendimethalin
MTL-5	6/27/12	0.20	<	UG/L	Pendimethalin
MTL-5	8/28/12	0.20	<	UG/L	Pendimethalin
MTL-66	5/24/12	0.20	<	UG/L	Pendimethalin
MTL-66	6/27/12	0.20	<	UG/L	Pendimethalin
MTL-66	8/28/12	0.20	<	UG/L	Pendimethalin
MTL-77	5/24/12	0.20	<	UG/L	Pendimethalin
MTL-77	6/27/12	0.20	<	UG/L	Pendimethalin
MTL-77	8/28/12	0.20	<	UG/L	Pendimethalin
MTL-8	5/24/12	0.20	<	UG/L	Pendimethalin
MTL-8	6/27/12	0.20	<	UG/L	Pendimethalin
IVIILU	0/21/12	0.20	`	30/L	1 GIGIII GII III

Site	Date	Result	Qualifier	Units	Parameter
MTL-8	8/28/12	0.20	<	UG/L	Pendimethalin
MTL-9	5/24/12	0.20	<	UG/L	Pendimethalin
MTL-9	6/27/12	0.20	<	UG/L	Pendimethalin
MTL-9	8/28/12	0.20	<	UG/L	Pendimethalin
MTL-15	5/24/12	2.0	<	MG/CU.M.	Pheophytin a
MTL-15	6/27/12	2.5		MG/CU.M.	Pheophytin a
MTL-15	8/28/12	2.0	<	MG/CU.M.	Pheophytin a
MTL-22	5/24/12	2.0	<	MG/CU.M.	Pheophytin a
MTL-22	6/27/12	2.0	<	MG/CU.M.	Pheophytin a
MTL-22	8/28/12	2.0	<	MG/CU.M.	Pheophytin a
MTL-33	5/24/12	2.0	<	MG/CU.M.	Pheophytin a
MTL-33	6/27/12	2.6		MG/CU.M.	Pheophytin a
MTL-33	8/28/12	2.0	<	MG/CU.M.	Pheophytin a
MTL-66	5/24/12	2.0	<	MG/CU.M.	Pheophytin a
MTL-66	6/27/12	2.2		MG/CU.M.	Pheophytin a
MTL-66	8/28/12	2.0	<	MG/CU.M.	Pheophytin a
MTL-77	5/24/12	2.0	<	MG/CU.M.	Pheophytin a
MTL-77	6/27/12	2.0	<	MG/CU.M.	Pheophytin a
MTL-77	8/28/12	2.0	<	MG/CU.M.	Pheophytin a
MTL-1	5/24/12	0.073		MG/L	Phosphorus
MTL-1	6/27/12	0.030		MG/L	Phosphorus
MTL-1	8/28/12	0.026		MG/L	Phosphorus
MTL-11	5/24/12	0.24		MG/L	Phosphorus
MTL-11	6/27/12	0.20		MG/L	Phosphorus
MTL-11	8/28/12	0.12		MG/L	Phosphorus
MTL-12	5/24/12	0.073		MG/L	Phosphorus
MTL-12	6/27/12	0.065		MG/L	Phosphorus
MTL-15	5/24/12	0.13		MG/L	Phosphorus
MTL-15	6/27/12	0.065		MG/L	Phosphorus
MTL-15	8/28/12	0.035		MG/L	Phosphorus
MTL-22	5/24/12	0.069		MG/L	Phosphorus
MTL-22	6/27/12	0.039		MG/L	Phosphorus
MTL-22	8/28/12	0.017		MG/L	Phosphorus
MTL-22-15	5/24/12	0.056		MG/L	Phosphorus
MTL-22-15	6/27/12	0.039		MG/L	Phosphorus
MTL-22-15	8/28/12	0.017		MG/L	Phosphorus
MTL-33	5/24/12	0.069		MG/L	Phosphorus
MTL-33	6/27/12	0.047		MG/L	Phosphorus
MTL-33	8/28/12	0.017		MG/L	Phosphorus
MTL-5	5/24/12	0.20		MG/L	Phosphorus
MTL-5	6/27/12	0.27		MG/L	Phosphorus
MTL-5	8/28/12	0.11		MG/L	Phosphorus
MTL-66	5/24/12	0.12		MG/L	Phosphorus
MTL-66	6/27/12	0.069		MG/L	Phosphorus
MTL-66	8/28/12	0.030		MG/L	Phosphorus
MTL-77	5/24/12	0.21		MG/L	Phosphorus
MTL-77	6/27/12	0.065		MG/L	Phosphorus
MTL-77	8/28/12	0.078		MG/L	Phosphorus
MTL-8	5/24/12	0.065		MG/L	Phosphorus
MTL-8	6/27/12	0.086		MG/L	Phosphorus
MTL-8	8/28/12	0.074		MG/L	Phosphorus
MTL-9	5/24/12	0.12		MG/L	Phosphorus
MTL-9	6/27/12	0.099		MG/L	Phosphorus
MTL-9	8/28/12	0.078		MG/L	Phosphorus

Site	Date	Result	Qualifier	Units	Parameter
MTL-1	5/24/12	0.011		MG/L	Phosphorus, -ortho
MTL-1	6/27/12	0.010	<	MG/L	Phosphorus, -ortho
MTL-1	8/28/12	0.010	<	MG/L	Phosphorus, -ortho
MTL-11	5/24/12	0.019		MG/L	Phosphorus, -ortho
MTL-11	6/27/12	0.010	<	MG/L	Phosphorus, -ortho
MTL-11	8/28/12	0.010	<	MG/L	Phosphorus, -ortho
MTL-12	5/24/12	0.016		MG/L	Phosphorus, -ortho
MTL-12	6/27/12	0.010	<	MG/L	Phosphorus, -ortho
MTL-15	5/24/12	0.055		MG/L	Phosphorus, -ortho
MTL-15	6/27/12	0.010	<	MG/L	Phosphorus, -ortho
MTL-15	8/28/12	0.010	<	MG/L	Phosphorus, -ortho
MTL-22	5/24/12	0.011		MG/L	Phosphorus, -ortho
MTL-22	6/27/12	0.010	<	MG/L	Phosphorus, -ortho
MTL-22	8/28/12	0.010	<	MG/L	Phosphorus, -ortho
MTL-22-15	5/24/12	0.011		MG/L	Phosphorus, -ortho
MTL-22-15	6/27/12	0.010	<	MG/L	Phosphorus, -ortho
MTL-22-15	8/28/12	0.010	<	MG/L	Phosphorus, -ortho
MTL-33	5/24/12	0.010	<	MG/L	Phosphorus, -ortho
MTL-33	6/27/12	0.010	<	MG/L	Phosphorus, -ortho
MTL-33	8/28/12	0.010	<	MG/L	Phosphorus, -ortho
MTL-5	5/24/12	0.042		MG/L	Phosphorus, -ortho
MTL-5	6/27/12	0.091		MG/L	Phosphorus, -ortho
MTL-5	8/28/12	0.016		MG/L	Phosphorus, -ortho
MTL-66	5/24/12	0.052		MG/L	Phosphorus, -ortho
MTL-66	6/27/12	0.010	<	MG/L	Phosphorus, -ortho
MTL-66	8/28/12	0.010	<	MG/L	Phosphorus, -ortho
MTL-77	5/24/12	0.10		MG/L	Phosphorus, -ortho
MTL-77	6/27/12	0.010	<	MG/L	Phosphorus, -ortho
MTL-77	8/28/12	0.010	<	MG/L	Phosphorus, -ortho
MTL-8	5/24/12	0.010	<	MG/L	Phosphorus, -ortho
MTL-8	6/27/12	0.018		MG/L	Phosphorus, -ortho
MTL-8	8/28/12	0.047		MG/L	Phosphorus, -ortho
MTL-9	5/24/12	0.014		MG/L	Phosphorus, -ortho
MTL-9	6/27/12	0.026		MG/L	Phosphorus, -ortho
MTL-9	8/28/12	0.010	<	MG/L	Phosphorus, -ortho
MTL-1	5/24/12	6.6		MG/L	Solids, Total Suspended
MTL-1	6/27/12	2.5		MG/L	Solids, Total Suspended
MTL-1	8/28/12	2.9		MG/L	Solids, Total Suspended
MTL-11	5/24/12	53.2		MG/L	Solids, Total Suspended
MTL-11	6/27/12	24.7		MG/L	Solids, Total Suspended
MTL-11	8/28/12	15.8		MG/L	Solids, Total Suspended
MTL-12	5/24/12	8.8		MG/L	Solids, Total Suspended
MTL-12	6/27/12	6.0		MG/L	Solids, Total Suspended
MTL-15	5/24/12	7.4		MG/L	Solids, Total Suspended
MTL-15	6/27/12	8.0		MG/L	Solids, Total Suspended
MTL-15	8/28/12	4.7		MG/L	Solids, Total Suspended
MTL-22	5/24/12	6.6		MG/L	Solids, Total Suspended
MTL-22	6/27/12	4.1		MG/L	Solids, Total Suspended
MTL-22	8/28/12	2.6		MG/L	Solids, Total Suspended
MTL-22-15	5/24/12	7.4		MG/L	Solids, Total Suspended
MTL-22-15	6/27/12	4.5		MG/L	Solids, Total Suspended
MTL-22-15	8/28/12	2.8		MG/L	Solids, Total Suspended
MTL-33	5/24/12	7.1		MG/L	Solids, Total Suspended
MTL-33	6/27/12	4.8		MG/L	Solids, Total Suspended

Site	Date	Result	Qualifier	Units	Parameter
MTL-33	8/28/12	3.2	- Cuaiiiioi	MG/L	Solids, Total Suspended
MTL-5	5/24/12	19.4		MG/L	Solids, Total Suspended
MTL-5	6/27/12	26.7		MG/L	Solids, Total Suspended
MTL-5	8/28/12	18.6		MG/L	Solids, Total Suspended
MTL-66	5/24/12	7.9		MG/L	Solids, Total Suspended
MTL-66	6/27/12	8.1		MG/L	Solids, Total Suspended
MTL-66	8/28/12	5.0		MG/L	Solids, Total Suspended
MTL-77	5/24/12	8.2		MG/L	Solids, Total Suspended
MTL-77	6/27/12	6.5		MG/L	Solids, Total Suspended
MTL-77	8/28/12	5.1		MG/L	Solids, Total Suspended
MTL-8	5/24/12	7.1		MG/L	Solids, Total Suspended
MTL-8	6/27/12	6.0		MG/L	Solids, Total Suspended
MTL-8	8/28/12	2.9		MG/L	Solids, Total Suspended
MTL-9	5/24/12	25.4		MG/L	Solids, Total Suspended
					-
MTL-9	6/27/12	11.8		MG/L	Solids, Total Suspended
MTL-9	8/28/12	8.4		MG/L	Solids, Total Suspended
MTL-1	5/24/12	2.0	<	MG/L	Solids, Volatile Suspended
MTL-1	6/27/12	1.0	<	MG/L	Solids, Volatile Suspended
MTL-1	8/28/12	2.2	<	MG/L	Solids, Volatile Suspended
MTL-11	5/24/12	10.0		MG/L	Solids, Volatile Suspended
MTL-11	6/27/12	8.0		MG/L	Solids, Volatile Suspended
MTL-11	8/28/12	4.6		MG/L	Solids, Volatile Suspended
MTL-12	5/24/12	1.8		MG/L	Solids, Volatile Suspended
MTL-12	6/27/12	2.2		MG/L	Solids, Volatile Suspended
MTL-15	5/24/12	1.9		MG/L	Solids, Volatile Suspended
MTL-15	6/27/12	3.8		MG/L	Solids, Volatile Suspended
MTL-15	8/28/12	2.9		MG/L	Solids, Volatile Suspended
MTL-22	5/24/12	2.4		MG/L	Solids, Volatile Suspended
MTL-22	6/27/12	2.6		MG/L	Solids, Volatile Suspended
MTL-22	8/28/12	1.9		MG/L	Solids, Volatile Suspended
MTL-22-15	5/24/12	1.9		MG/L	Solids, Volatile Suspended
MTL-22-15	6/27/12	2.0		MG/L	Solids, Volatile Suspended
MTL-22-15	8/28/12	1.7		MG/L	Solids, Volatile Suspended
MTL-33	5/24/12	1.7		MG/L	Solids, Volatile Suspended
MTL-33	6/27/12	2.8		MG/L	Solids, Volatile Suspended
MTL-33	8/28/12	2.3		MG/L	Solids, Volatile Suspended
MTL-5	5/24/12	4.6		MG/L	Solids, Volatile Suspended
MTL-5	6/27/12	8.0		MG/L	Solids, Volatile Suspended
MTL-5	8/28/12	4.4		MG/L	Solids, Volatile Suspended
MTL-66	5/24/12	1.7		MG/L	Solids, Volatile Suspended
MTL-66	6/27/12	4.0		MG/L	Solids, Volatile Suspended
MTL-66	8/28/12	3.0		MG/L	Solids, Volatile Suspended
MTL-77	5/24/12	1.2		MG/L	Solids, Volatile Suspended
MTL-77	6/27/12	2.5		MG/L	Solids, Volatile Suspended
MTL-77	8/28/12	3.1		MG/L	Solids, Volatile Suspended
MTL-8	5/24/12	2.3		MG/L	Solids, Volatile Suspended
		1.3		MG/L	-
MTL-8	6/27/12			MG/L	Solids, Volatile Suspended
MTL-8	8/28/12	1.4	<		Solids, Volatile Suspended
MTL-9	5/24/12	6.0		MG/L	Solids, Volatile Suspended
MTL-9	6/27/12	2.8		MG/L	Solids, Volatile Suspended
MTL-9	8/28/12	3.0		MG/L	Solids, Volatile Suspended
MTL-1	5/24/12	8.7		MG/L	Total Organic Carbon
MTL-1	6/27/12	6.2		MG/L	Total Organic Carbon
MTL-1	8/28/12	6.6		MG/L	Total Organic Carbon
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Site Date Result Qualifier Units Parameter MTL-11 5/24/12 9.5 MG/L Total Organic Carb MTL-11 6/27/12 6.9 MG/L Total Organic Carb MTL-11 8/28/12 7.4 MG/L Total Organic Carb MTL-12 5/24/12 9.7 MG/L Total Organic Carb MTL-12 6/27/12 6.6 MG/L Total Organic Carb MTL-15 5/24/12 10.2 MG/L Total Organic Carb MTL-15 6/27/12 7.2 MG/L Total Organic Carb MTL-15 8/28/12 6.9 MG/L Total Organic Carb MTL-22 5/24/12 8.7 MG/L Total Organic Carb MTL-22 6/27/12 7.0 MG/L Total Organic Carb MTL-22 8/28/12 7.0 MG/L Total Organic Carb MTL-22-15 5/24/12 8.8 MG/L Total Organic Carb MTL-22-15 5/24/12 8.8 MG/L	oon oon oon oon oon oon oon oon oon
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MTL-12 6/27/12 6.6 MG/L Total Organic Carb MTL-15 5/24/12 10.2 MG/L Total Organic Carb MTL-15 6/27/12 7.2 MG/L Total Organic Carb MTL-15 8/28/12 6.9 MG/L Total Organic Carb MTL-22 5/24/12 8.7 MG/L Total Organic Carb MTL-22 6/27/12 7.0 MG/L Total Organic Carb MTL-22 8/28/12 7.0 MG/L Total Organic Carb MTL-21 5/24/12 8.8 MG/L Total Organic Carb MTL-22-15 5/24/12 8.8 MG/L Total Organic Carb	oon oon oon oon oon oon oon
MTL-15 5/24/12 10.2 MG/L Total Organic Carb MTL-15 6/27/12 7.2 MG/L Total Organic Carb MTL-15 8/28/12 6.9 MG/L Total Organic Carb MTL-22 5/24/12 8.7 MG/L Total Organic Carb MTL-22 6/27/12 7.0 MG/L Total Organic Carb MTL-22 8/28/12 7.0 MG/L Total Organic Carb MTL-22-15 5/24/12 8.8 MG/L Total Organic Carb	oon oon oon oon oon oon
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MTL-15 8/28/12 6.9 MG/L Total Organic Carb MTL-22 5/24/12 8.7 MG/L Total Organic Carb MTL-22 6/27/12 7.0 MG/L Total Organic Carb MTL-22 8/28/12 7.0 MG/L Total Organic Carb MTL-22-15 5/24/12 8.8 MG/L Total Organic Carb	oon oon oon oon oon
MTL-22 5/24/12 8.7 MG/L Total Organic Carb MTL-22 6/27/12 7.0 MG/L Total Organic Carb MTL-22 8/28/12 7.0 MG/L Total Organic Carb MTL-22-15 5/24/12 8.8 MG/L Total Organic Carb MG/L Total Organic Carb Total Organic Carb Total Organic Carb	oon oon oon oon oon
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MTL-33 8/28/12 6.9 MG/L Total Organic Carb	
MTL-5 5/24/12 9.6 MG/L Total Organic Carb	
MTL-5 6/27/12 6.8 MG/L Total Organic Carb	
MTL-5 8/28/12 9.3 MG/L Total Organic Carb	
MTL-66 5/24/12 9.3 MG/L Total Organic Carb	
MTL-66 6/27/12 7.4 MG/L Total Organic Carb	
MTL-66 8/28/12 7.0 MG/L Total Organic Carb	
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MTL-77 6/27/12 8.0 MG/L Total Organic Carb	
MTL-77 8/28/12 6.7 MG/L Total Organic Carb	
MTL-8 5/24/12 8.7 MG/L Total Organic Carb	
MTL-8 6/27/12 7.9 MG/L Total Organic Carb	
MTL-8 8/28/12 10.2 MG/L Total Organic Carb	
MTL-9 5/24/12 10.0 MG/L Total Organic Carb	
MTL-9 6/27/12 6.7 MG/L Total Organic Carb	
MTL-9 8/28/12 7.9 MG/L Total Organic Carb	on
MTL-1 5/24/12 0.20 < UG/L Trifluralin	
MTL-1 6/27/12 0.20 < UG/L Trifluralin	
MTL-1 8/28/12 0.20 < UG/L Trifluralin	
MTL-11 5/24/12 0.20 < UG/L Trifluralin	
MTL-11 6/27/12 0.20 < UG/L Trifluralin	
MTL-11 8/28/12 0.20 < UG/L Trifluralin	
MTL-12 5/24/12 0.20 < UG/L Trifluralin	
MTL-12 6/27/12 0.20 < UG/L Trifluralin	
MTL-15 5/24/12 0.20 < UG/L Trifluralin	
MTL-15 6/27/12 0.20 < UG/L Trifluralin	
MTL-15 8/28/12 0.20 < UG/L Trifluralin	
MTL-22 5/24/12 0.20 < UG/L Trifluralin	
MTL-22 6/27/12 0.20 < UG/L Trifluralin	
MTL-22 8/28/12 0.20 < UG/L Trifluralin	
MTL-33 5/24/12 0.20 < UG/L Trifluralin	
MTL-33 6/27/12 0.20 < UG/L Trifluralin	
MTL-33 8/28/12 0.20 < UG/L Trifluralin	
MTL-5 5/24/12 0.20 < UG/L Trifluralin	
MTL-5 6/27/12 0.20 < UG/L Trifluralin	
MTL-5 8/28/12 0.20 < UG/L Trifluralin	
MTL-66 5/24/12 0.20 < UG/L Trifluralin	
MTL-66 6/27/12 0.20 < UG/L Trifluralin	

Site	Date	Result	Qualifier	Units	Parameter
MTL-66	8/28/12	0.20	<	UG/L	Trifluralin
MTL-77	5/24/12	0.20	<	UG/L	Trifluralin
MTL-77	6/27/12	0.20	<	UG/L	Trifluralin
MTL-77	8/28/12	0.20	<	UG/L	Trifluralin
MTL-8	5/24/12	0.20	<	UG/L	Trifluralin
MTL-8	6/27/12	0.20	<	UG/L	Trifluralin
MTL-8	8/28/12	0.20	<	UG/L	Trifluralin
MTL-9	5/24/12	0.20	<	UG/L	Trifluralin
MTL-9	6/27/12	0.20	<	UG/L	Trifluralin
MTL-9	8/28/12	0.20	<	UG/L	Trifluralin

 $U\ Analyte\ was\ not\ detected\\ J\ Estimated\ value\ between\ Method\ Detection\ Limit\ (MDL)\ and\ Practical\ Quantitation\ Limit\ (PQL)$

FIELD DATA

			Water Temp	Redox	Cond		DO			Seechi
Site	Date	Depth	(oC)	(mv)	(uS)	DO %	mg/l	рН	Time	(in)
MTL-1	5/24/12	1	19.21	306	169.2	96.6	8.62	6.49	1000	
MTL-1	6/27/12	1.2	21.92	419	207	42.7	3.71	7.62	946	
MTL-1	8/28/12	0.3	24.48	335	195	83.7	6.89	7.97	904	
MTL-5	5/24/12	0.4	26.99	279	270	135.2	10.7	8.32	1317	
MTL-5	6/27/12	Surveyo	r Not Working						1300	
MTL-5	8/28/12	0.3	24.73	238	191	119	9.76	9.19	1050	
MTL-8	5/24/12	0.9	24.09	284	292	114.8	9.56	7.82	1238	
MTL-8	6/27/12	Surveyo	r Not Working						1230	
MTL-8	8/28/12	0.4	26.83	279	277	4.4	0.35	8.19	1330	
MTL-9	5/24/12	0.4	23.71	279	274	90.2	7.58	7.51	1221	
MTL-9	6/27/12	Surveyo	r Not Working						1206	
MTL-9	8/28/12	0.4	25.7	204	423	102.7	8.25	7.96	1140	
MTL-11	5/24/12	0.7	24.27	277	293	92	7.63	7.12	1158	
MTL-11	6/27/12	Surveyo	r Not Working						1130	
MTL-11	8/28/12	0.3	25.62	284	249	3.9	0.31	7.84	1246	
MTL-12	5/24/12	0.7	21.32	294	171	111.2	9.75	6.92	1132	
MTL-12	6/27/12	0.3	27.54	304	193	9.99	8.78	8.75	1044	
MTL-12	9/10/12	0.1	24.72	317	201	122	10.21	7.86	1040	
MTL-22	5/24/12	1	22.12	258	163	114	9.87	8.6	1254	36
MTL-22	5/24/12	2	21.93	262	163	110.8	9.63	8.47	1255	
MTL-22	5/24/12	3	21.65	309	163	106.5	9.28	8.4	1301	
MTL-22	5/24/12	4	21.56	307	163	104.2	9.12	8.34	1302	
MTL-22	5/24/12	5	21.41	307	163	101	8.87	8.28	1303	
MTL-22	5/24/12	6	21.04	310	163	95.5	8.47	8.13	1304	
MTL-22	5/24/12	7	17.38	328	163	66.2	6.32	7.62	1306	
MTL-22	5/24/12	8	16.13	332	163	62	6.04	7.4	1307	
MTL-22	5/24/12	9	15.95	332	163	60.4	5.9	7.34	1308	
MTL-22	5/24/12	10	16.1	332	163	60.5	5.9	7.27	1309	
MTL-22	5/24/12	11	16.13	331	163	60.9	5.95	7.25	1310	
MTL-22	5/24/12	12	16.02	330	163	65.9	6.45	7.26	1311	
MTL-22	5/24/12	13	15.73	331	161	60	5.98	7.23	1312	
MTL-22	6/27/12	0.3	25.69	338	201	105.2	8.46	8.81	1102	68
MTL-22	6/27/12	1	25.67	339	201	105.6	8.49	8.82	1103	

			Water Temp	Redox	Cond		DO			Seechi
Site	Date	Depth	(oC)	(mv)	(uS)	DO %	mg/l	рН	Time	(in)
MTL-22	6/27/12	2	25.64	341	202	104.7	8.46	8.82	440=	
MTL-22	6/27/12	3	25.56	343	201	103.1	8.32	8.82	1105	
MTL-22	6/27/12	4	25.33	349	202	92.2	7.4	8.7	1106	
MTL-22	6/27/12	5	25.18	352	202	83.9	6.73	8.62	1107	
MTL-22	6/27/12	6	23.32	378	205	35.4	2.81	7.91	1108	
MTL-22	6/27/12	7	21.38	391	205	13.4	1.06	7.66	1109	
MTL-22	6/27/12	8	16.89	396	206	13.1	0.3	6.36	1109	
MTL-22	6/27/12	9	19.81	395	206	5.3	0.56	7.27	1110	
MTL-22	6/27/12	10	13.89	399	205	10.7	1.2	7.2	1110	
MTL-22	6/27/12	11	12.63	402	203	17.7	1.96	7.15	1112	
MTL-22	6/27/12	12	11.74	405	200	21.5	2.31	7.09	1112	
MTL-33	5/24/12	1	21.17	319	163	98.5	8.56	8.29	1033	35
MTL-33	5/24/12	2	19.1	335	165	76	6.82	7.9	1036	
MTL-33	5/24/12	3	18.79	336	164	71.4	6.58	7.78	1037	
MTL-33	5/24/12	4	16.59	343	164	58.9	5.55	7.64	1037	
MTL-33	5/24/12	5	15.78	346	163	57.5	5.69	7.54	1038	
MTL-33	5/24/12	6	15.62	347	163	57.6	5.69	7.46	1039	
MTL-33	5/24/12	7	15.26	348	163	57.6	5.77	7.41	1040	
MTL-33	5/24/12	8	14.31	350	162	57.9	5.89	7.38	1040	
MTL-33	5/24/12	9	13.86	351	159	56.4	5.77	7.35	1041	
MTL-33	5/24/12	10	13.32	352	158	53.8	5.6	7.31	1042	
MTL-33	5/24/12	11	12.46	354	156	51.6	5.41	7.28	1043	
MTL-33	5/24/12	12	11.41	356	154	50.2	5.46	7.23	1044	
MTL-33	5/24/12	13	10.03	359	151	44.3	4.86	7.18	1044	
MTL-33	5/24/12	14	9.21	360	149	45.8	5.26	7.14	1045	
MTL-33	6/27/12	0.3	25.19	379	203	84.4	6.85	8.55	1020	48
MTL-33	6/27/12	1	25.16	378	203	82.2	6.69	8.58	1021	
MTL-33	6/27/12	2	25.06	380	204	75	5.68	8.36	1023	
MTL-33	6/27/12	3	24.26	400	205	45.1	3.71	8.07	1024	
MTL-33	6/27/12	4	23.45	410	206	19.7	1.39	7.8	1025	
MTL-33	6/27/12	5	22.04	417	206	5.2	0.43	7.6	1025	
MTL-33	6/27/12	6	20.8	415	206	2.6	0.23	7.47	1026	
MTL-33	6/27/12	7	18.29	406	208	1.5	0.18	7.32	1026	
MTL-66	5/24/12	1	22.35	316	155	101.8	8.73	8.23	1148	24
MTL-66	5/24/12	2	22.34	317	154	99.8	8.61	8.13	1149	
MTL-66	5/24/12	3	22.21	317	154	98.5	8.48	8.1	1150	

			Water Temp	Redox	Cond		DO			Seechi
Site	Date	Depth	(oC)	(mv)	(uS)	DO %	mg/l	рН	Time	(in)
MTL-66	5/24/12	4	21.6	326	152	87	7.54	7.88	1151	
MTL-66	5/24/12	5	21.45	330	153	82.1	7.18	7.75	1151	
MTL-66	5/24/12	6	21.23	333	153	76.3	6.7	7.62	1152	
MTL-66	5/24/12	7	18.52	346	152	28.7	2.3	7.37	1154	
MTL-66	5/24/12	8	16.1	351	155	13.6	1.3	7.25	1154	
MTL-66	5/24/12	9	14.68	354	159	7.8	0.78	7.14	1155	
MTL-66	5/24/12	10	13.95	355	160	5.6	0.57	7.06	1156	
MTL-66	5/24/12	11	13.14	356	162	5.8	0.6	7.01	1157	
MTL-66	6/27/12	0.3	26.21	330	195	126.7	10.08	8.93	1216	
MTL-66	6/27/12	1	26.29	330	194	127.8	10.18	8.97	1217	
MTL-66	6/27/12	2	25.75	336	196	110.4	8.68	8.8	1218	
MTL-66	6/27/12	3	25.72	341	196	105.3	8.44	8.74	1219	
MTL-66	6/27/12	4	25.55	347	197	95.8	7.61	8.63	1220	
MTL-66	6/27/12	5	25.46	356	198	79.5	6.39	8.47	1220	
MTL-66	6/27/12	6	25.35	375	198	59.8	4.87	8.08	1223	
MTL-66	6/27/12	7	20.97	397	206	7	0.59	7.6	1224	
MTL-66	6/27/12	8	18.2	392	211	2.6	0.23	7.28	1226	
MTL-66	6/27/12	9	15.55	378	213	2.2	0.21	7.19	1227	
MTL-66	6/27/12	10	13.87	372	215	2.1	0.21	7.11	1227	
MTL-77	5/24/12	1	21.7	321	140	75.8	6.62	7.7	1212	14
MTL-77	5/24/12	2	21.61	322	141	75.1	6.56	7.6	1214	
MTL-77	5/24/12	3	21.53	324	142	74.4	6.52	7.55	1215	
MTL-77	5/24/12	4	20.48	328	148	65.4	5.82	7.47	1216	
MTL-77	5/24/12	5	19	333	155	51.1	4.68	7.35	1217	
MTL-77	5/24/12	6	16.42	339	159	37.7	3.6	7.25	1218	
MTL-77	5/24/12	7	15.85	341	161	35.2	3.44	7.18	1219	
MTL-77	5/24/12	8	15.07	342	163	35.4	3.57	7.12	1220	
MTL-77	5/24/12	9	14.2	346	163	23.9	2.36	7.06	1221	
MTL-77	5/24/12	10	13.05	399	165	16	1.67	6.99	1222	
MTL-77	6/27/12	0.3	26.4	335	196	107	8.56	8.9	1155	49
MTL-77	6/27/12	1	26.3	338	195	107	8.52	8.9	1155	
MTL-77	6/27/12	2	26.13	340	196	106.7	8.51	8.89	1156	
MTL-77	6/27/12	3	26.05	341	196	105.2	8.4	8.9	1157	
MTL-77	6/27/12	4	25.94	343	196	101.4	8.1	8.85	1158	
MTL-77	6/27/12	5	25.87	345	196	96.5	7.7	8.82	1159	
MTL-77	6/27/12	6	25.6	355	198	75.4	5.96	8.54	1200	

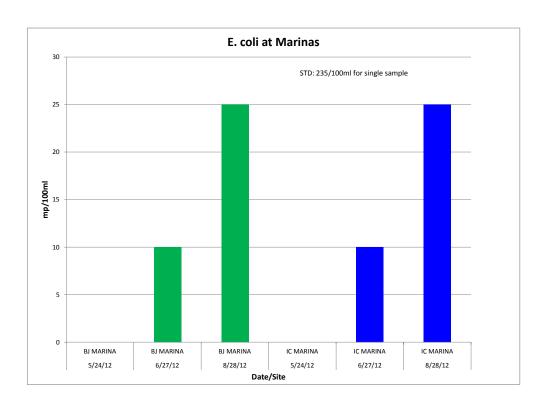
			Water Temp	Redox	Cond		DO			Seechi
Site	Date	Depth	(oC)	(mv)	(uS)	DO %	mg/l	рН	Time	(in)
MTL-77	6/27/12	7	22.56	378	207	19	1.36	7.97	1200	
MTL-77	6/27/12	8	17.42	394	212	4	0.37	7.62	1201	

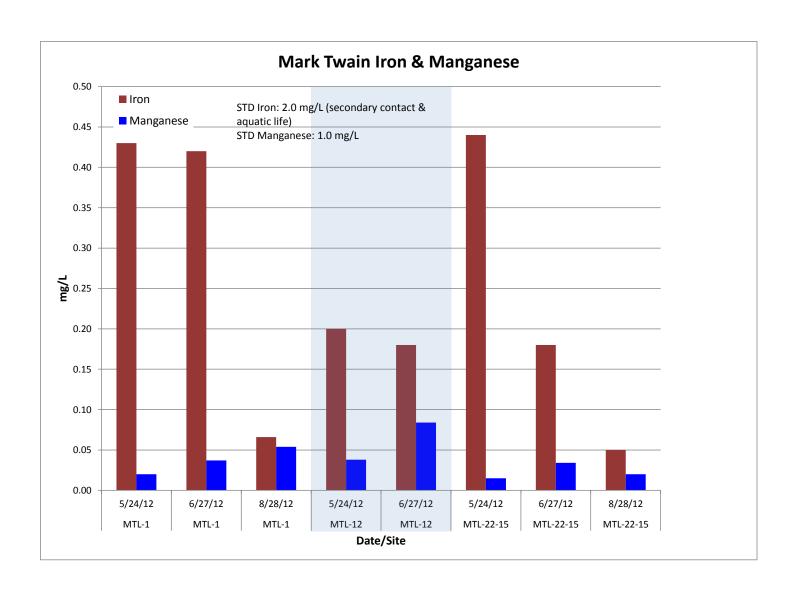
Marina Data

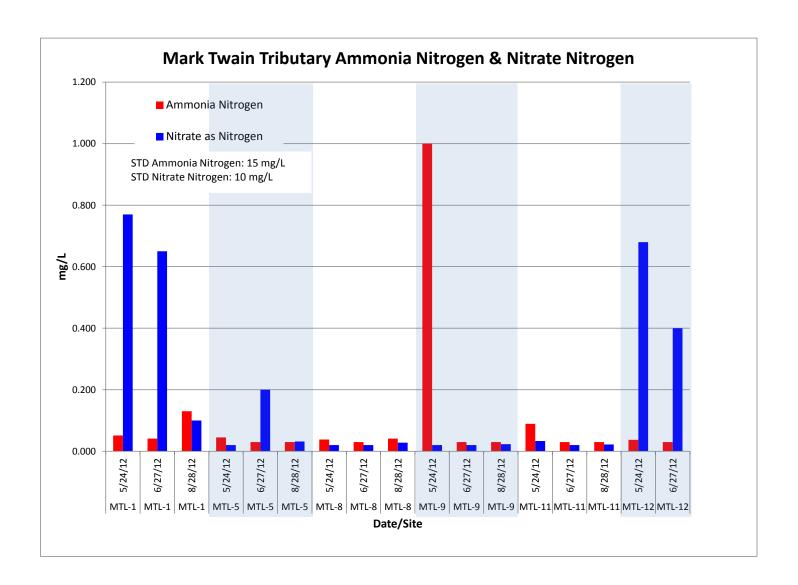
Marina	Date	Result	Qualifier	Units	Parameter
BJ MARINA	5/24/12	NEGATIVE			E. Coliform
BJ MARINA	6/27/12	10.0	<	COL/100 ML	E. Coliform
BJ MARINA	8/28/12	25.0	<	COL/100 ML	E. Coliform
IC MARINA	5/24/12	NEGATIVE			E. Coliform
IC MARINA	6/27/12	10.0	<	COL/100 ML	E. Coliform
IC MARINA	8/28/12	25.0	<	COL/100 ML	E. Coliform

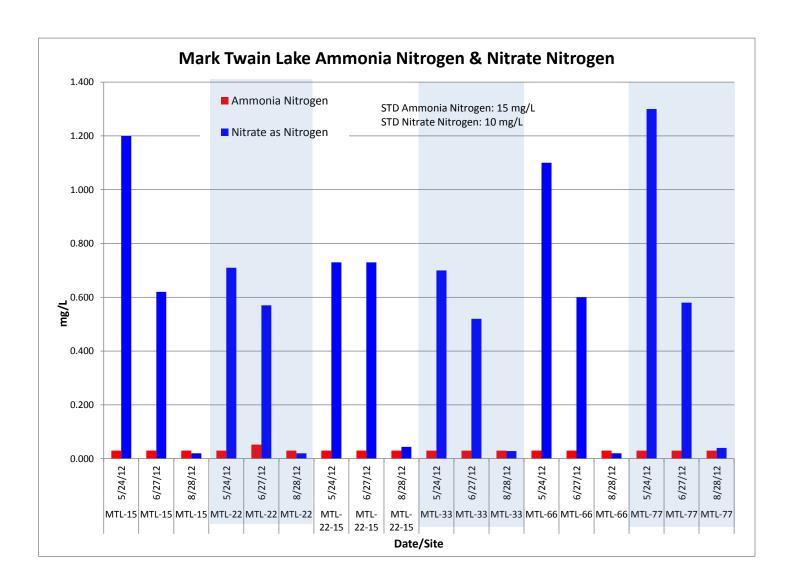
APPENDIX B

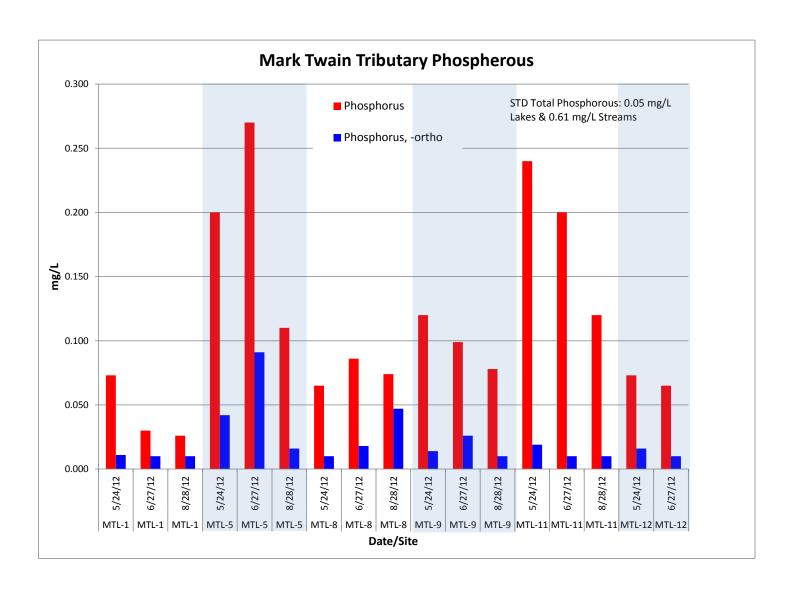
LAB DATA GRAPHS

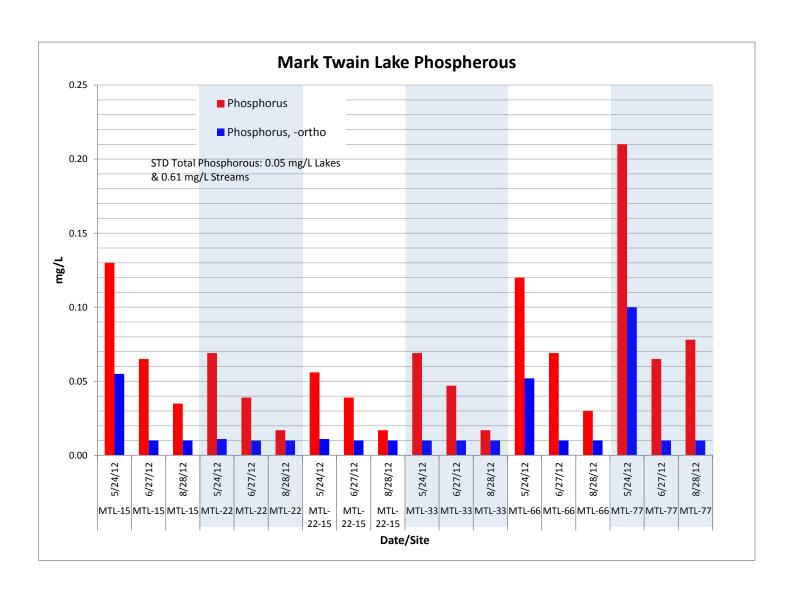


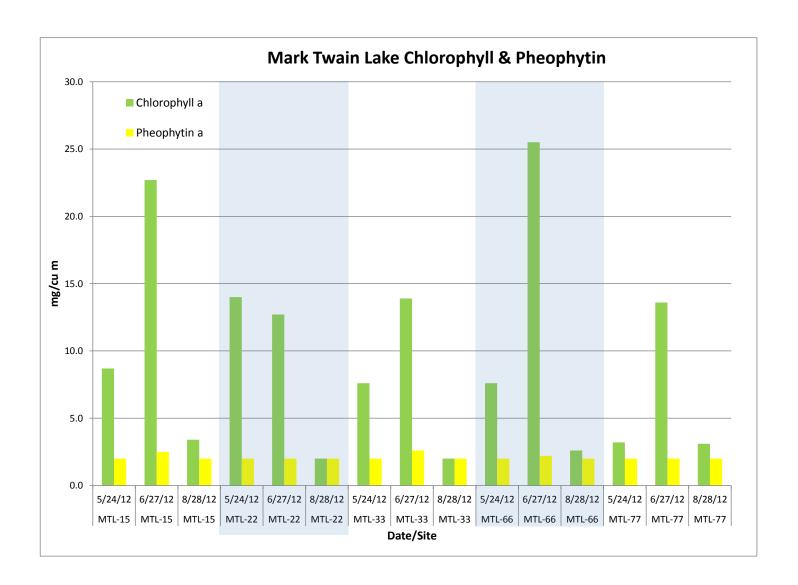


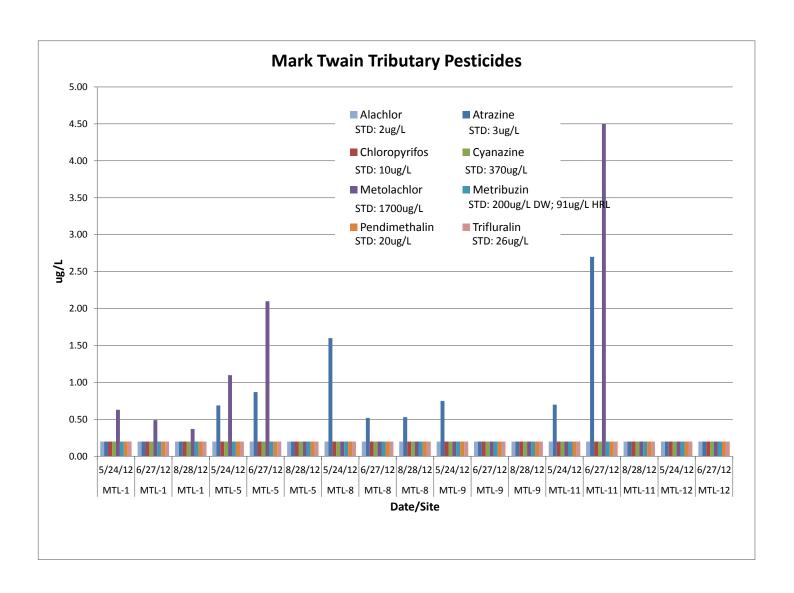


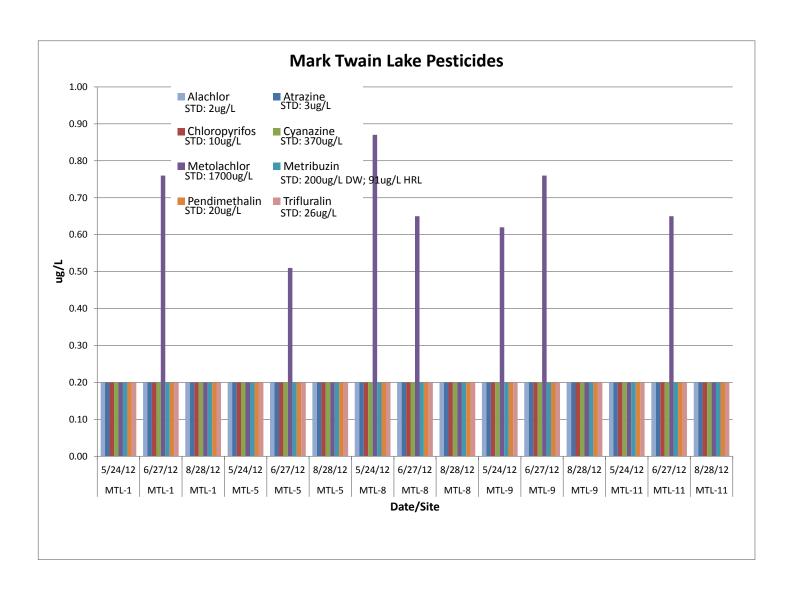


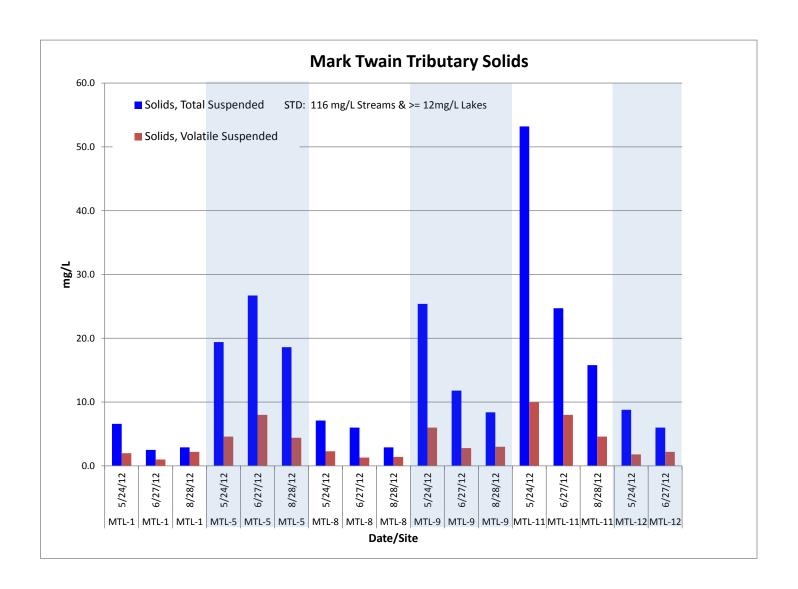


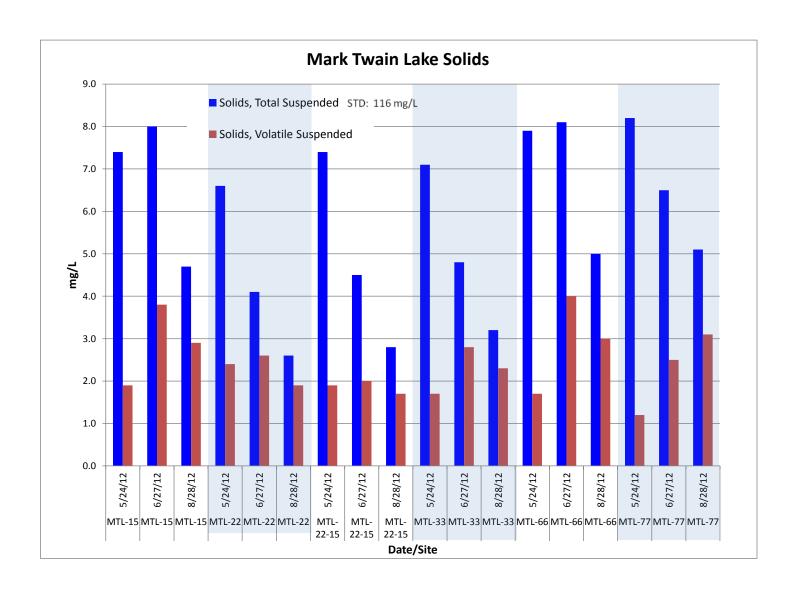


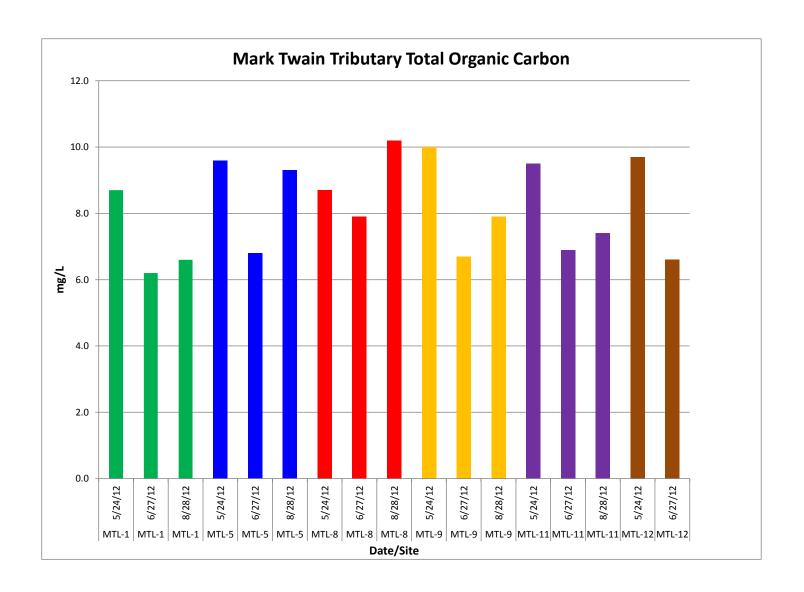


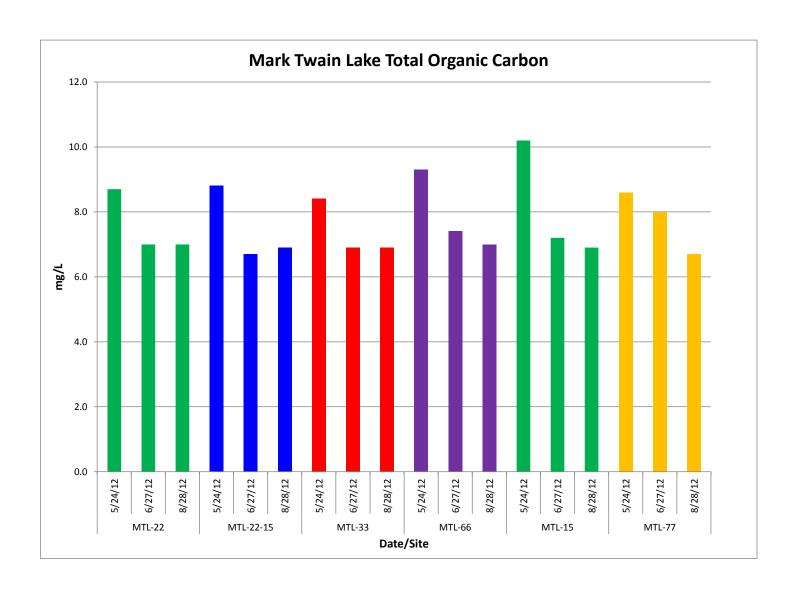






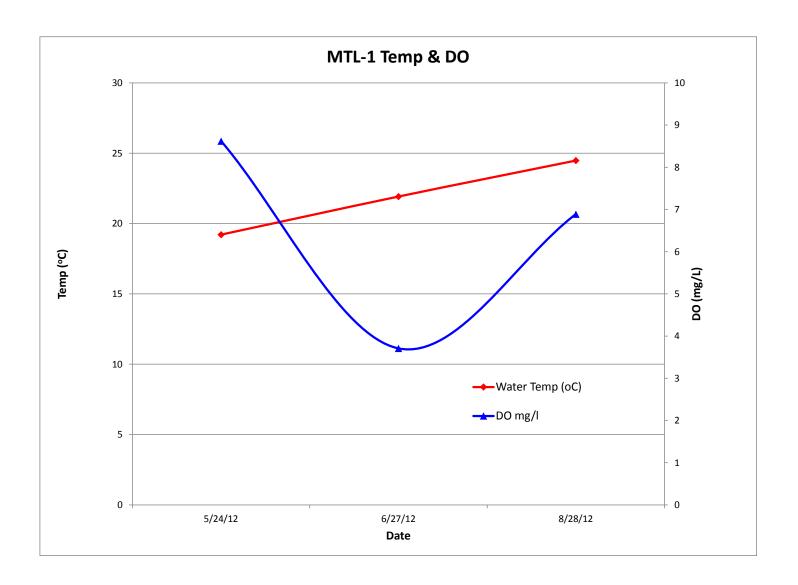


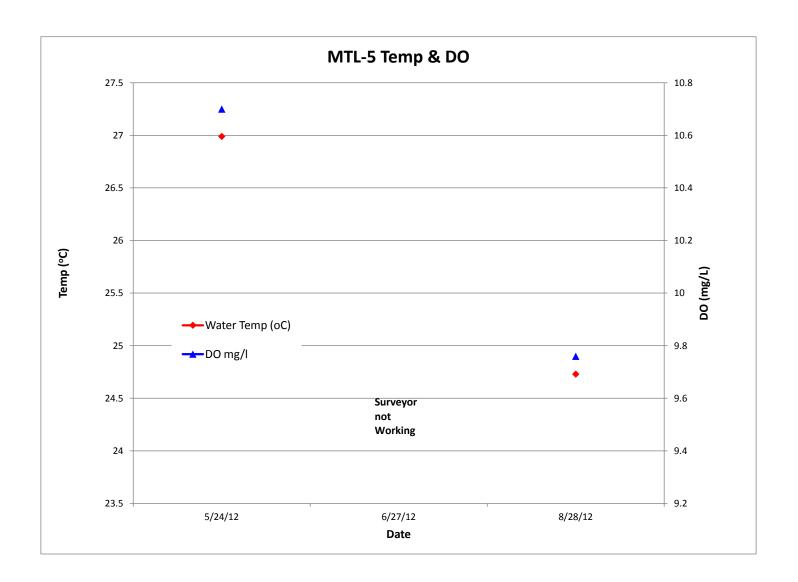


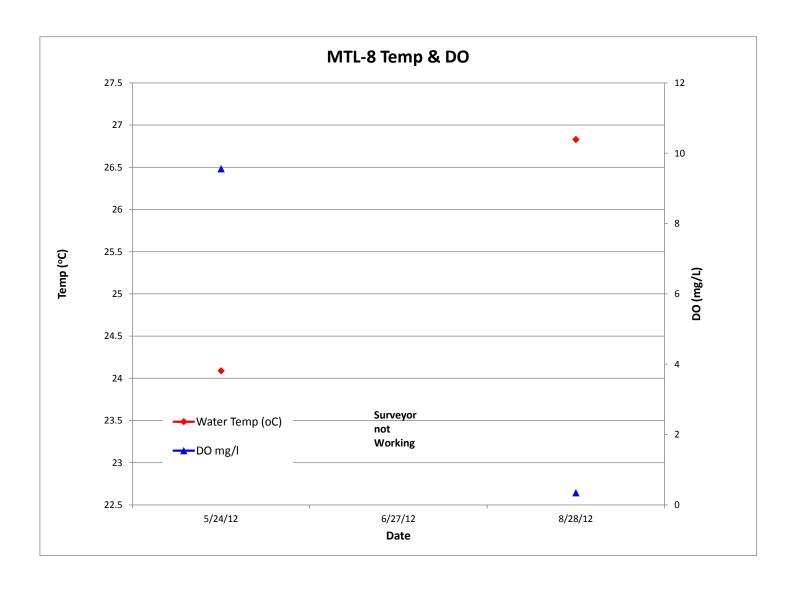


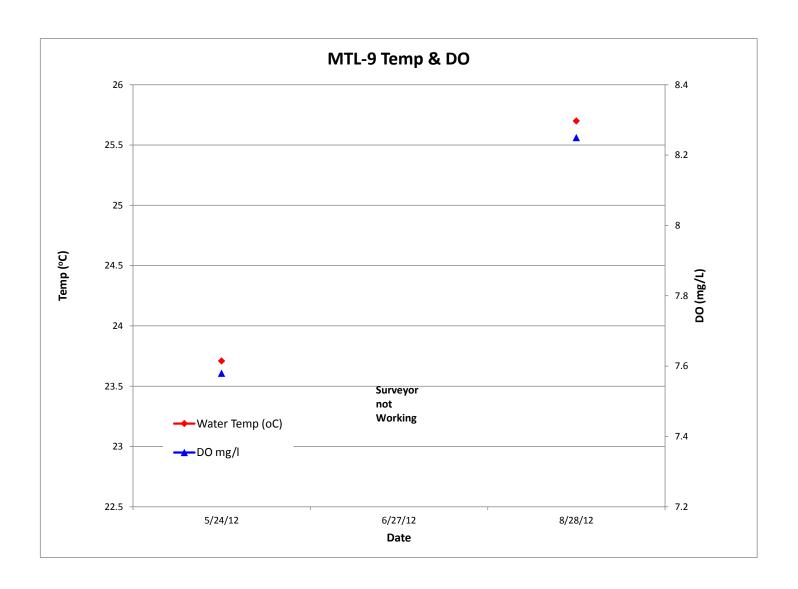
APPENDIX C

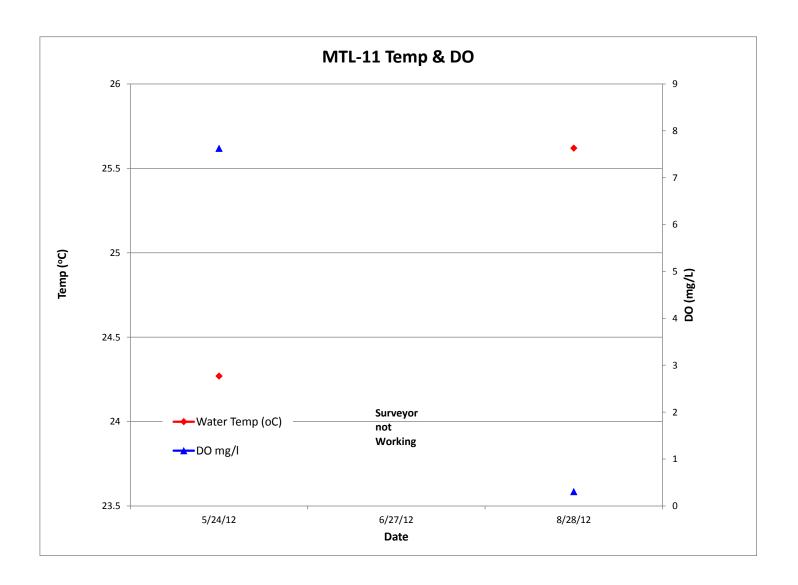
FIELD DATA GRAPHS

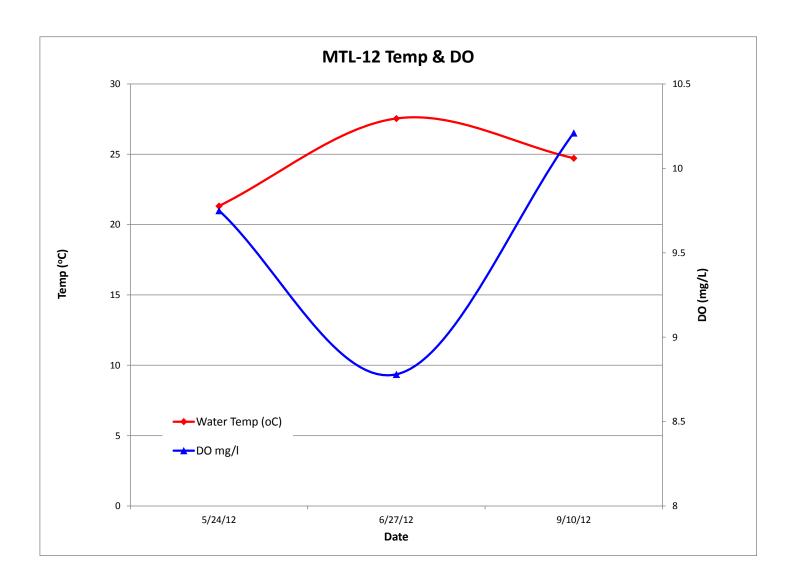




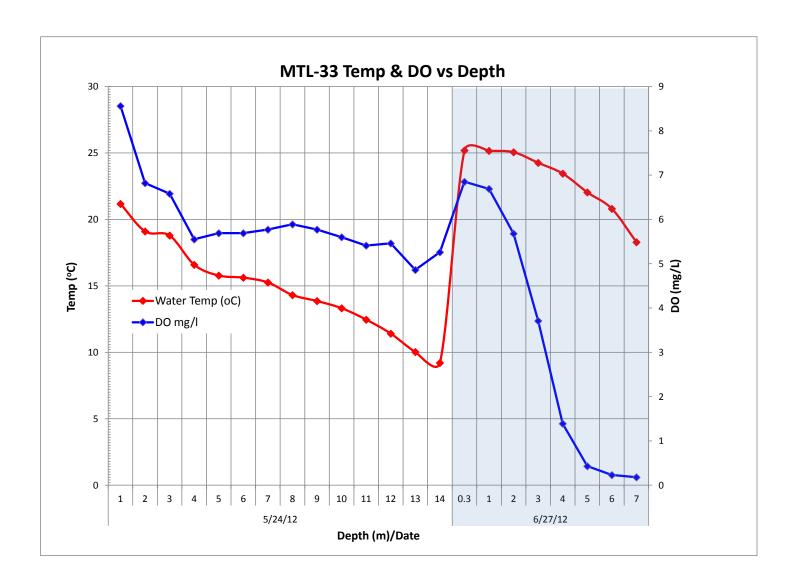


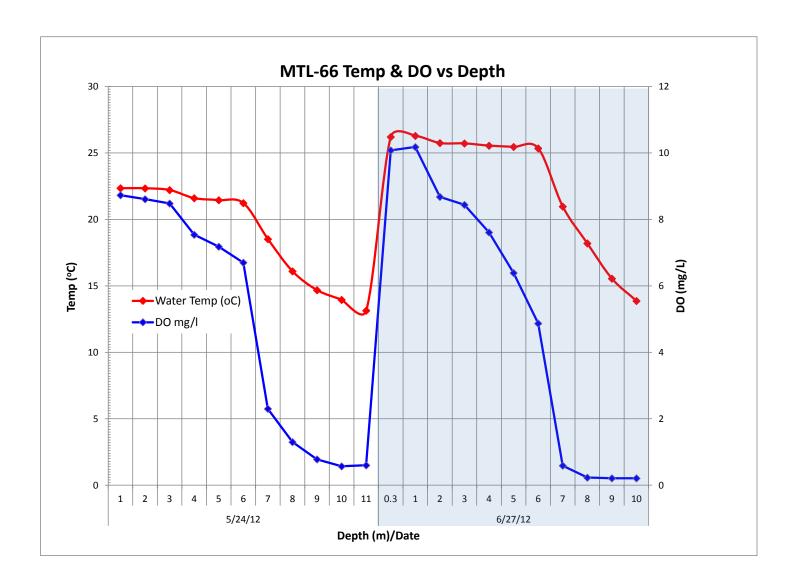


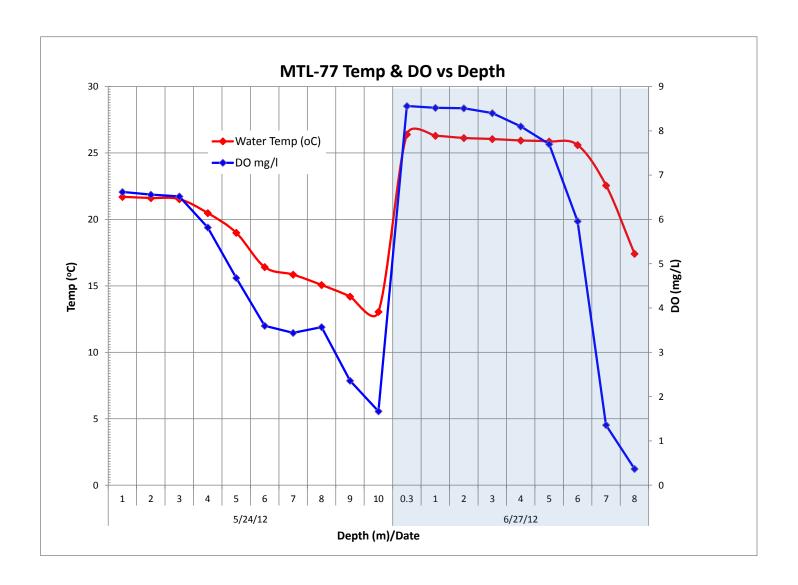


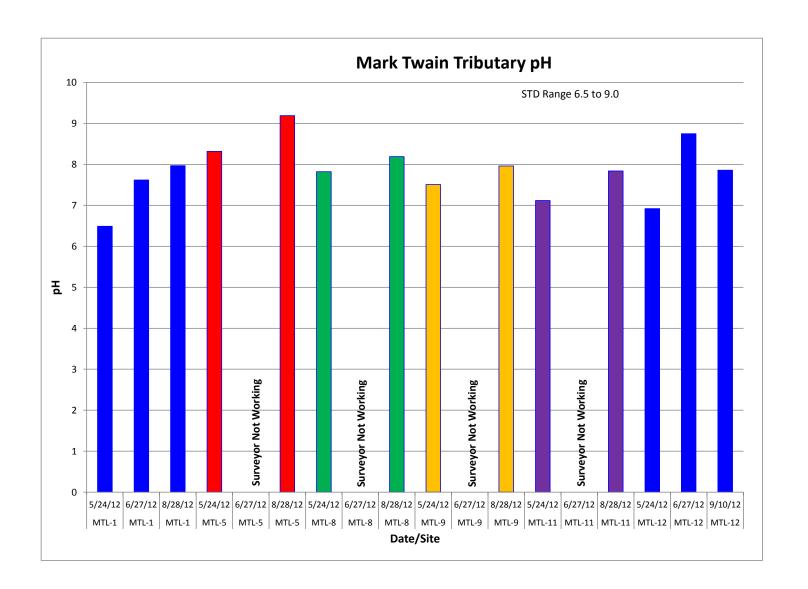


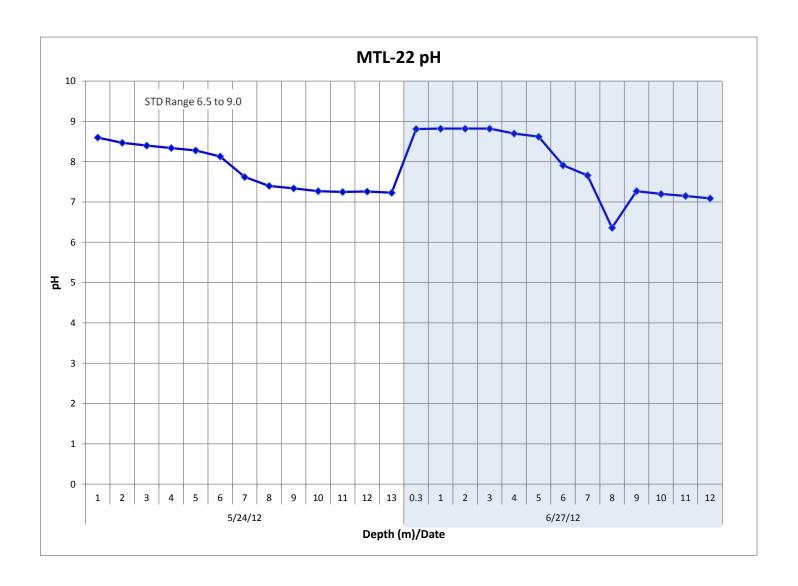


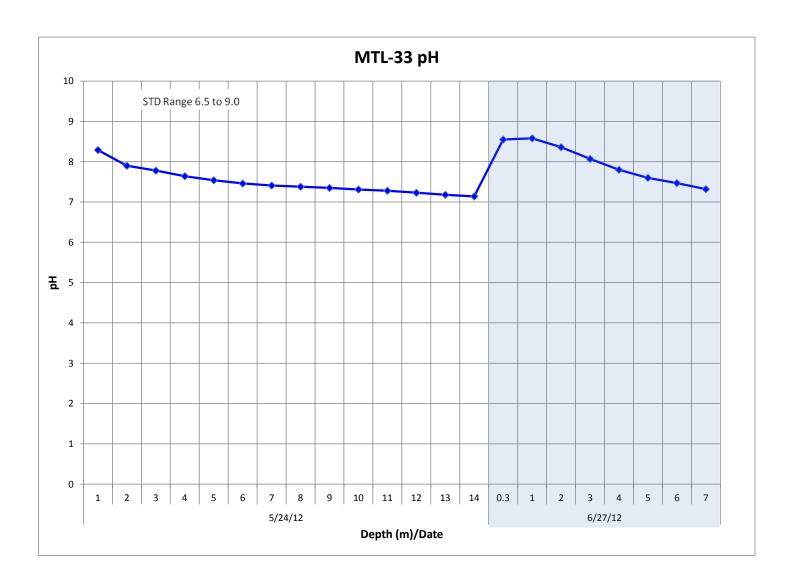


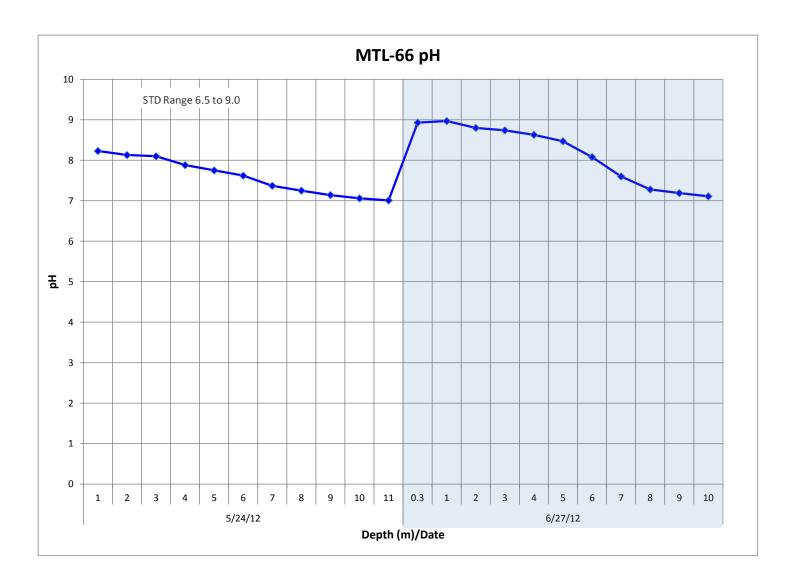


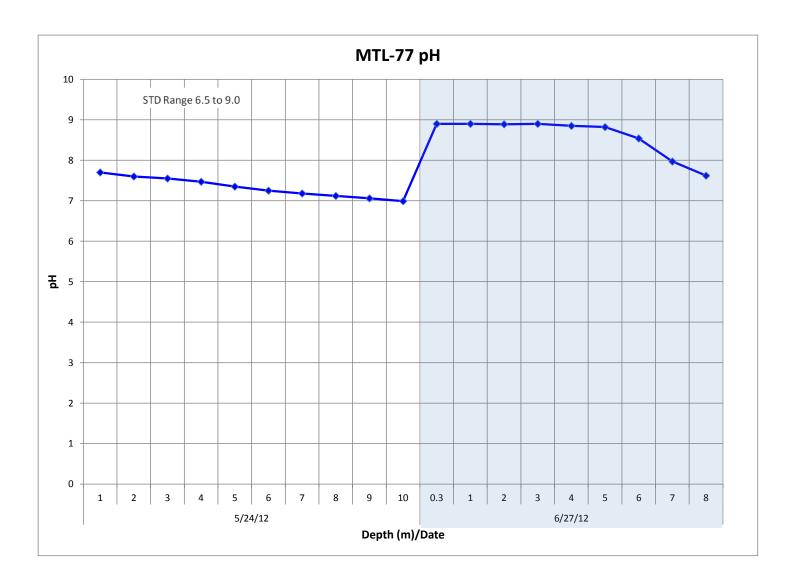


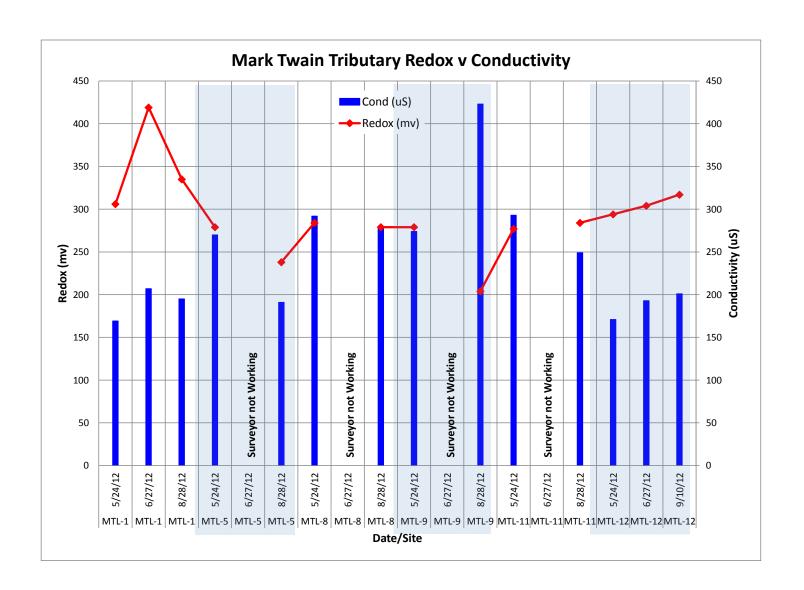


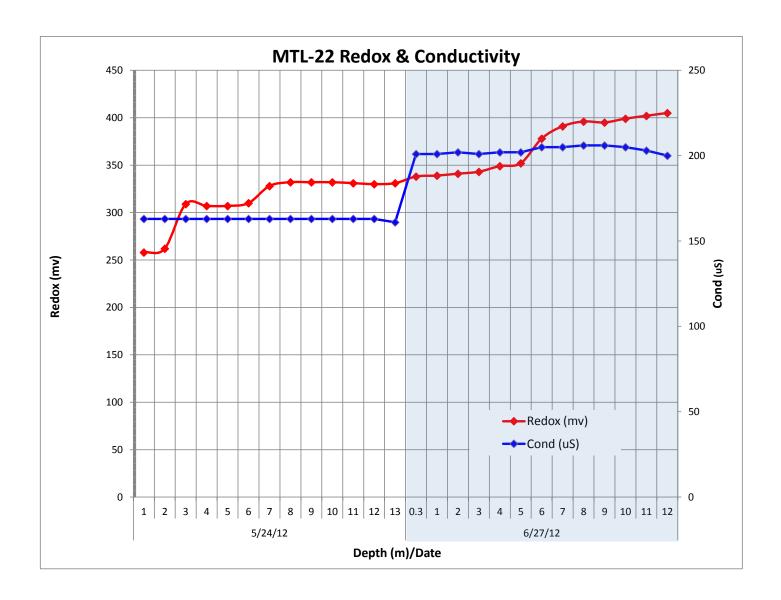


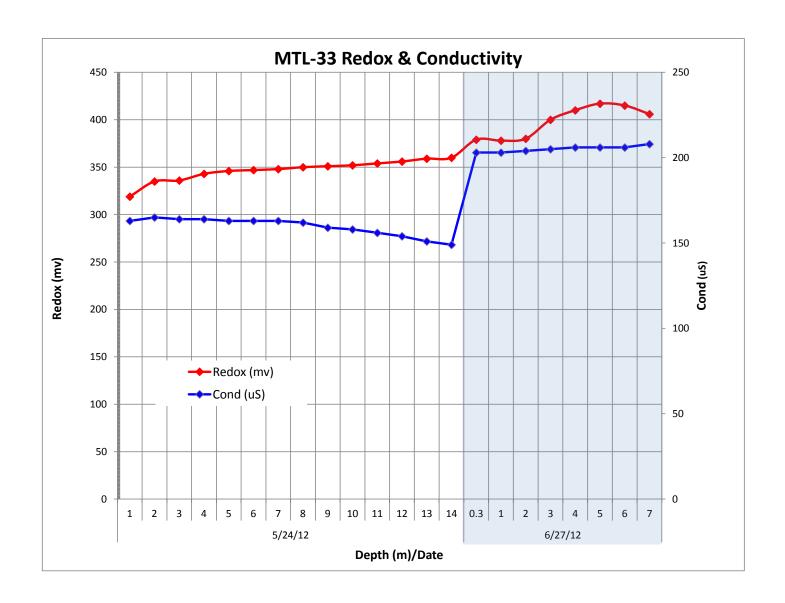




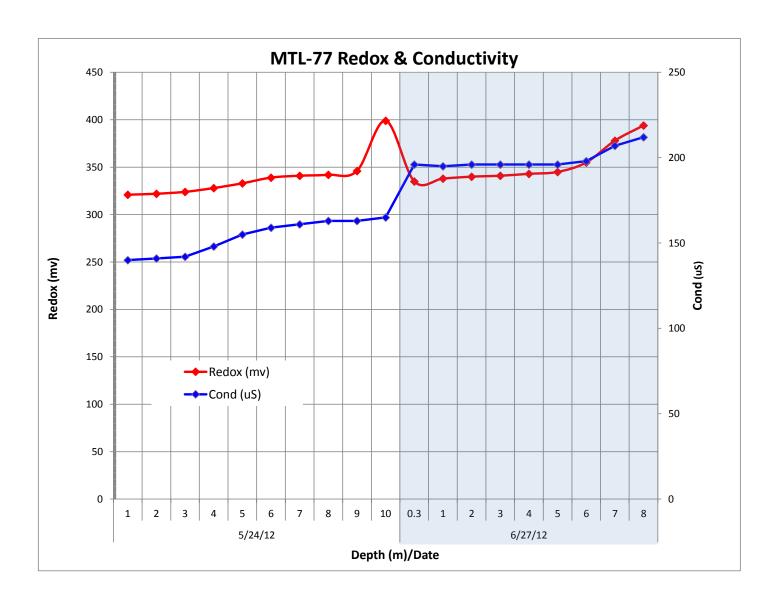


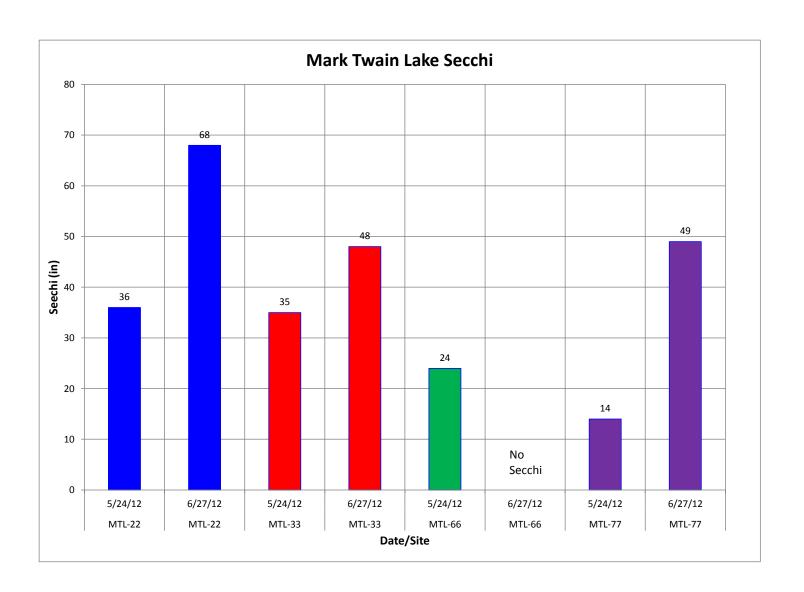


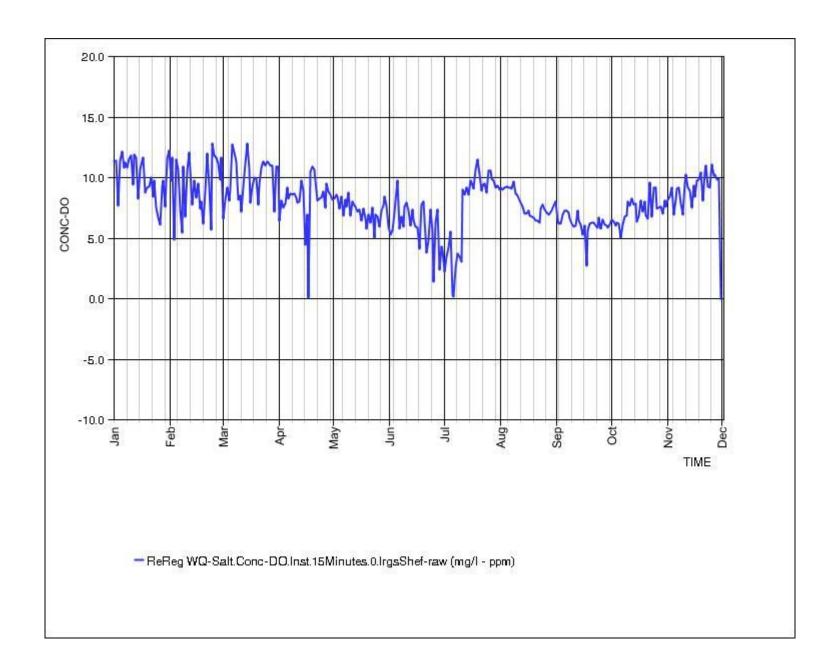


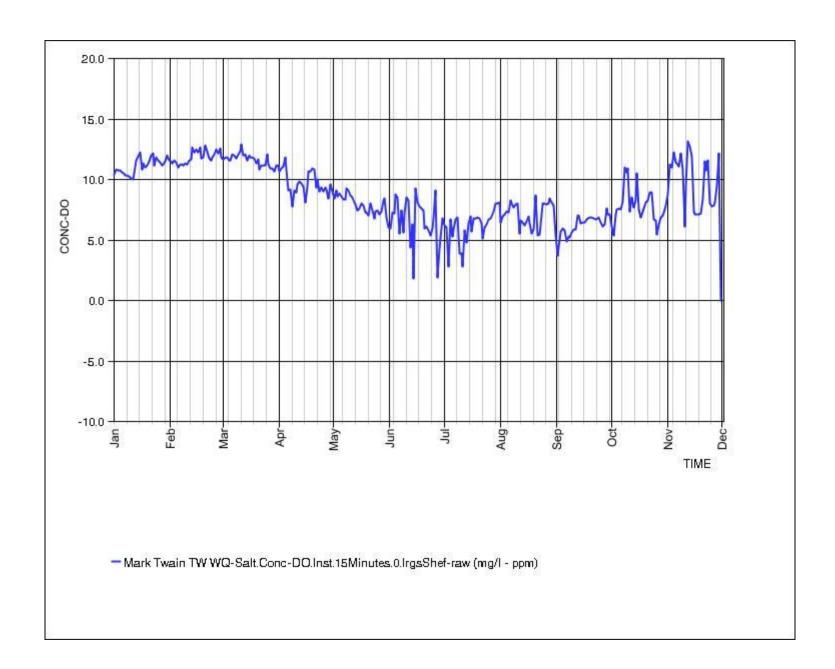












APPENDIX D

Lakes of Missouri Volunteer Program (LMVP) Data

Lakes of Missouri Volunteer Program (LMVP) Data

Site	Date	Temp	Secchi	TP	TN	TCHL	NVSS	VSS	TSS
1	4/22/2012	57	54	30	1350	4.4	2.6	1.2	3.8
1	5/13/2012	59	34	34	1690	7.1	3.9	2.1	6
1	6/24/2012	71	50	30	1460	7.9	1.6	2.6	4.2
1	8/11/2012	78	47	17	860	11.6			
1	9/15/2012	63	80	15	530	11.7	1.1	2.3	3.4
1	7/14/2012	80	52	24	1260	12.3	1.2	3	4.2
1	8/26/2012	68	53	16	670	18.1	0.9	0.3	1.2
1	5/30/2012	79	35	51	2060	24.3	4.2	4.1	8.3
2	4/22/2012	57	48	29	1290	4.9	3.1	0.7	3.8
2	6/24/2012	76	42	36	1560	10.7	1.4	3.2	4.6
2	5/13/2012	60	31	29	1700	12.6	5.1	2.4	7.5
2	9/15/2012	65	64	19	590	12.8	1.4	2.2	3.6
2	7/14/2012	77	45	25	1250	12.9	1.2	3.2	4.4
2	8/11/2012	78	36	20	780	13.9	2.1	4	6.1
2	5/30/2012	80	38	46	1710	14.8	3	3.4	6.4
2	8/26/2012	70	49	19	670	19	1.2	3.3	4.5
5	4/22/2012	57	52	38	1460	4.6			
5	9/15/2012	64	69	19	540	10.2			
5	7/14/2012	77	45	24	1310	11.1			
5	8/11/2012	78	38	19	730	13.1			
5	6/24/2012	76	41	35	1560	14.2			
5	8/26/2012	70	54	18	640	18.5			
5	5/13/2012	60	30	30		18.9			
5	5/30/2012	78	33	59	2040	19.6			

Site 1 - near dam

Site 2 - Indian Creek

Site 5 - Confluence of North Fork & South Fork

Parameter	Abbreviation	Unit of Measure		
Water Clarity (using Secchi disk)	Secchi	Inches (")		
Total Phosphorus	TP	Micrograms per liter (ug/L) or parts per billion (ppb)		
Total Nitrogen	TN	Micrograms per liter (ug/L) or parts per billion (ppb)		
Chlorophyll	CHL	Micrograms per liter (ug/L) or parts per billion (ppb)		
Inorganic Suspended Sediments	ISS	Milligrams per liter (mg/L), or parts per million (ppm) 1mg = 1000 ug		
Total Suspended Sediments	TSS	Milligrams per liter (mg/L), or parts per million (ppm) 1mg = 1000 ug		

Full report for all lakes in the LMVP can be found at http://www.lmvp.org/lakes.htm.

APPENDIX E

United Water Services Clarence Cannon WTP Data

April

							PLANT EF	FLUENT							
	Flow	рΗ	Alkalinity	Turbidity	Free CI2	Total Cl2	Hardness	Iron	Mn	NH3	Fluoride	TDS	Color	Temp	Total
DATE	(mgd)	-	(mg/l)	(NTU)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(u)	(°C)	Coliforms
1	3.86	7.88	104	0.07	0.06	3.09	174	0.008		0.25		179	0.0	18	
2	4.63	7.79	101	0.07	0.06	3.23	175	0.010		0.19		220	0.0	18	Α
3	4.47	7.84	101	0.07	0.05	3.22	164	0.004		0.18		210	0.0	19	
4	4.41	7.83	103	0.06	0.06	3.18	176	0.005	0.012	0.11		199	0.0	18	Α
5	3.75	8.00	106	0.06	0.06	3.26	180	0.011		0.21		183	0.0	17	
6	3.90	8.08	104	0.06	0.07	3.23	180	0.009		0.15		183	0.0	18	Α
7	4.57	7.97	100	0.08	0.08	3.36	180	0.004		0.21		192	1.0	17	
8	3.87	7.90	99	0.07	0.06	3.15	167	0.040		0.18		194	1.0	17	
9	4.17	7.87	103	0.06	0.05	3.13	178	0.007		0.19		184	0.0	17	Α
10	3.79	7.87	104	0.06	0.06	3.20	180	0.003		0.19		193	0.0	18	
11	4.51	7.83	100	0.08	0.06	3.18	165	0.080	0.003	0.19		195	0.0	17	Α
12	3.36	7.85	99	0.07	0.06	3.27	175	0.006		0.24		195	0.0	17	
13	4.82	7.82	99	0.06	0.05	3.29	164	0.006		0.18		190	1.0	17	Α
14	3.82	7.90	106	0.06	0.05	3.21	178	0.006		0.23		201	0.0	16	
15	4.33	8.03	106	0.06	0.05	3.23	180	0.006		0.24		201	0.0	16	
16	3.55	8.07	105	0.06	0.06	3.37	178	0.008		0.21		208	0.0	17	Α
17	4.21	8.01	105	0.06	0.05	3.21	175	0.006		0.24		189	0.0	17	
18	3.88	7.95	107	0.06	0.07	3.20	166	0.003	0.006	0.33		186	0.0	17	Α
19	4.33	7.98	110	0.06	0.07	3.12	180	0.007		0.23		200	0.0	17	
20	3.85	7.98	103	0.06	0.05	2.96	168	0.004		0.19		184	0.0	17	Α
21	4.13	7.91	105	0.08	0.06	3.13	173	0.080		0.18		190	1.0	17	
22	3.67	7.95	103	0.08	0.05	3.26	176	0.006		0.19		192	0.0	17	
23	4.26	7.99	106	0.07	0.06	3.32	175	0.009		0.18		177	0.0	16	Α
24	4.27	7.98	105	0.06	0.06	3.31	180	0.008		0.13		182	0.0	17	
25	4.07	7.92	102	0.07	0.07	3.34	173	0.007	0.005	0.14		186	0.0	17	Α
26	4.56	7.89	104	0.07	0.05	3.31	168	0.006		0.16		190	0.0	17	
27	4.32	7.88	102	0.07	0.05	3.28	170	0.006		0.15		190	0.0	17	Α
28	4.67	7.94	105	0.06	0.08	3.25	180	0.009		0.20		185	0.0	18	

	Flow	рΗ	Alkalinity	Turbidity	Free CI2	Total Cl2	Hardness	Iron	Mn	NH3	Fluoride	TDS	Color	Temp	Total
DATE	(mgd)	-	(mg/l)	(NTU)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(u)	(°C)	Coliforms
29	3.65	7.96	104	0.06	0.06	3.22	180	0.010		0.20		194	0.0	16	
30	4.11	7.96	102	0.06	0.05	3.28	170	0.008		0.19		200	1.0	16	Α
AVG	4.13	7.93	103	0.07	0.06	3.23	174	0.013	0.007	0.19		192	0.2	17	
TOTAL	123.80														

May

							PLANT E	FFLUEN	Τ						
	Flow	рΗ	Alkalinity	Turbidity	Free CI2	Total Cl2	Hardness	Iron	Mn	NH3	Fluoride	TDS	Color	Temp	Total
DATE	(mgd)	-	(mg/l)	(NTU)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(u)	(°C)	Coliforms
1	3.10	7.93	101	0.08	0.06	3.52	170	0.006		0.14		200	0.0	16	
2	4.32	7.84	105	0.06	0.06	3.21	174	0.006	0.019	0.13		180	0.0	16	Α
3	4.30	7.78	103	0.06	0.07	3.14	178	0.004		0.18		184	0.0	17	
4	3.01	7.75	101	0.06	0.07	3.08	172	0.005		0.16		188	0.0	17	Α
5	4.34	7.76	93	0.07	0.07	3.06	168	0.004		0.15		190	0.0	18	
6	3.74	7.87	95	0.07	0.07	3.18	168	0.010		0.12		192	1.0	18	
7	4.58	7.96	100	0.05	0.07	3.04	170	0.005		0.21		188	0.0	17	Α
8	3.98	7.98	96	0.06	0.08	3.18	164	0.008		0.21		180	0.0	17	
9	4.17	7.97	95	0.06	0.06	3.21	174	0.008	0.011	0.22		196	0.0	19	Α
10	4.21	7.90	96	0.06	0.05	3.21	176	0.008		0.33		183	0.0	18	
11	4.31	7.97	99	0.07	0.07	3.23	172	0.008		0.19		186	0.0	18	Α
12	4.58	7.97	101	0.05	0.06	2.95	172	0.004		0.29		174	0.0	19	
13	4.06	7.98	99	0.05	0.06	2.80	166	0.001		0.30		164	0.0	20	
14	4.59	7.88	96	0.07	0.05	2.92	168	0.004		0.28		196	0.0	19	Α
15	5.07	7.91	97	0.07	0.06	2.97	162	0.004		0.30		190	0.0	19	
16	4.44	7.93	98	0.07	0.05	2.79	168	0.005	0.011	0.26		192	0.0	20	Α
17	4.50	7.90	99	0.06	0.06	2.78	172	0.003		0.27		185	0.0	20	
18	4.79	7.88	95	0.06	0.06	3.16	178	0.004		0.28		180	0.0	20	Α
19	5.22	8.04	94	0.06	0.07	3.30	166	0.004		0.23		188	0.0	19	
20	4.18	7.92	96	0.07	0.07	3.26	165	0.003		0.28		192	0.0	20	

E2

	Flow	рΗ	Alkalinity	Turbidity	Free CI2	Total Cl2	Hardness	Iron	Mn	NH3	Fluoride	TDS	Color	Temp	Total
DATE	(mgd)	-	(mg/l)	(NTU)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(u)	(°C)	Coliforms
21	4.91	8.01	97	0.06	0.06	3.00	168	0.007		0.16		179	0.0	22	Α
22	5.06	8.11	97	0.06	0.06	3.16	168	0.010		0.11		188	0.0	23	
23	4.32	7.86	92	0.09	0.06	3.13	162	0.010	0.005	0.21		184	0.0	21	Α
24	4.96	7.83	94	0.08	0.08	3.27	160	0.055		0.14		190	1.0	21	
25	5.29	7.93	95	0.07	0.07	3.11	165	0.007		0.21		190	1.0	22	Α
26	5.06	8.02	101	0.07	0.08	3.11	168	0.008		0.20		192	0.0	25	
27	5.05	8.01	102	0.06	0.07	3.22	170	0.002		0.21		182	0.0	24	
28	5.26	7.94	98	0.07	0.07	3.03	172	0.004		0.21		188	0.0	23	Α
29	5.39	7.94	97	0.06	0.07	3.04	166	0.004		0.25		185	1.0	24	
30	5.12	7.88	103	0.05	0.07	3.08	176	0.004	0.011	0.23		187	0.0	23	Α
31	4.33	7.88	104	0.05	0.06	3.05	178	0.005		0.17		171	0.0	23	
AVG	4.52	7.92	98	0.06	0.06	3.10	170	0.007	0.011	0.21		186	0.1	20	
TOTAL	140.24														

June

							PLANT EF	FLUENT							
DATE	Flow (mgd)	рН	Alkalinity (mg/l)	Turbidity (NTU)	Free Cl2 (mg/l)	Total Cl2 (mg/l)	Hardness (mg/l)	Iron (mg/l)	Mn (mg/l)	NH3 (mg/l)	NO ₂ (mg/l)	TDS (mg/l)	Color (u)	Temp (°C)	Total Coliforms
DAIL	(iligu)		(1119/1)	(1410)	(ilig/i)		(ilig/i)	(ilig/i)	(ilig/i)	(IIIg/I)	(1119/1)	(1119/1)	(u)	(0)	Comornis
1	4.14	8.02	104	0.07	0.05	3.06	167	0.008		0.15		180	0.0	21	
2	4.86	7.92	92	0.07	0.05	3.05	179	0.008		0.17		195	0.0	23	
3	4.31	7.83	92	0.07	0.07	3.11	160	0.006		0.18		190	0.0	21	
4	5.17	7.75	99	0.07	0.08	3.22	166	0.006		0.17		181	0.0	23	
5	5.58	7.85	102	0.06	0.07	3.13	164	0.007		0.14		184	0.0	22	
6	4.32	7.86	97	0.08	0.07	3.15	160	0.005	0.013	0.16		187	0.0	22	
7	5.63	7.98	94	0.08	0.06	3.22	160	0.006		0.22		179	0.0	22	
8	5.01	7.89	94	0.08	0.07	3.19	156	0.003		0.25		189	0.0	23	
9	5.24	7.74	100	0.09	0.08	3.03	158	0.011		0.25		175	0.0	25	
10	5.33	7.82	104	0.09	0.07	2.98	163	0.007		0.23		181	0.0	25	
11	4.53	7.91	106	0.10	0.06	3.05	160	0.006		0.22		188	0.0	26	

	Flow	рН	Alkalinity	Turbidity	Free Cl2	Total Cl2	Hardness	Iron	Mn	NH3	NO ₂	TDS	Color	Temp	Total
DATE	(mgd)	· <u> </u>	(mg/l)	(NTU)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(u)	(°C)	Coliforms
12	4.58	8.07	103	0.10	0.06	3.30	164	0.108		0.21		188	0.0	25	
13	4.66	7.68	101	0.10	0.06	3.30	162	0.008	0.012	0.21		174	0.0	25	
14	4.81	7.73	104	0.06	0.07	3.14	171	0.006		0.20		193	0.0	25	
15	4.35	7.96	109	0.05	0.07	3.13	178	0.007		0.17		181	0.0	25	
16	5.16	7.91	103	0.07	0.06	3.11	177	0.006		0.18		194	0.0	24	
17	3.99	7.99	106	0.05	0.07	3.18	168	0.008		0.18		186	0.0	25	
18	4.78	7.98	110	0.05	0.08	3.00	176	0.003		0.27		192	0.0	25	
19	4.85	7.73	109	0.05	0.07	2.99	176	0.007		0.22		176	0.0	26	
20	4.49	7.80	105	0.06	0.06	3.02	169	0.008	0.008	0.20		186	0.0	26	
21	5.02	7.94	106	0.07	0.06	3.02	171	0.007		0.20		185	1.0	25	
22	4.98	8.07	94	0.06	0.43	3.06	171	0.003		0.23		189	0.0	26	
23	5.12	8.01	110	0.05	0.07	3.00	174	0.007		0.45		195	0.0	26	
24	4.49	7.97	110	0.05	0.07	3.10	179	0.005		0.21		204	0.0	27	
25	5.00	7.99	108	0.05	0.07	3.09	176	0.007		0.16		204	0.0	28	
26	5.75	8.02	107	0.06	0.06	2.97	174	0.009		0.17		212	0.0	28	
27	5.16	7.97	108	0.05	0.07	3.03	173	0.005		0.19	0.006	220	0.0	27	
28	5.51	7.80	107	0.05	0.08	3.12	174	0.004		0.24		215	0.0	29	
29	5.54	7.86	105	0.05	0.07	3.12	182	0.001		0.21		196	0.0	27	
30	5.86	7.79	102	0.06	0.07	3.07	180	0.003		0.20		200	0.0	28	
AVG	4.94	7.89	103	0.07	0.08	3.10	170	0.009	0.011	0.21	0.006	190	0.0	25	
TOTAL	148.22														

July

							PLANT EF	FLUEN	Т						
					Free	Total									
	Flow	рН	Alkalinity	Turbidity	CI2	CI2	Hardness	Iron	Mn	NH3	NO ₂	TDS	Color	Temp	Total
DATE	(mgd)	-	(mg/l)	(NTU)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(u)	(°C)	Coliforms
1	5.60	7.79	105	0.06	0.06	3.04	171	0.005		0.19		202	0.0	28	
2	5.50	7.81	110	0.04	0.08	2.94	172	0.004		0.25		218	0.0	28	Α
3	5.92	7.87	108	0.05	0.06	2.85	175	0.004		0.19		210	0.0	27	
4	5.17	7.99	105	0.05	0.06	3.00	168	0.004	0.001	0.20	0.011	210	0.0	27	Α
5	5.52	7.84	104	0.06	0.06	3.10	173	0.003		0.20		206	0.0	27	
6	5.71	7.80	106	0.06	0.08	3.16	169	0.002		0.22		210	0.0	29	Α
7	6.05	8.00	109	0.06	0.09	3.11	173	0.005		0.24		217	0.0	30	
8	5.48	7.99	109	0.06	0.08	3.00	169	0.004		0.23		216	0.0	28	
9	5.43	8.16	104	0.07	0.09	3.00	170	0.005		0.20		211	0.0	28	Α
10	5.64	8.01	97	0.08	0.07	3.01	158	0.002		0.23		213	0.0	28	
11	5.26	7.93	100	0.08	0.08	2.90	160	0.009	0.013	0.22	0.009	203	0.0	28	Α
12	5.02	7.92	99	0.08	0.08	2.84	161	0.010		0.26		206	0.0	29	
13	5.09	7.91	99	0.07	0.07	2.92	164	0.008		0.13		205	0.0	29	Α
14	4.79	7.93	94	0.10	0.07	2.99	161	0.006		0.20		211	0.0	28	
15	5.00	7.89	98	0.08	0.06	2.95	161	0.009		0.19		212	0.0	28	
16	4.97	7.86	104	0.07	0.07	3.05	165	0.005		0.17		202	0.0	28	Α
17	5.04	7.86	105	0.07	0.08	3.10	173	0.008		0.18		211	0.0	29	
18	5.33	7.73	101	0.07	0.07	3.05	165	0.008	0.003	0.17	0.011	210	0.0	28	Α
19	5.46	7.79	99	0.07	0.07	3.15	160	0.007		0.18		212	0.0	28	
20	5.43	7.86	101	0.07	0.06	3.19	163	0.008		0.20		211	0.0	28	Α
21	5.39	7.96	105	0.07	0.08	3.12	165	0.007		0.14		206	0.0	28	
22	4.98	7.99	105	0.07	0.08	3.04	165	0.004		0.14		209	0.0	29	
23	5.42	7.93	97	0.08	0.08	3.01	162	0.005		0.14		215	0.0	29	Α
24	5.71	7.84	98	0.08	0.09	3.06	164	0.005		0.20		210	0.0	30	
25	5.79	7.78	107	0.07	0.08	2.91	164	0.004	0.010	0.16	0.005	213	0.0	30	Α
26	5.12	7.92	108	0.08	0.06	2.91	165	0.008		0.18		212	0.0	29	
27	4.96	8.02	107	0.09	0.07	2.97	167	0.003		0.16		210	0.0	28	Α

	Flow	рН	Alkalinity	Turbidity	Free Cl2	Total Cl2	Hardness	Iron	Mn	NH3	NO ₂	TDS	Color	Temp	Total
DATE	(mgd)	-	(mg/l)	(NTU)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(u)	(°C)	Coliforms
28	4.76	7.96	100	0.09	0.06	3.06	154	0.007		0.17		212	0.0	28	
29	4.65	7.84	101	0.09	0.07	3.04	156	0.005		0.17		210	0.0	28	
30	4.79	7.80	104	0.08	80.0	2.93	163	0.007		0.20		204	0.0	28	Α
31	4.86	7.81	105	0.09	0.07	3.00	163	0.013		0.16		202	0.0	28	
AVG	5.29	7.90	103	0.07	0.07	3.01	165	0.006	0.007	0.19	0.009	210	0.0	28	
TOTAL	163.84							•	•			•			

HIGH SERVICE August

							PLANT EF	FLUEN	Т						
DATE	Flow (mgd)	pH -	Alkalinity (mg/l)	Turbidity (NTU)	Free Cl2 (mg/l)	Total Cl2 (mg/l)	Hardness (mg/l)	Iron (mg/l)	Mn (mg/l)	NH3 (mg/l)	NO ₂ (mg/l)	TDS (mg/l)	Color (u)	Temp (°C)	Total Coliforms
1	4.84	7.82	102	0.10	0.07	3.03	157	0.013	0.003	0.19	0.012	212	0.0	29	A
2	5.10	7.85	101	0.09	0.07	3.04	159	0.012	0.000	0.18	0.012	206	0.0	29	,,
3	5.14	7.99	104	0.10	0.07	3.00	159	0.014		0.17		210	0.0	29	Α
4	4.72	7.99	108	0.10	0.08	2.98	161	0.012		0.19		202	0.0	29	
5	5.14	8.00	106	0.09	0.08	2.98	163	0.010		0.16		201	0.0	28	
6	4.85	8.00	101	0.09	0.07	3.05	163	0.012		0.15		192	0.0	28	Α
7	5.42	7.93	100	0.09	0.07	3.09	162	0.010		0.16		197	0.0	29	
8	5.46	7.78	105	0.08	0.08	3.06	160	0.010	0.011	0.19	0.006	201	0.0	28	Α
9	5.24	7.94	104	0.09	0.07	3.15	158	0.011		0.14		196	0.0	29	
10	5.76	7.91	107	0.09	0.08	3.09	159	0.011		0.18		195	0.0	27	Α
11	5.09	7.90	101	0.09	0.07	3.09	161	0.009		0.20		200	0.0	27	
12	4.80	7.85	101	0.08	0.07	3.08	160	0.008		0.20		210	0.0	27	
13	3.73	7.75	105	0.08	0.07	3.13	163	0.009		0.16		185	0.0	26	Α
14	5.05	7.75	106	0.06	0.07	2.96	164	0.007		0.13		187	0.0	25	
15	5.12	7.85	103	0.07	0.07	3.03	163	0.039	0.010	0.15	0.100	196	0.0	25	Α
16	4.91	7.86	106	0.07	0.08	3.14	166	0.008		0.14		210	0.0	26	
17	4.90	7.84	107	0.07	0.06	3.20	165	0.007		0.18		208	0.0	25	Α

	Flow	рН	Alkalinity	Turbidity	Free Cl2	Total Cl2	Hardness	Iron	Mn	NH3	NO ₂	TDS	Color	Temp	Total
DATE	(mgd)	·-	(mg/l)	(NTU)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(u)	(°C)	Coliforms
18	4.45	7.90	109	0.07	0.08	3.25	166	0.005		0.10		206	0.0	25	
19	4.94	8.04	115	0.08	0.07	3.12	165	0.005		0.11		199	0.0	25	
20	4.71	8.05	110	0.08	0.07	3.19	164	0.007		0.17		200	0.0	25	Α
21	4.82	7.89	106	0.08	0.07	3.25	134	0.007		0.17		210	0.0	25	
22	5.04	7.73	107	0.07	80.0	3.22	166	0.009	0.019	0.10	0.005	174	0.0	24	Α
23	5.24	7.73	111	0.07	80.0	3.10	165	0.005		0.15		193	0.0	26	
24	5.22	7.78	111	0.07	80.0	3.10	170	0.009		0.05		191	0.0	25	Α
25	5.16	7.86	107	0.07	0.06	3.17	165	0.008		0.12		200	0.0	25	
26	3.56	7.82	108	0.08	0.07	3.22	166	0.009		0.17		200	0.0	25	
27	5.38	7.82	112	0.07	0.06	3.16	166	0.009		0.31		199	0.0	26	Α
28	5.15	7.89	113	0.07	80.0	3.17	169	0.014		0.13		193	0.0	26	
29	5.46	7.97	108	0.06	0.07	3.41	166	0.013	0.010	0.16	0.110	200	0.0	26	Α
30	4.94	8.06	111	0.08	0.07	3.37	169	0.012		0.15		190	0.0	26	
31	4.84	8.03	112	0.07	0.06	3.13	168	0.011		0.19		197	0.0	26	Α
AVG	4.97	7.89	107	0.08	0.07	3.13	163	0.010	0.011	0.16	0.047	199	0.0	26	
TOTAL	154.18														

HIGH SERVICE September

							PLANT EF	FLUENT							
DATE	Flow (mgd)	pH -	Alkalinity (mg/l)	Turbidity (NTU)	Free Cl2 (mg/l)	Total Cl2 (mg/l)	Hardness (mg/l)	Iron (mg/l)	Mn (mg/l)	NH3 (mg/l)	NO2 (mg/l)	TDS (mg/l)	Color (u)	Temp (°C)	Total Coliforms
1	4.53	8.03	114	0.07	0.07	2.98	164	0.005		0.10		189	0.0	26	
2	4.72	8.01	113	0.07	0.06	2.99	166	0.008		0.15		194	0.0	25	
3	4.59	8.00	110	0.08	0.07	3.16	166	0.008		0.16		200	0.0	26	Α
4	4.32	7.91	109	0.07	0.07	3.14	163	0.006		0.15		199	0.0	27	
5	3.85	7.82	113	0.07	0.08	2.96	168	0.010	0.020	0.25	0.006	194	0.0	26	Α
6	5.81	7.87	112	0.07	0.07	3.07	164	0.006		0.17		186	0.0	26	
7	3.68	8.00	112	0.07	0.07	3.18	172	0.007		0.08		178	0.0	25	Α

	l				Free	Total		_						_	
DATE	Flow	рН	Alkalinity	Turbidity	CI2	CI2	Hardness	Iron	Mn (******(*)	NH3	NO ₂	TDS	Color	Temp	Total
DATE	(mgd)	-	(mg/l)	(NTU)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(u)	(°C)	Coliforms
8	4.21	8.02	106	0.07	0.06	3.19	172	0.009		0.12		202	0.0	24	
9	4.49	8.00	103	0.07	0.07	3.26	169	0.004		0.08		194	0.0	25	
10	4.50	7.92	112	0.07	0.07	3.19	170	0.005		0.18		190	0.0	25	Α
11	4.37	7.82	111	0.07	0.06	3.19	167	0.008		0.13		179	0.0	24	
12	4.56	7.71	110	0.08	0.06	3.17	168	0.070	0.002	0.11	0.006	193	0.0	24	Α
13	4.29	7.73	112	0.08	0.05	3.19	164	0.033		0.12		192	0.0	25	
14	4.68	7.86	114	0.08	0.05	3.16	169	0.005		0.11		194	0.0	24	Α
15	3.96	7.94	115	0.07	0.05	3.00	170	0.005		0.05		197	0.0	23	
16	4.34	7.91	116	0.07	0.05	2.74	174	0.026		0.04		197	0.0	23	
17	4.30	7.81	114	0.07	0.05	2.80	167	0.006		0.08		199	0.0	23	Α
18	4.30	7.86	111	0.08	0.06	3.08	170	0.009		0.11		203	0.0	23	
19	4.09	8.01	116	0.07	0.05	3.13	175	0.008	0.007	0.11	0.005	198	0.0	17	Α
20	4.33	7.95	116	0.06	0.06	3.17	173	0.004		0.12		188	0.0	22	
21	4.36	7.88	115	0.07	0.07	3.10	170	0.006		0.04		187	0.0	22	Α
22	4.50	7.85	115	0.07	0.05	3.23	166	0.007		0.06		192	0.0	23	
23	4.11	7.86	110	0.07	0.06	3.23	169	0.007		0.11		194	0.0	21	
24	4.68	7.87	106	0.06	0.05	3.21	171	0.008		0.13		195	0.0	21	Α
25	4.20	7.80	114	0.07	0.06	3.44	171	0.006		0.16		194	0.0	21	
26	4.23	7.77	116	0.07	0.08	3.37	164	0.007	0.004	0.19	0.100	196	0.0	21	Α
27	4.37	7.82	116	0.07	0.05	3.34	170	0.007		0.17		199	0.0	21	
28	4.01	7.89	114	0.07	0.06	3.29	176	0.006		0.18	0.009	195	0.0	21	Α
29	4.47	7.91	118	0.06	0.06	3.25	172	0.008		0.15		199	0.0	21	
30	4.41	7.97	118	0.06	0.06	3.05	175	0.006		0.13		205	0.0	21	
AVG	4.38	7.89	113	0.07	0.06	3.14	169	0.010	0.008	0.12	0.025	194	0.0	23	
TOTAL	131.26														

October

	PLANT EFFLUENT														
DATE	Flow	рН	Alkalinity	Turbidity	Free Cl2	Total Cl2	Hardness	Iron	Mn	NH3	NO ₂	TDS	Color	Temp	Total
DATE	(mgd)	-	(mg/l)	(NTU)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(u)	(°C)	Coliforms
1	4.15	7.88	112	0.07	1.43	3.12	175	0.006		0.06		196	0.0	21	Α
2	4.53	7.76	109	0.06	2.94	3.58	172	0.002		0.00		209	0.0	21	_
3	4.67	7.77	109	0.06	3.17	3.78	175	0.003	0.003	0.00	0.005	201	0.0	21	Α
4	4.11	7.73	109	0.07	3.28	3.92	176	0.003		0.00		198	0.0	20	
5	4.04	7.66	111	0.07	3.22	3.91	171	0.006		0.00		210	0.0	20	Α
6	4.55	7.75	112	0.06	3.09	3.66	173	0.006		0.00		199	0.0	20	
7	4.42	7.81	113	0.06	3.08	3.80	169	0.007		0.00		200	0.0	20	
8	4.69	7.79	116	0.06	3.05	3.81	176	0.007		0.00		211	0.0	18	Α
9	4.14	7.82	116	0.05	3.24	4.07	185	0.005		0.00		207	0.0	19	
10	4.94	7.80	114	0.06	3.28	3.96	176	0.005	0.002	0.00	0.005	200	0.0	18	Α
11	4.01	7.88	118	0.07	3.18	3.77	176	0.006		0.00		210	0.0	18	
12	4.52	7.89	118	0.06	2.94	3.60	179	0.031		0.00		205	0.0	18	Α
13	4.32	7.86	120	0.05	2.92	3.64	185	0.002		0.00		212	0.0	18	
14	4.97	7.80	119	0.05	3.07	3.79	181	0.004		0.00		211	0.0	17	
15	4.37	7.75	116	0.07	3.14	3.87	180	0.003		0.00		210	0.0	17	Α
16	4.68	7.81	116	0.08	3.00	3.77	175	0.022		0.00		210	0.0	18	
17	4.22	7.82	118	0.06	2.82	3.43	180	0.006	0.008	0.00		203	0.0	18	Α
18	4.34	7.84	117	0.06	2.86	3.50	181	0.009		0.00		211	0.0	17	
19	3.81	7.82	118	0.05	2.92	3.61	181	0.006		0.00		201	0.0	17	Α
20	4.38	7.81	117	0.07	3.04	3.67	180	0.005		0.00		210	0.0	16	
21	4.24	7.85	116	0.06	3.14	3.68	177	0.006		0.00		208	0.0	19	
22	4.63	7.80	118	0.06	2.92	3.52	183	0.001		0.00		204	0.0	18	Α
23	3.90	7.82	119	0.06	2.78	3.52	182	0.006		0.00		209	0.0	19	
24	4.31	7.85	116	0.08	2.94	3.68	180	0.006	0.008	0.00		210	0.0	18	Α
25	4.37	7.85	115	0.06	2.96	3.58	180	0.004		0.00		210	0.0	17	
26	3.87	7.81	115	0.07	2.87	3.48	175	0.006		0.00		212	0.0	18	Α
27	4.05	7.81	118	0.05	2.87	3.58	182	0.002		0.00		210	0.0	17	

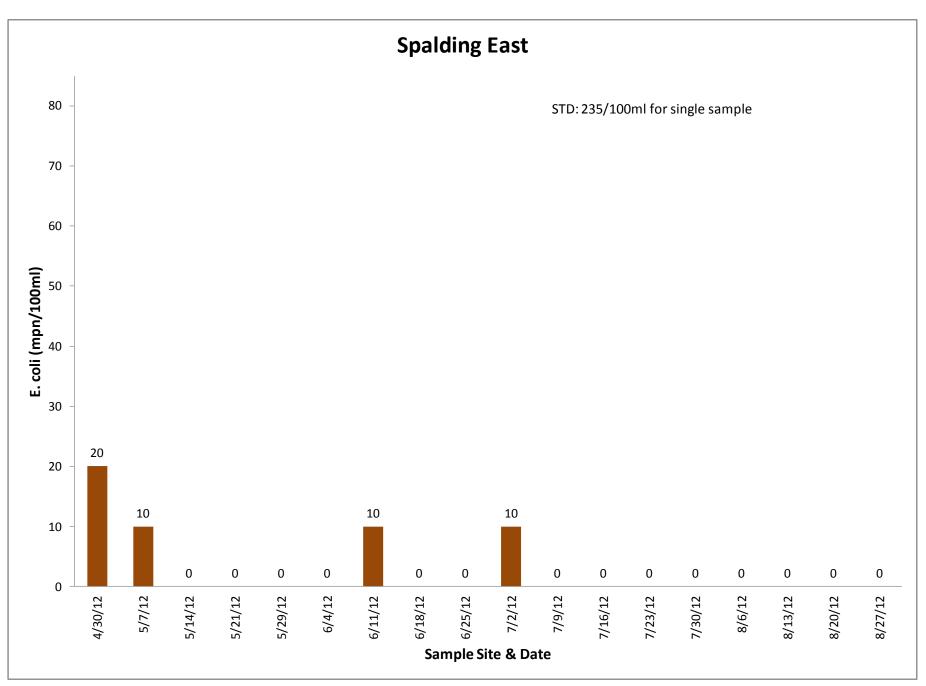
	Flow	рН	Alkalinity	Turbidity	Free Cl2	Total Cl2	Hardness	Iron	Mn	NНз	NO ₂	TDS	Color	Temp	Total
DATE	(mgd)	-	(mg/l)	(NTU)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(u)	(°C)	Coliforms
28	4.29	7.80	118	0.05	2.84	3.63	181	0.003		0.00		208	0.0	17	
29	4.14	7.77	116	0.07	3.05	3.72	180	0.004		0.00		210	0.0	18	Α
30	4.21	7.80	116	0.08	2.80	3.64	176	0.006		0.00		213	0.0	17	
31	3.42	7.85	119	0.06	2.85	3.50	182	0.004	0.018	0.00	0.009	208	0.0	17	Α
AVG	4.30	7.81	116	0.06	2.96	3.67	178	0.006	0.008	0.00	0.006	207	0.0	18	
TOTAL	133.29														

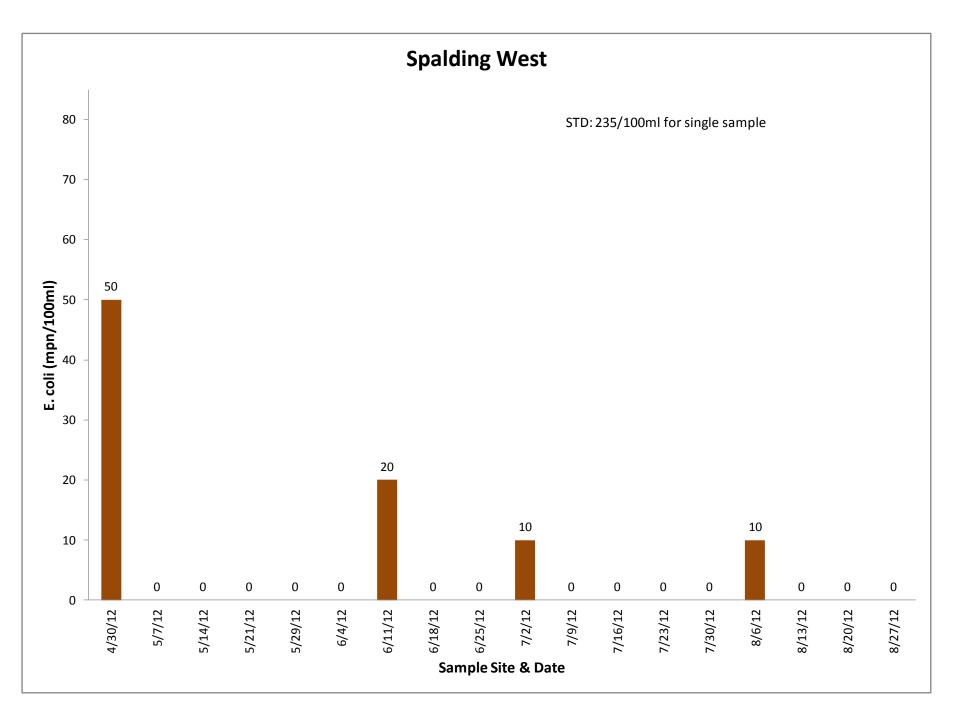
APPENDIX F

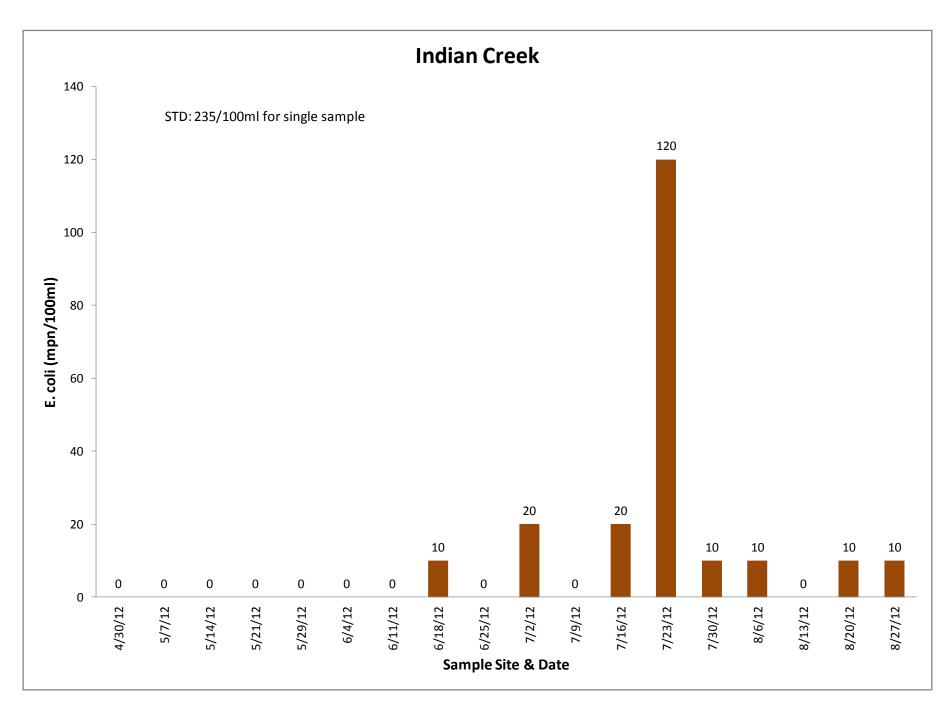
Beach Data & Graphs

Beach Data

						<u>Indian</u>
		Spalding East		Spalding		Creek (E.
	<u>Bottle</u>	(E. Coli / 100		West (E. Coli		Coli / 100
<u>Date</u>	<u>Number</u>	<u>ml)</u>	Bottle Number	<u>/ 100 ml)</u>	Bottle Number	<u>ml)</u>
4/30/2012	4396	20	4397	50	4398	0
5/7/2012	4369	10	4380	0	4388	0
5/14/2012	4508	0	4514	0	4525	0
5/21/2012	4447	0	4449	0	4450	0
5/29/2012	4505	0	4526	0	4460	0
6/4/2012	4425	0	4426	0	4523	0
6/11/2012	4451	10	4461	20	4472	0
6/18/2012	4392	0	4419	0	4429	10
6/25/2012	4409	0	4423	0	4439	0
7/2/2012	4536	10	4538	10	4539	20
7/9/2012	4421	0	4438	0	4537	0
7/16/2012	4510	0	4529	0	4533	20
7/23/2012	4490	0	4493	0	4519	120
7/30/2012	4654	0	4655	0	4656	10
8/6/2012	4561	0	4566	10	4571	10
8/13/2012	4458	0	4480	0	4569	0
8/20/2012	4624	0	4631	0	4633	10
8/27/2012	4609	0	4645	0	4662	10







Mark Twain Lake State Park Beach E. coli

