WATER QUALITY DATABASE EVALUATION AND TREND ANALYSIS FOR: MARK TWAIN LAKE

Prepared for

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1.0 EXECUTIVE SUMMARY

The purpose of this report is to provide a statistical analysis of water quality conditions within Mark Twain Lake during the period 2001-2005.

Statistical evaluations were performed using water quality data values acquired during the referenced period on a wide variety of organic, inorganic and biological parameters from a number of sampling points spread throughout the lake. Analytical data reviewed consisted of Mark Twain Lake water quality data has been collected from lake surface waters at six (6) sites and from one subsurface site. Additional data have been acquired from samples taken at sites located in the watershed of the lake. The samples were collected by the Corps of Engineers, St. Louis District, Environmental Quality Section. Statistical analysis and the results were evaluated for seventeen (17) parameters for all sites that contained sufficient data (i.e. data from two years or more and/or a sufficient number of data points above the detection limit) on a combined and individual basis.

The data collected indicated a generally improving to stable water quality within Mark Twain Lake.

2.0 INTRODUCTION

Water quality monitoring within the lakes and rivers under the control of the U.S. Army Corps of Engineers is essential to assure that environmental conditions are safe for human and wildlife contact and general usage. The Corps of Engineers, St. Louis District, Environmental Quality Section has maintained a database of monitoring sites within Mark Twain Lake since 1989. The data as collected is reviewed to assure that immediate environmental conditions are within acceptable ranges. The data is then archived within a database file.

The values regarding water quality in Mark Twain Lake which are presented herein were acquired during the calendar years 2001 to 2005. Statistical analysis of the data was performed on data sets from individual sampling sites within the lake system. The statistical results obtained are compared to applicable water quality standards currently in force by regulation (State and/or Federal). In those cases where there is no regulatory limited the values observed are compared to those which are generally accepted as a good range for water quality. Missouri regulations for water quality appear in Rules of the Department of Natural Resources, Division 20, Clean Water Commission, Title 10 CSR 20-7.031.

3.0 MARK TWAIN LAKE WATER QUALITY DATA EVALUATION

3.1 Data Sets

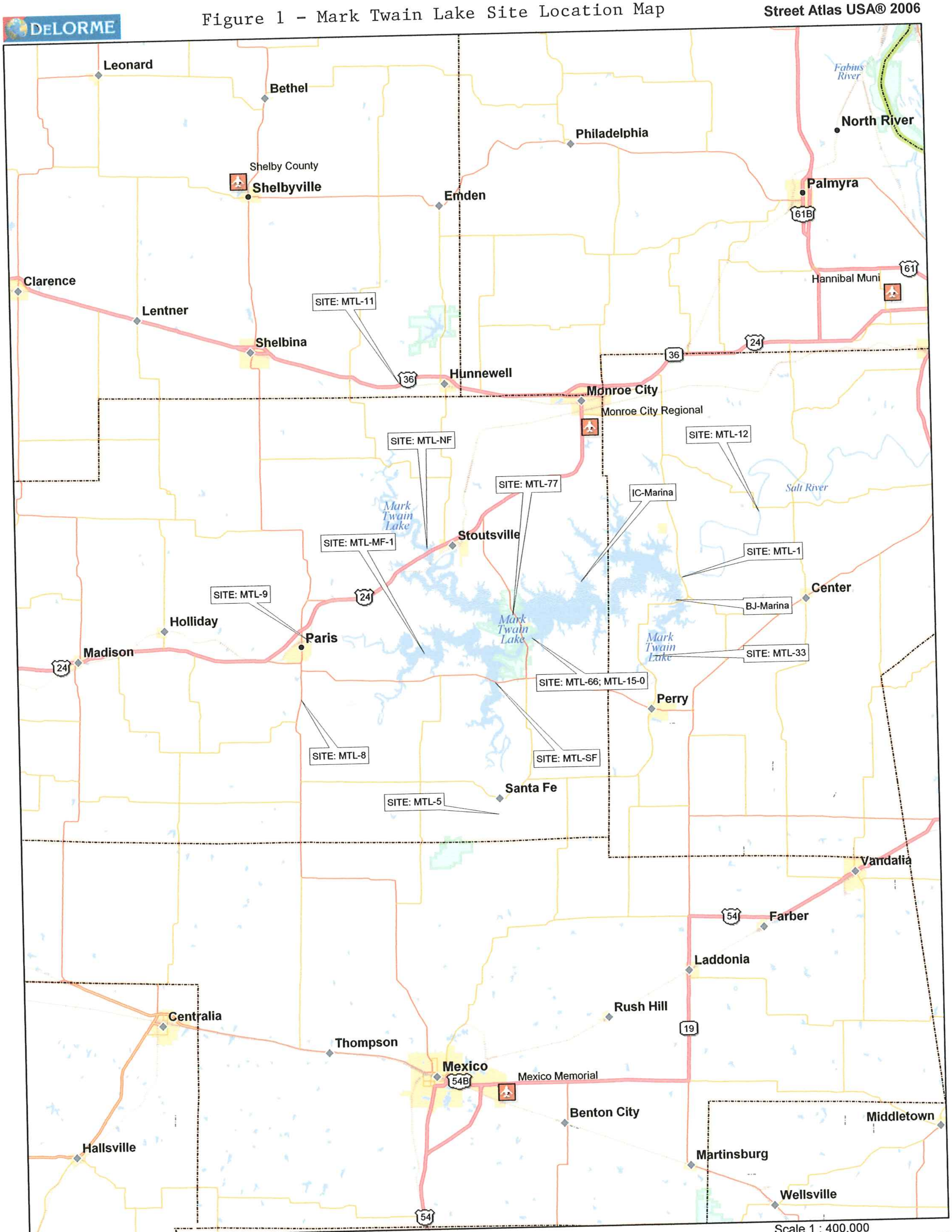
Data sets evaluated for Mark Twain Lake originated from field sampling by the St. Louis District Corps of Engineers Environmental Quality Section at a total of seven (7) sites. Figure 1 shows the locations of these sites.

3.2 Evaluation

Evaluation of data was performed in two ways: 1) the combined values for each parameter observed at all sites; and 2) the values for each parameter observed at each site. A descriptive statistical summary of each parameter for all sites taken as a whole and for each site individually appears in Sections 3.3 and 3.4, below. As noted, the current levels are compared to State and/or Federal regulatory limits where such limits have been set. Trend analysis plots and descriptive statistics for all sites combined are provided in the various figures and tables in the referenced sections. The equation for the trendline appears in the upper right hand corner of all plots. All data utilized from the monitored sites for this evaluation is provided in electronic format on CD which is attached hereto as an Appendix.. The files on the disk can be accessed with Microsoft Excel.

Figure 1 - Mark Twain Lake Site Location Map

Street Atlas USA® 2006



Data use subject to license.

TN MN (0.7°E)

Scale 1 : 400,000

1" = 6.31 mi   Data Zoom 9-0

3.2.1 Trend and Descriptive Statistics Analysis Summary

The descriptive statistics calculated and reviewed for the combined data sets are defined in Table 1.

3.3 Data From All Sites

3.3.1 Dissolved Oxygen

Figure 2 shows the data from all sites for Dissolved Oxygen (DO). The descriptive statistics for those data appear in the table below the plotted values.

Dissolved oxygen levels depend on temperature and atmospheric pressure as well as on the chemical and biological activities occurring in an aqueous system. A minimum quality standard of 5.0 mg dissolved oxygen/L has been established for protection of aquatic life by Missouri.

Review of the figure will show that in general the observed values are in an approximate range of 5 to 10 mg/L. The mean, median and mode for the observed data were 6.3, 6.2 and 7.5, respectively. These data (excluding the exceptions noted below) indicate that D.O. levels in the system are acceptable and that those levels are stable.

The exceptions noted were:

- six values of less than 1 mg/L observed during summer months throughout the time span of the study at sites 2-10 and 11-0; and
- six values greater than the solubility of oxygen in water at 40° F (13 mg/L) were observed at differing sites.

Since the solubility of oxygen decreases exponentially as temperature rises, the high values were excluded from the statistics and were not plotted.

3.3.2 pH

Figure 3 is a logarithmic plot of the pH values observed at all sites. The descriptive statistics for those data appear in the table below the plotted values.

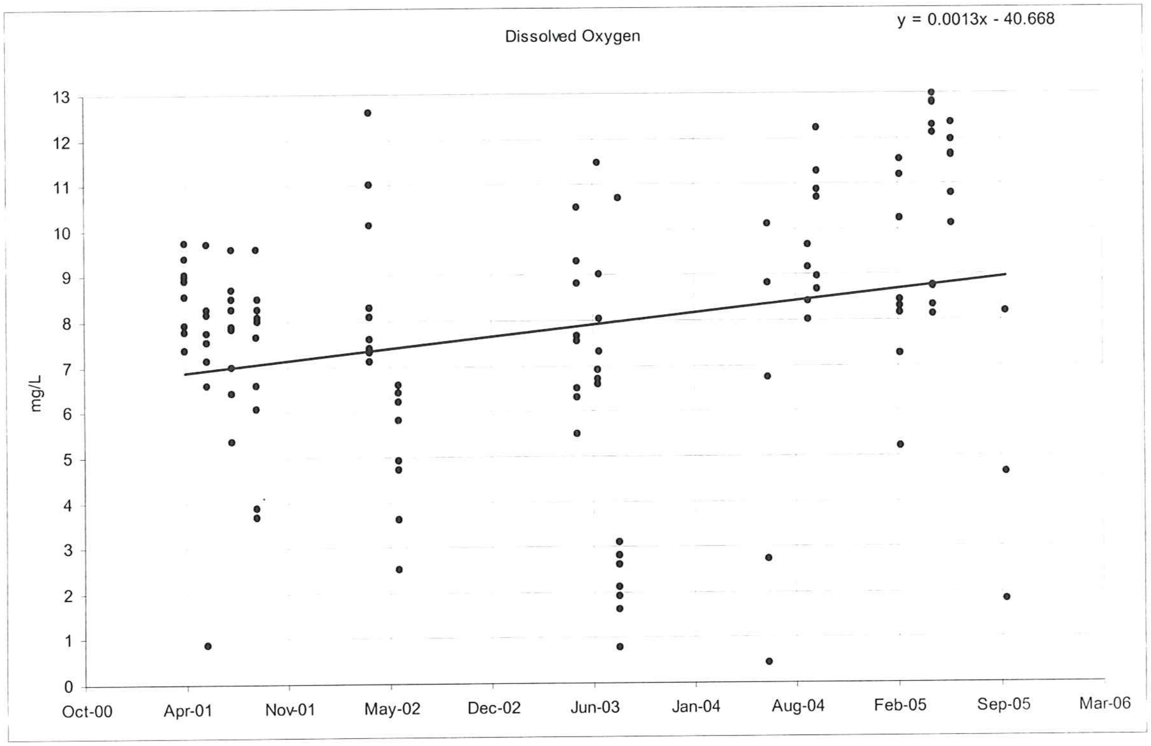
The value for pH is a logarithmic expression of the concentration of hydrogen ions. It is governed by the combined effects of dissolved gases (principally carbon dioxide) and the levels of the various salts which are present. A "neutral" system is pH 6 to 8. The pH of an acidic system is less than 6 and that of a basic system is greater than 8.

Review of Figure 3 and the statistics in accompanying table shows that, when plotted on a logarithmic scale, individual measurements were closely similar in all sites at all times. The values, however, can be strongly influenced temporarily by

Table 1 – Definitions for Descriptive Statistics

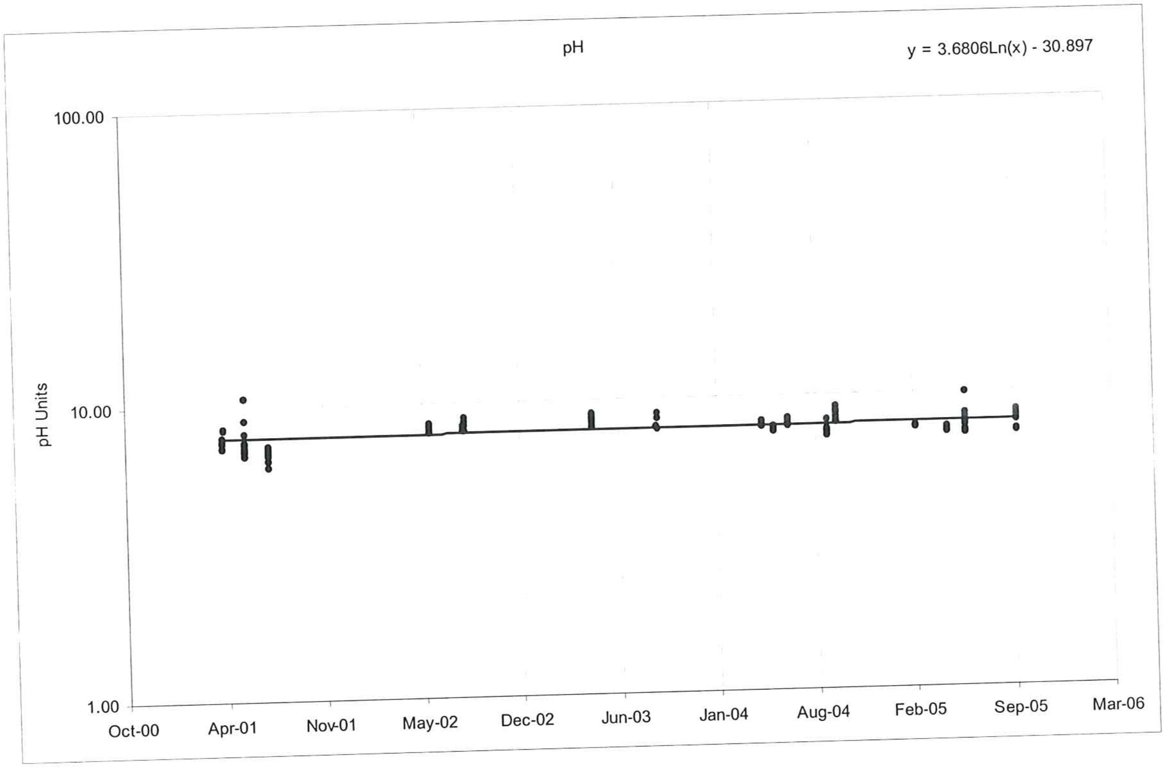
Statistic	Definition
Mean	Arithmetic average of all the data points.
Standard Error	Measure of the amount of error in the prediction of the Y(parameter of interest) data point for an individual X data point. The statistic is a function of standard deviation and the number of measurements made.
Median	Number in the middle of a set of numbers; that is, half the numbers have values that are greater than the median, and half have values that are less.
Mode	Most frequently occurring, or repetitive, value in an array or range of data.
Standard Deviation	Measure of how widely values are dispersed from the average value
Variance	Calculation of potential difference from the norm/mean.
Kurtosis	Characterizes the relative peakedness or flatness of a distribution compared with the normal distribution. Positive kurtosis indicates a relatively peaked distribution. Negative kurtosis indicates a relatively flat distribution
Skewness	Characterizes the degree of asymmetry of a distribution around its mean. Positive skewness indicates a distribution with an asymmetric tail extending toward more positive values. Negative skewness indicates a distribution with an asymmetric tail extending toward more negative values

Figure 2



Statistic	Value
Average	7.79
Standard Error	0.26
Median	8.10
Mode	8.10
Standard Deviation	2.85
Sample Variance	8.11
Kurtosis	0.14
Skewness	-0.53
Range	12.54
Minimum	0.42
Maximum	12.96
Sum	966
Count	124

Figure 3



Statistic	Value
Average	7.89
Standard Error	0.05
Median	7.92
Mode	8.30
Standard Deviation	0.62
Sample Variance	0.38
Kurtosis	2.49
Skewness	0.61
Range	4.40
Minimum	6.20
Maximum	10.60
Sum	1026
Count	130

local conditions associated with unusually hot or cold temperatures, flooding, increased runoff due to rainfall, erosion from land disturbances caused by agricultural activities or land development.

Although some of the observed values are above the range of 6 to 9 standard pH units appearing in various sections of Missouri regulations, the mean, median and mode are at or near to neutrality and the majority of the readings obtained are well within state guidelines. The trendline for the parameter over the five year period reflected in the plot is virtually flat, indicating that the current general conditions will remain stable in the future.

3.3.3 ORP (Oxidation Reduction Potential)

Figure 4 shows the data from all sites for ORP. The descriptive statistics for those data appear in the table below the plotted values.

ORP is dependent upon the net effects and the balance of the complex interactions of dissolved components, pH, temperature and other variables. A positive ORP indicates an excess of oxidizing components and a negative ORP indicates an excess of reducing agents. In general terms, a positive ORP is considered beneficial since the system is healthy and operating aerobically. A negative ORP, however, sometimes (but not always) indicates that a system is operating anaerobically, a condition which generally leads to generation of objectionable odors through putrefaction.

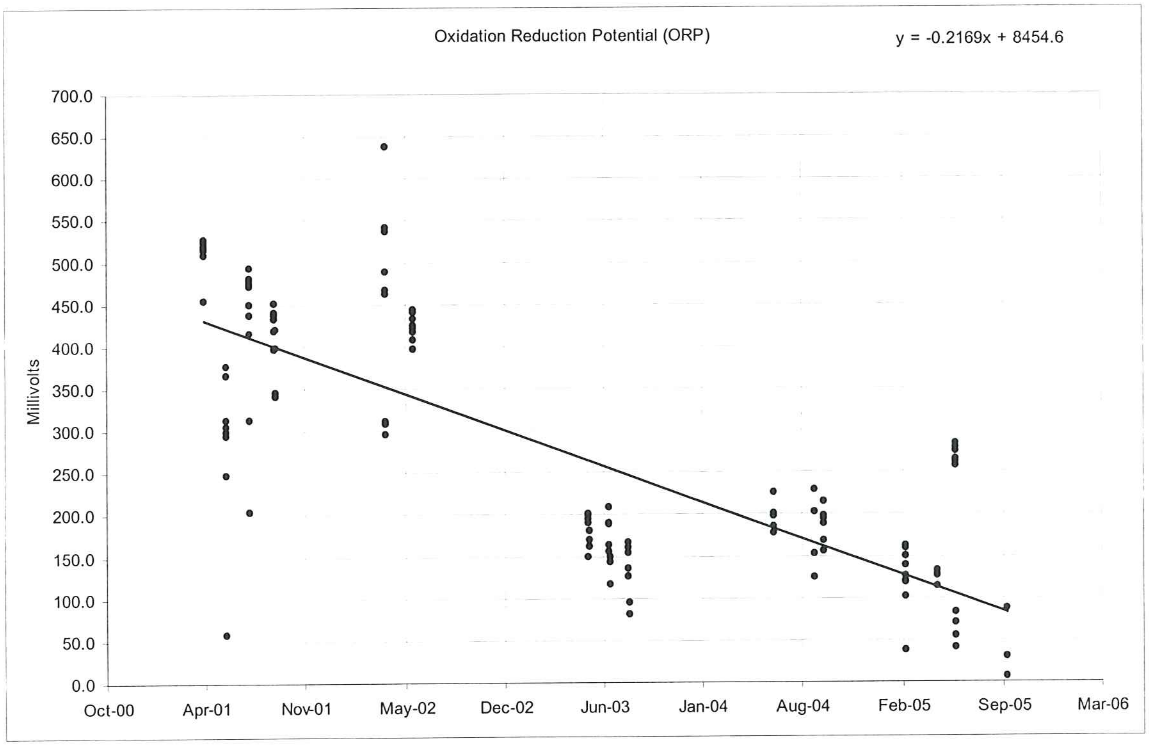
Values of ORP data are plotted in Figures 4. Review of the plot will show that during the period studied, the mean of the values observed for ORP decreased steadily from a high of approximately 450 millivolts to a low in the order of 100 millivolts or approximately 20% each period of seven months. The data indicate that this trend will continue.

No specific regulations for ORP in general purpose waters have been generated by the states or federal government.

3.3.4 Conductivity

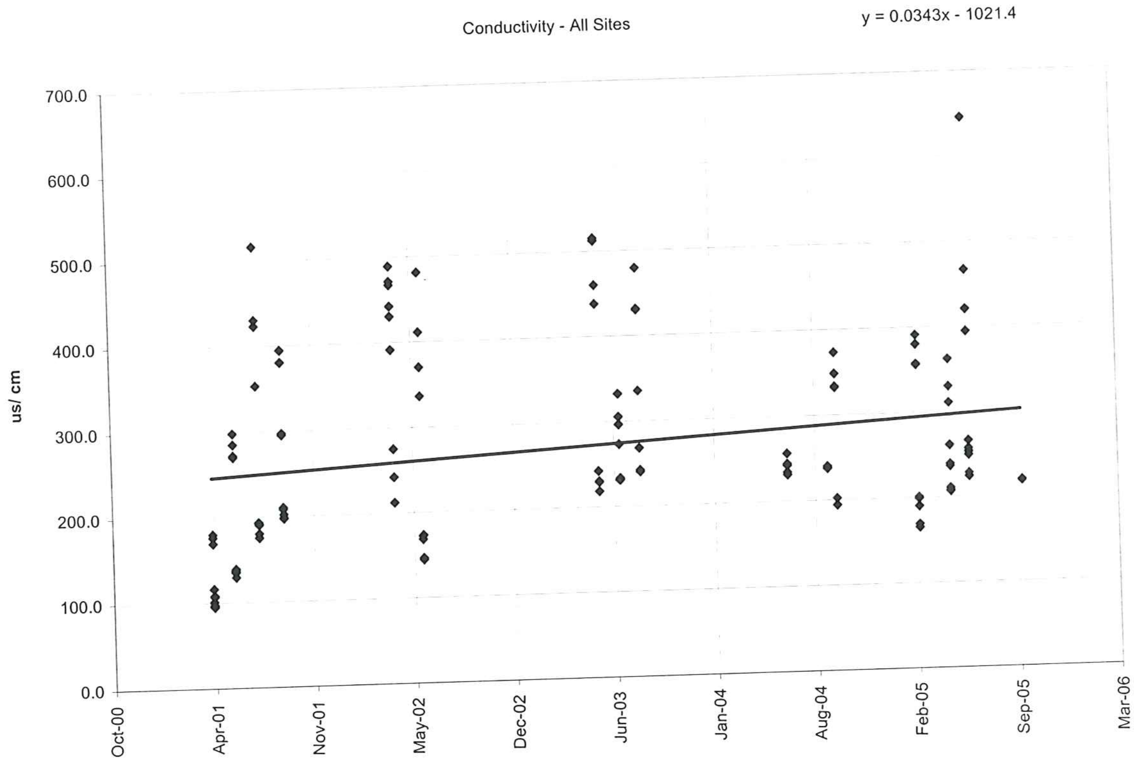
The data for conductivity appears in Figure 5. The descriptive statistics for those data appear in the table below the plotted values.

Figure 4



Statistic	Value
Average	277.17
Standard Error	13.83
Median	227.50
Mode	519.00
Standard Deviation	153.95
Sample Variance	23702.13
Kurtosis	-1.20
Skewness	0.30
Range	631.00
Minimum	6.00
Maximum	637.00
Sum	34369
Count	124

Figure 5



Statistic	Value
Average	271.84
Standard Error	9.66
Median	239.50
Mode	242.00
Standard Deviation	110.09
Sample Variance	12119.39
Kurtosis	0.15
Skewness	0.78
Range	550.00
Minimum	95.00
Maximum	645.00
Sum	35340
Count	130

Conductivity in an aqueous system is governed by the concentrations, mobility, oxidation state and other properties of dissolved ionized substances. Conductivity is also directly proportional to temperature and an approximate 2% rise in conductance of water occurs for every 1° C rise in temperature in the system. Many of the ionized substances present in natural waters (especially carbonates which also impact system pH) are leached from local and watershed soil and rocks and many more are introduced by runoff from agricultural and land development activities. Most of the nutrients from agricultural runoff are ionized.

The complex of interactions which determines conductivity tends to make individual readings highly variable. The data acquired during the subject study reflect that variability. The maximum observed was 645 uS/cm. The mean, mode and median of the values, however, are in close agreement at approximately 250 uS/cm. There is a slight downward trend in those values but the data suggest that future values for this property will be of magnitudes similar to those found during the current study.

No water quality standard for conductivity has been established by Missouri,

3.3.5 Total Suspended Solids

The data for total suspended solids appears in Figure 6.. The descriptive statistics for those data appear in the table below the plotted values.

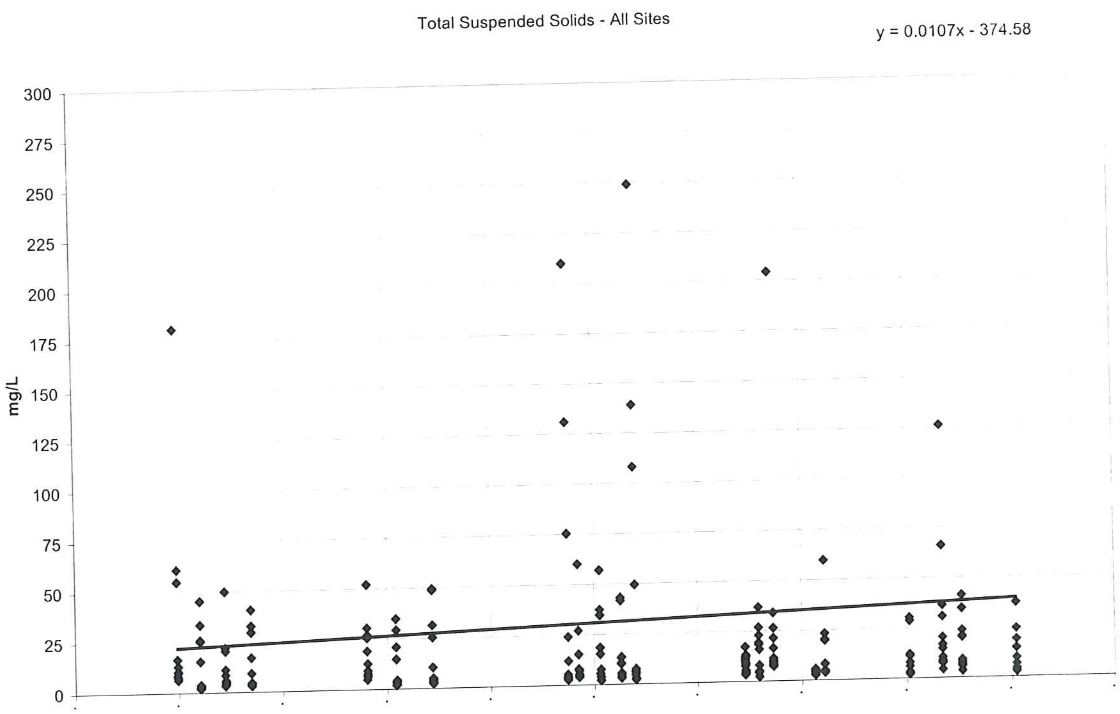
Suspended solids affect the clarity and appearance of water. In general, these solids are soil and/or plant particulates introduced to the system by local or watershed erosion or biomaterials produced by aquatic flora and fauna. Individual measurements taken at separate sites in the system are quite often highly variable because of these localized effects. The data acquired are in reasonable agreement except for four values in the range 400 to 1000 which were observed in samples from off-lake sites. Those high values do not appear in the plot. The data indicate that this property is stable and that it will remain in the range shown in the plot for the foreseeable future.

No quality water quality standard for suspended solids has been set by Missouri.

3.3.6 Volatile Suspended Solids

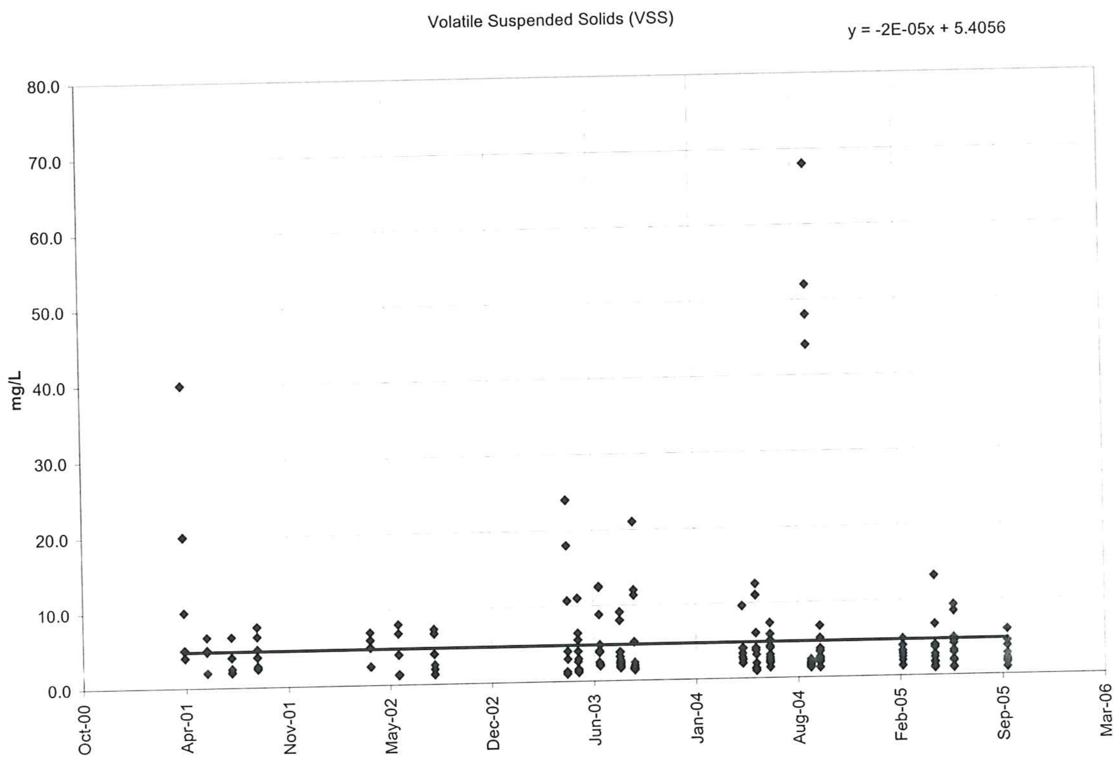
The data for volatile suspended solids appears in Figure 7.. The descriptive statistics for those data appear in the table below the plotted values.

Figure 6



Statistic	Value
Average	31.05
Standard Error	6.03
Median	8.00
Mode	3.80
Standard Deviation	94.69
Sample Variance	8966.59
Kurtosis	47.15
Skewness	6.51
Range	902.20
Minimum	1.80
Maximum	904.00
Sum	7670
Count	247

Figure 7



Statistic	Value
Average	4.79
Standard Error	0.48
Median	2.60
Mode	2.00
Standard Deviation	7.49
Sample Variance	56.16
Kurtosis	34.80
Skewness	5.45
Range	67.00
Minimum	1.00
Maximum	68.00
Sum	1184
Count	247

Volatile suspended solids are usually organic and impact on the oxygen levels as they degrade. In general, those materials were found in low concentration at levels that were approximately one quarter of total solids. The trendline is flat, indicating that the current values are stable and that future determinations will be similar in distribution and magnitude.

No quality water quality standard for volatile suspended solids has been set by Missouri.

3.3.7 Total Phosphorus

The data for total phosphorus appears in Figure 8. The descriptive statistics for those data appear in the table below the plotted values.

Phosphorus is an active nutrient. Elevated levels of the element in virtually any form (and other nutrients as well) adds to the risk of algal blooms and other problems associated with eutrophication-related water quality problems. The principal source of these materials is runoff from agricultural activities. The trendline is flat indicating that the characteristic is stable and that future data will parallel the values shown in the figure.

The average of these data exceeds the current water quality standard of Missouri (0.05 mg/L) by a factor of approximately three. Moreover, some values in the order of 20 times the prescribed level were occasionally observed . The data indicate that samples taken from locations in the watershed were the principal sources of these high values.

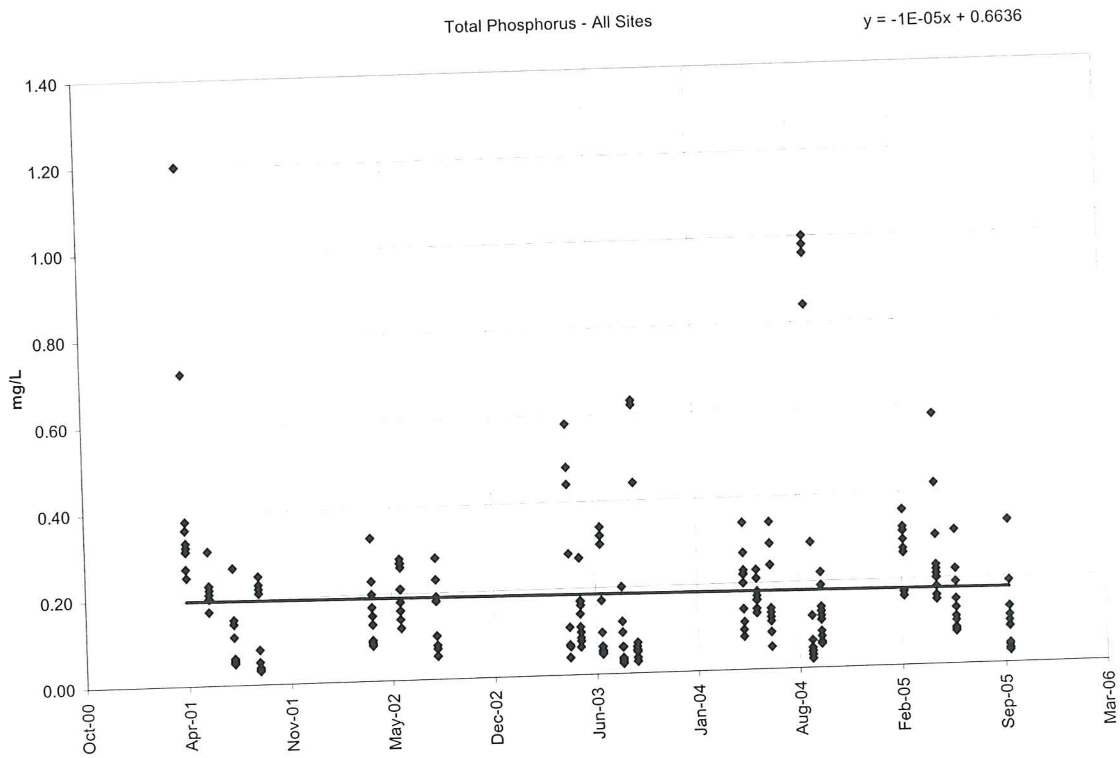
3.3.8 Soluble Phosphorus (ortho Phosphate)

The data for ortho-phosphate appears in Figure 9. The descriptive statistics for those data appear in the table below the plotted values.

The data plotted in Figure 9 show total phosphorus (Figure 8) which is in soluble form. The remarks relative to the action, environmental threat potential and origin of total phosphorus entities apply to soluble forms as well. The data indicate that the profile of the nutrient in lake waters is stable.

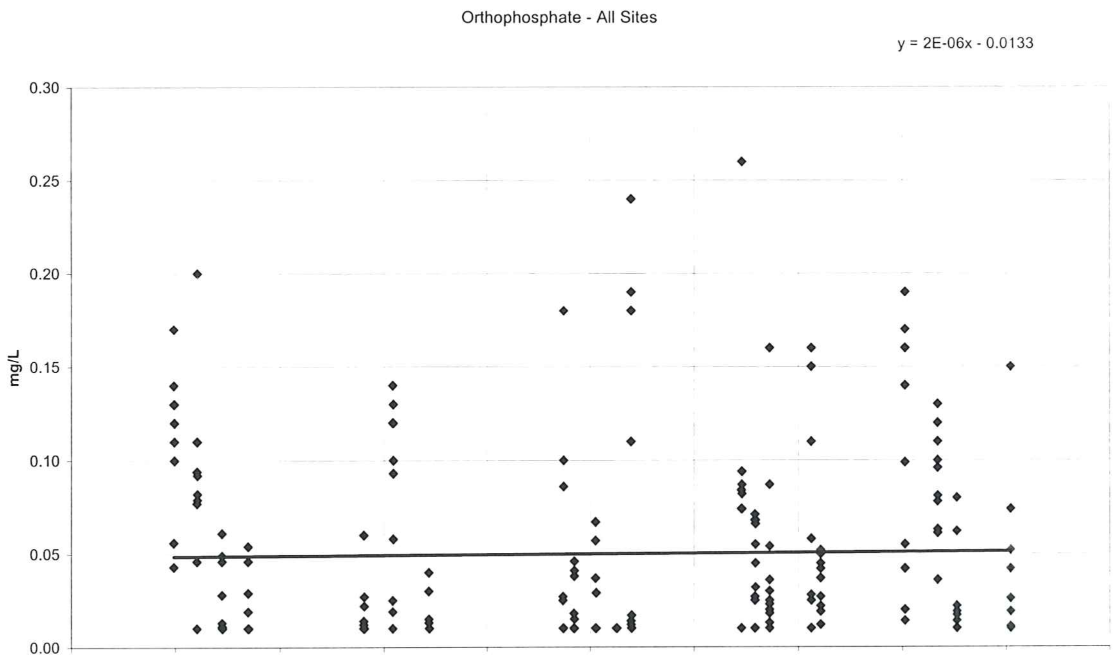
There is no water quality standard for this particular form of the nutrient set by Missouri.

Figure 8



Statistic	Value
Average	0.18
Standard Error	0.01
Median	0.15
Mode	0.11
Standard Deviation	0.17
Sample Variance	0.03
Kurtosis	10.89
Skewness	2.80
Range	1.18
Minimum	0.02
Maximum	1.20
Sum	46
Count	248

Figure 9



Statistic	Value
Average	0.050
Standard Error	0.003
Median	0.025
Mode	0.010
Standard Deviation	0.052
Sample Variance	0.003
Kurtosis	1.50
Skewness	1.42
Range	0.25
Minimum	0.010
Maximum	0.26
Sum	12
Count	249

3.3.9 Nitrate

The data for nitrate appears in Figure 10. The descriptive statistics for those data appear in the table below the plotted values.

Nitrate, like phosphorus, is an active nutrient and can have a detrimental environmental effect when it degrades to nitrite, a nutrient for algae. Nitrates may be introduced into water systems by the decay of nitrogenous organic matter or runoff from either or both agricultural or industrial sites.

The limit for finished dinking water and for groundwater set by Missouri for this nutrient is 10 mg/L. The highest observed level approached half of that value but the mean, median and mode of the data are well below it. The data show that the concentrations of this nutrient in the lake are stable and acceptable.

3.3.10 Ammonia

The data for ammonia appears in Figure 11. The descriptive statistics for those data appear in the table below the plotted values.

Like phosphorus and nitrate, ammonia is an active nutrient. It may be present in runoff from agricultural or industrial sites, may form in aqueous systems from the decay of nitrogenous wastes or may indicate the presence of improperly treated discharges from waste treatment plants. The levels of ammonia observed in lake samples are acceptable and stable.

Missouri regulations for this compound are aimed at protection of aquatic life and based on pH values and temperature in the receiving body of water. The typical levels for those parameters and the concentrations of ammonia found in lake waters are well within Missouri water quality standards.

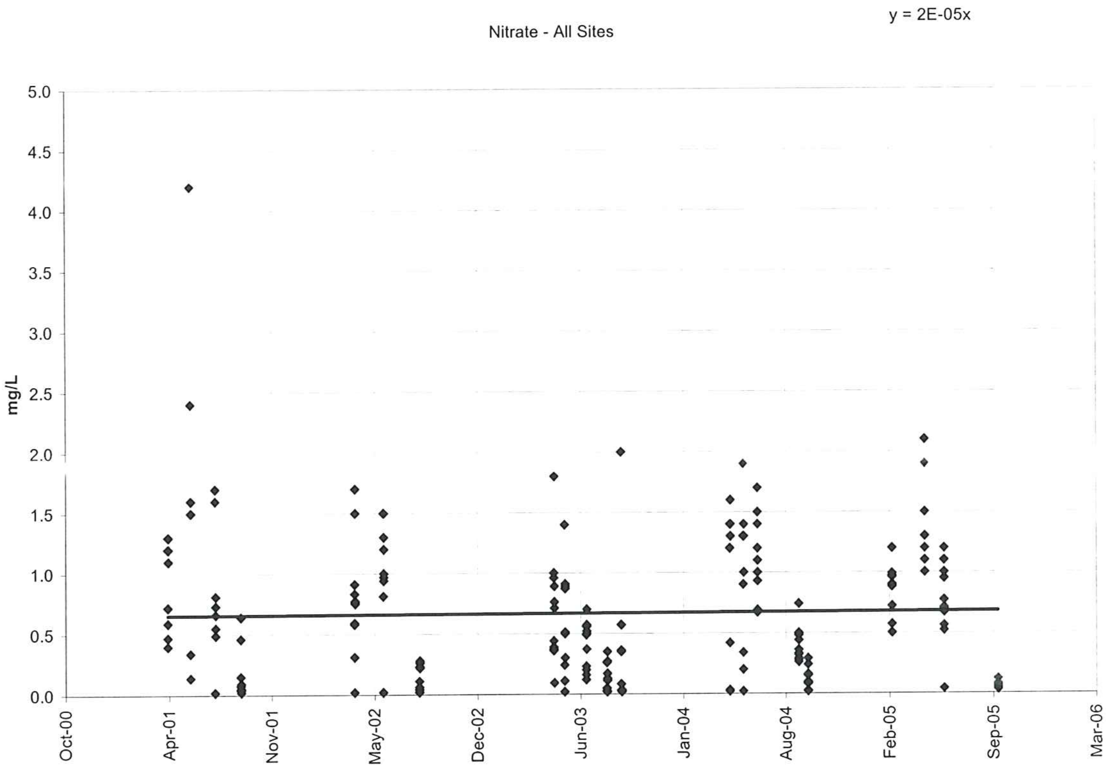
3.3.11 Manganese

Manganese was evaluated in samples collected from three sites. The data are plotted in Figure 12. Statistics calculated from the data appear in the table below the chart.

Manganese was observed in all samples. The median and mode of observed data were approximately 0.04 mg/L and all but 6 values were 0.15 mg/L or less. The level of the metal in lake waters is stable.

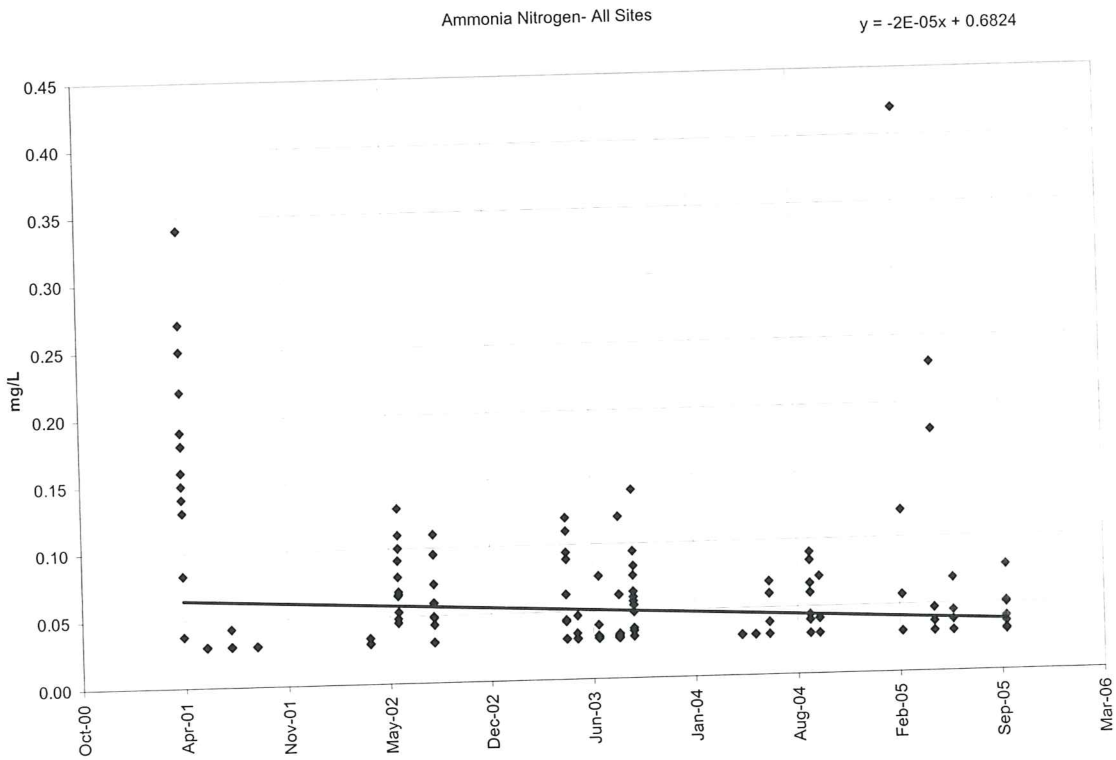
The regulatory limit for manganese in ground water set by Missouri is 0.05 mg/L. A secondary maximum contaminant level (SMCL) for manganese in drinking water at the same level has been set by Federal Clean Water Act standards. SMCL values are set on aesthetic grounds and imply no health hazard.

Figure 10



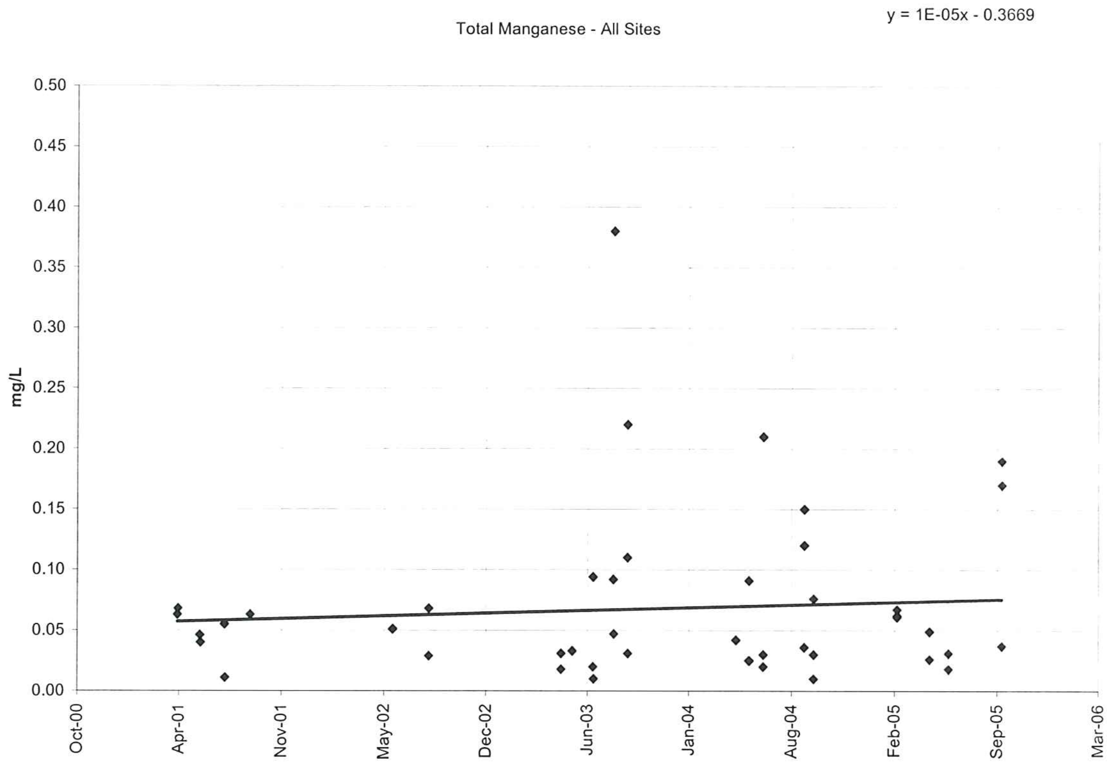
Statistic	Value
Average	0.669
Standard Error	0.038
Median	0.520
Mode	0.020
Standard Deviation	0.596
Sample Variance	0.355
Kurtosis	3.76
Skewness	1.24
Range	4.18
Minimum	0.020
Maximum	4.20
Sum	167
Count	249

Figure 11



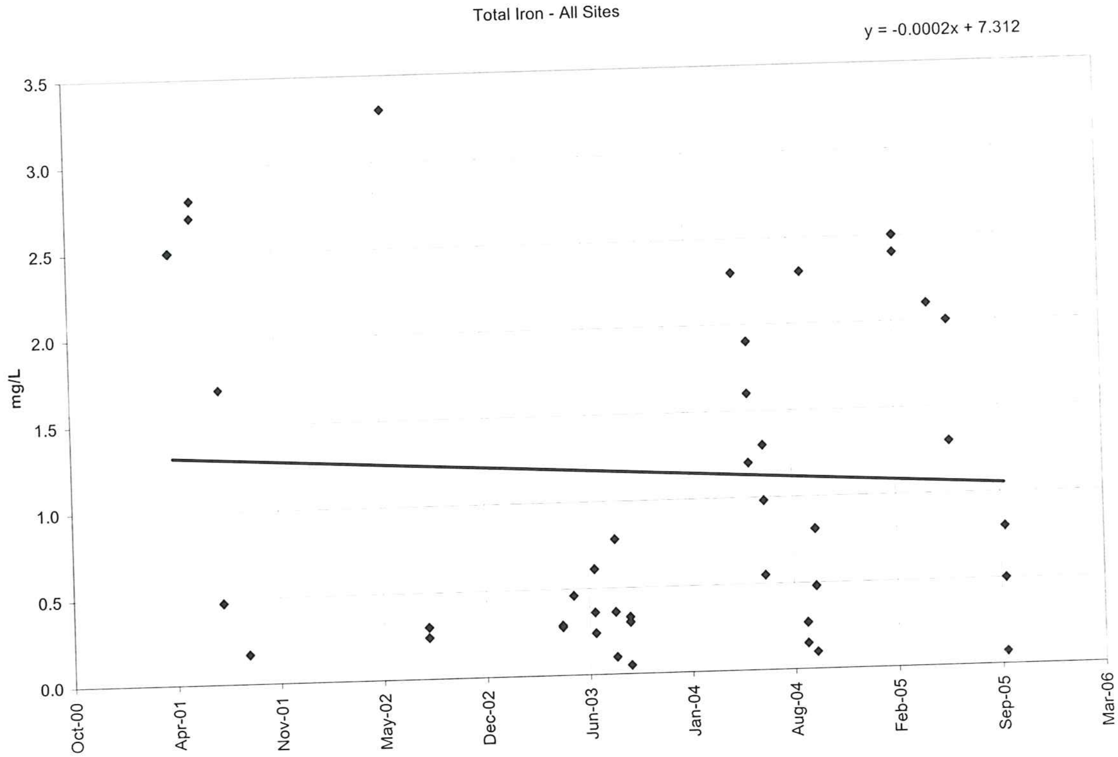
Statistic	Value
Average	0.051
Standard Error	0.003
Median	0.030
Mode	0.030
Standard Deviation	0.049
Sample Variance	0.002
Kurtosis	20.36
Skewness	4.01
Range	0.31
Minimum	0.030
Maximum	0.42
Sum	13
Count	249

Figure 12



Statistic	Value
Average	0.068
Standard Error	0.010
Median	0.046
Mode	0.031
Standard Deviation	0.070
Sample Variance	0.005
Kurtosis	8.23
Skewness	2.58
Range	0.37
Minimum	0.010
Maximum	0.38
Sum	3
Count	47

Figure 13



Statistic	Value
Average	1.156
Standard Error	0.140
Median	0.800
Mode	2.500
Standard Deviation	0.958
Sample Variance	0.918
Kurtosis	-1.17
Skewness	0.53
Range	3.25
Minimum	0.050
Maximum	3.30
Sum	54
Count	47

3.3.12 Iron

Iron was evaluated in samples collected from three sites. The data are plotted in Figure 13 and statistics calculated from them appear in the table below the chart.

Iron was detected in all samples but one. Although a concentration of 2.5 mg/L was the most frequently observed value the mean and median of the acquired data were less than half of the level, indicating that the preponderance of the values were lower . The data indicate the iron concentrations in lake waters are stable.

The Missouri regulatory limits for protection of aquatic life and groundwater are 1 mg/L and 0.3 mg/L, respectively. The secondary maximum contaminant level (SMCL) for iron in drinking water set by federal standards is 0.3 mg/L. SMCL values are set on aesthetic grounds and imply no health hazard.

3.3.13 Alachlor

The data for Alachlor at all sites appears in Figure 14.

A total of 160 samples were evaluated for the pre-emergence herbicide, Alachlor. All values observed except one were less than the detection limit (approximately 0.05 ug/L. The single high value observed was approximately 1.9 ug/L and it is included in the plot of the data along with reporting limit. By convention, non-detects are plotted data at the reporting limits. These varied from sample to sample between 1.0 and 1.3 ug/L dependent on the volume available for analysis. The data did not support use of a trendline and no descriptive statistics appear below the plotted values.

Because this compound is suspected to be carcinogenic a low regulatory limit of 2 ug/L has been set by the USEPA for drinking waters. Missouri quality standards for both drinking and ground waters are set at the same level.

3.3.14 Atrazine

The data for Atrazine at all sites appears in Figure 15. The descriptive statistics for those data appear in the table below the plotted values.

A total of 104 samples were analyzed for the herbicide, Atrazine. The compound was detected in 80 of those samples. Of those 18 were above the regulatory limit of 3 ug/L set by Missouri and the USEPA, some by a factor of two or more. Half of the remaining values were less than the reporting limit (approximately 1 ug/L) but greater than the detection limit (0.4 ug/L).

Figure 14

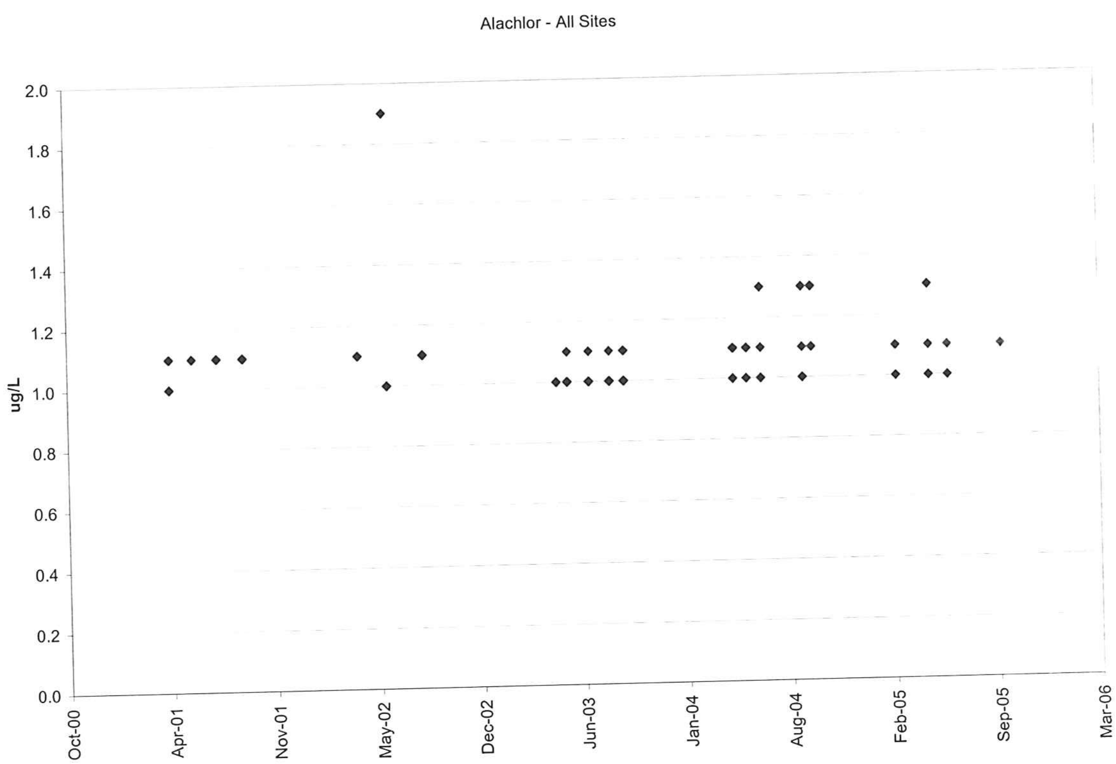
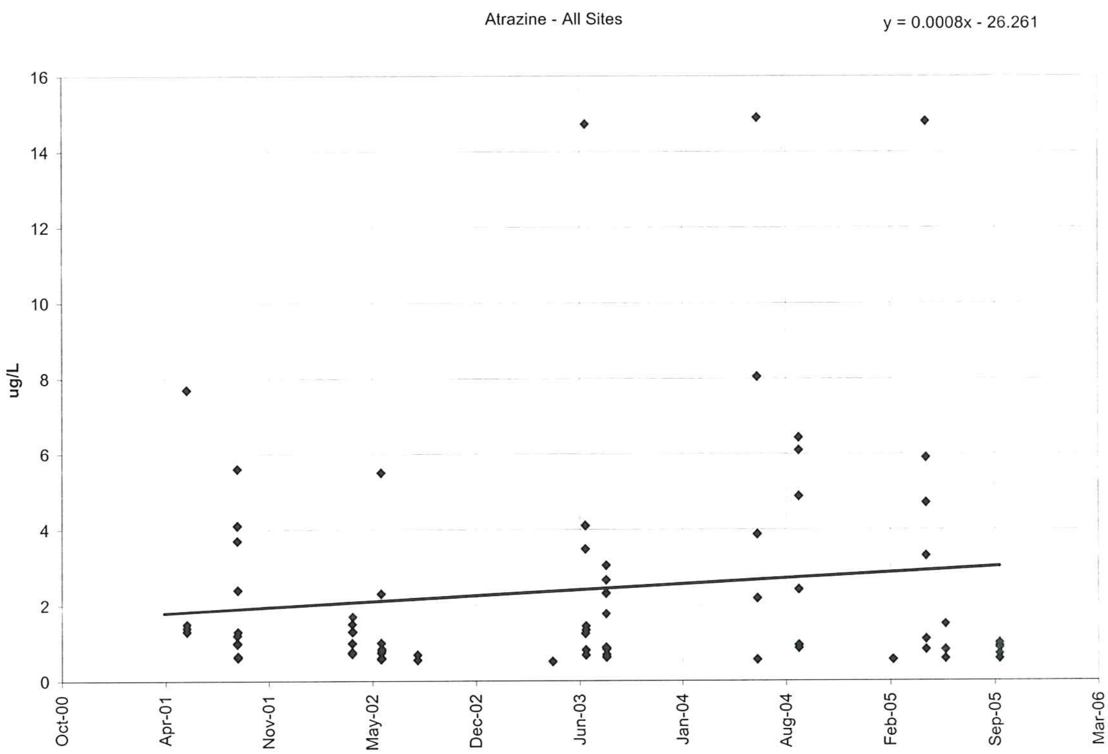

Alachlor - All Sites
ug/L
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Oct-00
Apr-01
Nov-01
May-02
Dec-02
Jun-03
Jan-04
Aug-04
Feb-05
Sep-05
Mar-06

Figure 15



Statistic	Value
Average	2.369
Standard Error	0.336
Median	1.100
Mode	1.000
Standard Deviation	3.025
Sample Variance	9.152
Kurtosis	8.94
Skewness	2.87
Range	14.39
Minimum	0.510
Maximum	14.90
Sum	192
Count	81

3.3.15 Chlorophyll

The data for chlorophyll at all sites appears in Figure 16. The descriptive statistics for those data appear in the table below the plotted values.

Chlorophyll is the photosynthetic pigment present in all plant except the fungi and bacteria. There are three forms of the pigment, chlorophyll A, B and C. The concentration of chlorophyll is an indicator of the rate of formation of organic carbon in the plant bodies from atmospheric carbon dioxide.

There is no regulatory limit for chlorophyll. The mean and median values for the property were within a few points and there was an increasing trendline in the data. Evaluation of data indicates an increase in primary productivity in lake waters.

3.3.16 Pheophytin

The data for pheophytin at all sites appears in Figure 17.

Pheophytin is a photosynthetic pigment and degradation product of chlorophyll. The material was never detected in any of the samples evaluated. The non-detects are plotted at the method reporting limit (5 mg/cubic meter) in Figure 17. No descriptive statistics for those data were calculated.

There is no regulatory limit for the compound.

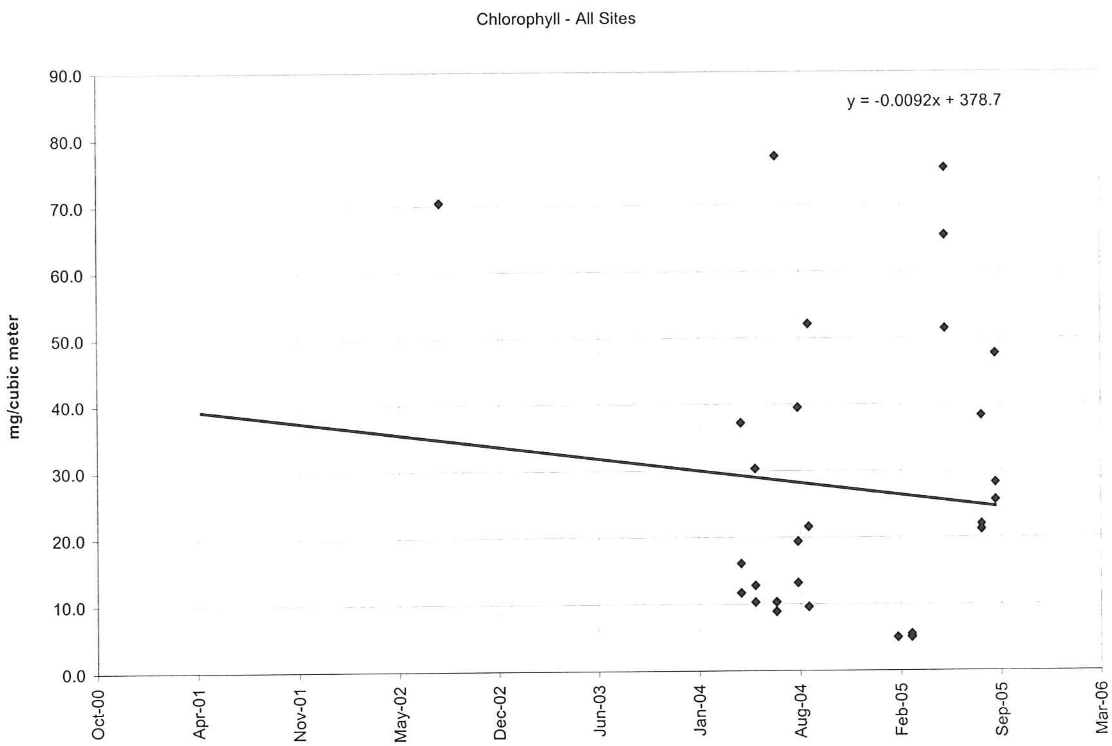
3.3.17 Total Organic Carbon

The data for total organic carbon at all sites appears in Figure 18. The descriptive statistics for those data appear in the table below the plotted values.

Total organic carbon measurements are important in water quality monitoring. The measurement provides an index for estimating the levels of toxins, teratogens and other organic materials which may increase the demand for available oxygen in the system.

The values observed at all sites during the current study were an average of 6.9 and a median of 6.4 mg/L. These data strongly suggest that all aspects of dealing with organic materials in Mark Twain Lake are stable and healthy. There is no regulatory limit set for this property

Figure 16



Statistic	Value
Average	26.96
Standard Error	3.30
Median	21.30
Mode	5.00
Standard Deviation	21.12
Sample Variance	445.89
Kurtosis	-0.09
Skewness	0.91
Range	72.30
Minimum	5.00
Maximum	77.30
Sum	1105.30
Count	41

Figure 17

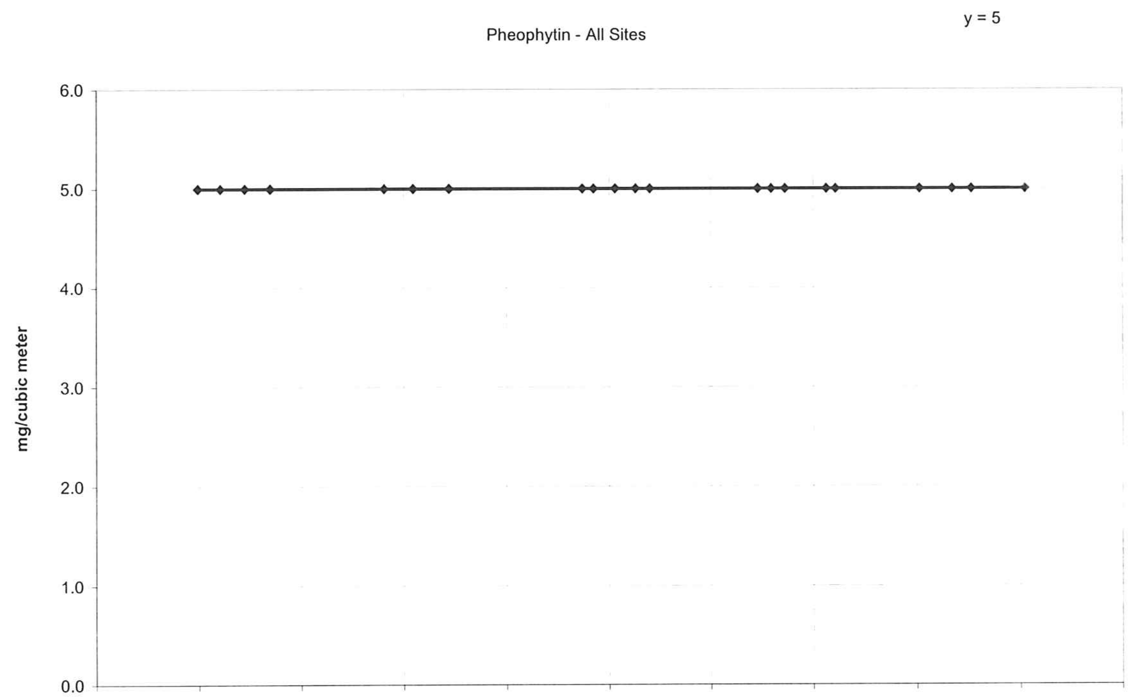
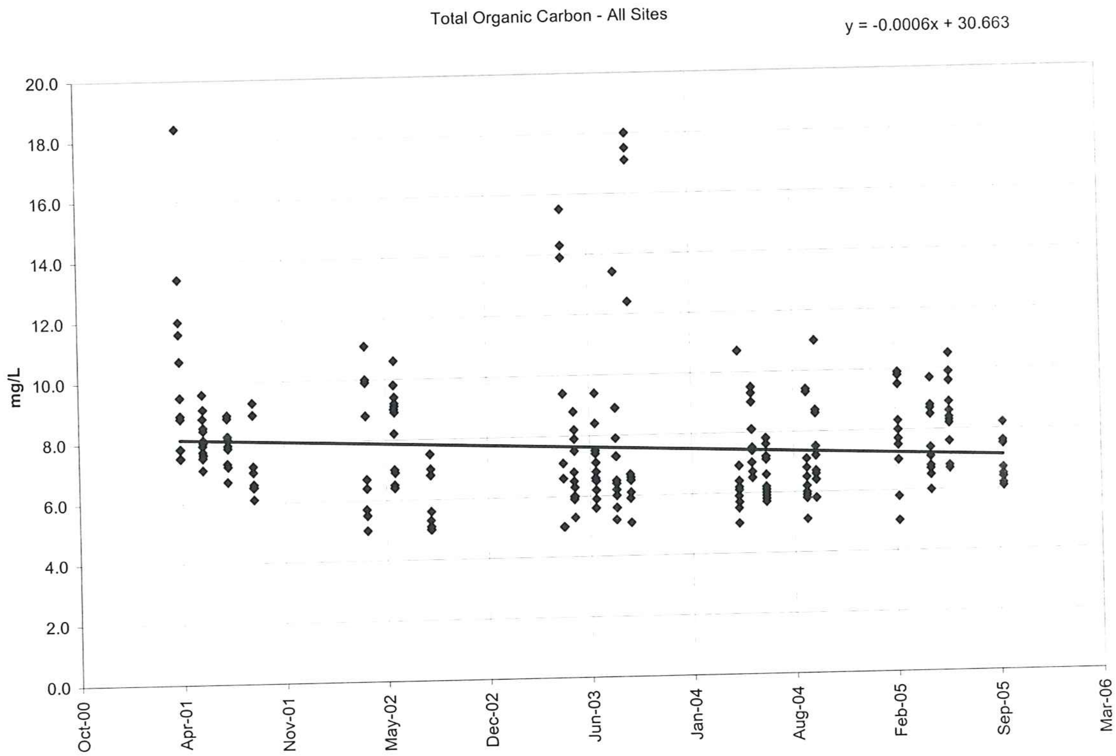


Figure 18

d



Statistic	Value
Average	6.62
Standard Error	0.25
Median	5.10
Mode	5.00
Standard Deviation	2.77
Sample Variance	7.673
Kurtosis	3.63
Skewness	2.01
Range	13.40
Minimum	5.00
Maximum	18.40
Sum	814.00
Count	123

3.4 Individual Sites

3.4.1 Overview

Surface waters from six sites on the lake proper and subsurface water from one of those sites were evaluated during performance of the subject study. Samples of streams in the watershed of the lake were also evaluated. The known locations of all sites are shown in Figure 1 and summarized in the table below.

Lake			Watershed	
Site Number	Location		Site Number	Location
MTL-1	Surface water. At dam		MTL-5	South
MTL-15-0	Surface water. Lake center		MTL-8	Southwest
MTL-22-0	Surface water. Locale Unspecified		MTL-9	West
MTL-22-15	Subsurface water. Locale unspecified		MTL-11	Northwest
MTL-33-0	Surface water. SE arm		MTL-12	Northeast
MTL-66-0	Surface water. Lake center		---	---
MTL-77-0	Surface water. Lake center		---	---

In the text below the data are compared between sites and to the values found at all sites. Plots of the levels found for properties evaluated at each site appear in Appendix 1. Except for data on iron and manganese concentration, there are three page of charts (four charts per page) for each water quality characteristic evaluated. In those case where no samples were taken, a blank chart appears. Two statistics (average and median) calculated from the data collected at each site for each parameter appear in Table 2.

As review of that table and the plots of the data acquired during the study shows water quality values in samples taken from the body of the lake were generally nominal. The exceptions to that trend are noted in the paragraphs below. Those exceptions are often associated with the values found in the watershed samples identified in the table above.

3.4.2 Chemical/Physical Properties

3.4.2.1 Dissolved Oxygen

The profile of dissolved oxygen was similar at all. Mean and median levels were in reasonable agreement and trend lines were essentially flat

3.4.2.2 pH

The profile of pH was also reasonably constant at all sites although two abnormally acidic values were observed at Site 1-0. In all cases, trend lines were flat.

Table 2 – Site Specific Statistics

		MTL-1	MTL-15-0	MTL-22-0	MTL-22-15	MTL-33-0	MTL-66-0
Dissolved Oxygen	mean	6.57	---	8.0	---	8.19	7.86
	median	7.15	---	8.7	---	8.41	8.26
pH	mean	7.57	---	8.14	---	8.25	8.00
	median	7.68	---	8.30	---	8.13	8.1
ORP	mean	319	---	246	---	239	234
	median	294	---	180	---	229	180
Conductivity	mean	211	---	203	---	192	207
	median	205	---	220	---	207	218
TSS	mean	5.2	6.6	4.2	4.8	5.0	7.2
	median	4.2	5.2	3.8	3.7	4.6	5.8
VSS	mean	2.2	2.4	2.0	1.9	2.2	2.5
	median	2.0	2.3	1.9	1.9	2.2	2.4
Total Phosphorus	mean	0.13	0.13	0.11	0.12	0.11	0.13
	median	0.09	0.11	0.08	0.12	0.08	0.11
Soluble Phosphorus	mean	0.051	0.045	0.042	0.053	0.043	0.051
	median	0.022	0.027	0.012	0.046	0.010	0.027
Nitrate	mean	0.78	0.69	0.72	0.84	0.66	0.76
	median	0.69	0.75	0.73	0.89	0.52	0.89
Ammonia	mean	0.045	0.048	0.045	0.047	0.047	0.054
	median	0.030	0.030	0.030	0.030	0.030	0.030
Manganese	mean	0.059	---	---	0.057	---	---
	median	0.046	---	---	0.031	---	---
Iron	mean	1.13	---	---	1.17	---	---
	median	0.55	---	---	0.78	---	---
Alachlor	mean	---	---	---	---	---	---
	median	---	---	---	---	---	---
Atrazine	mean	0.8	1.3	0.8	---	1.0	0.9
	median	0.7	1.1	0.7	---	0.8	0.9
Chlorophyll	mean	---	6.4	6.7	---	6.5	7.1
	median	---	5.2	5.0	---	5.0	5.0
Pheophytin	mean	---	---	---	---	---	---
	median	---	---	---	---	---	---
TOC	mean	6.8	7.5	6.5	6.6	6.6	7.5
	median	6.5	7.1	6.3	6.4	6.4	7.1

Table 2 (continued) – Site Specific Statistics

		MTL-77-0	MTL-5	MTL-8	MTL-9	MTL-11	MTL-12
Dissolved Oxygen	mean	8.0	8.7	8.1	7.5	7.4	7.6
	median	8.3	8.9	8.2	7.5	7.3	7.7
pH	mean	8.04	7.80	7.76	7.73	7.82	7.82
	median	8.09	7.69	7.85	7.9	7.78	7.8
ORP	mean	236	321	323	317	262	296
	median	169	283	298	289	197	253
Conductivity	mean	208	372	375	346	359	243
	median	230	333	391	336	380	208
TSS	mean	6.8	80	70	64	99	15
	median	5.6	31	24	26	43	14
VSS	mean	2.4	10.0	9.0	7.7	11.0	3.6
	median	2.1	6.4	5.0	4.8	7.3	3.8
Total Phosphorus	mean	0.14	0.31	0.29	0.25	0.31	0.16
	median	0.12	0.28	0.18	0.19	0.23	0.14
Soluble Phosphorus	mean	0.048	0.083	0.061	0.037	0.045	0.042
	median	0.022	0.057	0.046	0.025	0.030	0.019
Nitrate	mean	0.78	0.97	0.56	0.39	0.31	0.59
	median	0.89	0.72	0.42	0.34	0.14	0.49
Ammonia	mean	0.054	0.061	0.052	0.044	0.060	0.050
	median	0.030	0.038	0.030	0.030	0.030	0.030
Manganese	mean	---	---	---	---	---	0.102
	median	---	---	---	---	---	0.092
Iron	mean	---	---	---	---	---	1.17
	median	---	---	---	---	---	0.98
Alachlor	mean	---	---	---	---	---	---
	median	---	---	---	---	---	---
Atrazine	mean	0.8	6.3	2.9	3.0	3.2	1.0
	median	0.8	4.1	1.8	2.8	3.1	1.0
Chlorophyll	mean	6.36	---	---	---	---	---
	median	5	---	---	---	---	---
Pheophytin	mean	---	---	---	---	---	---
	median	---	---	---	---	---	---
TOC	mean	7.1	8.6	8.8	9.1	8.7	7.2
	median	6.7	8.5	7.9	8.8	8.1	6.7

3.4.2.3 Oxidation Reduction Potential (ORP)

Over the course of the study there was a marked decrease in the readings taken at all sites, both when all readings are combined or considered at each individual site. In addition to that trend there were also variations related to the months when samples were taken as shown in the table of readings (in millivolts) shown below.

	Feb	Apr	May	Jun	Jul	Aug	Sep
Mean	123	420	240	278	299	142	280
median	123	509	201	269	208	144	341

This property is non-specific in that, like conductivity, it is related to the composition of the ions present in solution and their respective oxidation state, activity and mobility.

3.4.2.4 Conductivity

Trend lines rose slightly for all sites. Excepting MTL-12, readings in all watershed sites were approximately 50% higher than the values observed at on-lake sites. There was a slight rise in readings taken at all sites each month to a peak of approximately 300 uS/cm in August. The higher readings in watershed sites may be related to increased agricultural or land development activities in the areas drained.

3.4.3 Total and Volatile Suspended Solids

As shown in the table below, suspended solids values of both kinds were reasonable and in general agreement for sites located in the same general areas. Again excepting MTL-12, values observed for both TSS and VSS in samples taken in all watershed sites were approximately an order of magnitude higher than those found in samples taken at on-lake sites. In some cases very high levels of TSS (400 to 1000 mg/L) were observed in watershed sites. These values are off scale in the plots of TSS observed at Sites MTL-5, -8 and -11. Trend lines are not shown on these plots because of the distortion in slope caused by the off scale values.

3.4.4 Nutrients

As shown in tables below, date related patterns of variation in the observed levels of some nutrients were noted in the data acquired during the study. These variations may be related to agricultural activity in the area.

3.4.4.1 Phosphorus

As already noted, total phosphorus values in all locations in the lake are above Missouri water quality standards by factors of five or more. These high levels were observed in all samples from all sites. As noted in the table below, the readings in late winter and early spring were higher than those in late spring and summer months. The levels observed are most likely due to agricultural practices in the area.

	Feb	Apr	May	Jun	Jul	Aug	Sep
Mean	0.28	0.26	0.18	0.17	0.12	0.19	0.14
Median	0.29	0.22	0.17	0.15	0.06	0.07	0.07

3.4.4.2 Nitrate

Levels of this compound in lake pose no threat to overall water quality in the lake. Although average and median levels were higher in the off-lake sites, the distribution of results was generally the same at all sites. It is noteworthy that the trend noted for time-related changes in total phosphorus concentration is repeated for nitrate. As shown in the table below, the highest values were found in the period February through June with the amounts decreasing steadily thereafter. Again, the changes are most probably associated with seasonal agricultural practices.

	Feb	Apr	May	Jun	Jul	Aug	Sep
Mean	0.88	1.03	0.97	0.94	0.50	0.24	0.16
Median	0.93	1.20	0.90	1.00	0.50	0.26	0.06

3.4.4.3 Ammonia

Levels of this compound in lake pose no threat to overall water quality in the lake. There was general agreement in the levels found in all sites in all years of the study. A cyclic trend was noted in the observed concentrations with a high levels in February and May followed by steadily declining levels in the intervening months. The most probable cause for those changes is seasonal agricultural practices.

	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Mean	0.12	0.070	0.042	0.169	0.073	0.076	0.095	0.070
Median	0.11	0.074	0.031	0.140	0.053	0.062	0.030	0.064

3.4.4.4 Iron and Manganese

Levels of these metals were evaluated at three sites: two for the entire duration of the study and one for the last two years. The observed concentrations of both were approximately equivalent at all sites, for all years and all months studied.

3.4.5 Organics

3.4.5.1 Herbicides

The levels of the nitrogen-phosphorus herbicides Atrazine and Alachlor were evaluated in samples collected from Mark Twain Lake sites. As already noted, except for one instance (at MTL-9, June, 2002), no concentrations of Alachlor above the detection limit of 0.5 ug/L were detected in any of the samples collected. No plots of the concentrations found at individual sites were prepared

Atrazine, however, was observed in samples from several sites at concentrations above the detection limit of 0.5 ug/L but below the reporting limit of approximately 1 ug/L. The values were noted only in the months April through September. As noted in the table below, the concentrations (in ug/L) were highest in March and decreased steadily through August. The highest levels were invariably found in all of the watershed sites except MTL-12.

	Mar	Apr	May	Jun	Jul	Aug
Mean	5.02	2.79	2.483	1.28	0.62	0.62
Median	3.03	1.30	1.500	0.81	0.62	0.62

3.4.5.2 Chlorophyll/Pheophytin

During the years 2002, 2004 and 2005 Sites MTL-15, -22-0 and 66-0 were evaluated for Chlorophyll and Pheophytin. Detectible levels of chlorophyll were observed in all samples analyzed. The concentrations of the material were in reasonable agreement in all sites, at all times. No detectible levels of Pheophytin were found in any of the samples

3.4.5.3 Total Organic Carbon (TOC)

Excepting occasional high levels of TOC observed in all samples, most contained less than the minimum detectible level. That situation is reflected in the plots of these data by the heavy concentration of points at the 5 mg/L level. These was no significant difference in this property observed at any site in any particular month or year of the study

4.0 CONCLUSIONS AND RECOMMENDATIONS

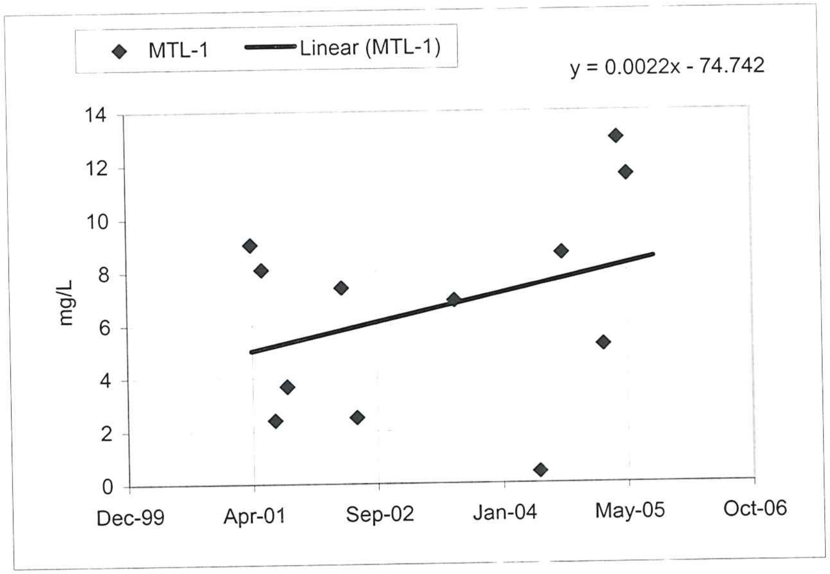
The result of the evaluations in this document are compared in the table below to those described in the referenced previous report

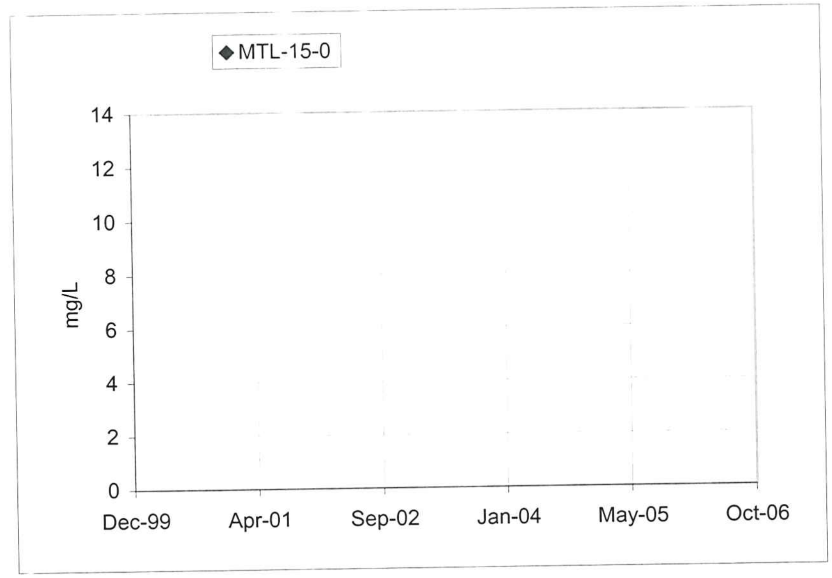
PARAMETER	TREND
Dissolved Oxygen	Stable
pH	Stable
Oxidation Reduction Potential	Improving
Conductivity	Stable
Total Suspended Solids	Stable
Volatile Suspended Solids	Stable
Total Phosphorus	Stable but high
Soluble Phosphorous (ortho-Phosphate)	Stable
Nitrate	Cyclic
Ammonia	Cyclic
Manganese	Stable
Iron	Stable
Alachlor	Stable
Atrazine	Cyclic
Chlorophyll	Stable
Pheophytin	Stable
Total Organic Carbon (TOC)	Stable

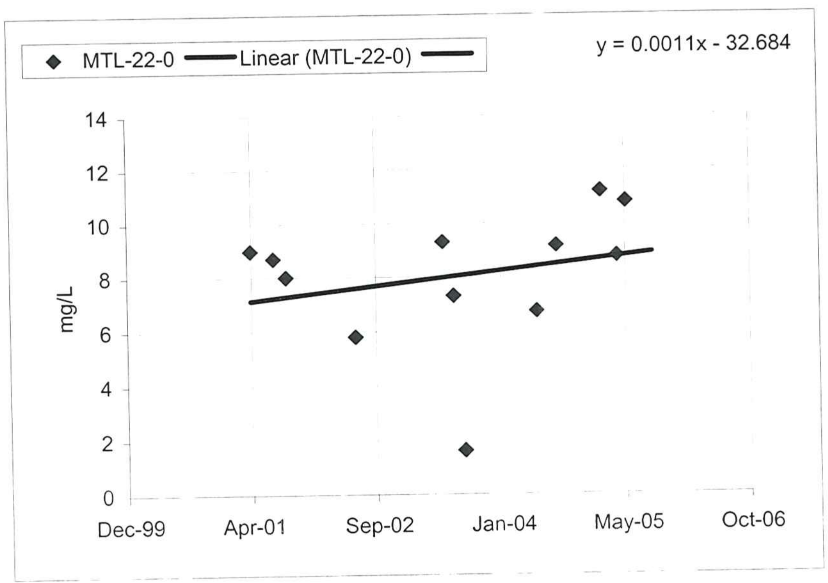
The trends noted suggest that the condition of Mark Twain Lake has improved and is stable. Efforts to achieve better control of and lower the phosphate levels in the system should be considered.

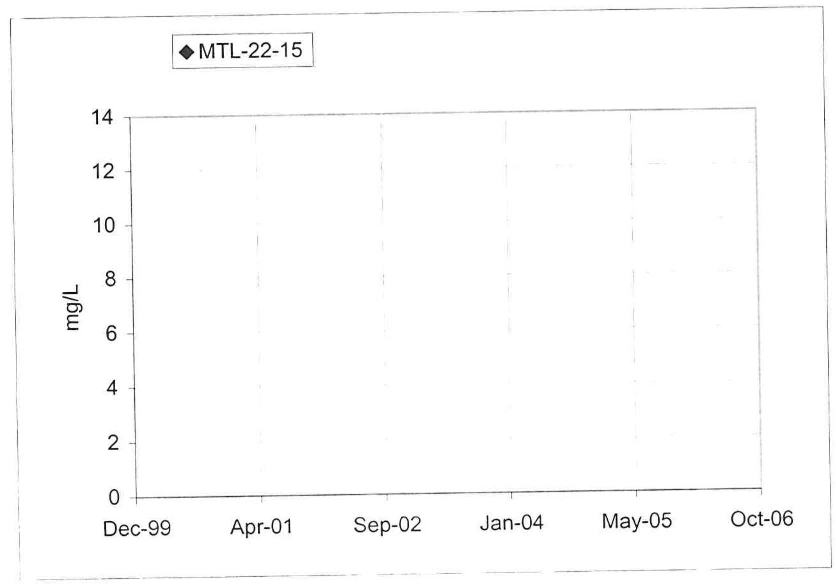
Appendix 1 – Plots of Data Collected from Individual Sample Sites

DIssolved Oxygen

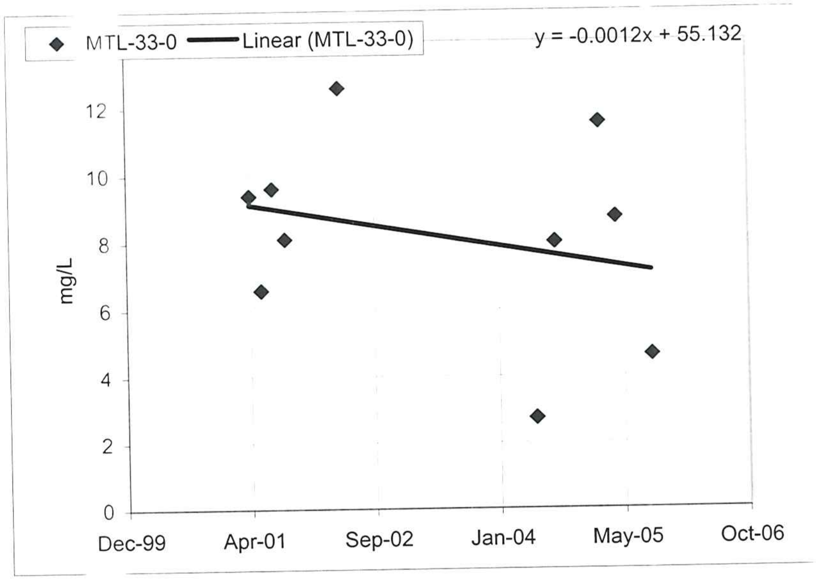


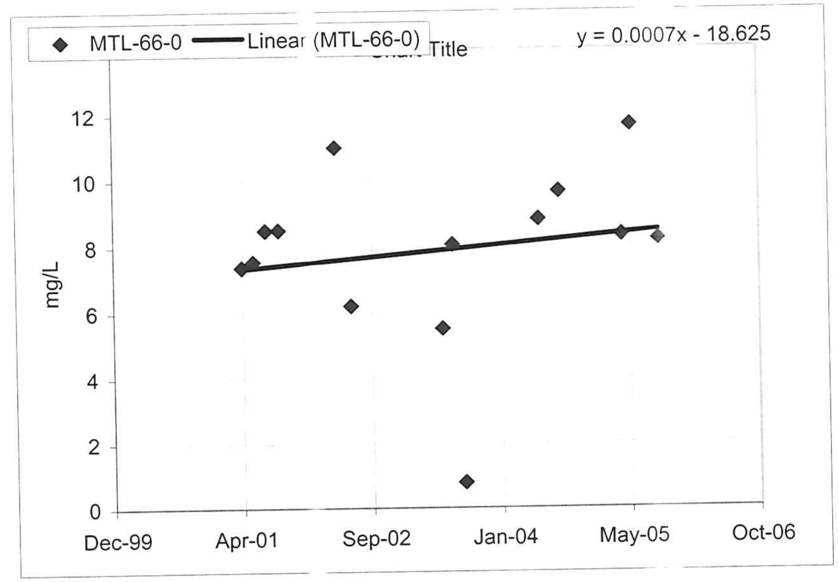


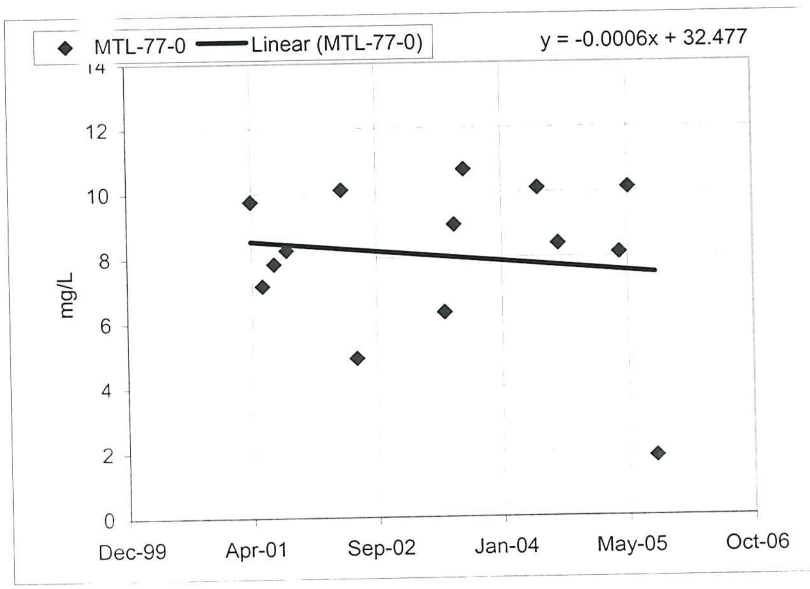


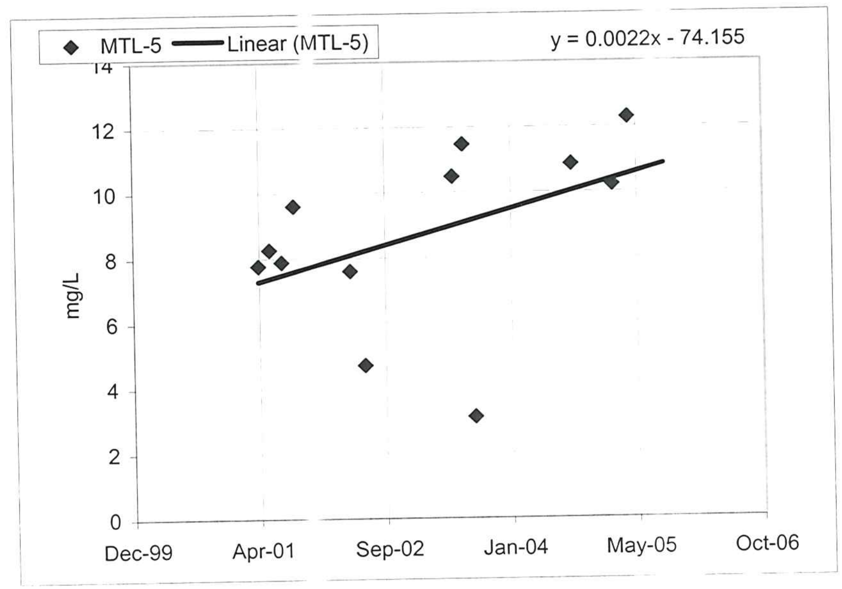


Dissolved Oxygen

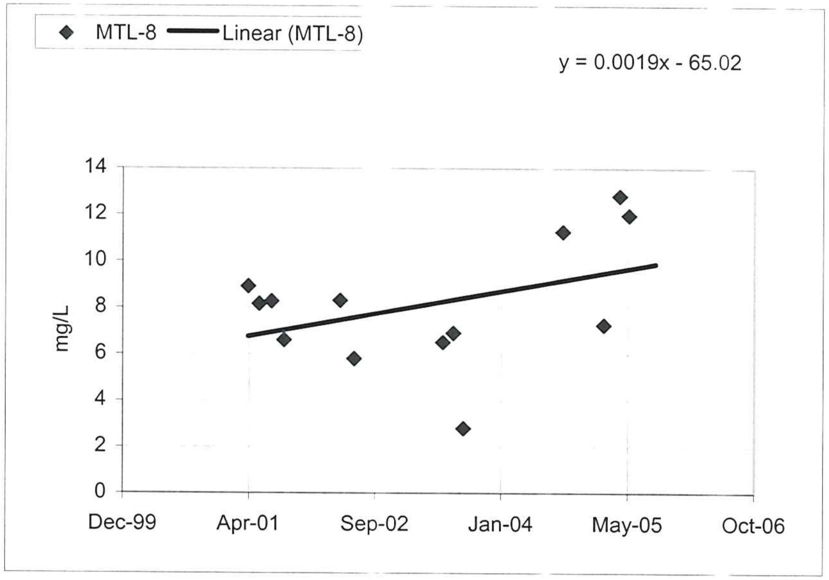


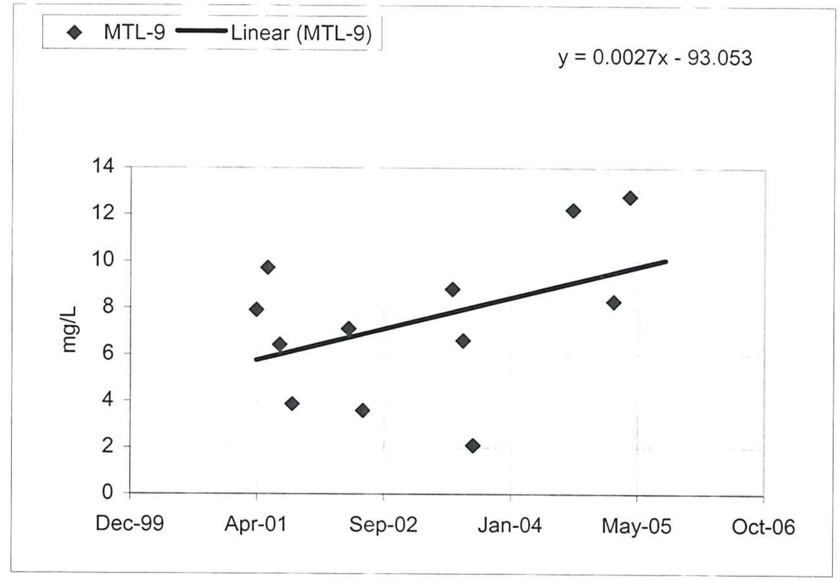


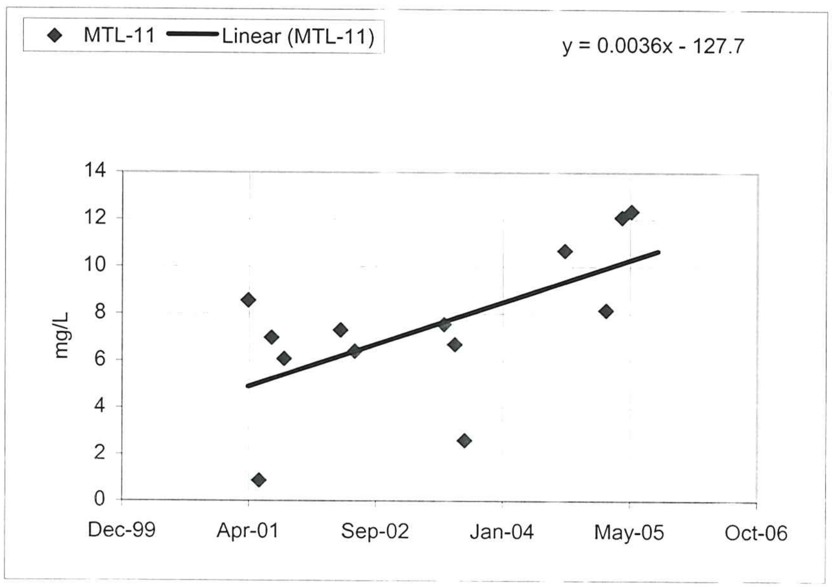


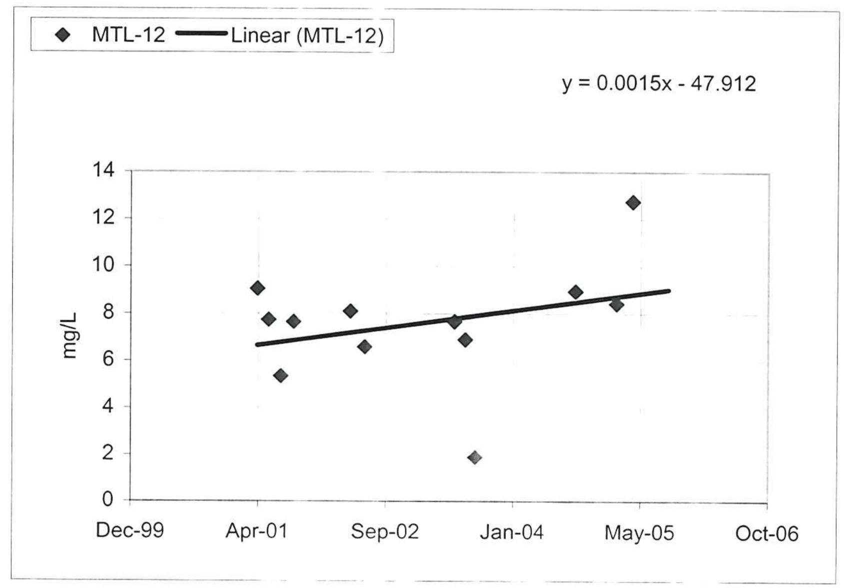


DIssolved Oxygen

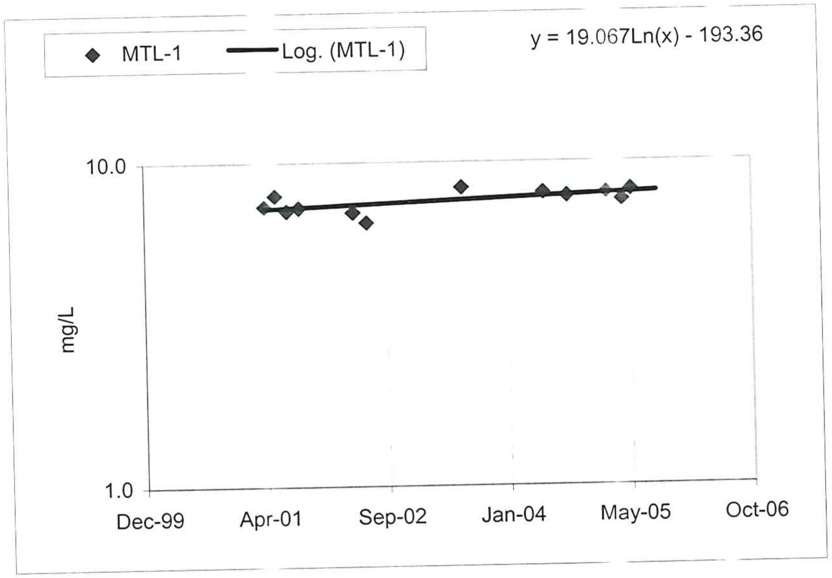




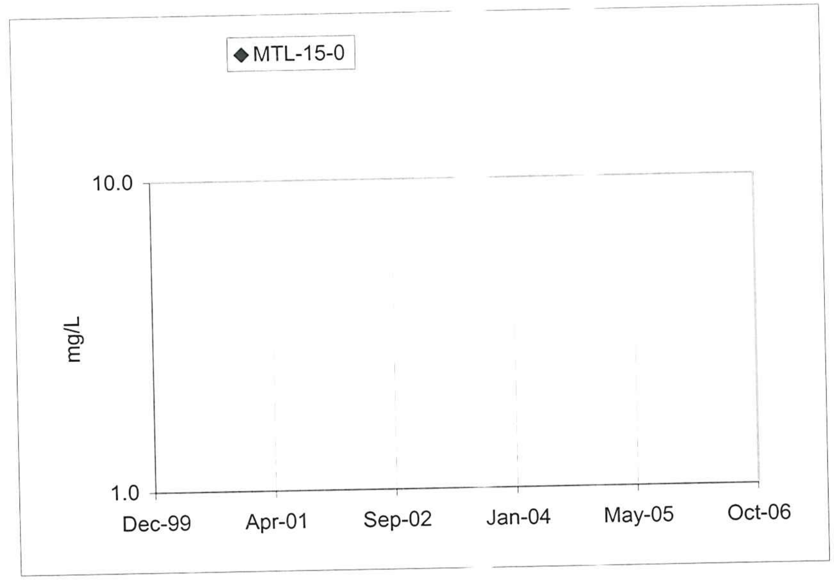




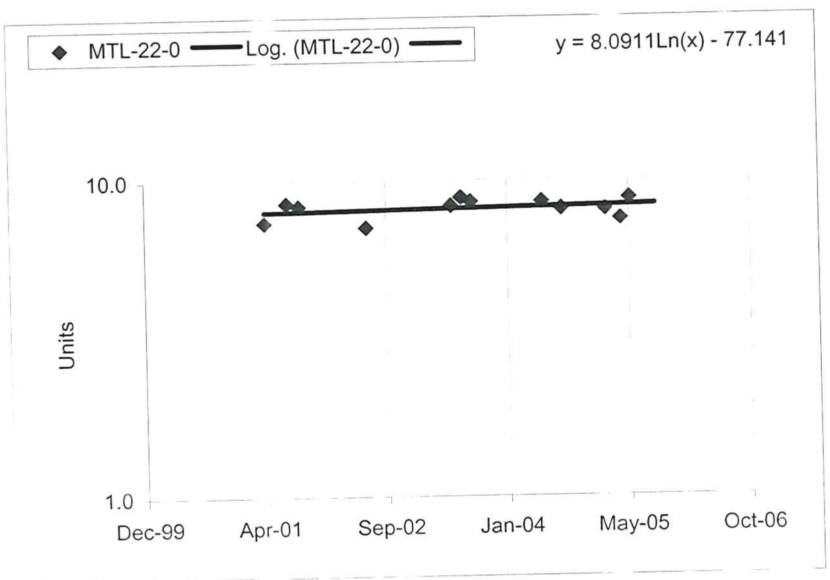
pH



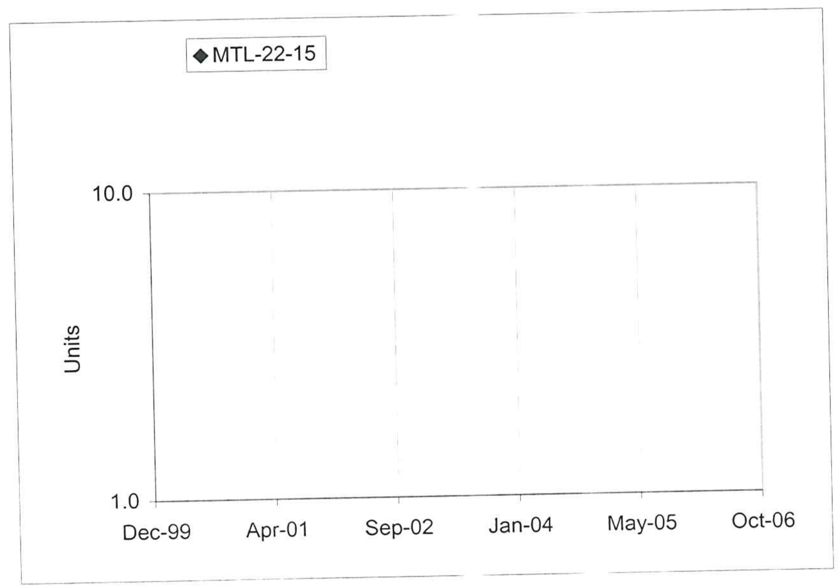
MTL-1
Log. (MTL-1)
y = 19.067Ln(x) - 193.36
10.0
1.0
mg/L
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Oct-06



MTL-15-0
10.0
1.0
mg/L
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Oct-06

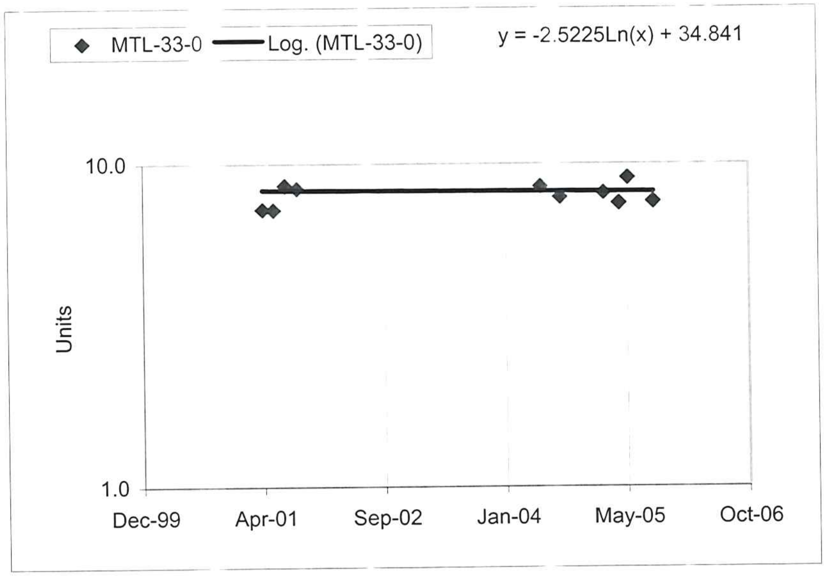


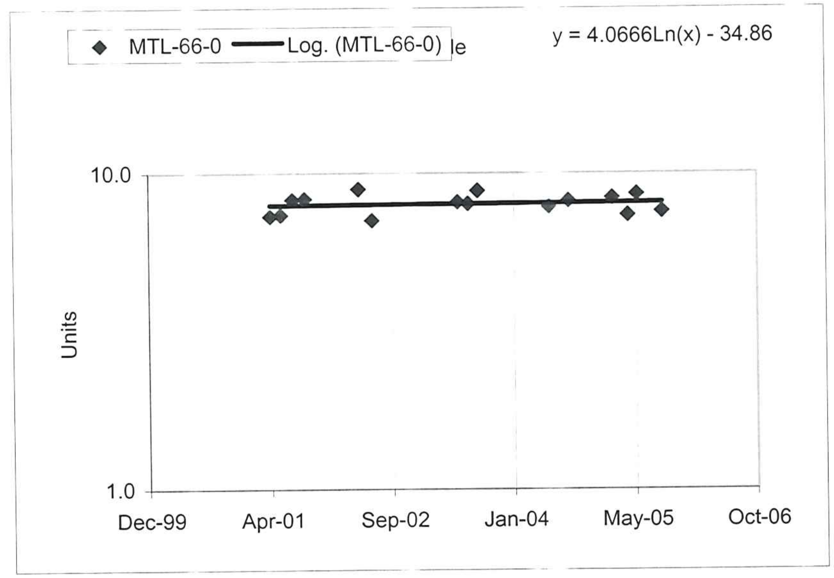
MTL-22-0
Log. (MTL-22-0)
y = 8.0911Ln(x) - 77.141
10.0
1.0
Units
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Oct-06

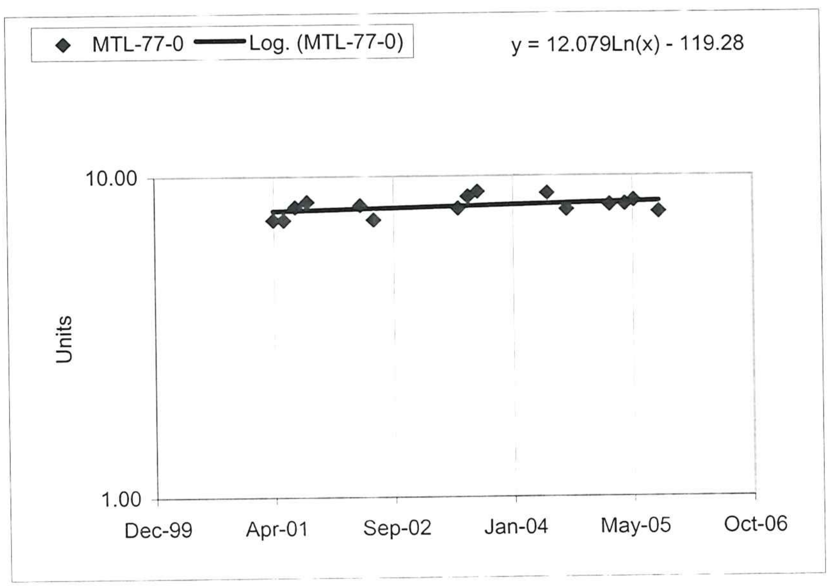


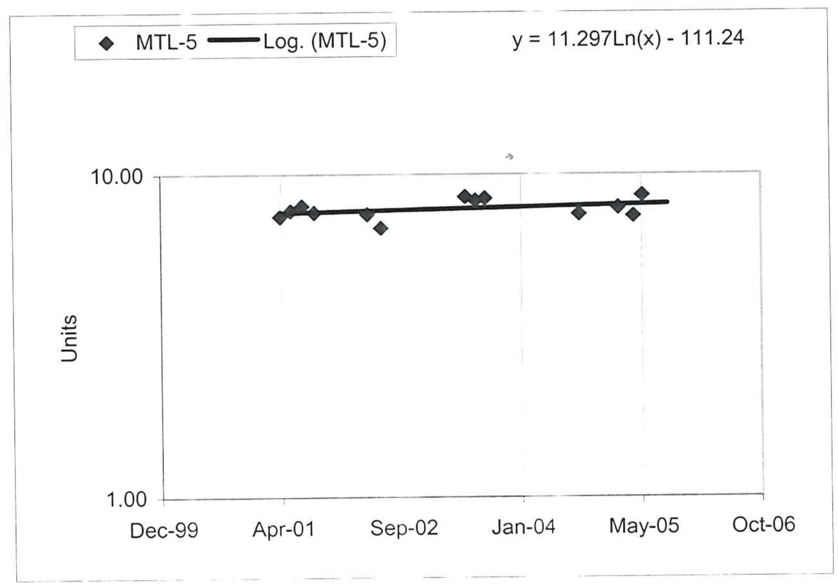
MTL-22-15
10.0
1.0
Units
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Oct-06

pH

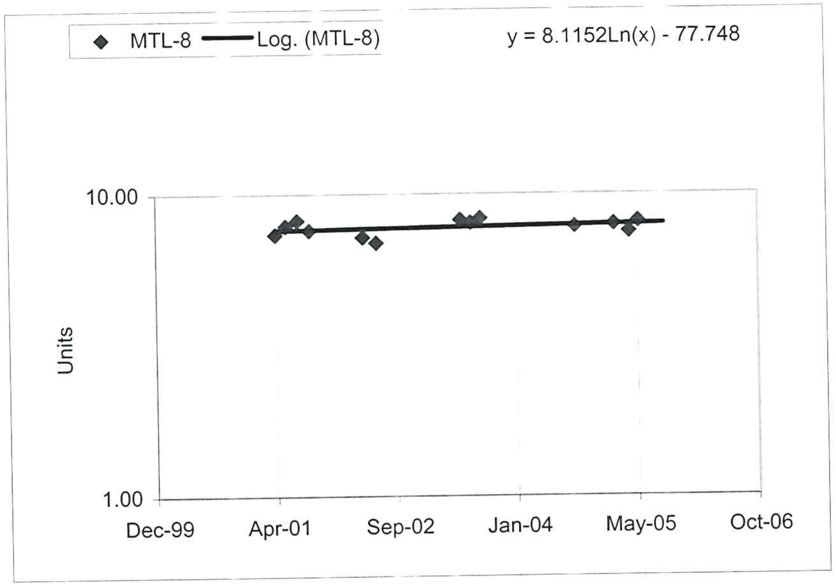

MTL-33-0
Log. (MTL-33-0)
y = -2.5225Ln(x) + 34.841
10.0
1.0
Units
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Oct-06


MTL-66-0
Log. (MTL-66-0)
y = 4.0666Ln(x) - 34.86
10.0
1.0
Units
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Oct-06

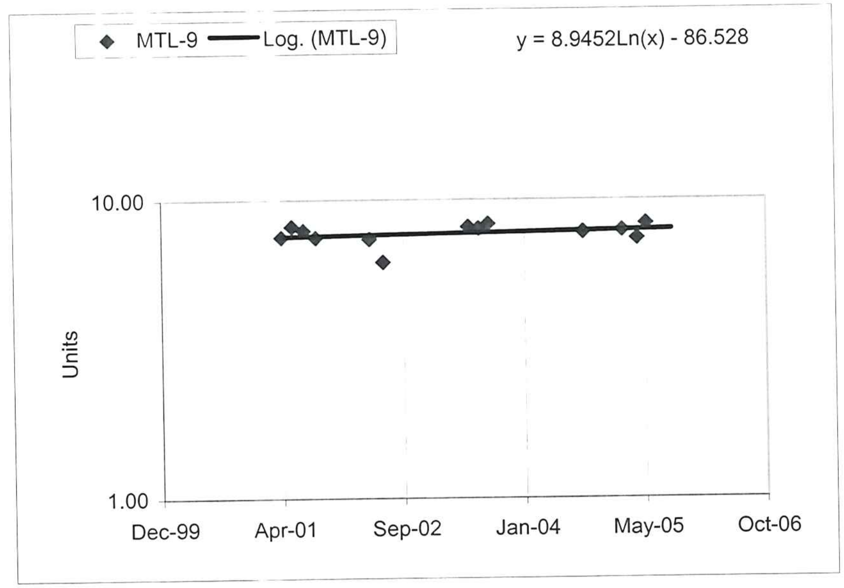

MTL-77-0
Log. (MTL-77-0)
y = 12.079Ln(x) - 119.28
10.00
1.00
Units
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Oct-06


MTL-5
Log. (MTL-5)
y = 11.297Ln(x) - 111.24
10.00
1.00
Units
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Oct-06

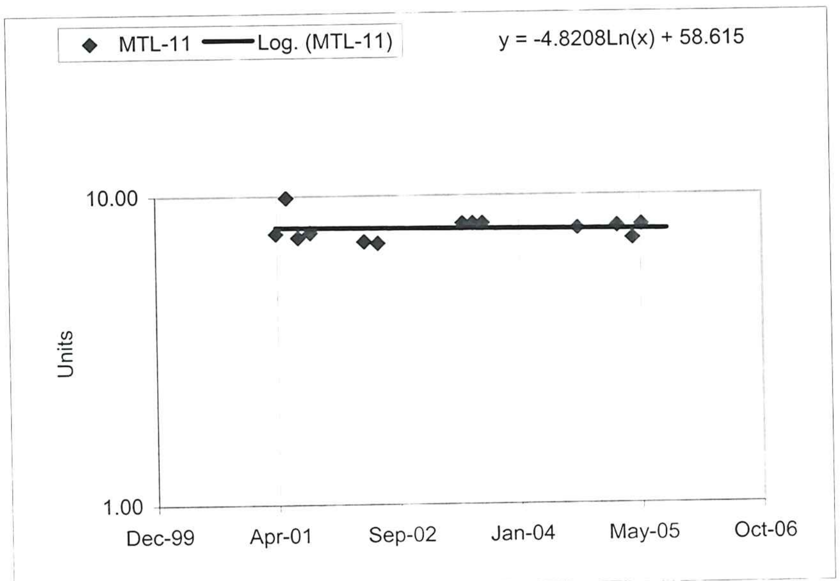
pH



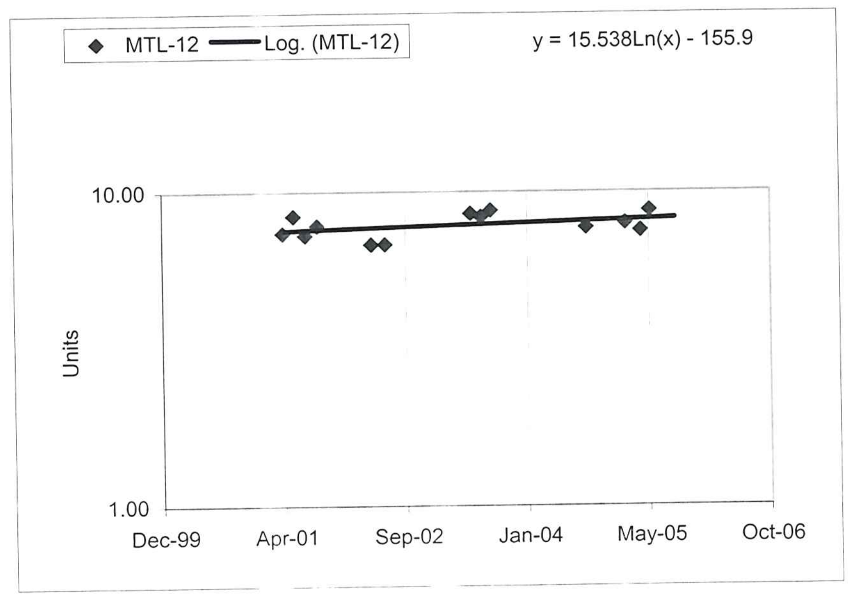
MTL-8
Log. (MTL-8)
y = 8.1152Ln(x) - 77.748
10.00
1.00
Units
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Oct-06



MTL-9
Log. (MTL-9)
y = 8.9452Ln(x) - 86.528
10.00
1.00
Units
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Oct-06

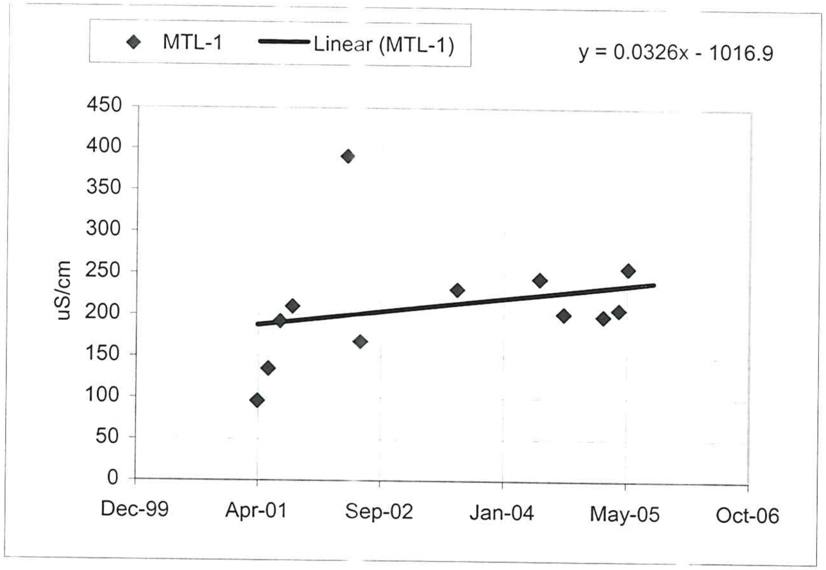


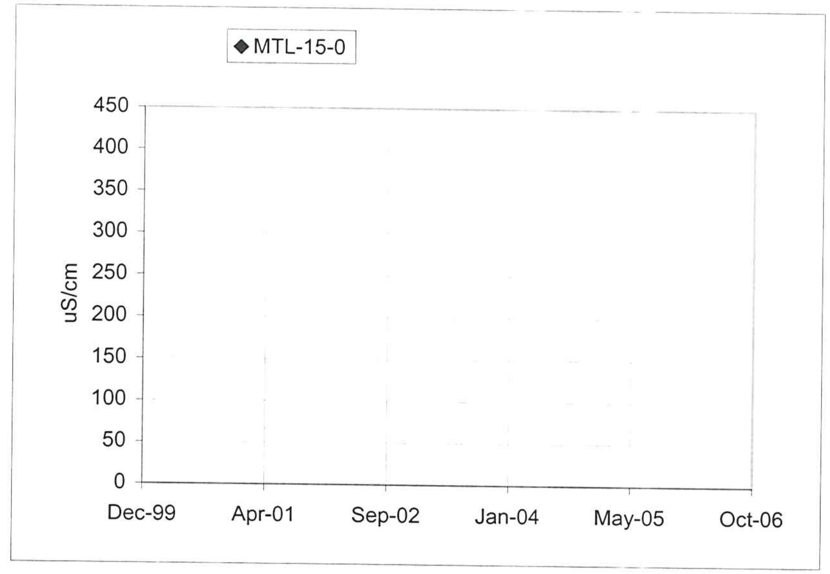
MTL-11
Log. (MTL-11)
y = -4.8208Ln(x) + 58.615
10.00
1.00
Units
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Oct-06

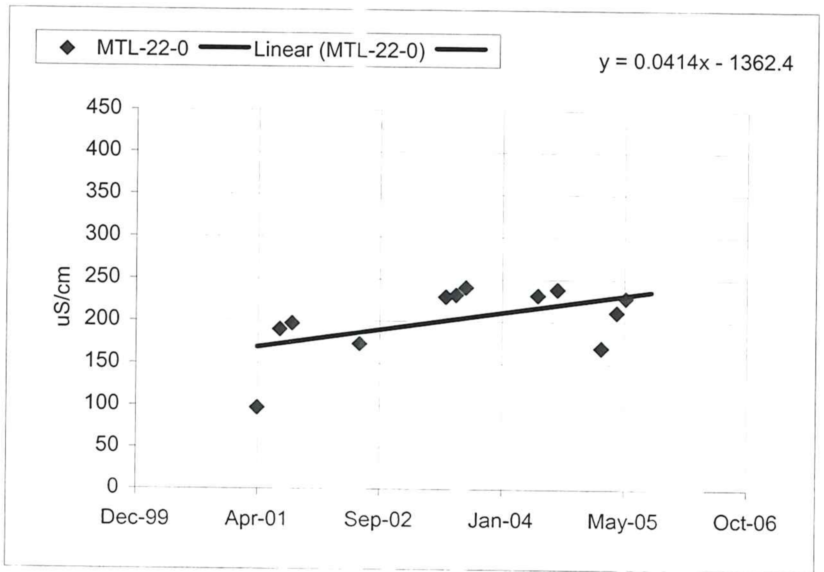


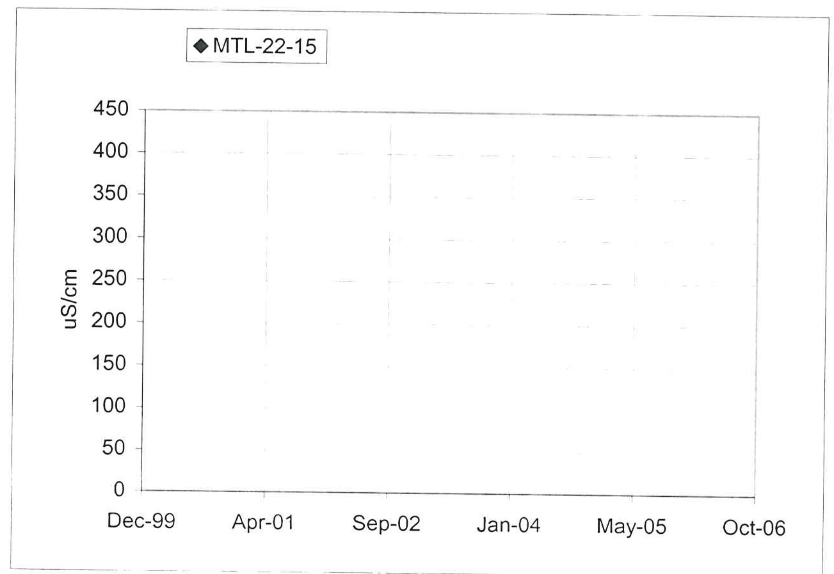
MTL-12
Log. (MTL-12)
y = 15.538Ln(x) - 155.9
10.00
1.00
Units
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Oct-06

Conductivity

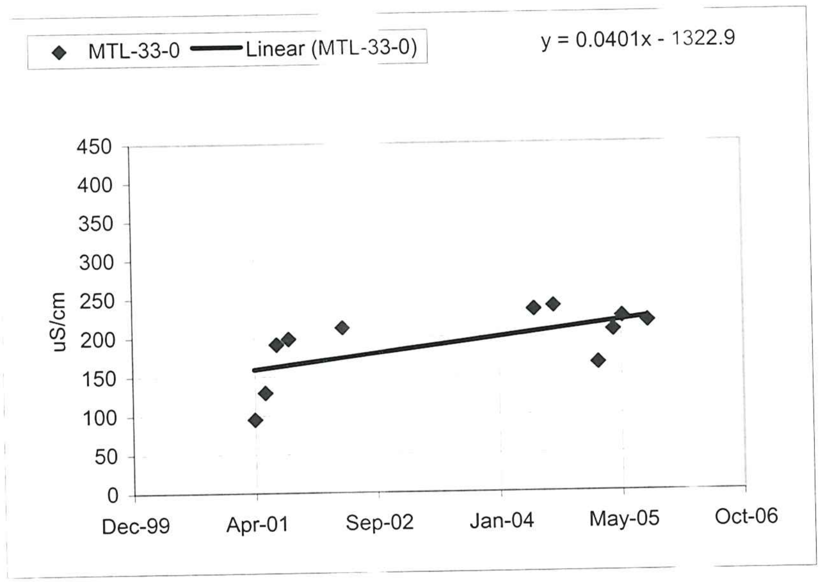


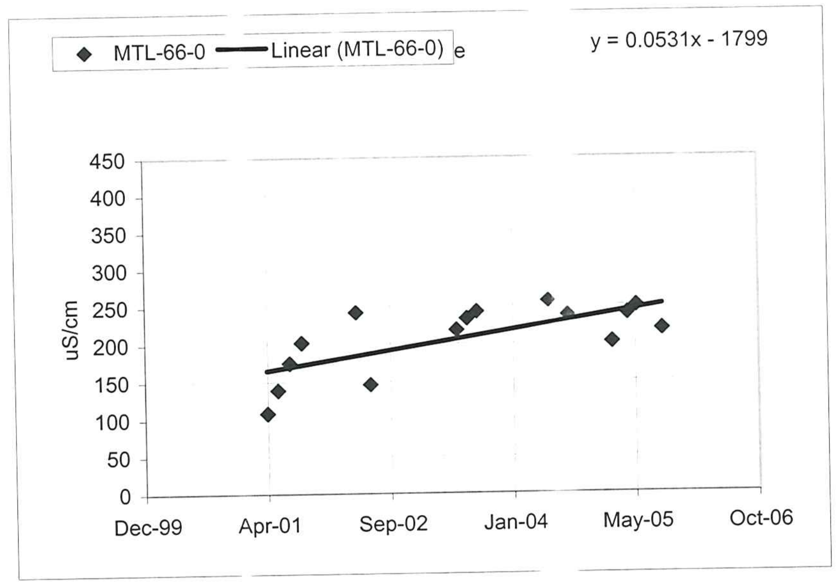


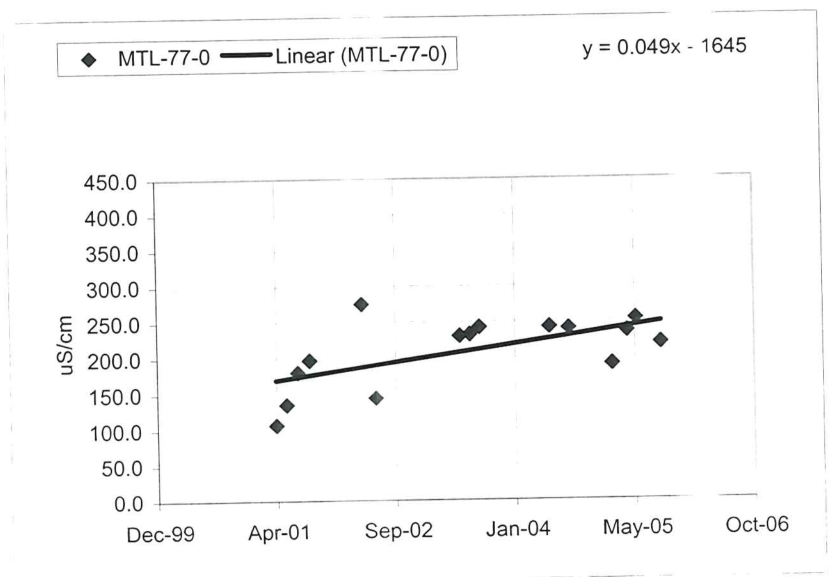


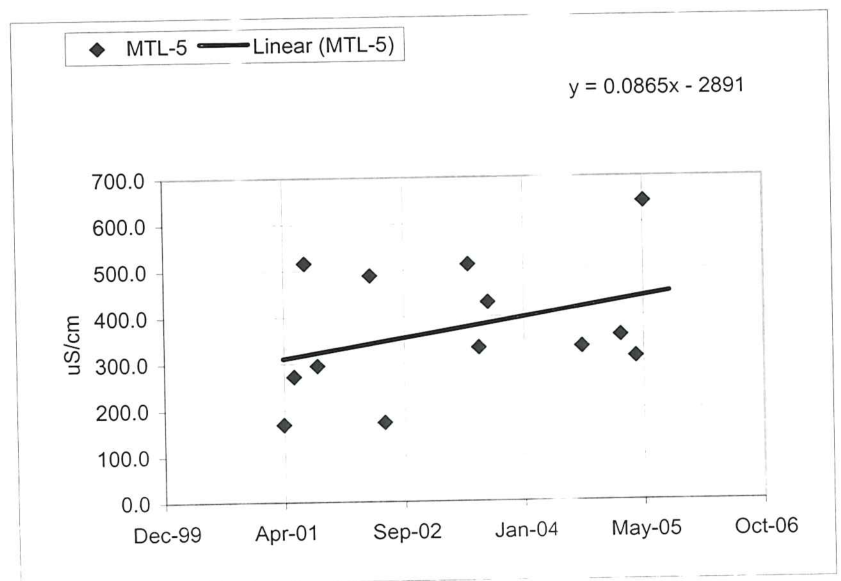


Conductivity

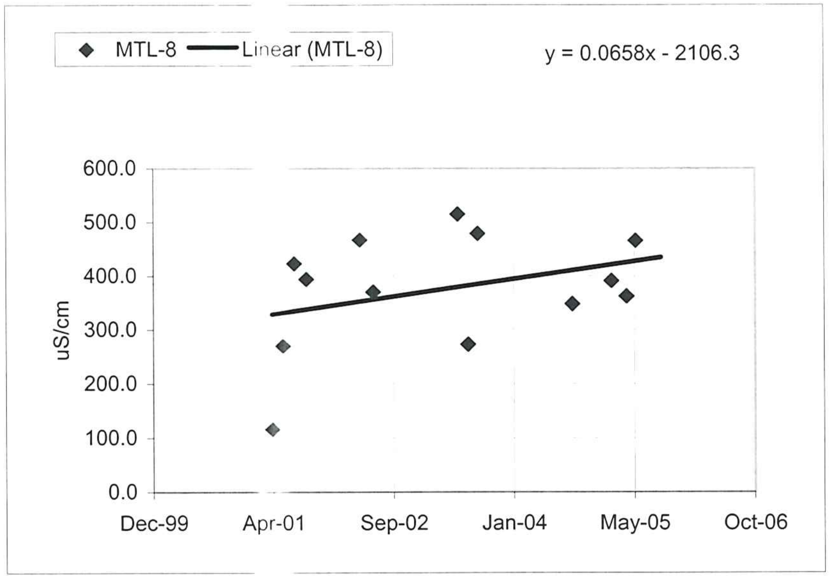


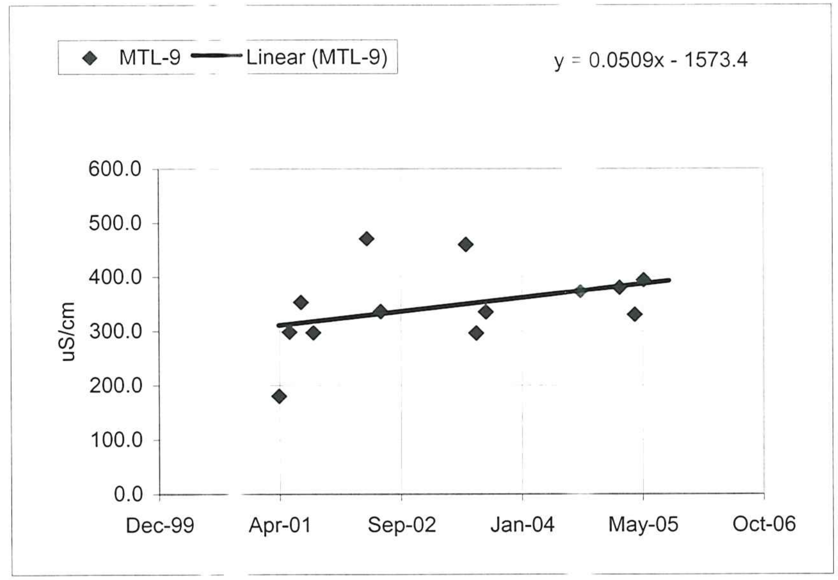


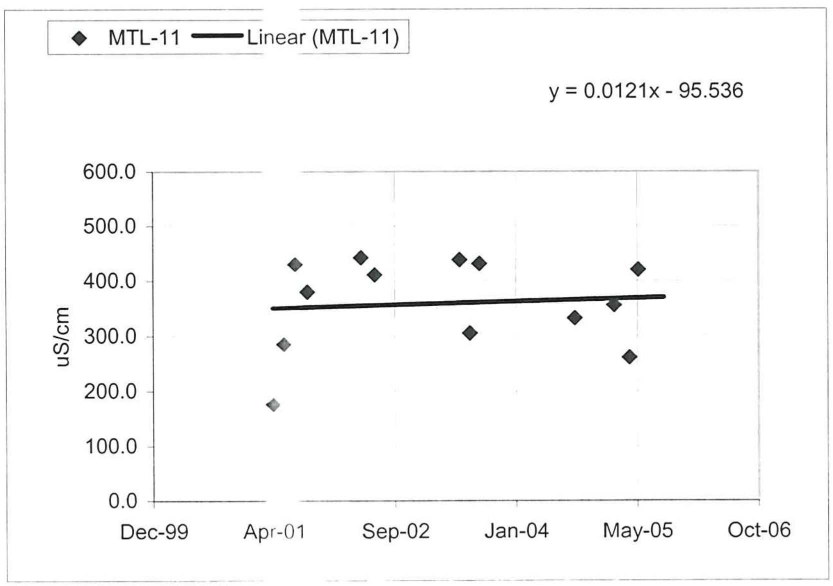


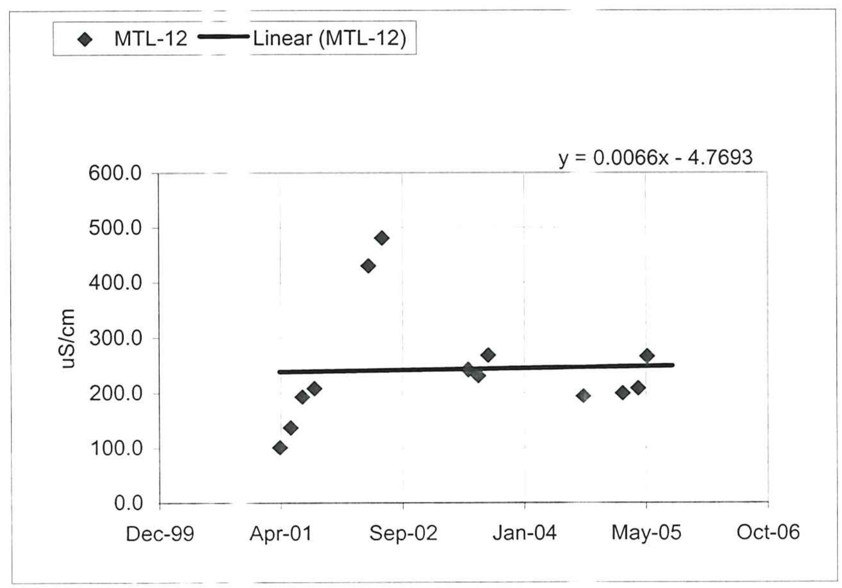


Conductivity

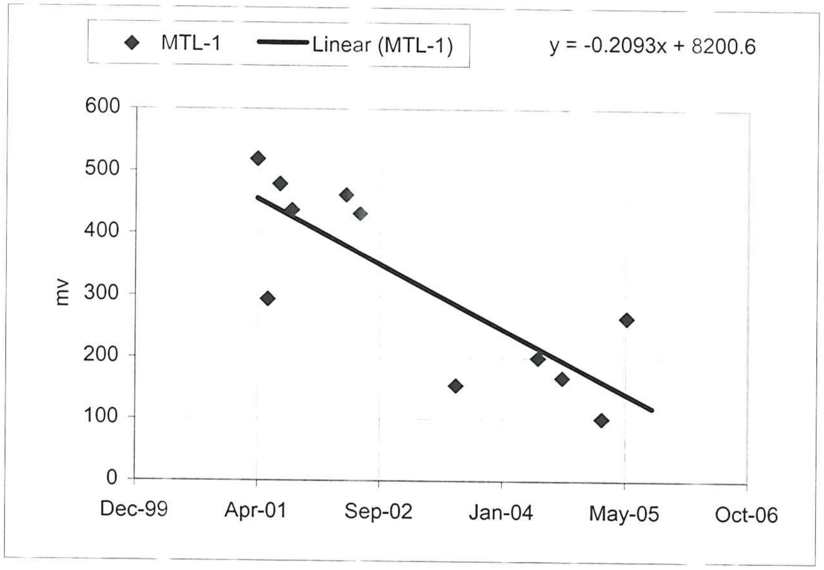


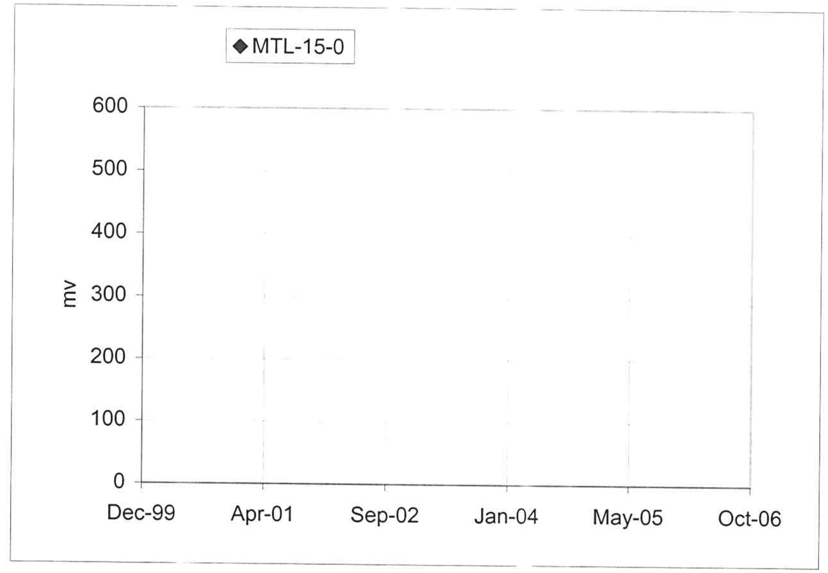


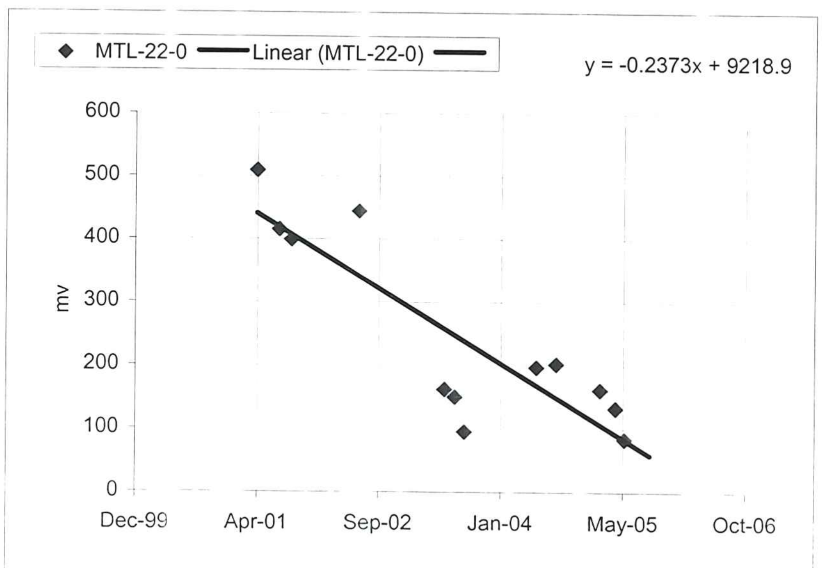


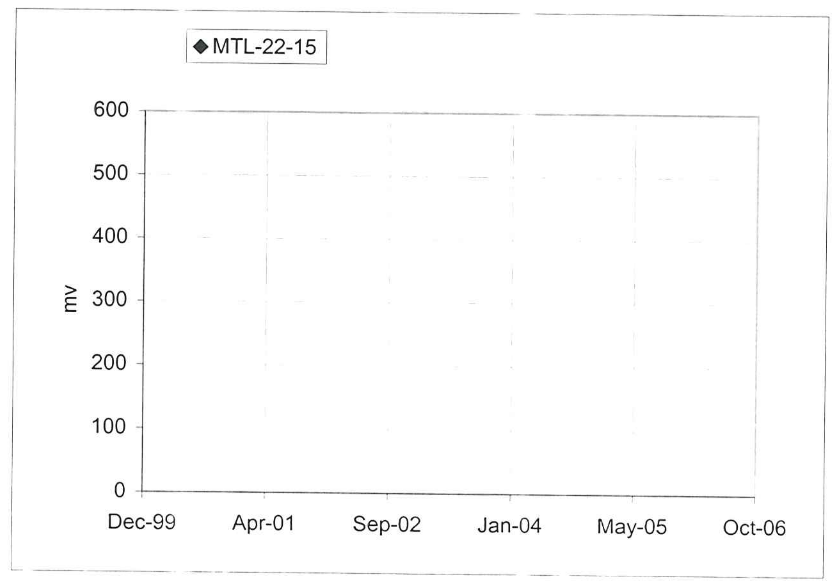


Oxidation Reduction Potential (ORP)









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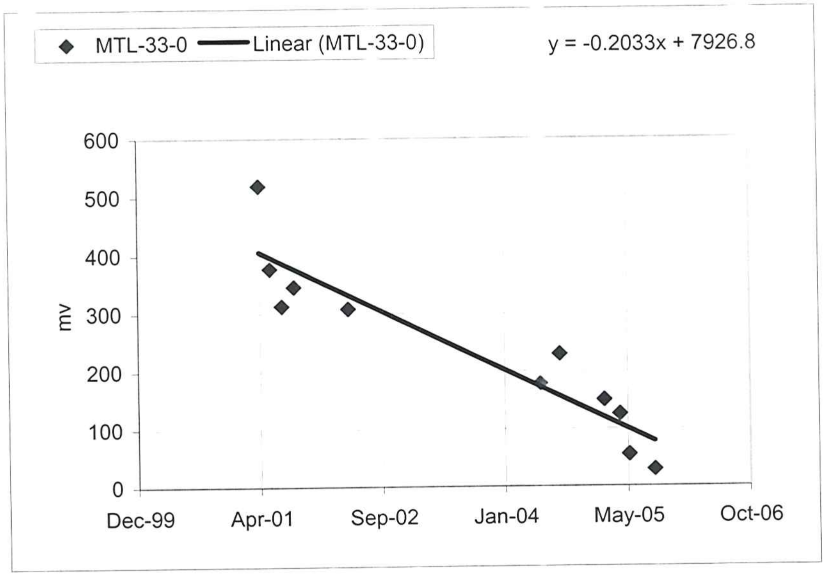

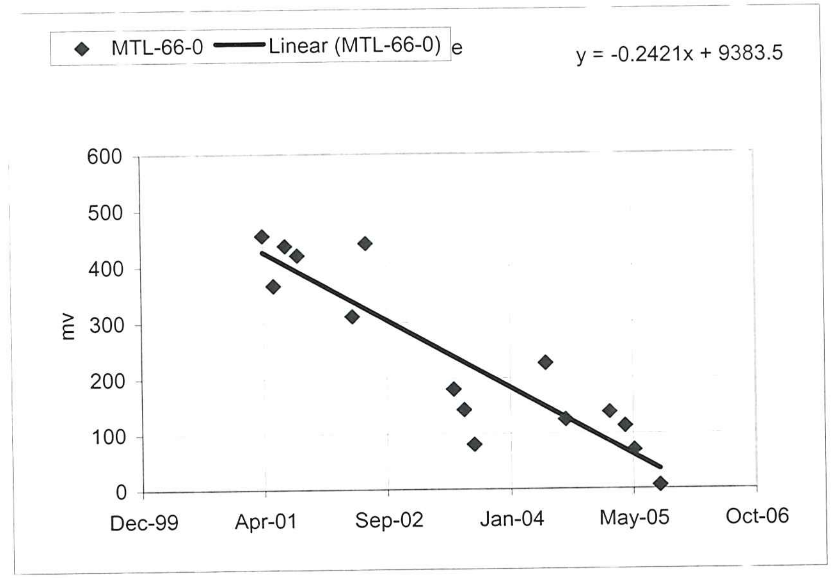

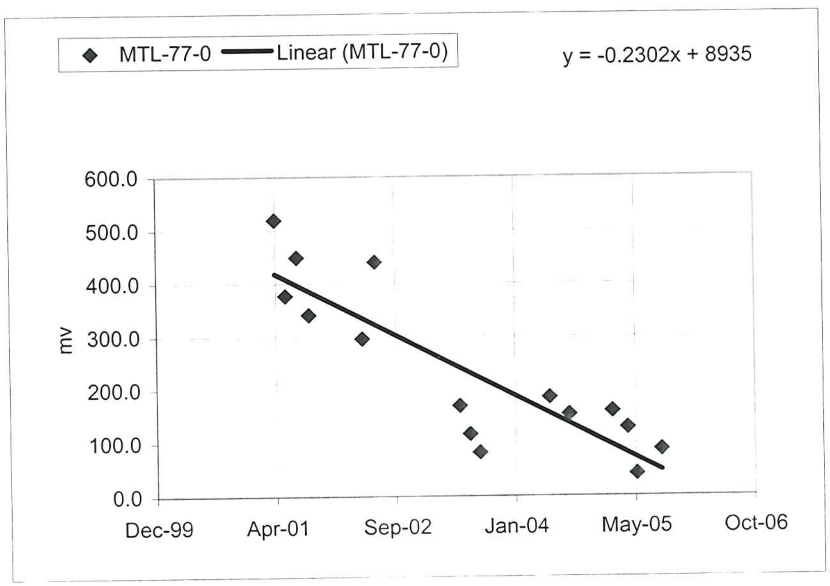

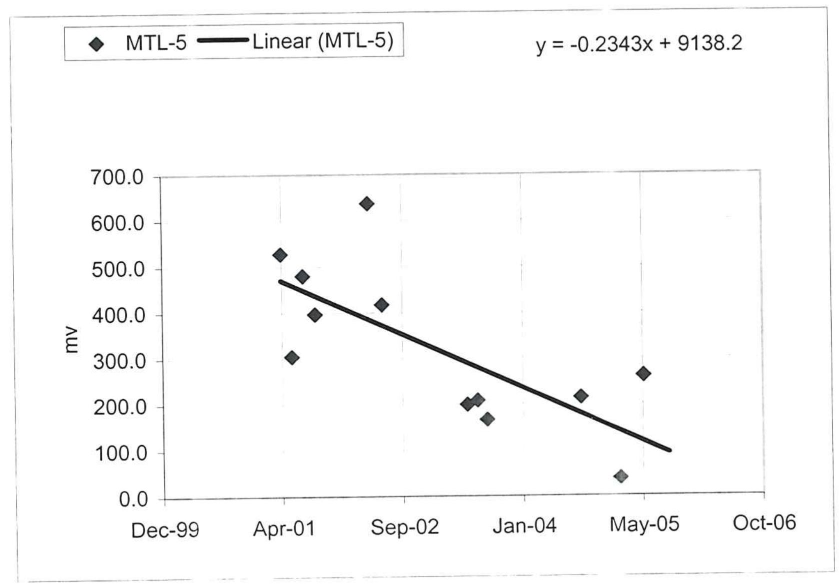

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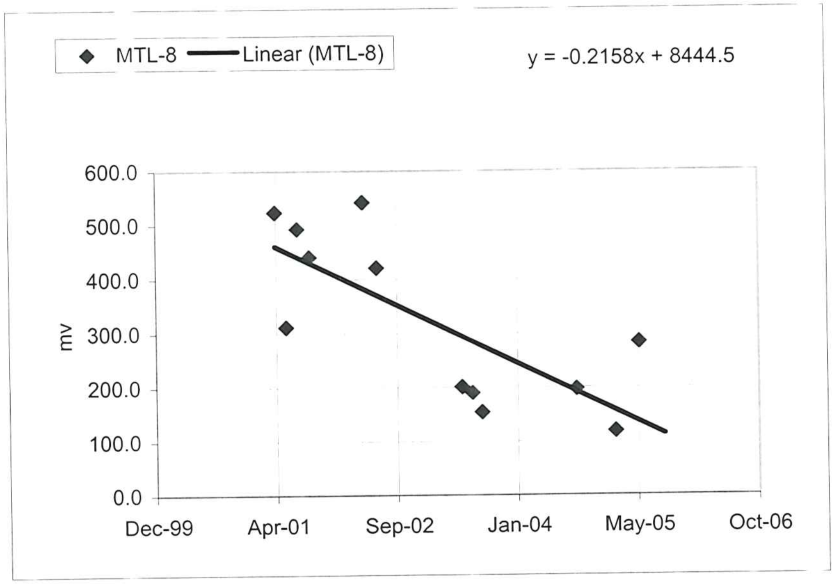
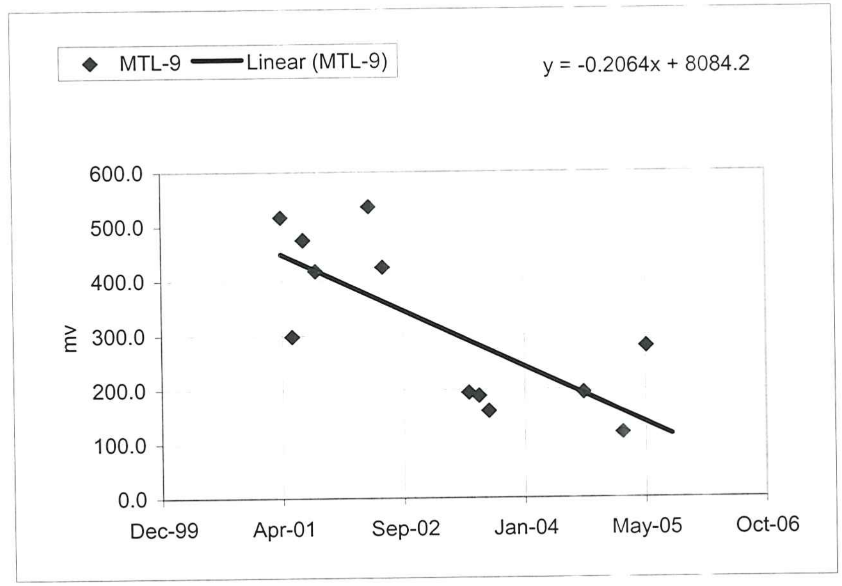
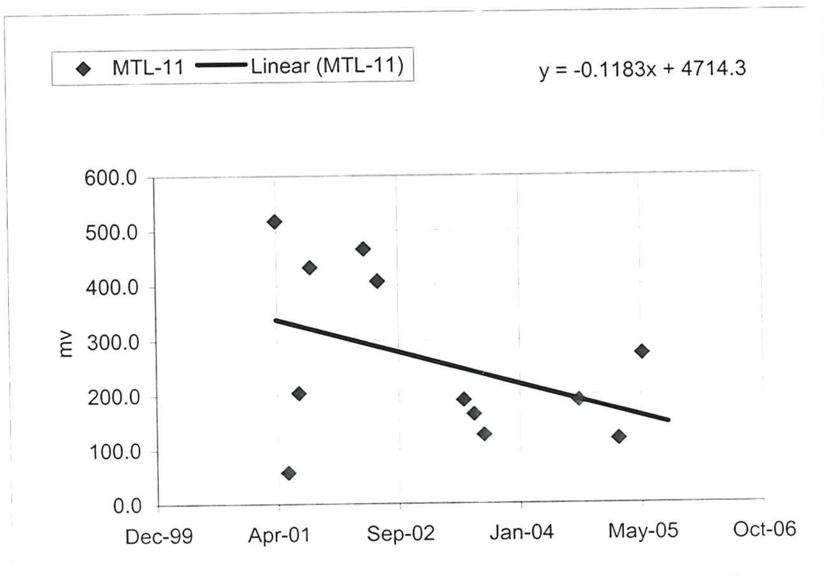
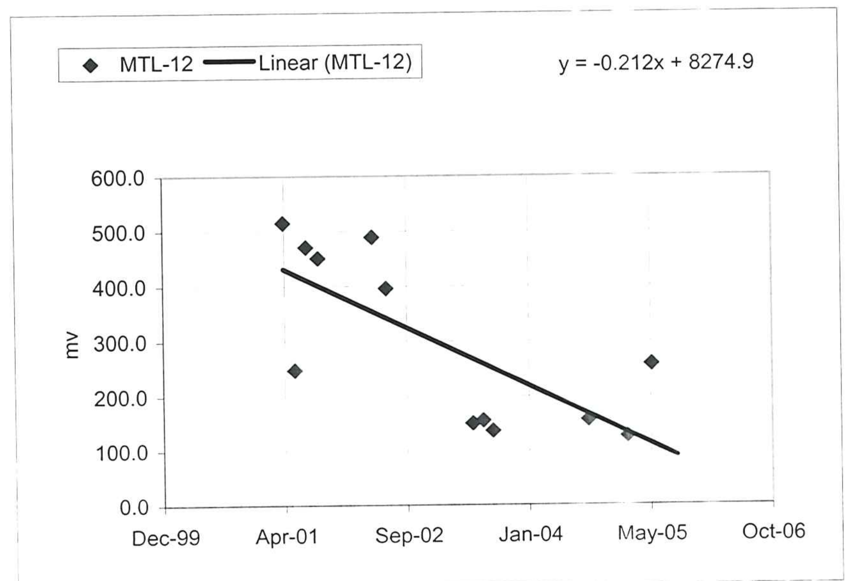
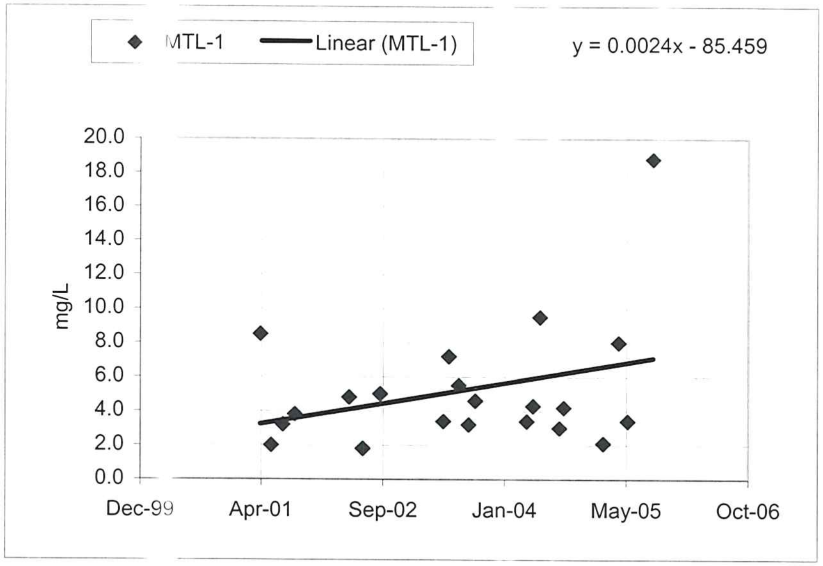


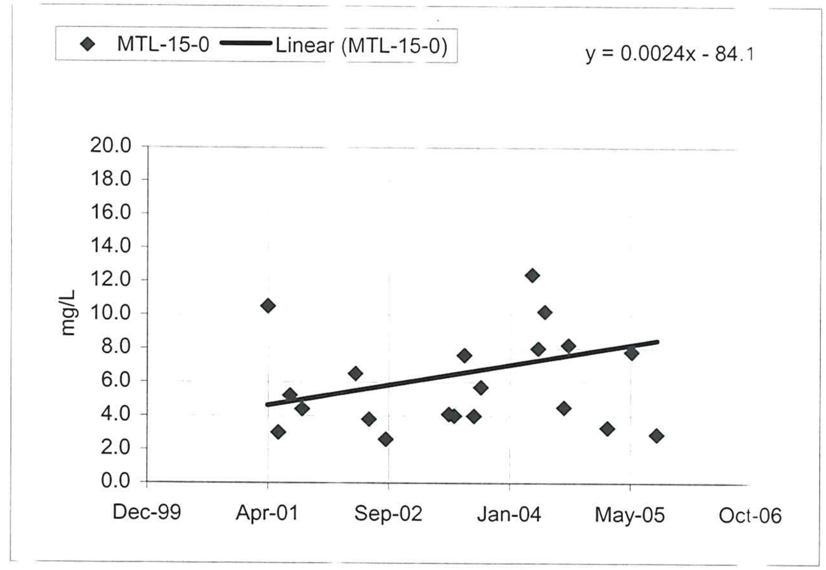


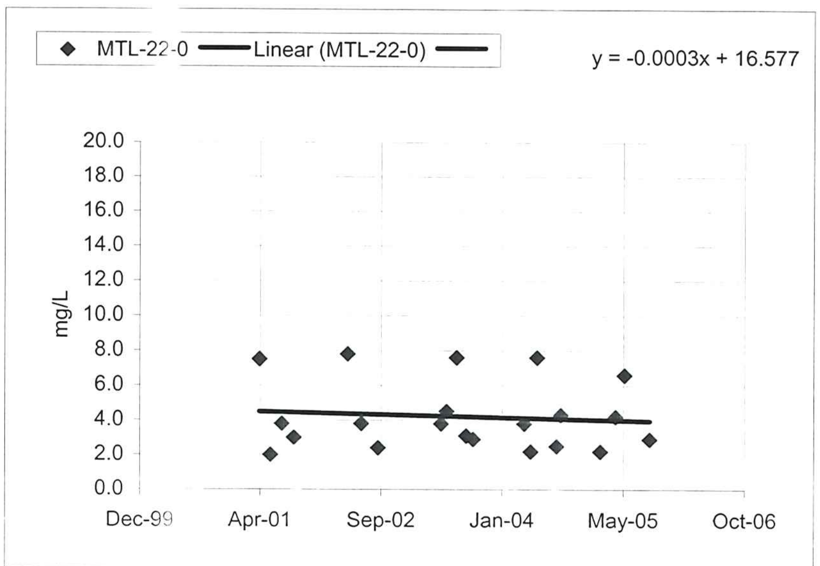


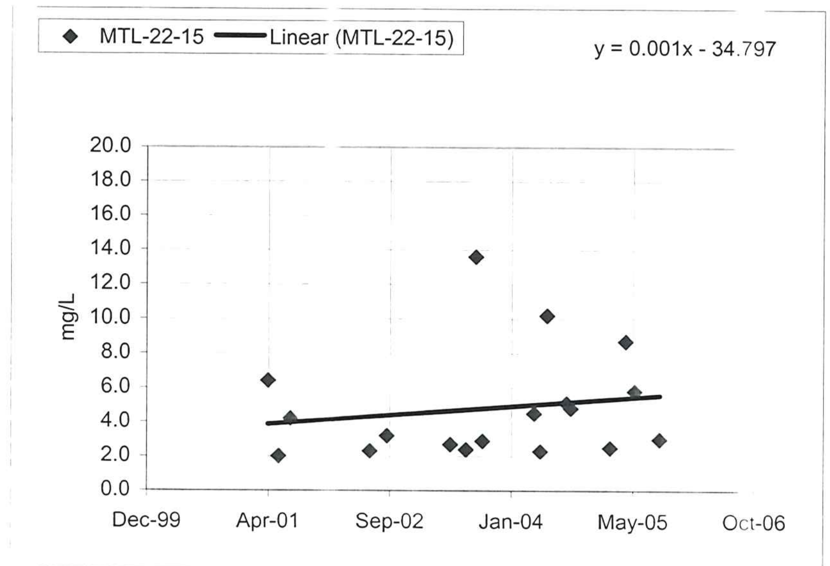


Total Suspended Solids (TSS)









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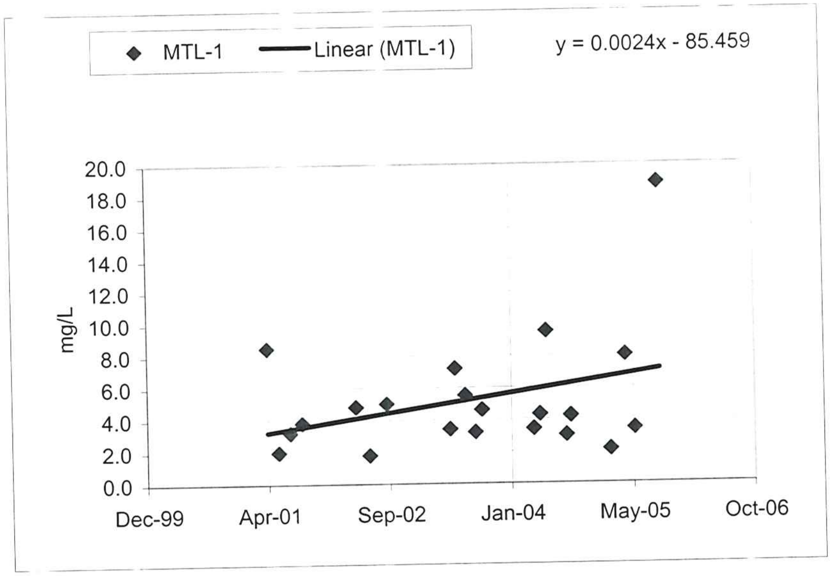
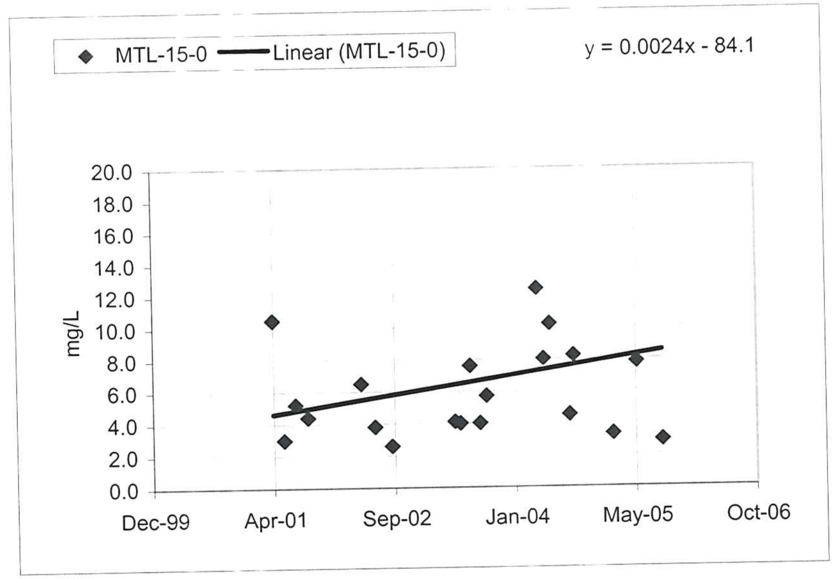
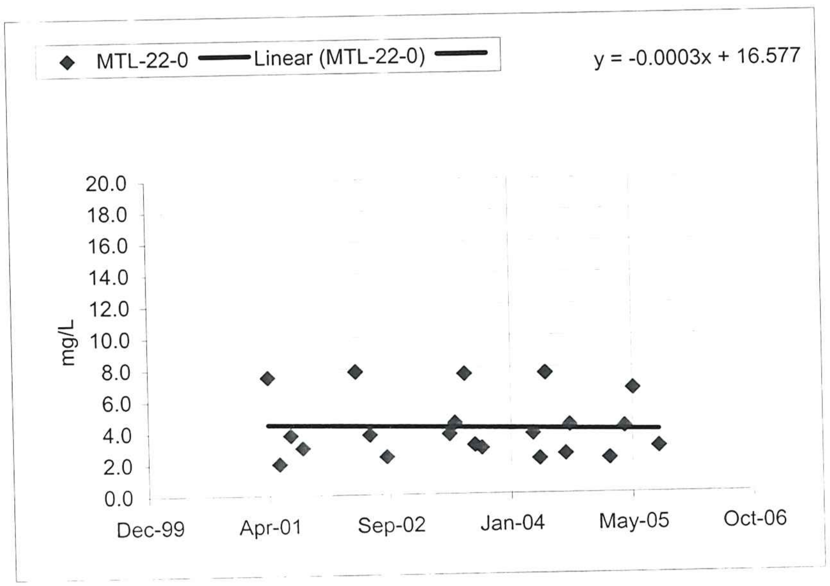
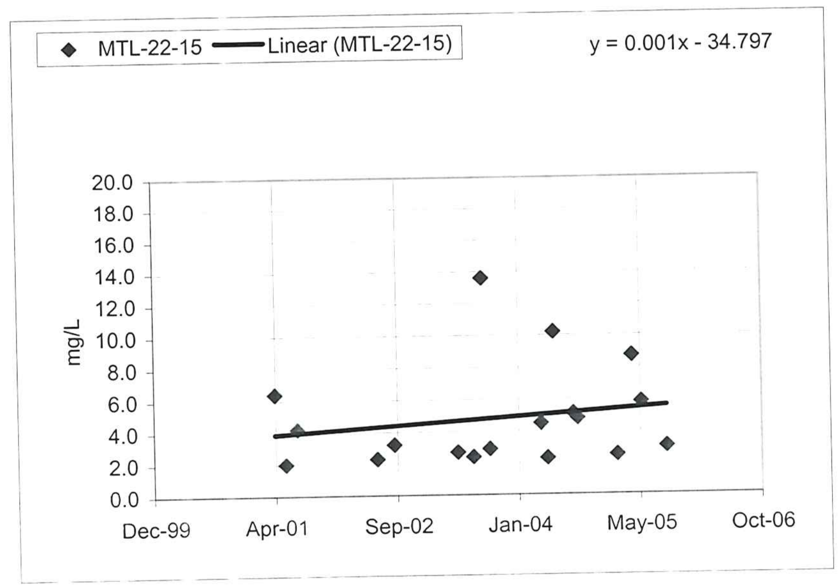
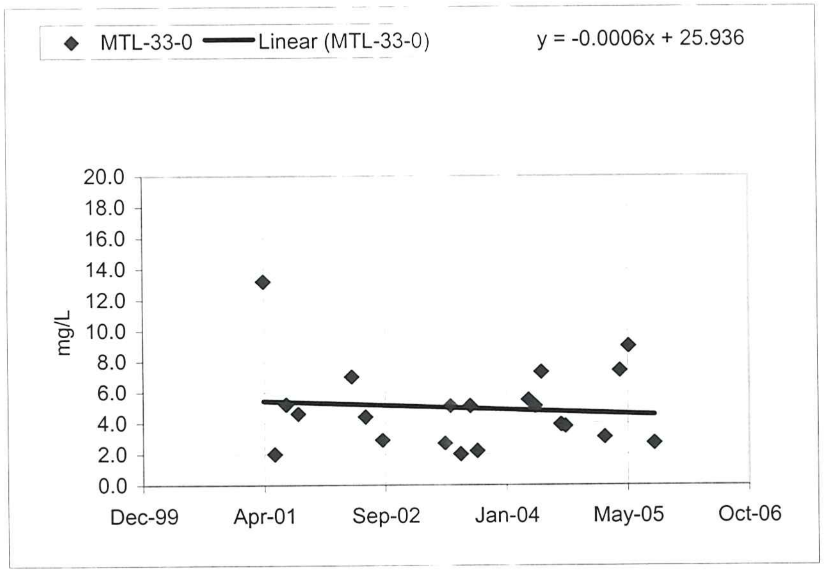


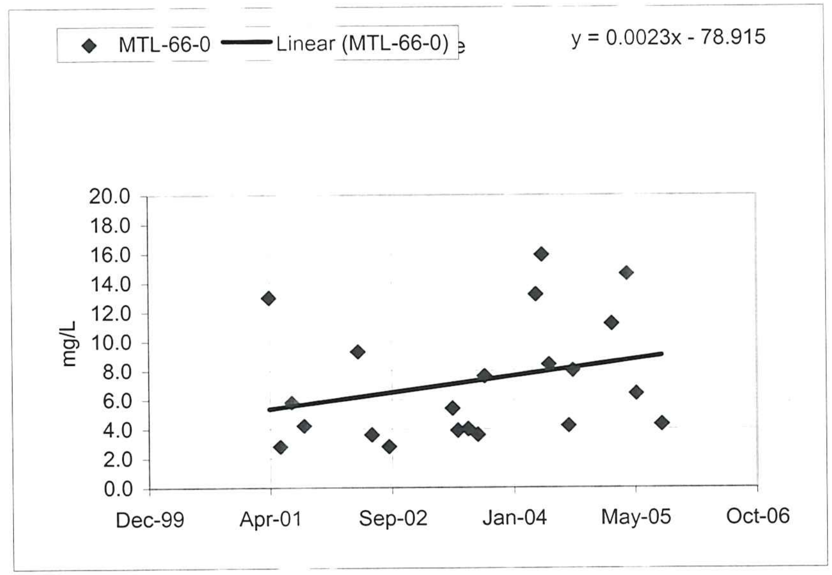


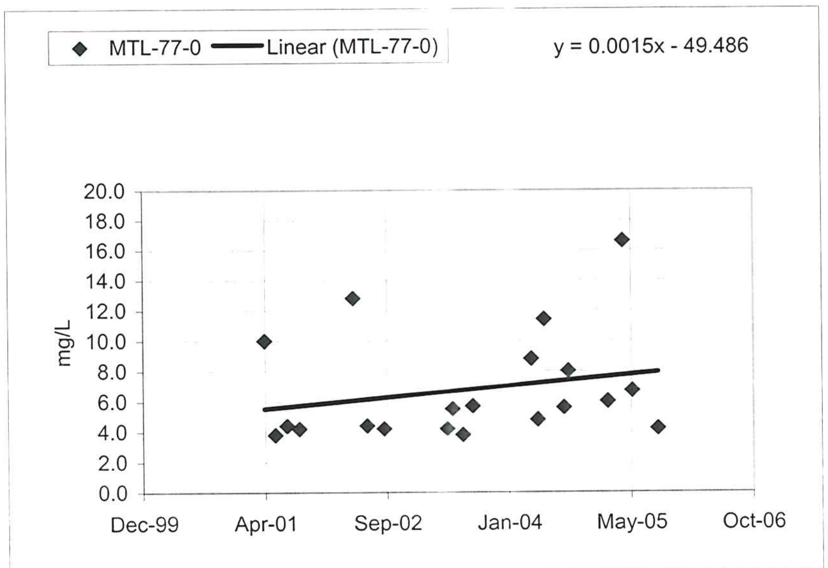


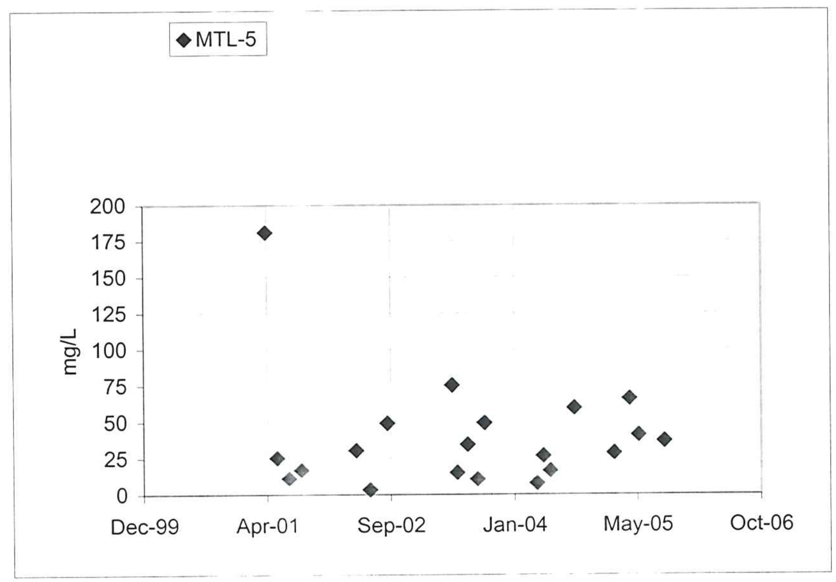


Total Suspended Solids (TSS)









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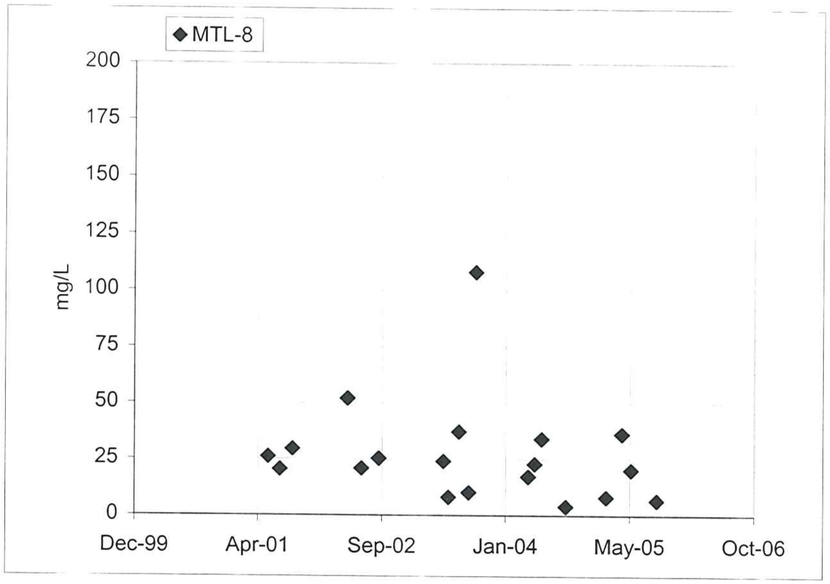
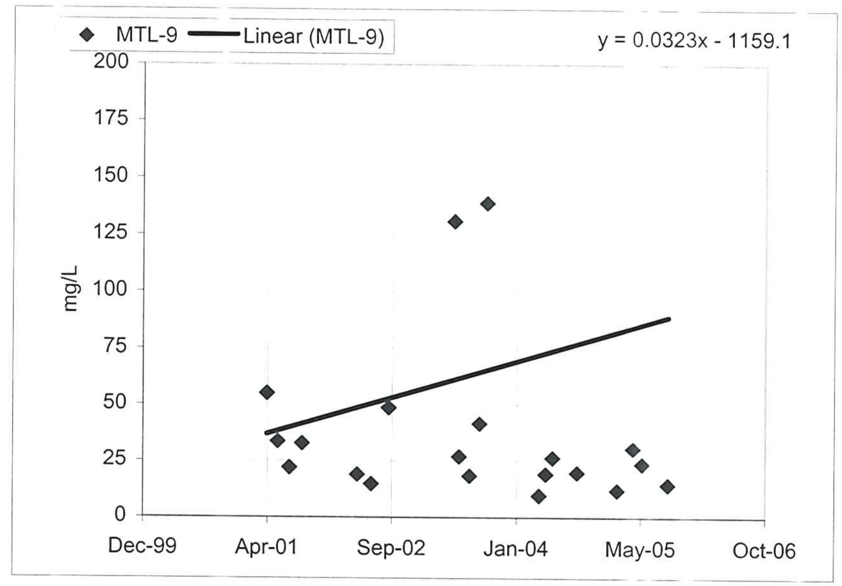
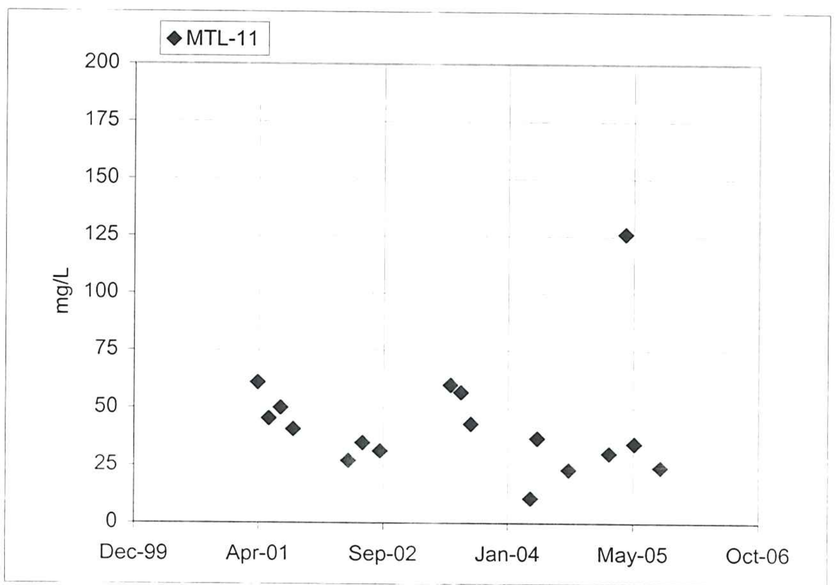
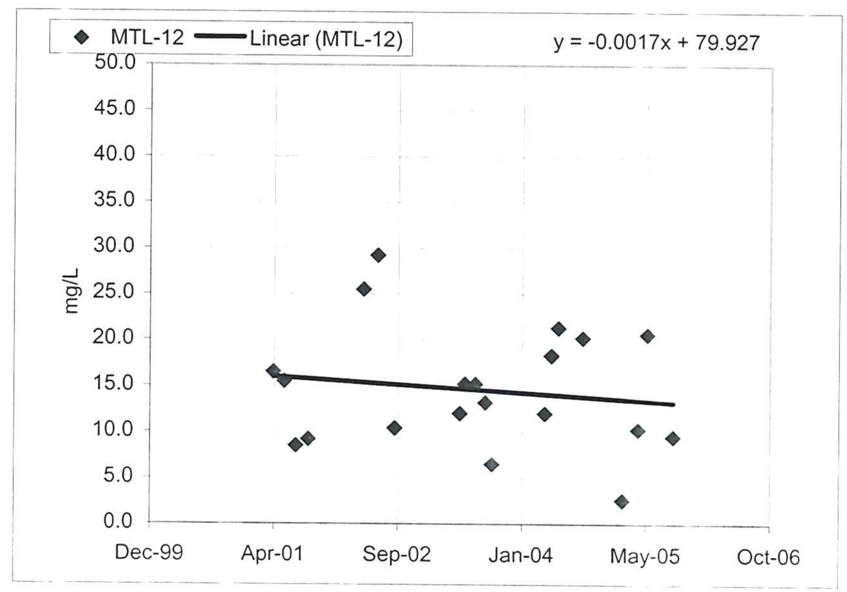
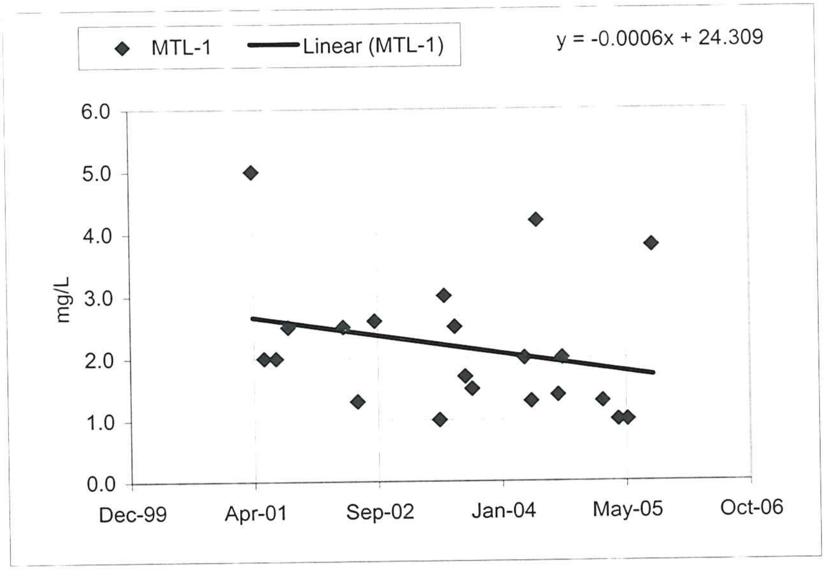


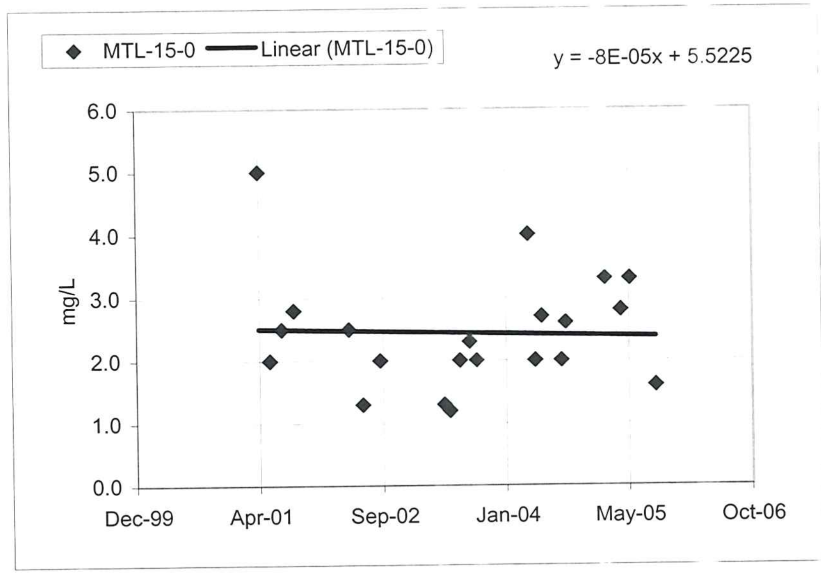


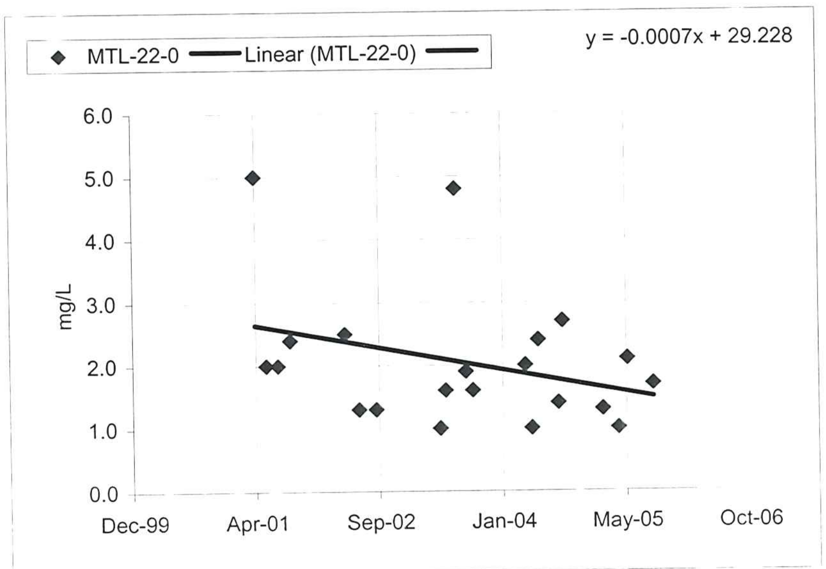


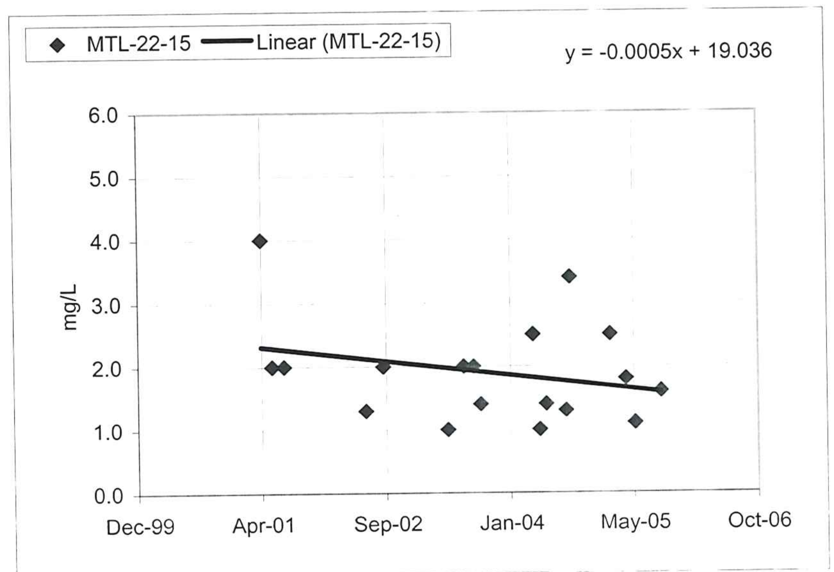


Volatile Suspended Solids (VSS)

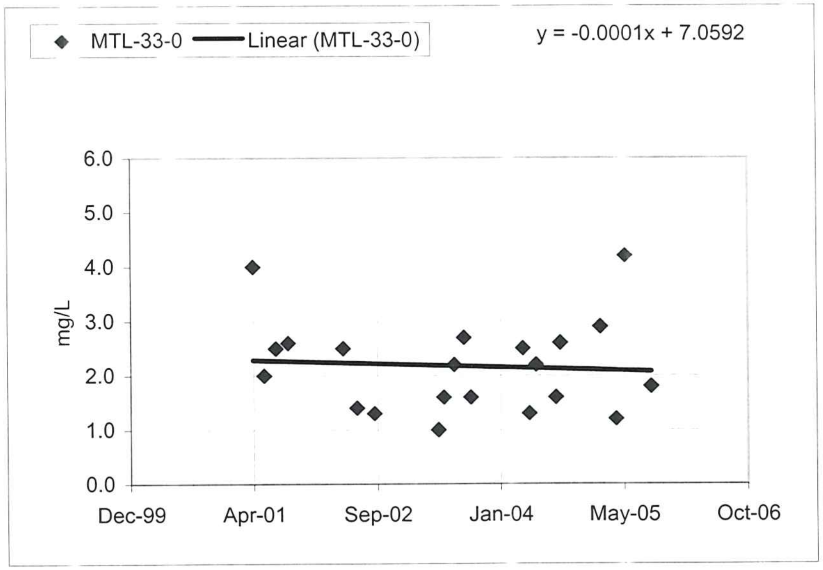


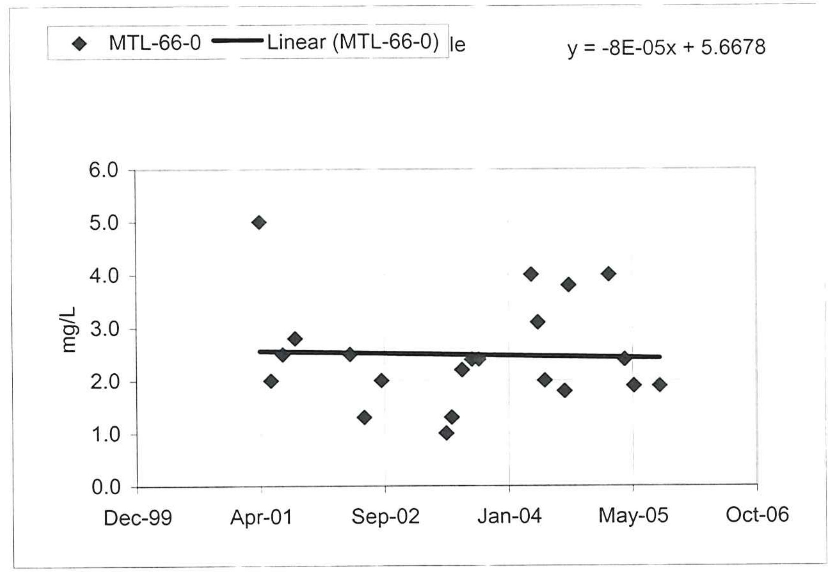


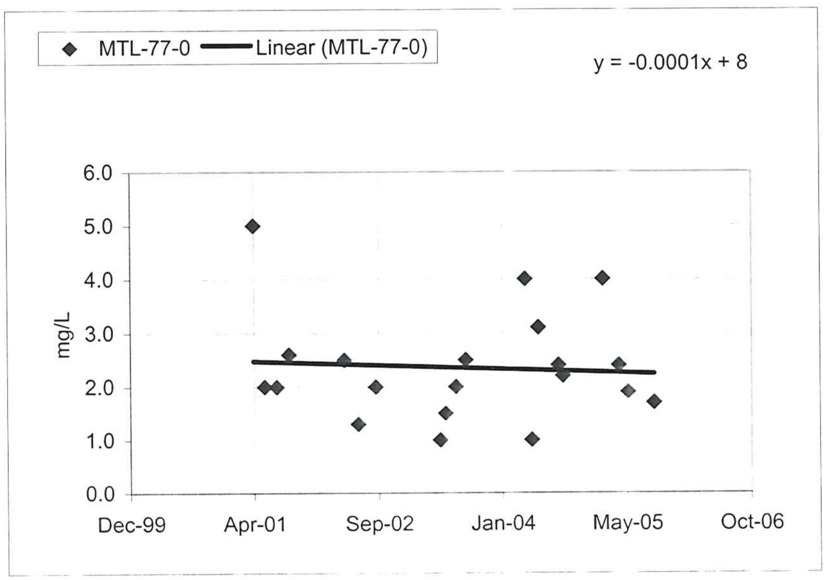


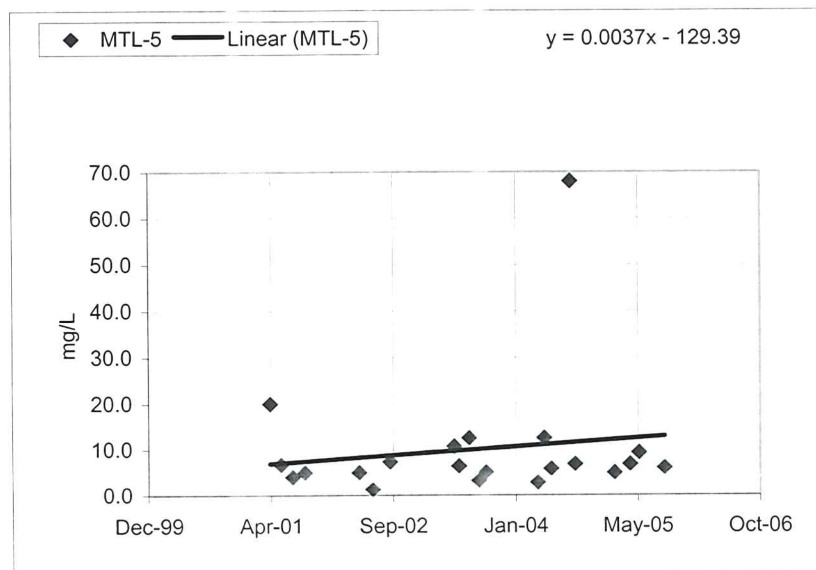


Volatile Suspended Solids (VSS)

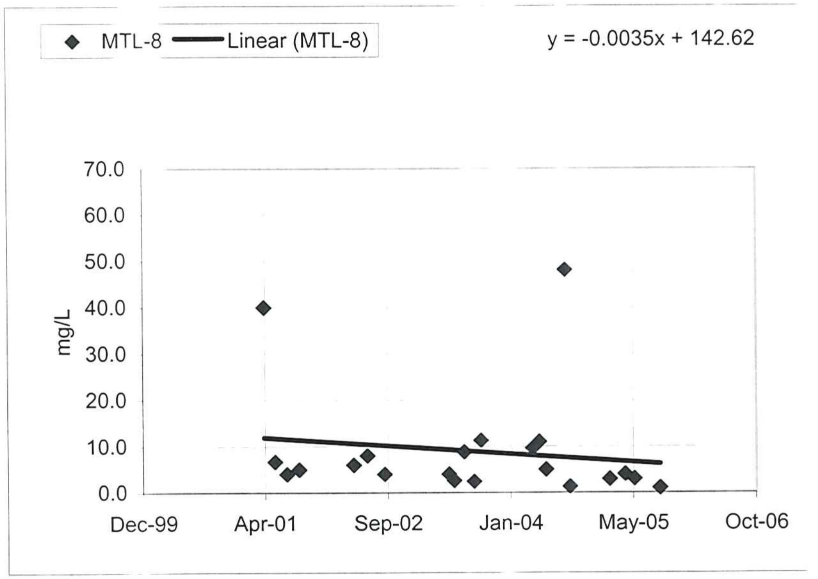


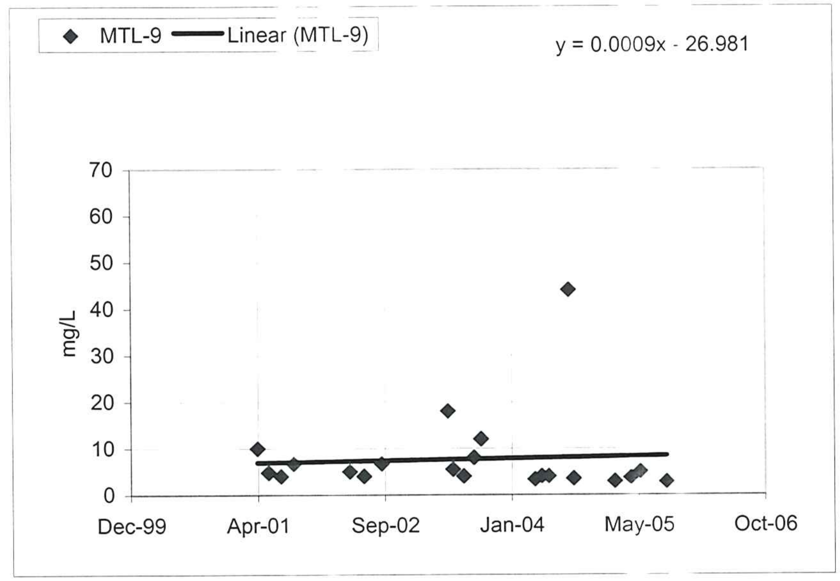


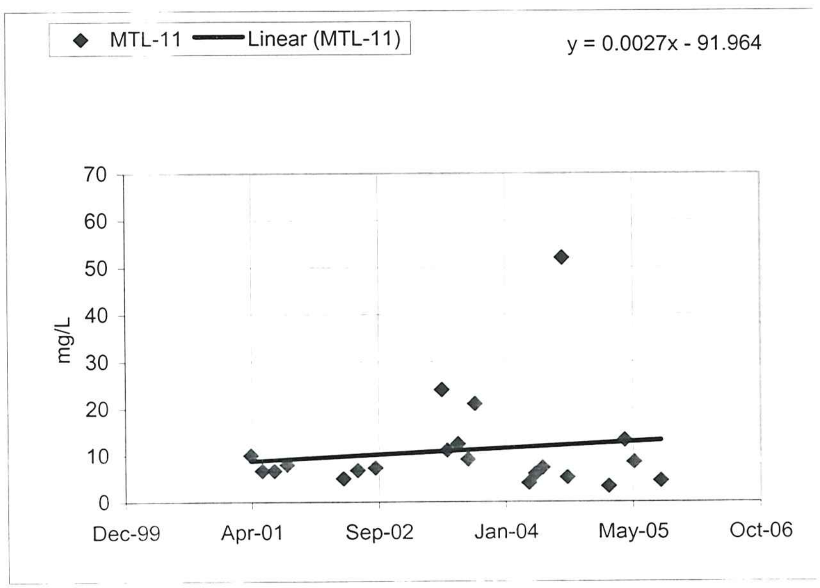


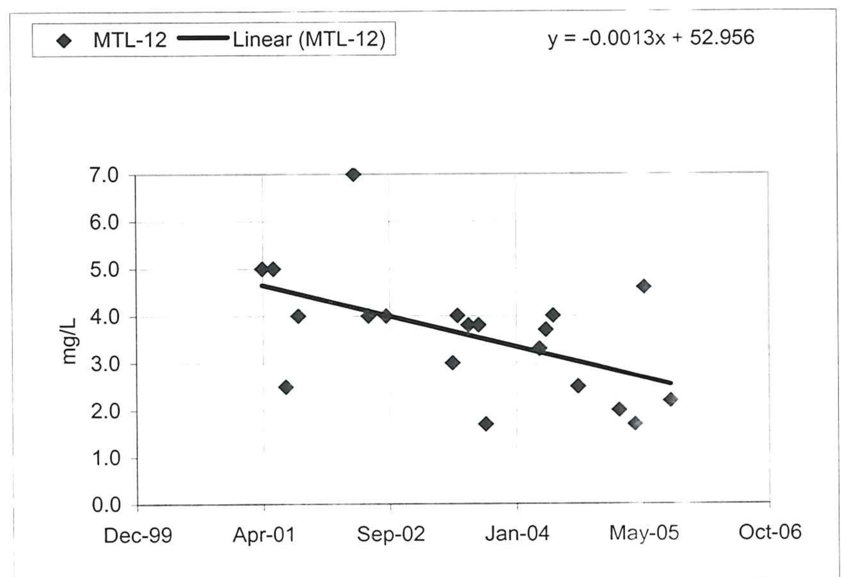


Volatile Suspended Solids (VSS)

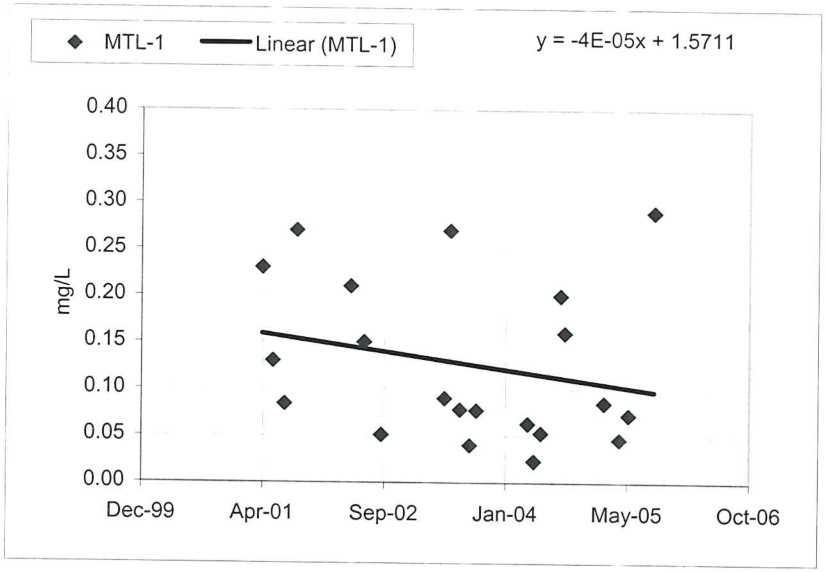


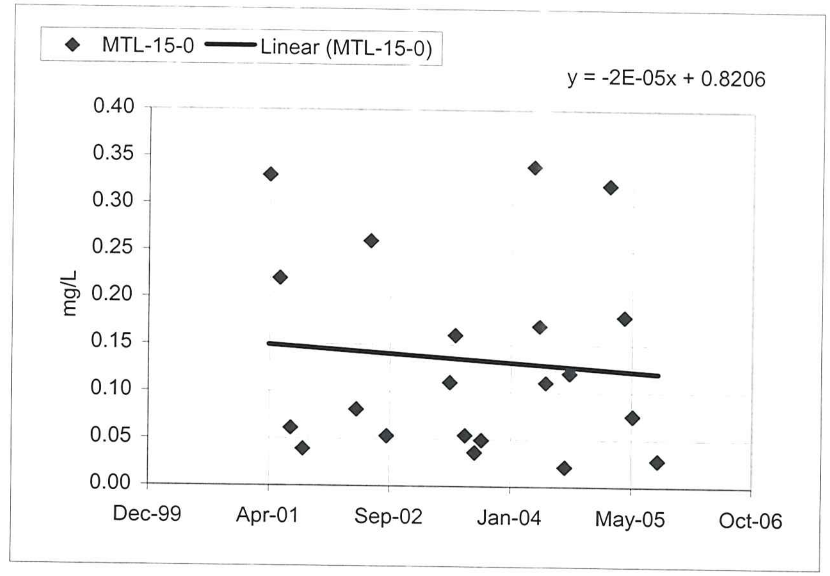


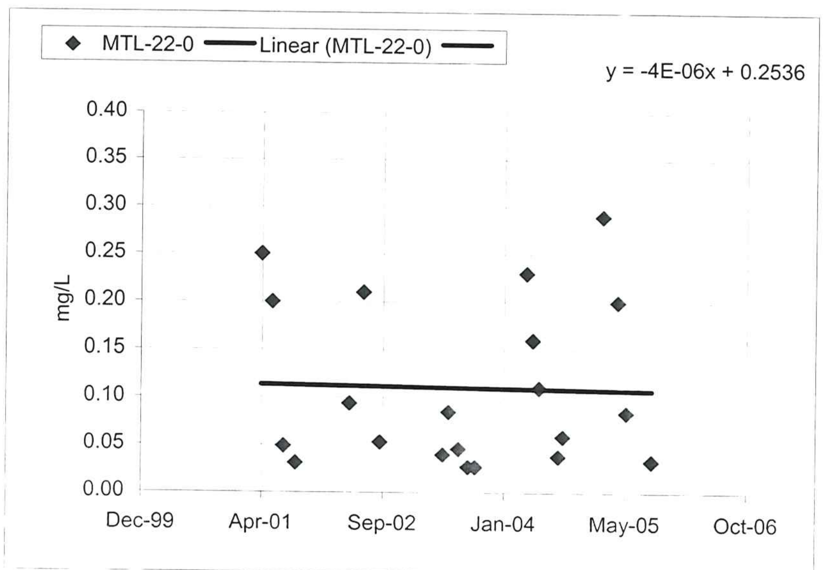


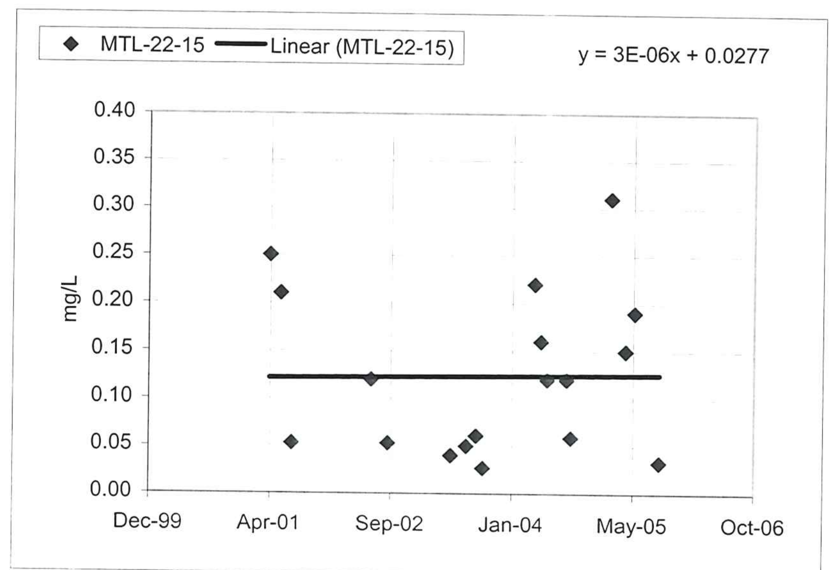


Total Phosphorus

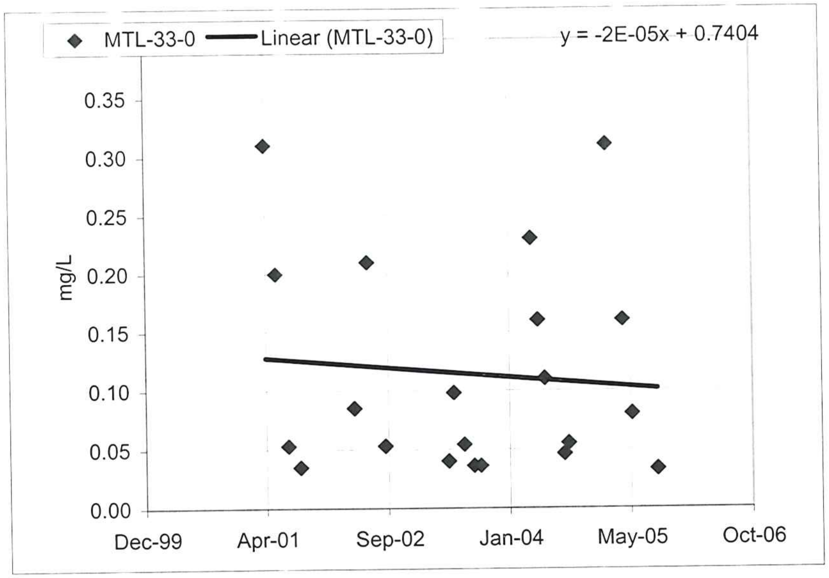


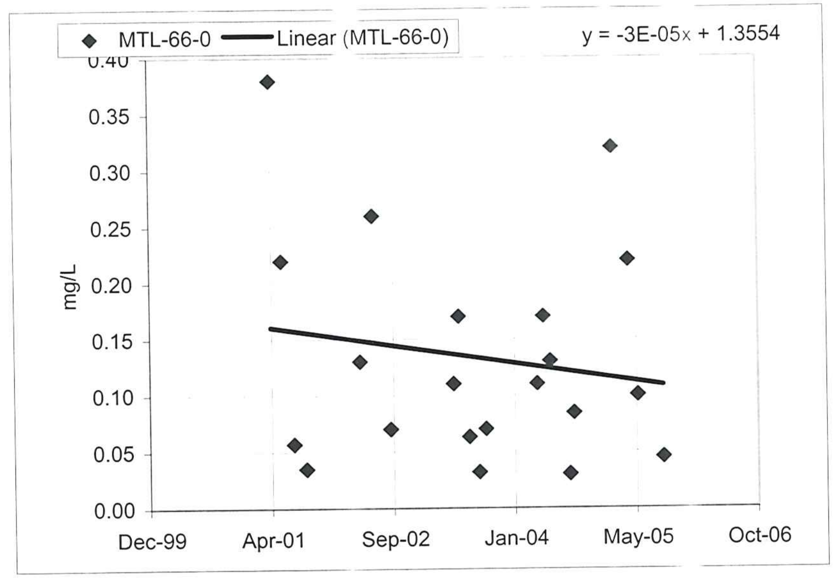


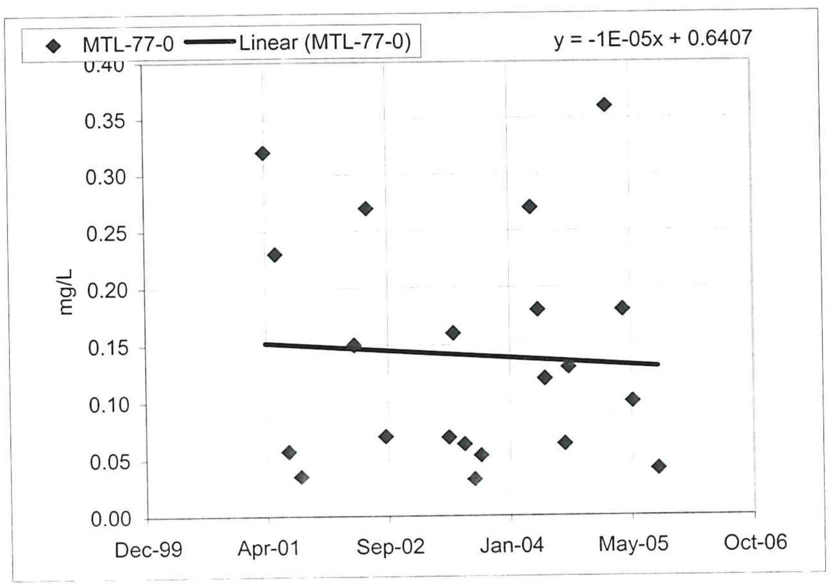


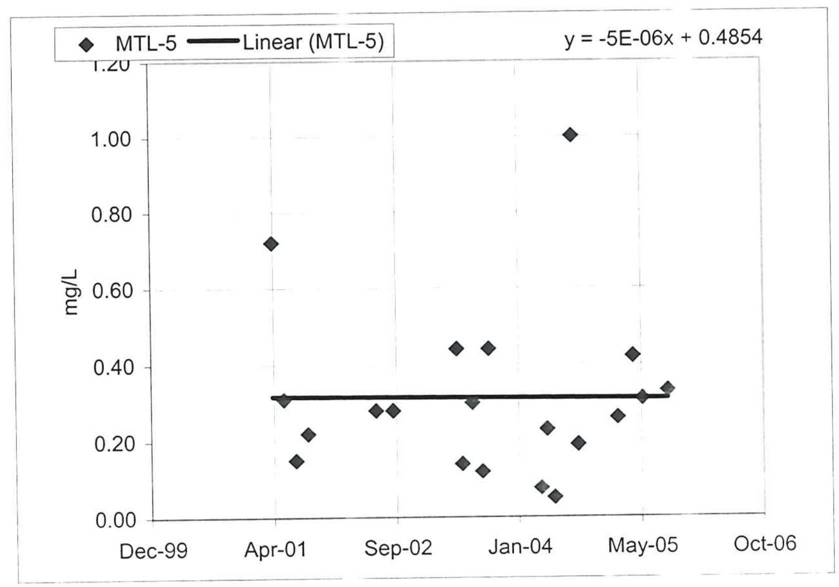


Total Phosphorus

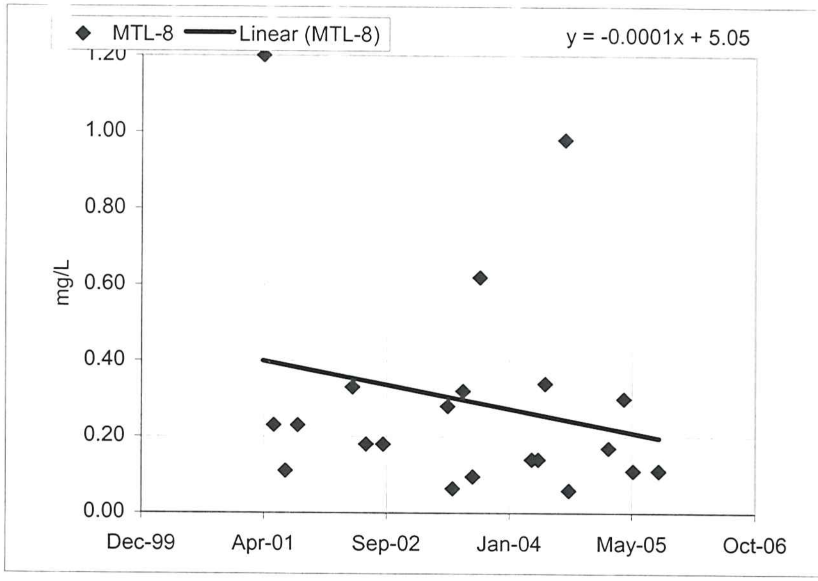


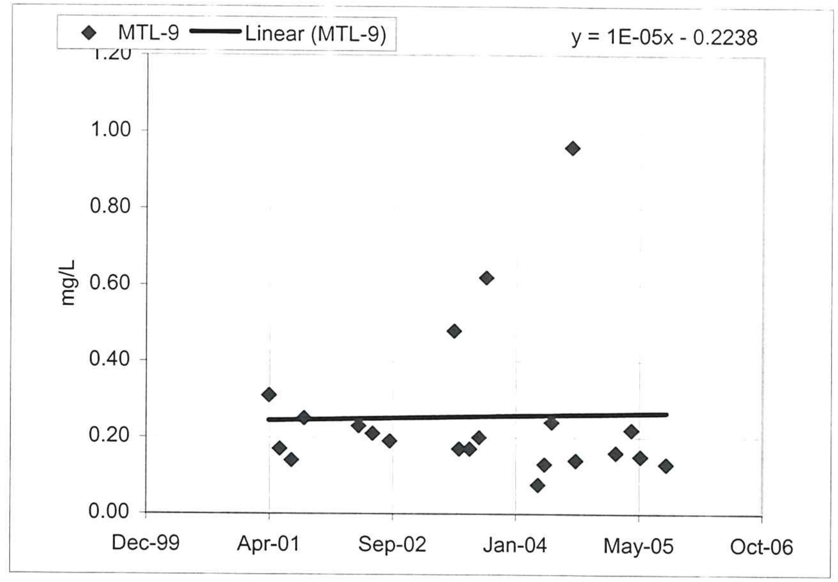


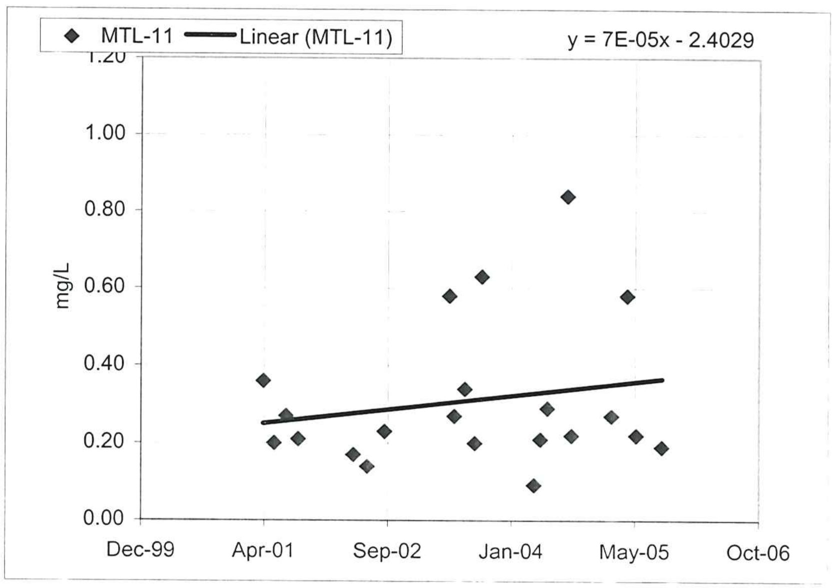


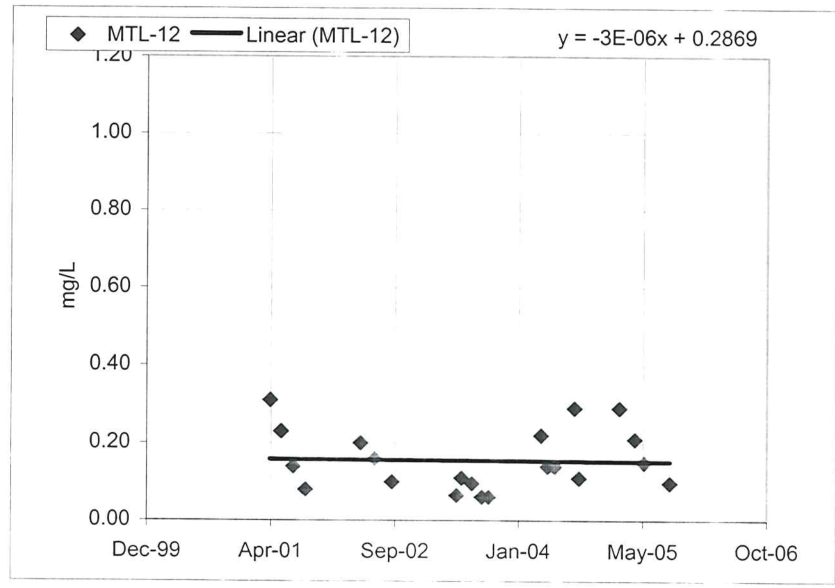


Total Phosphorus

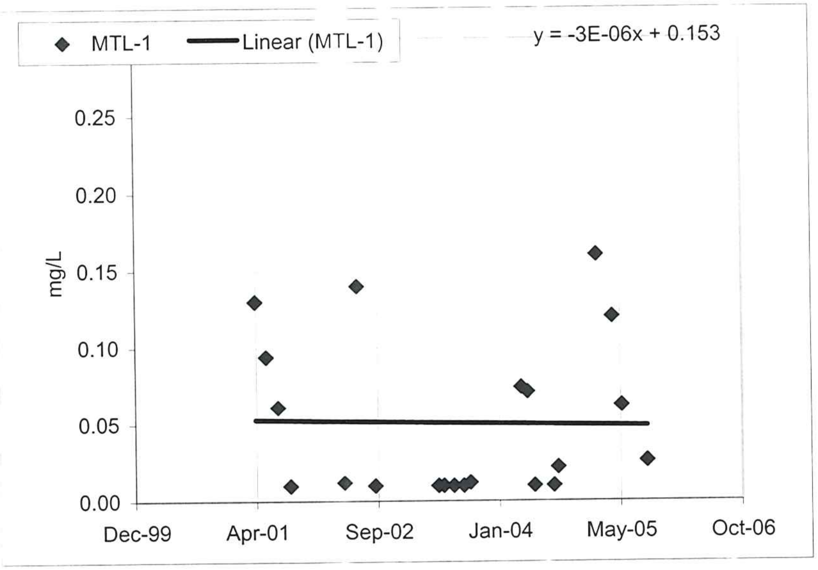


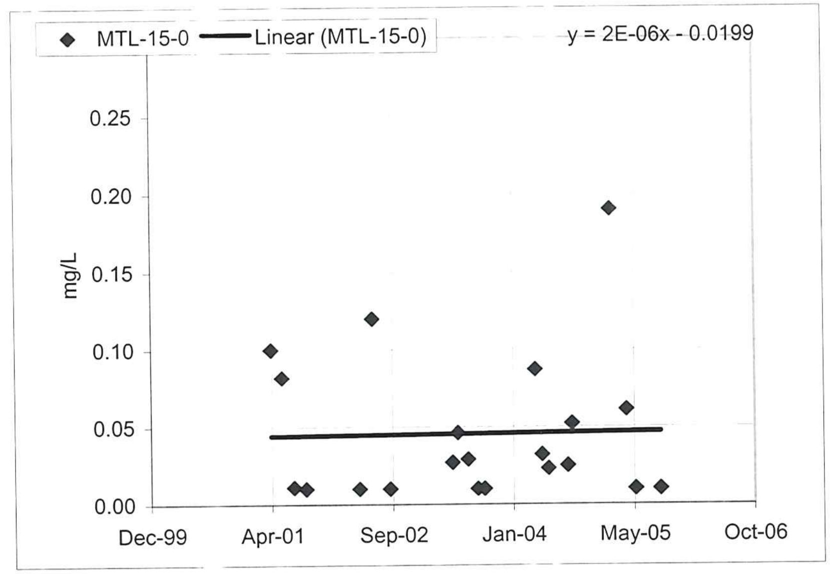


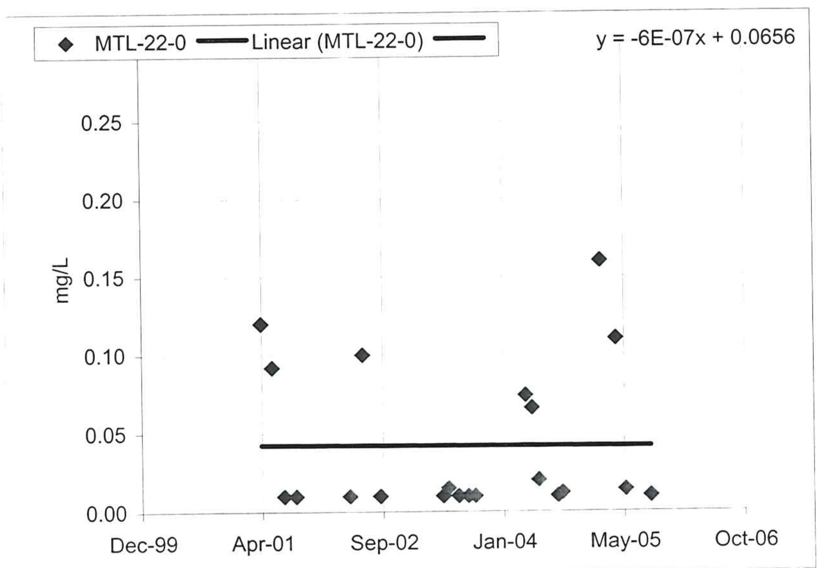


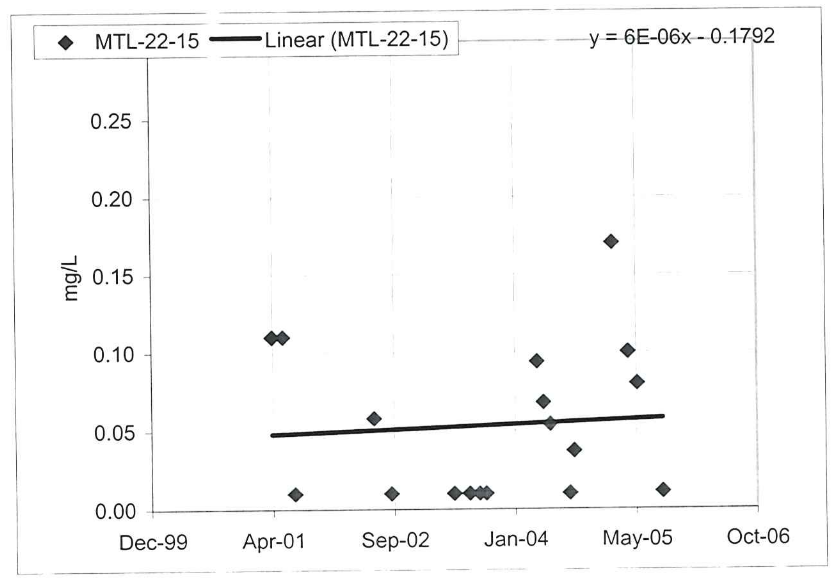


Soluble Phosphorus (ortho-Phosphate)

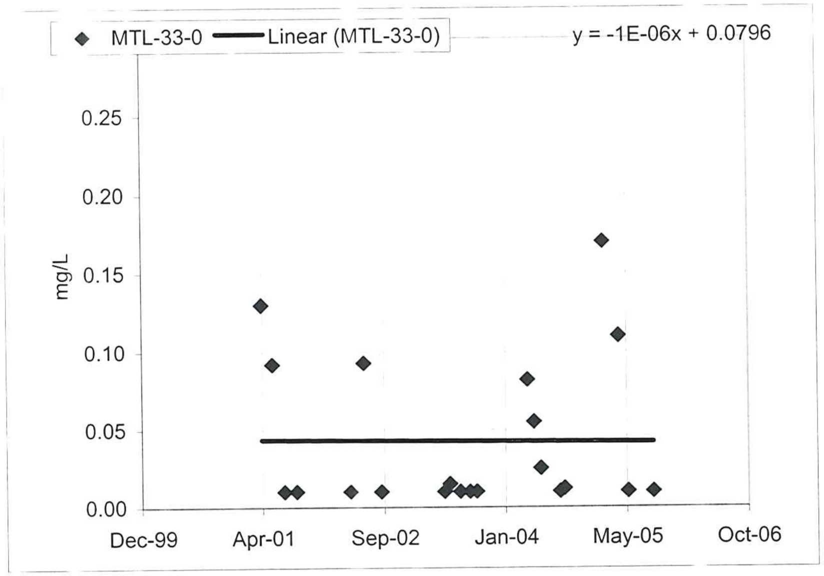


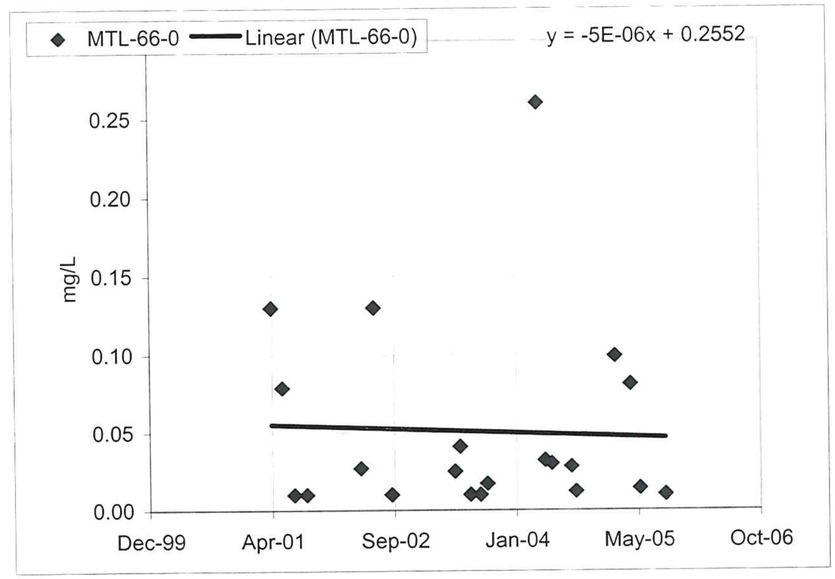


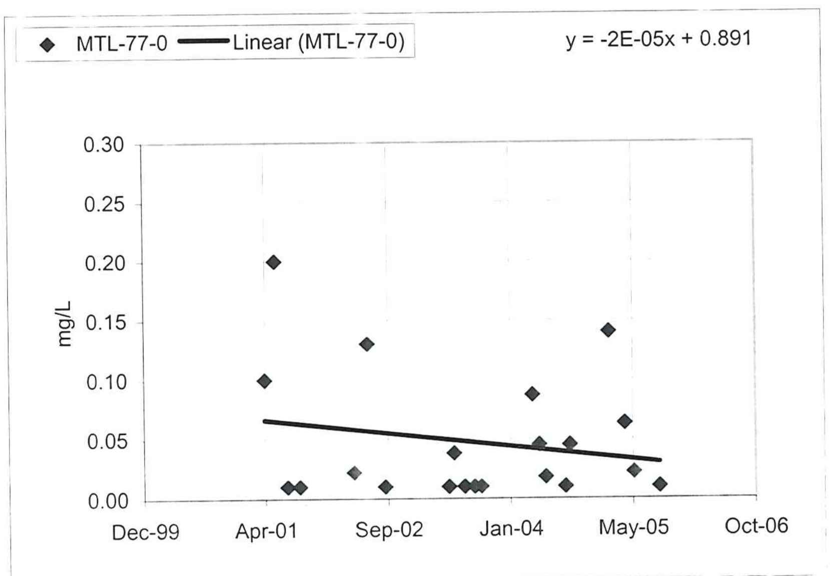


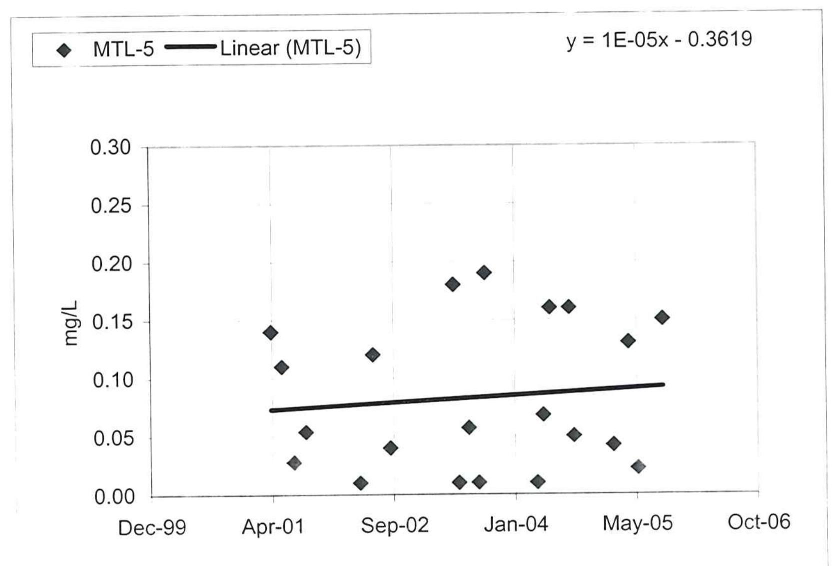


Soluble Phosphorus (ortho-Phosphate)

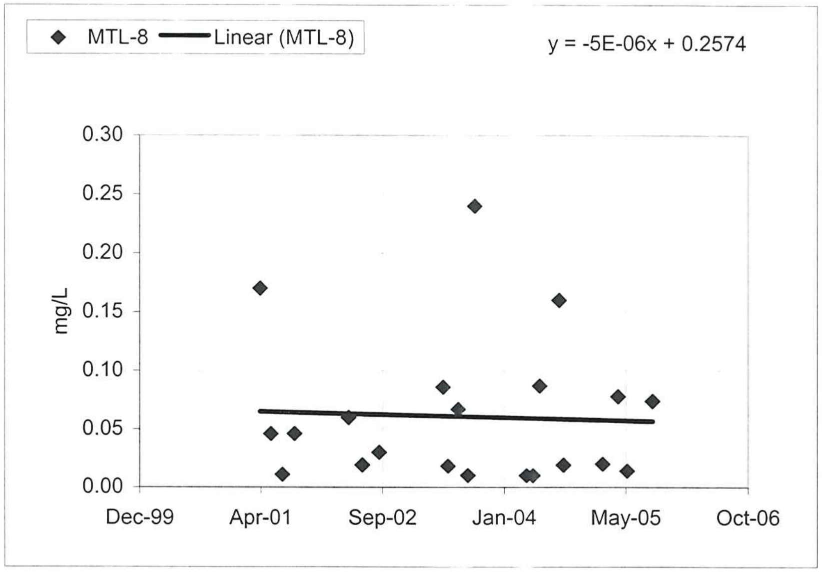


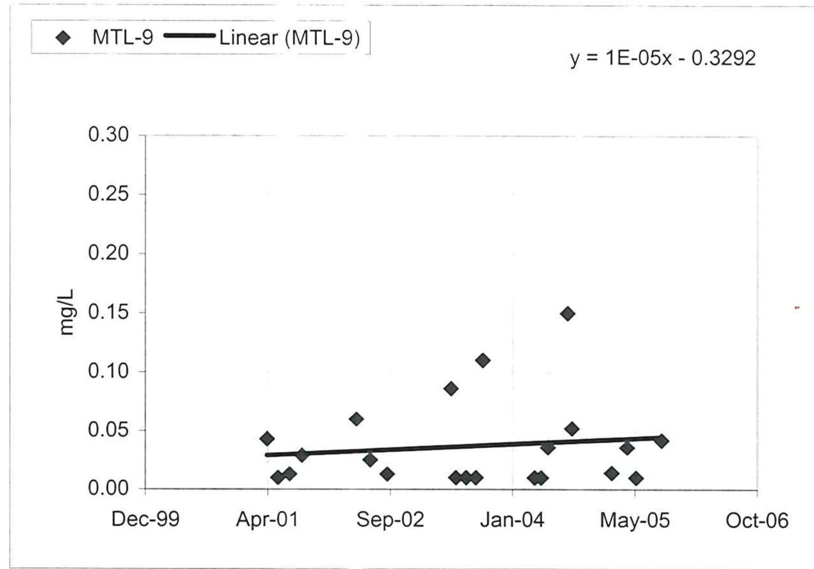


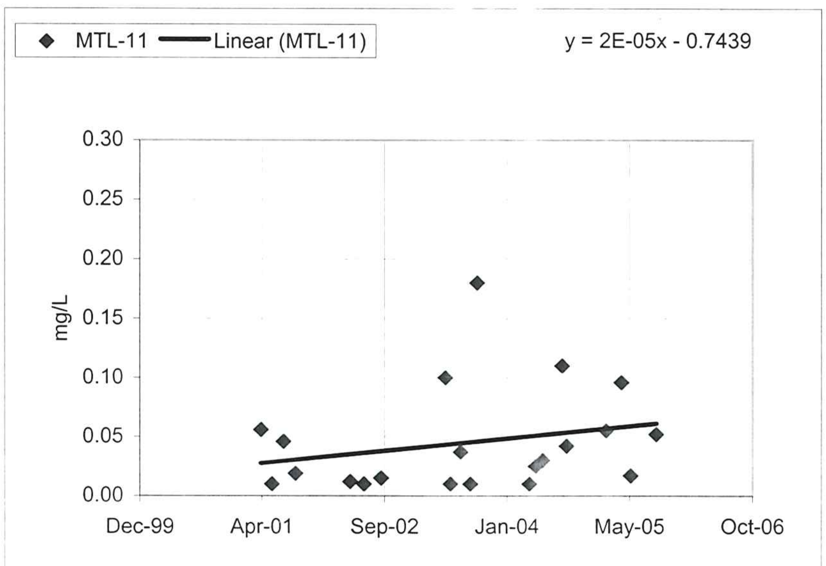


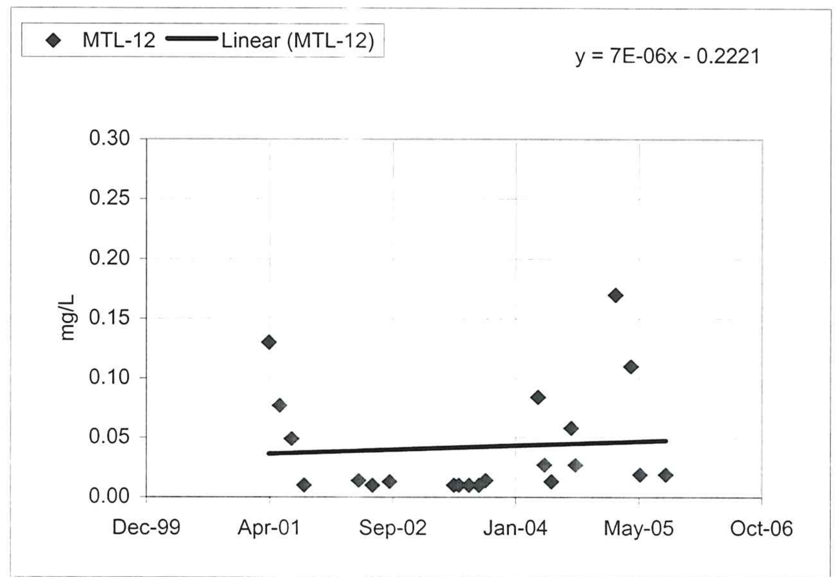


Soluble Phosphorus (ortho-Phosphate)

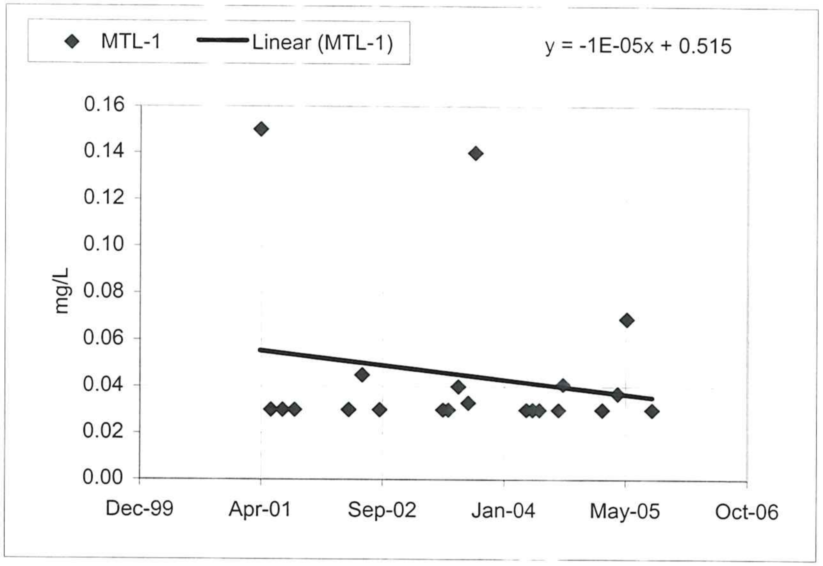




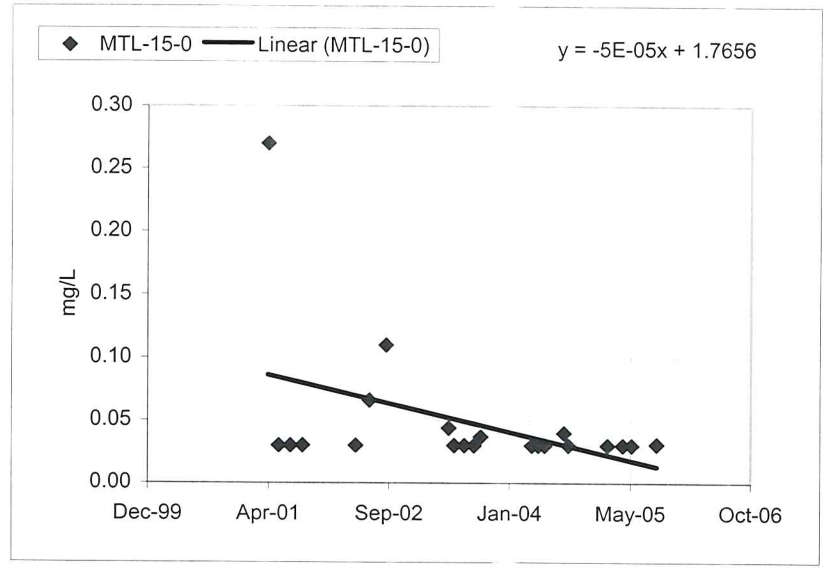




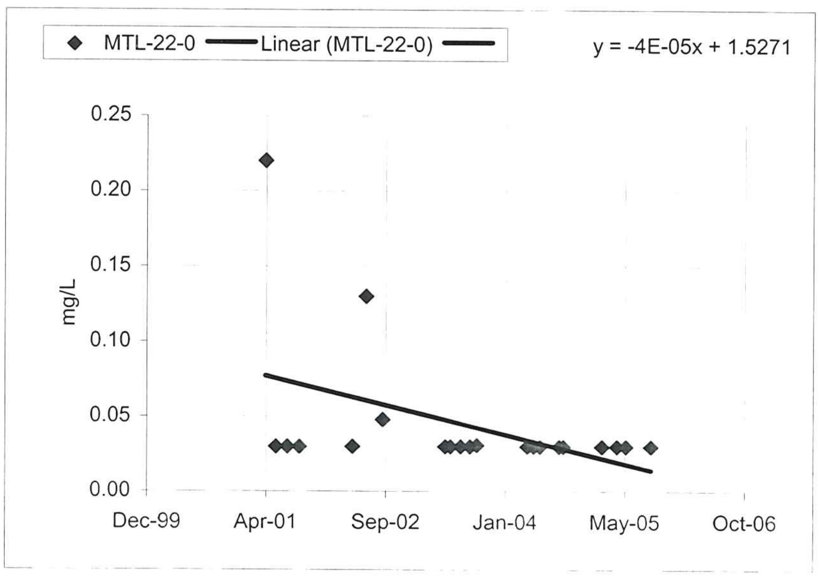
Ammonia



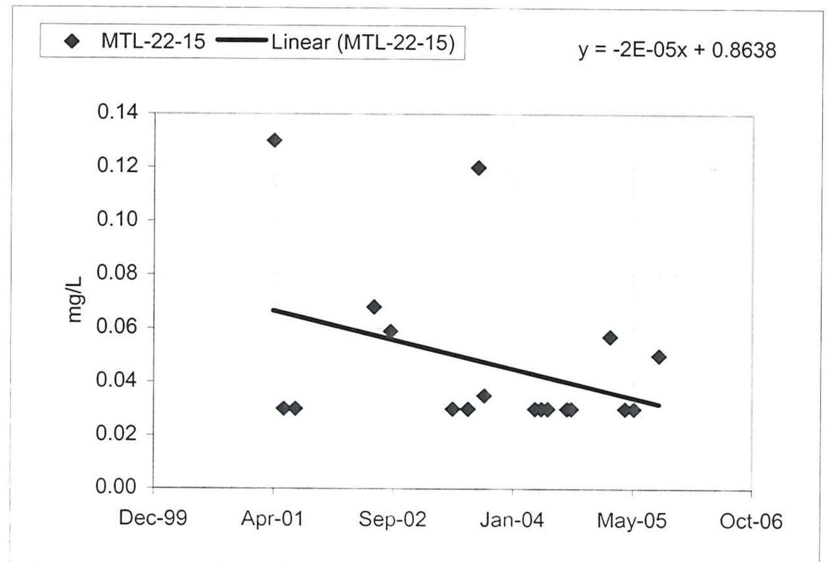
MTL-1
Linear (MTL-1)
y = -1E-05x + 0.515
mg/L
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Oct-06



MTL-15-0
Linear (MTL-15-0)
y = -5E-05x + 1.7656
mg/L
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Oct-06

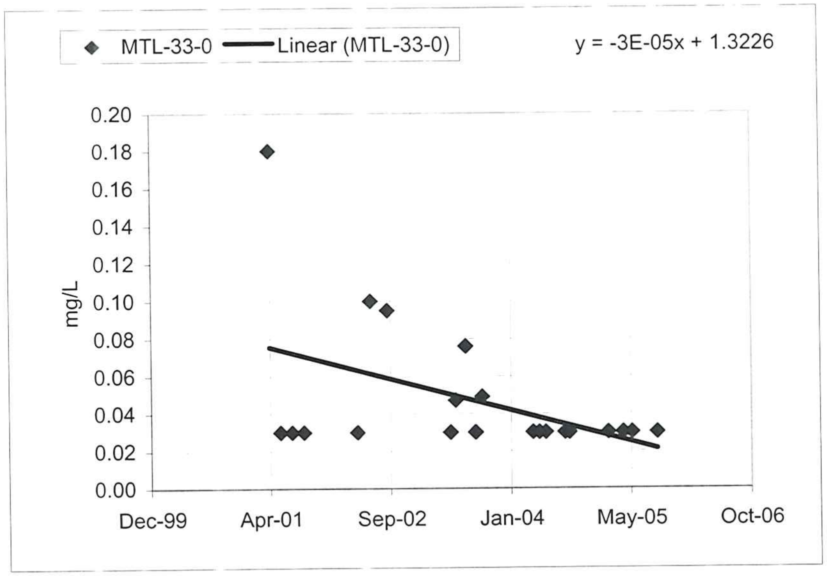


MTL-22-0
Linear (MTL-22-0)
y = -4E-05x + 1.5271
mg/L
0.25
0.20
0.15
0.10
0.05
0.00
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Oct-06

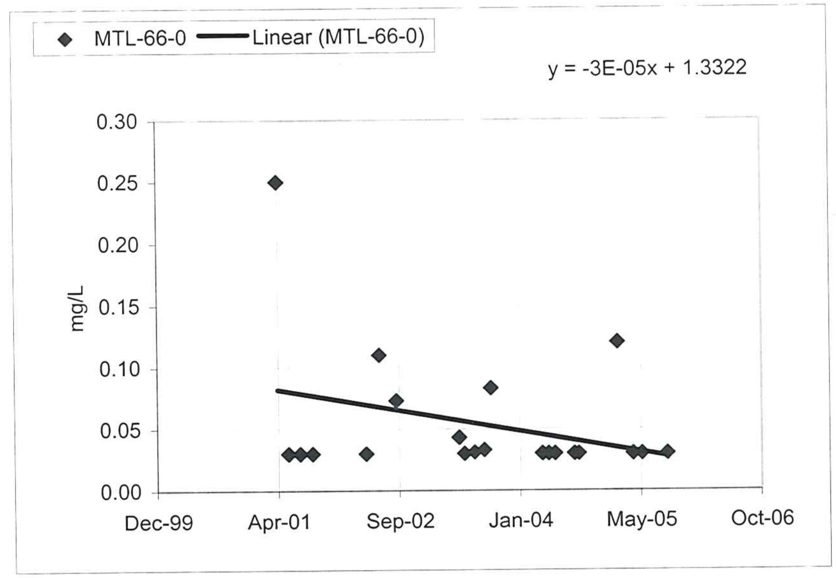


MTL-22-15
Linear (MTL-22-15)
y = -2E-05x + 0.8638
mg/L
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Oct-06

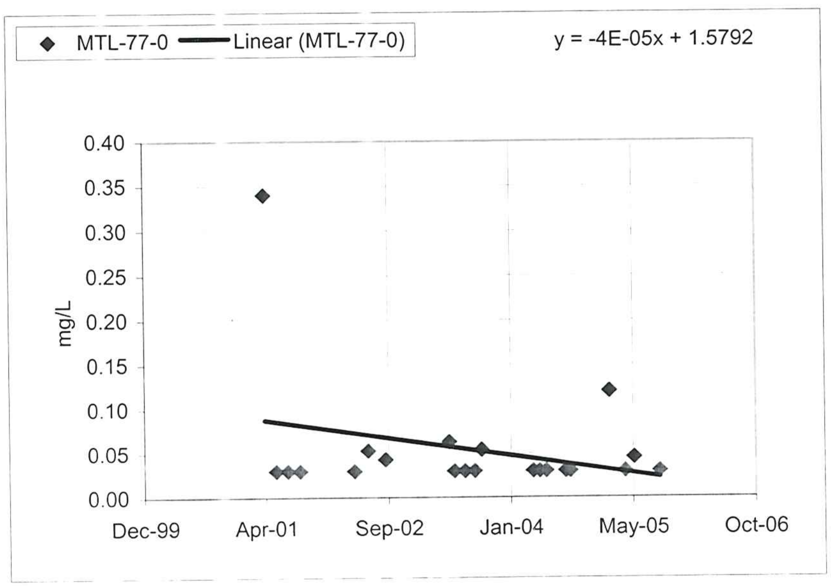
Ammonia



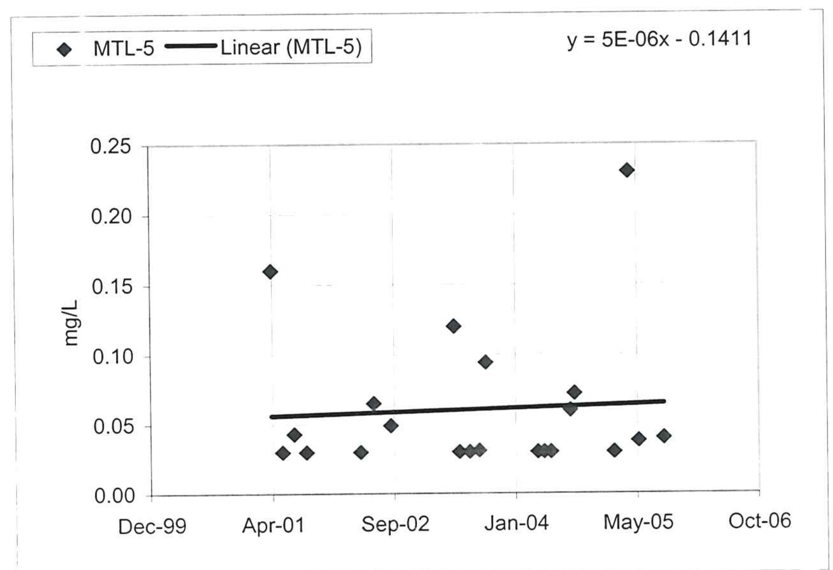
MTL-33-0
Linear (MTL-33-0)
y = -3E-05x + 1.3226
mg/L
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Oct-06



MTL-66-0
Linear (MTL-66-0)
y = -3E-05x + 1.3322
mg/L
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Oct-06

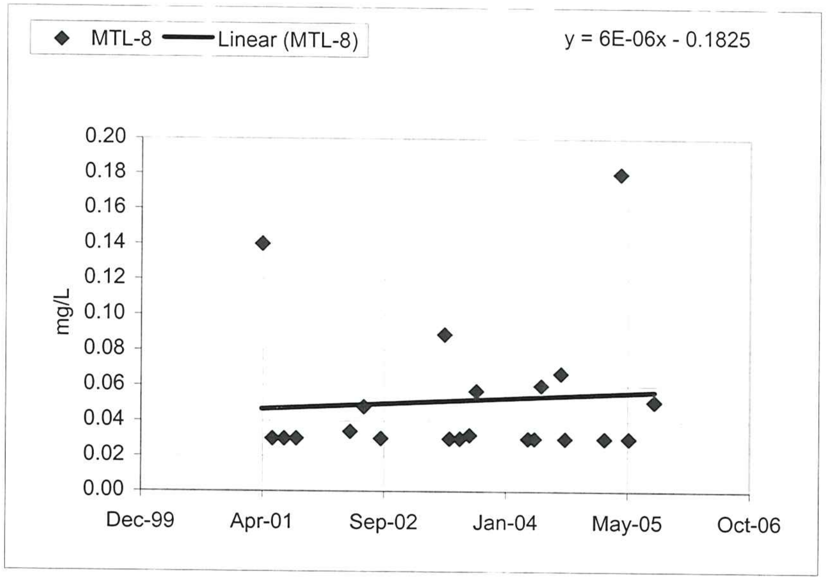


MTL-77-0
Linear (MTL-77-0)
y = -4E-05x + 1.5792
mg/L
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Oct-06

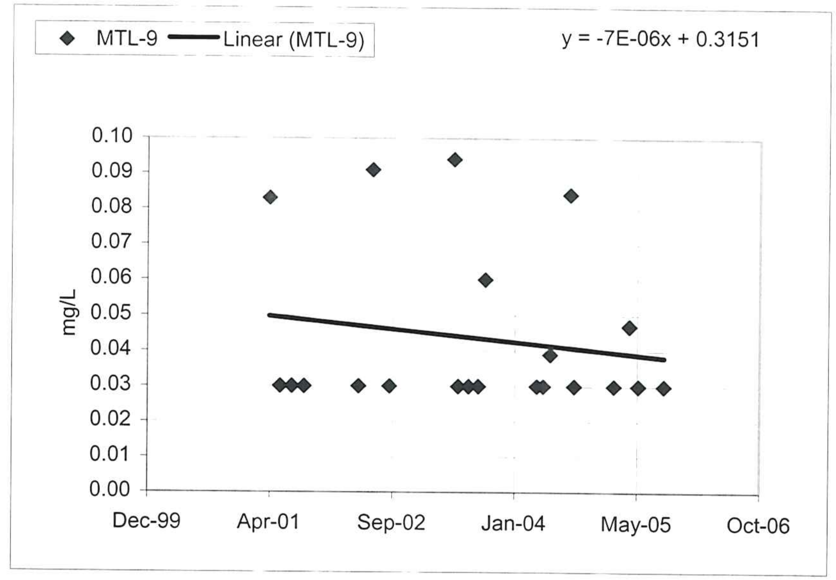


MTL-5
Linear (MTL-5)
y = 5E-06x - 0.1411
mg/L
0.25
0.20
0.15
0.10
0.05
0.00
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Oct-06

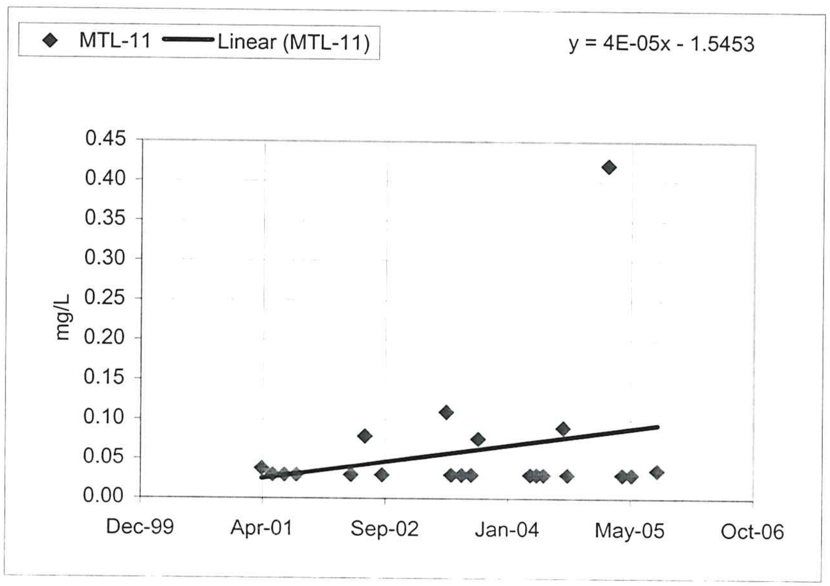
Ammonia



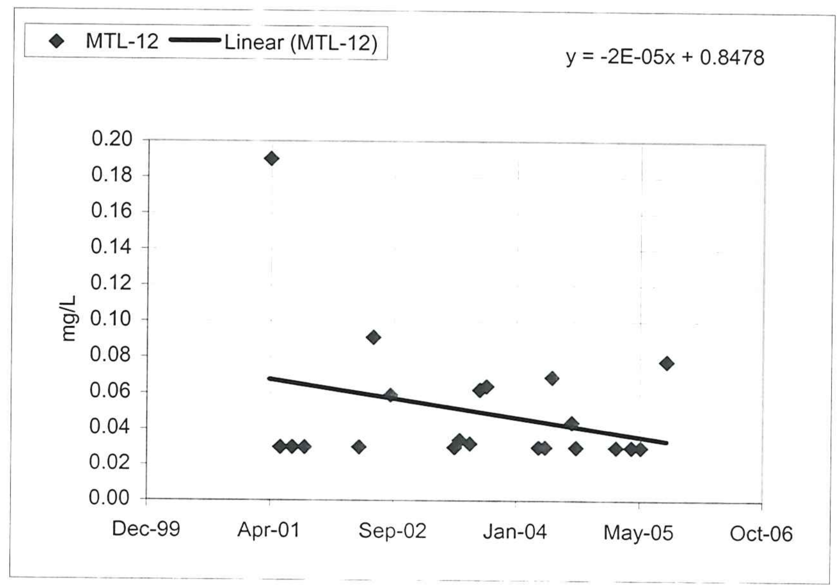
MTL-8
Linear (MTL-8)
y = 6E-06x - 0.1825
mg/L
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Oct-06



MTL-9
Linear (MTL-9)
y = -7E-06x + 0.3151
mg/L
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Oct-06

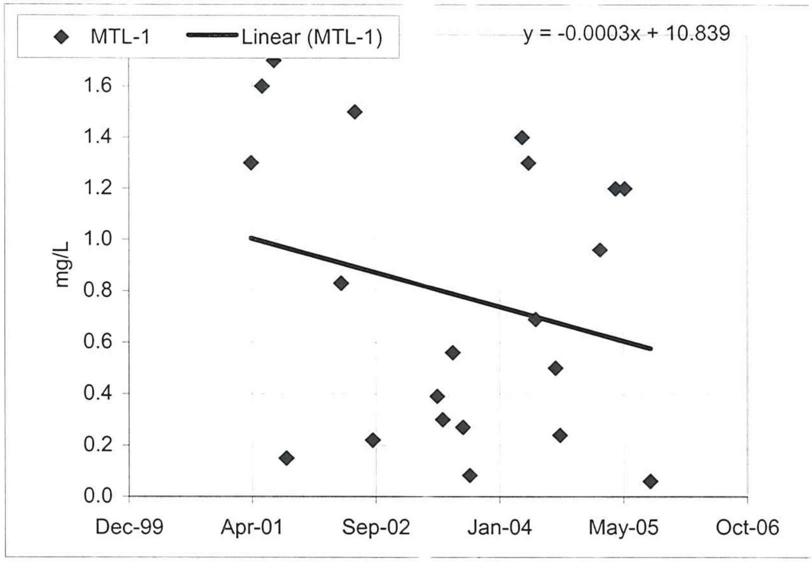


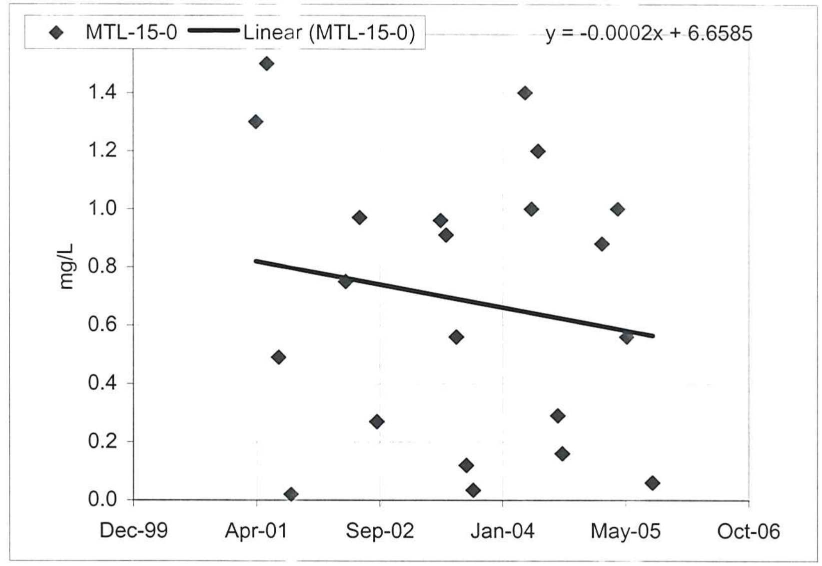
MTL-11
Linear (MTL-11)
y = 4E-05x - 1.5453
mg/L
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Oct-06

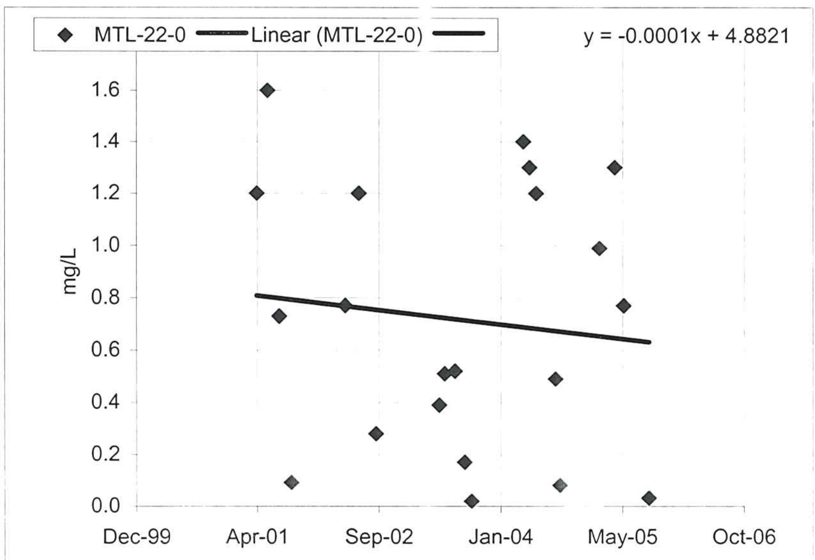


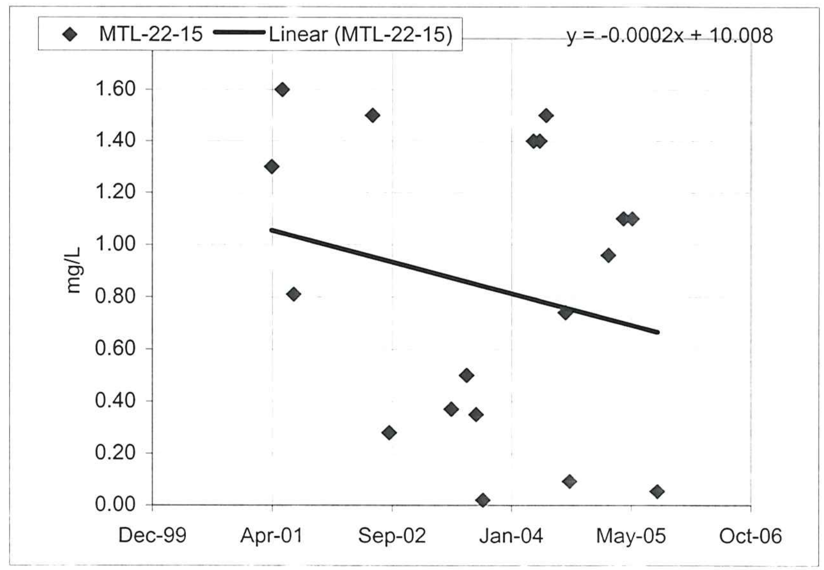
MTL-12
Linear (MTL-12)
y = -2E-05x + 0.8478
mg/L
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Oct-06

Nitrate

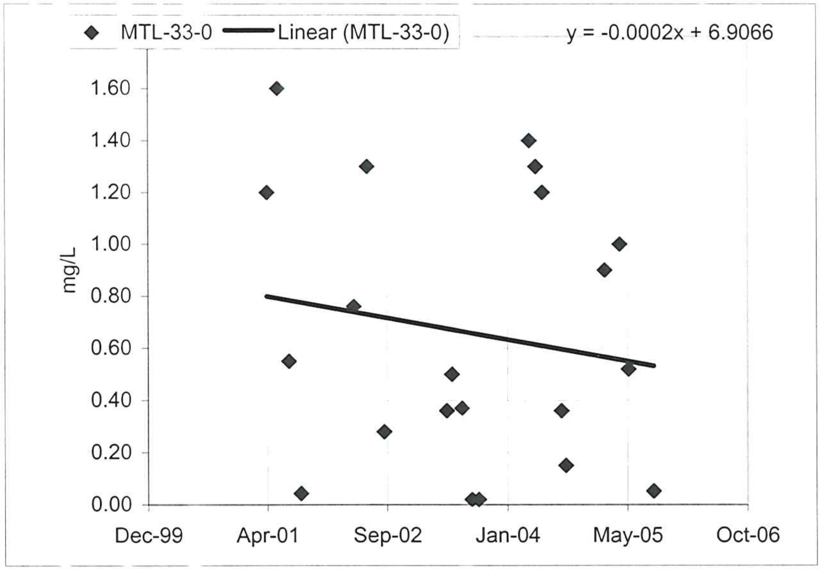

MTL-1
Linear (MTL-1)
y = -0.0003x + 10.839
mg/L
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Oct-06


MTL-15-0
Linear (MTL-15-0)
y = -0.0002x + 6.6585
mg/L
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Oct-06

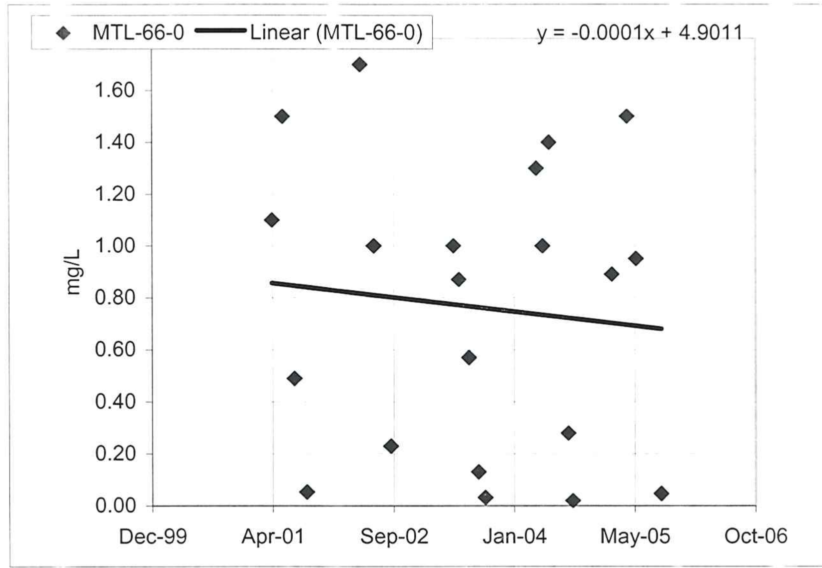

MTL-22-0
Linear (MTL-22-0)
y = -0.0001x + 4.8821
mg/L
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Oct-06


MTL-22-15
Linear (MTL-22-15)
y = -0.0002x + 10.008
mg/L
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Oct-06

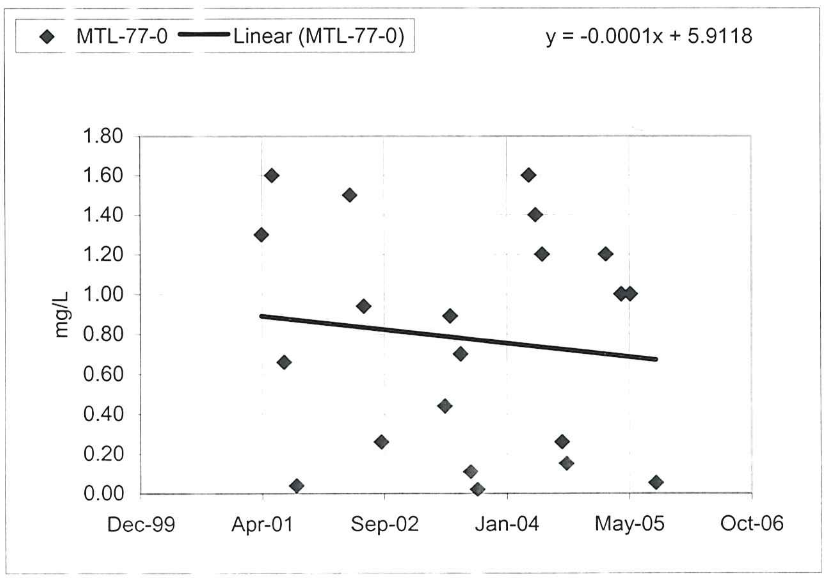
Nitrate



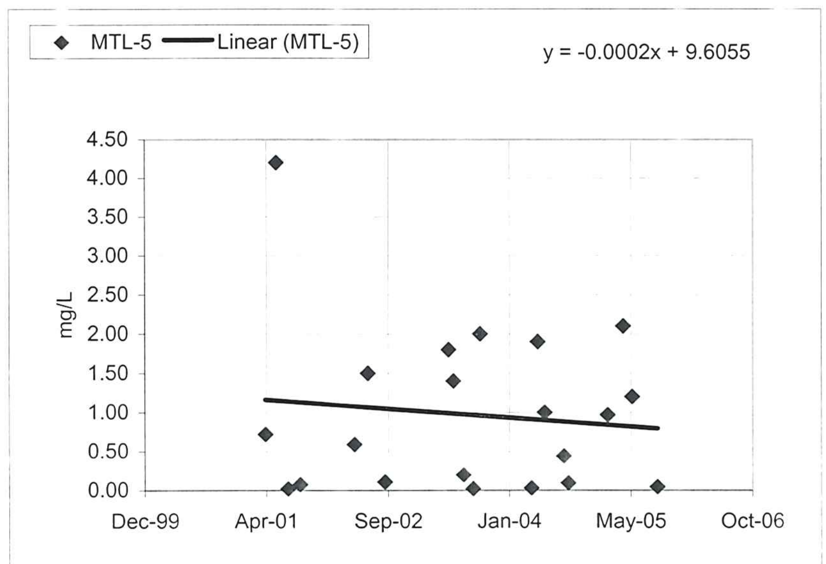
MTL-33-0
Linear (MTL-33-0)
y = -0.0002x + 6.9066
mg/L
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Oct-06



MTL-66-0
Linear (MTL-66-0)
y = -0.0001x + 4.9011
mg/L
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Oct-06

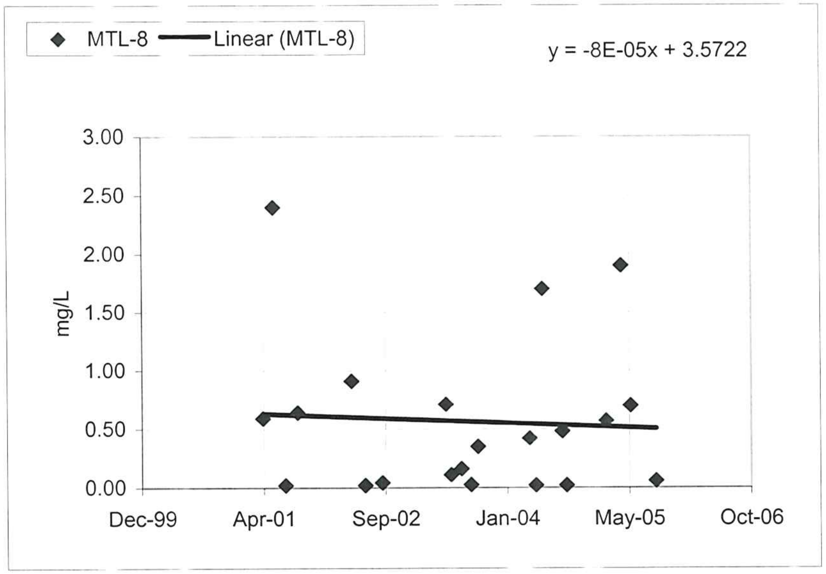


MTL-77-0
Linear (MTL-77-0)
y = -0.0001x + 5.9118
mg/L
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Oct-06

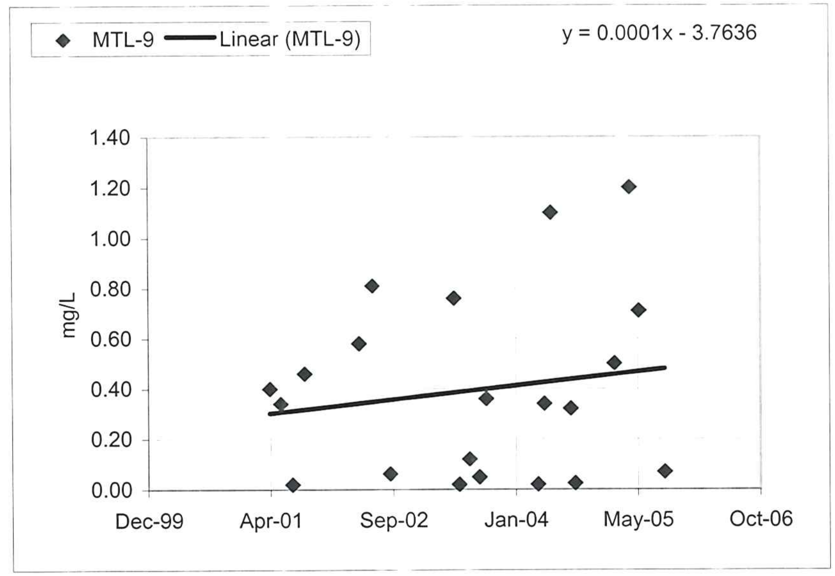


MTL-5
Linear (MTL-5)
y = -0.0002x + 9.6055
mg/L
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Oct-06

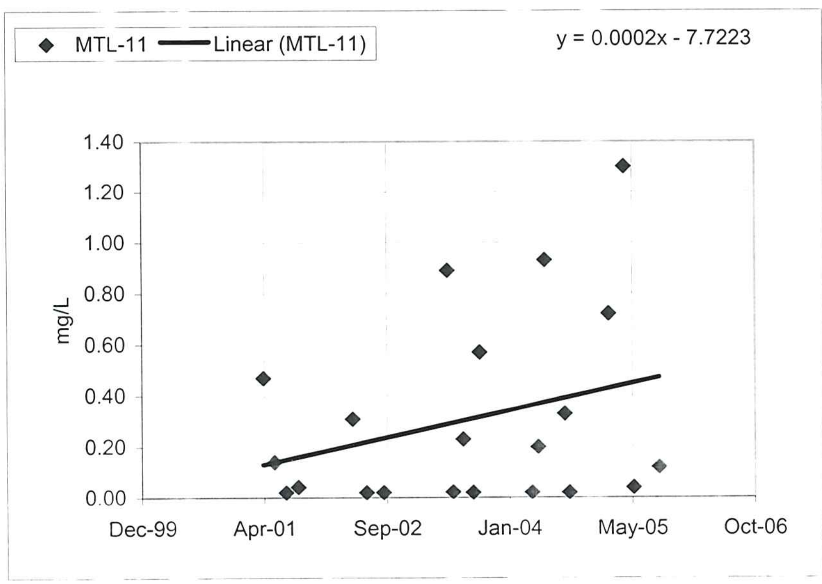
Nitrate



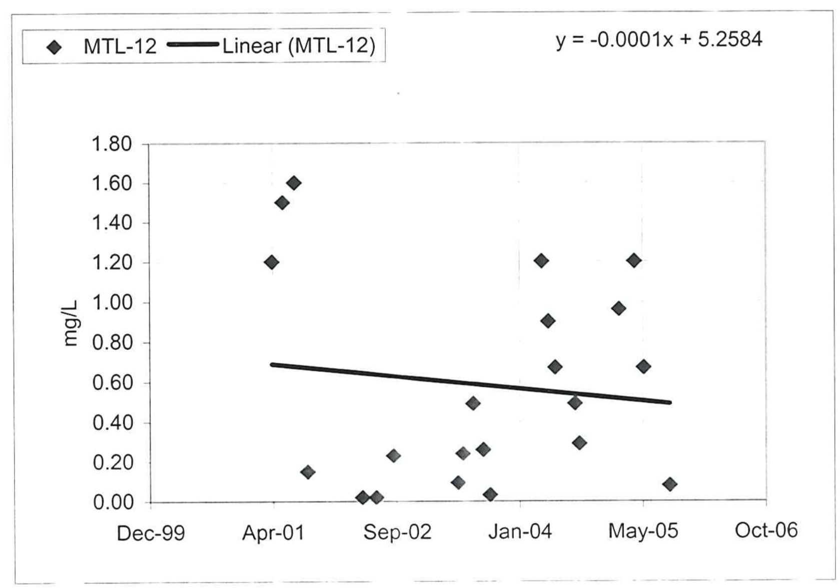
MTL-8
Linear (MTL-8)
y = -8E-05x + 3.5722
mg/L
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Oct-06



MTL-9
Linear (MTL-9)
y = 0.0001x - 3.7636
mg/L
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Oct-06

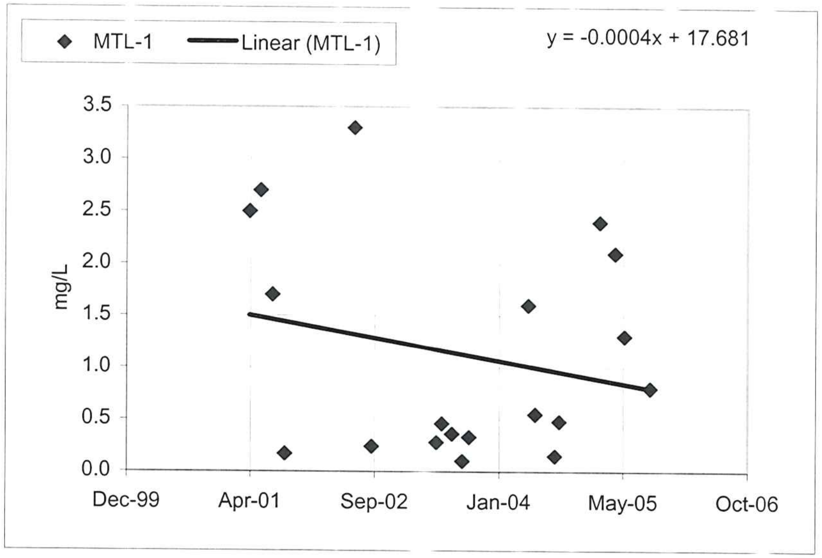


MTL-11
Linear (MTL-11)
y = 0.0002x - 7.7223
mg/L
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Oct-06

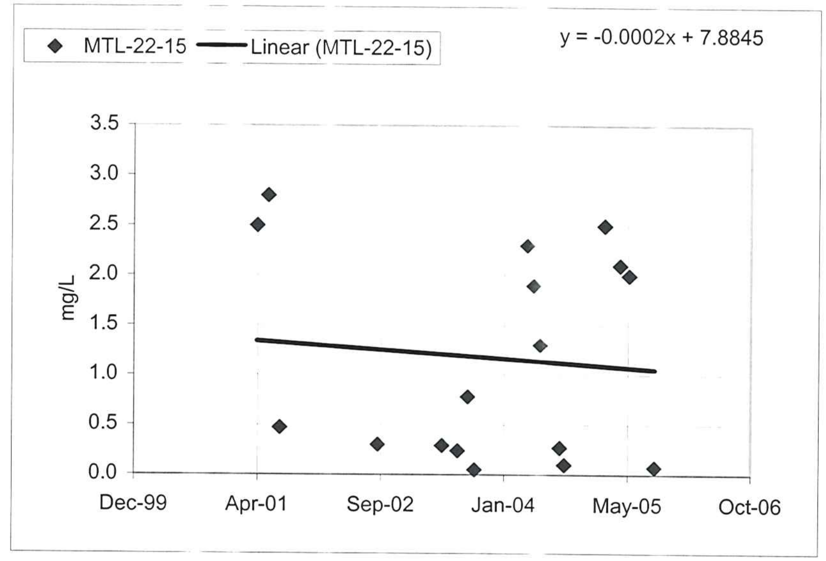


MTL-12
Linear (MTL-12)
y = -0.0001x + 5.2584
mg/L
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Oct-06

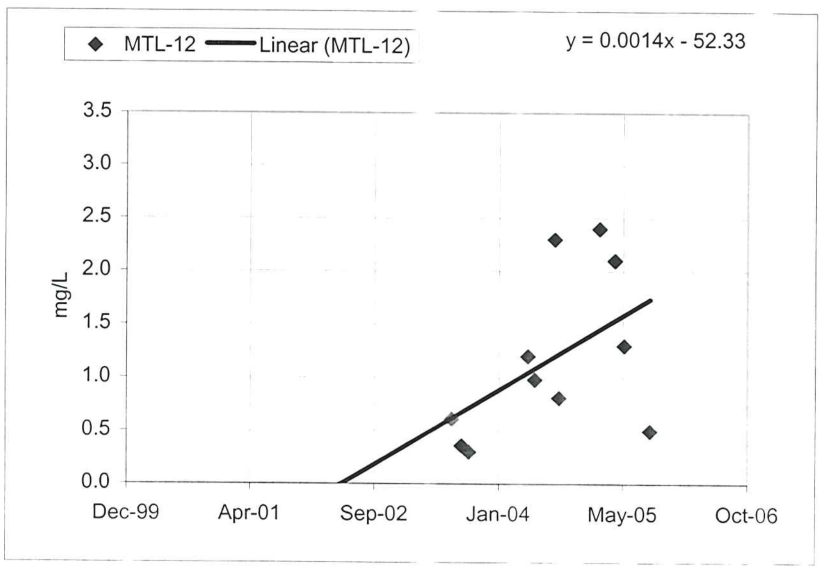
Iron



MTL-1
Linear (MTL-1)
y = -0.0004x + 17.681
mg/L
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Oct-06

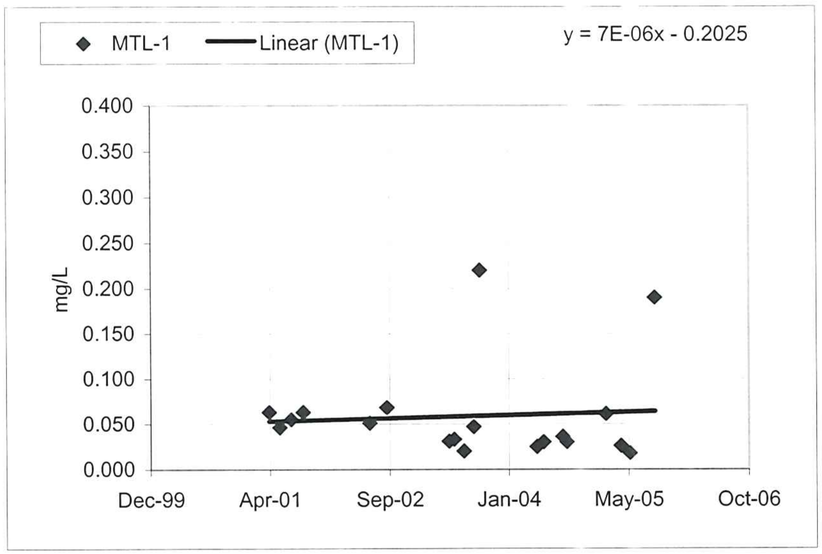


MTL-22-15
Linear (MTL-22-15)
y = -0.0002x + 7.8845
mg/L
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Oct-06

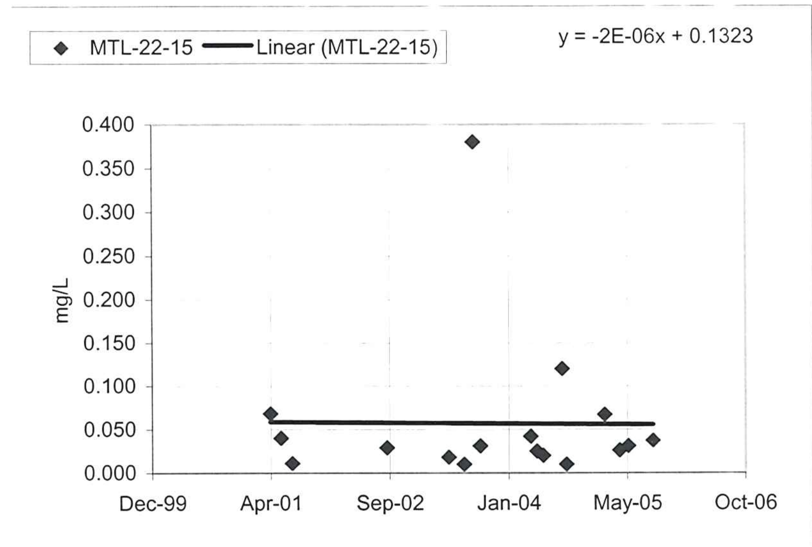


MTL-12
Linear (MTL-12)
y = 0.0014x - 52.33
mg/L
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Oct-06

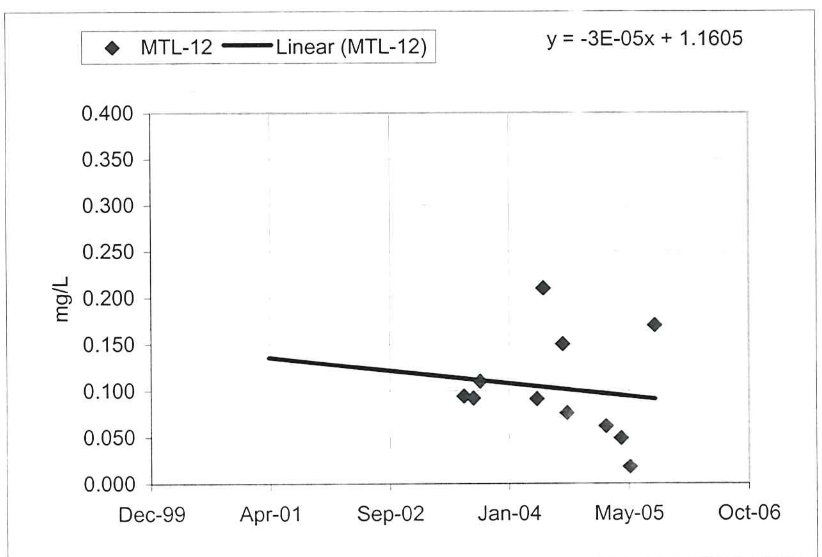
Manganese



MTL-1
Linear (MTL-1)
y = 7E-06x - 0.2025
mg/L
0.400
0.350
0.300
0.250
0.200
0.150
0.100
0.050
0.000
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Oct-06

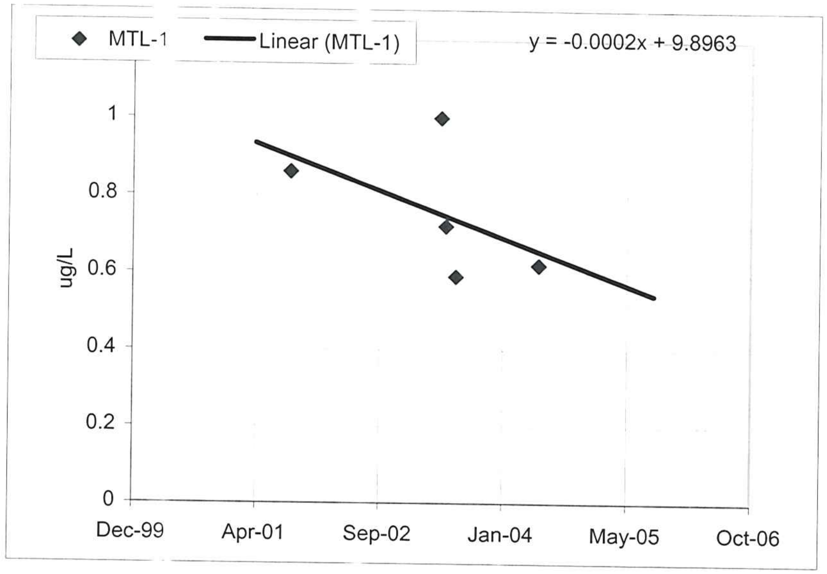


MTL-22-15
Linear (MTL-22-15)
y = -2E-06x + 0.1323
mg/L
0.400
0.350
0.300
0.250
0.200
0.150
0.100
0.050
0.000
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Oct-06

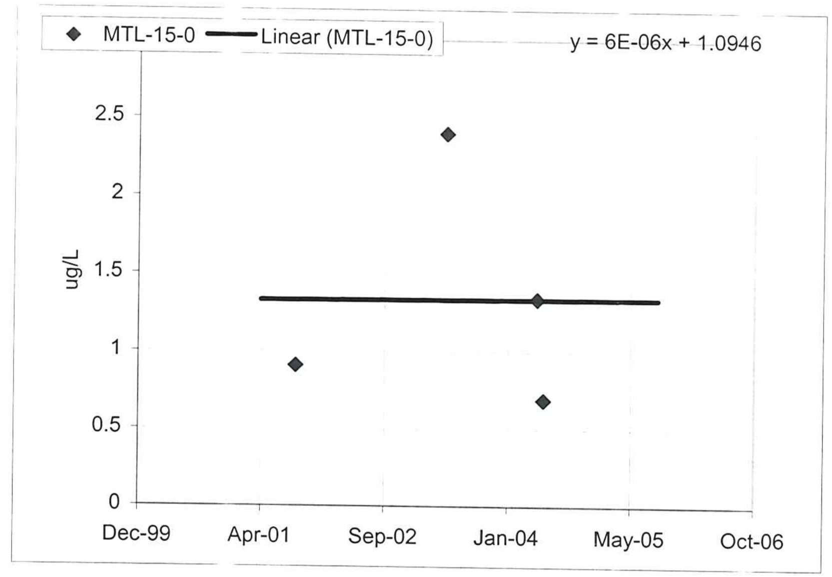


MTL-12
Linear (MTL-12)
y = -3E-05x + 1.1605
mg/L
0.400
0.350
0.300
0.250
0.200
0.150
0.100
0.050
0.000
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Oct-06

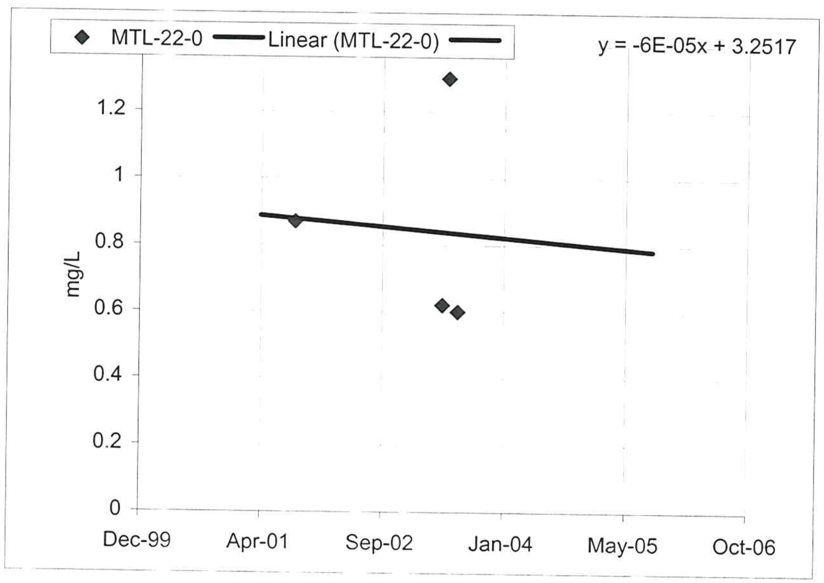
Atrazine



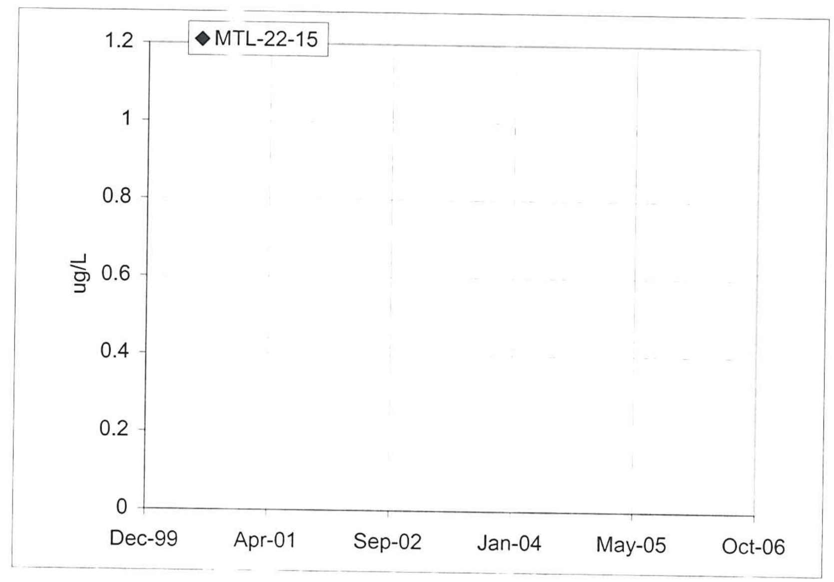
MTL-1
Linear (MTL-1)
y = -0.0002x + 9.8963
ug/L
1
0.8
0.6
0.4
0.2
0
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Oct-06



MTL-15-0
Linear (MTL-15-0)
y = 6E-06x + 1.0946
ug/L
2.5
2
1.5
1
0.5
0
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Oct-06

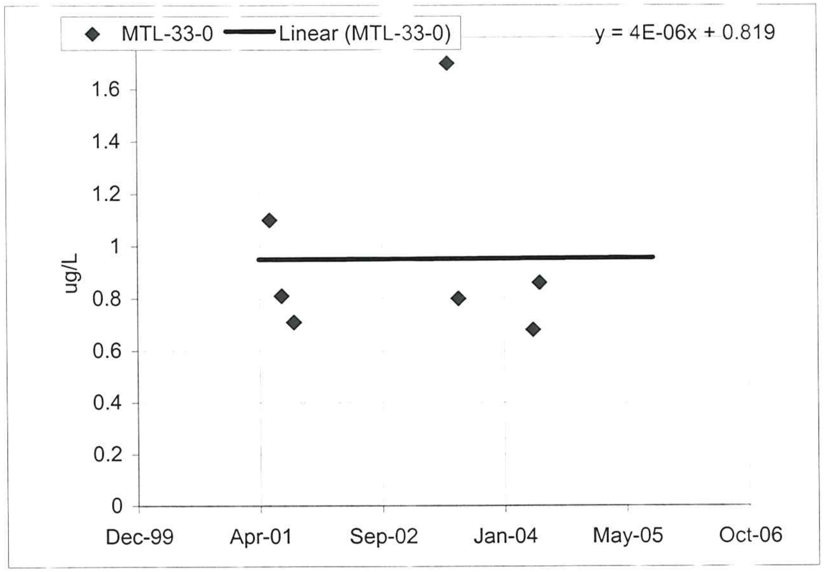


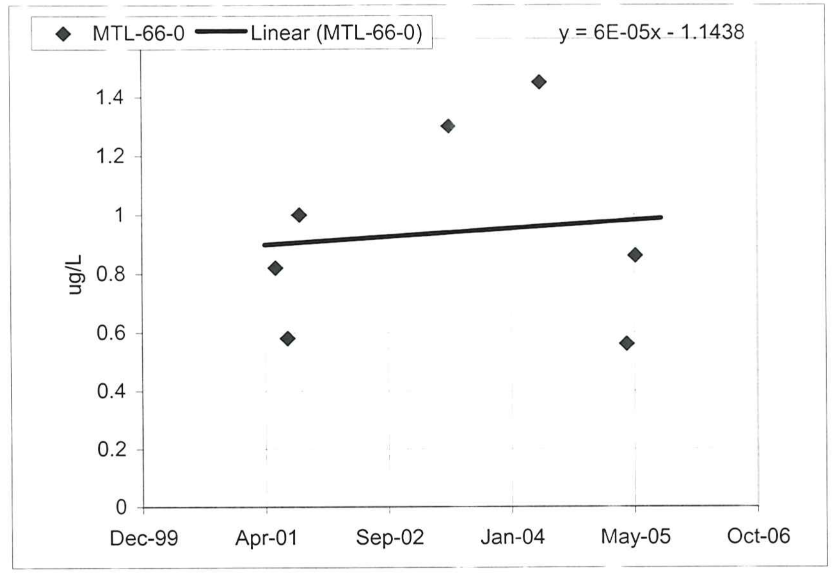
MTL-22-0
Linear (MTL-22-0)
y = -6E-05x + 3.2517
mg/L
1.2
1
0.8
0.6
0.4
0.2
0
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Oct-06

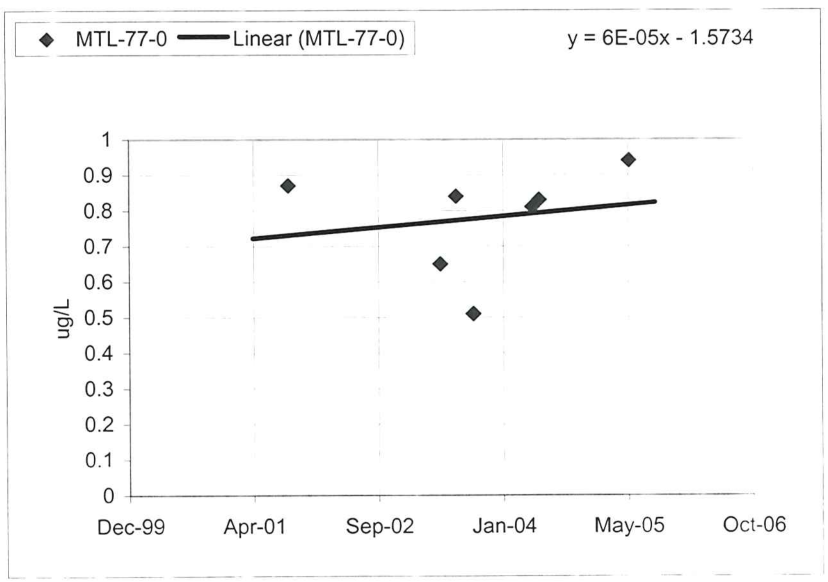


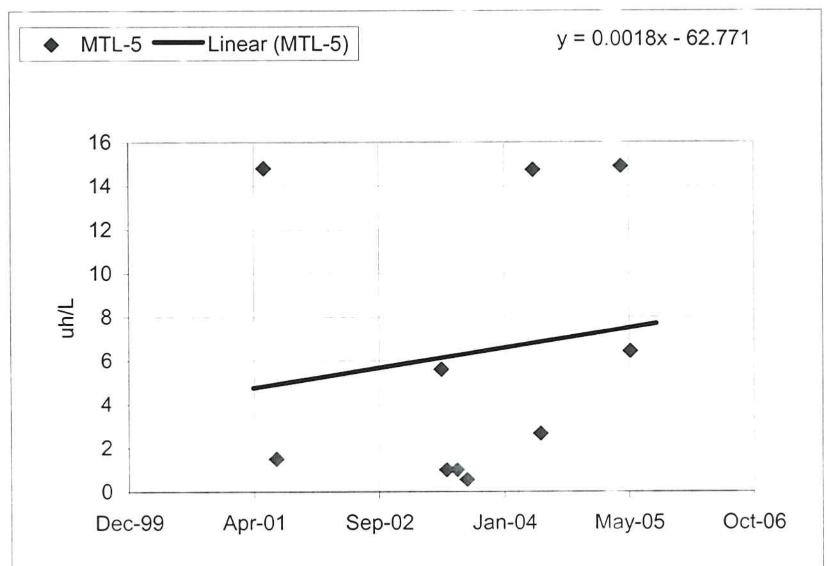
MTL-22-15
ug/L
1.2
1
0.8
0.6
0.4
0.2
0
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Oct-06

Atrazine

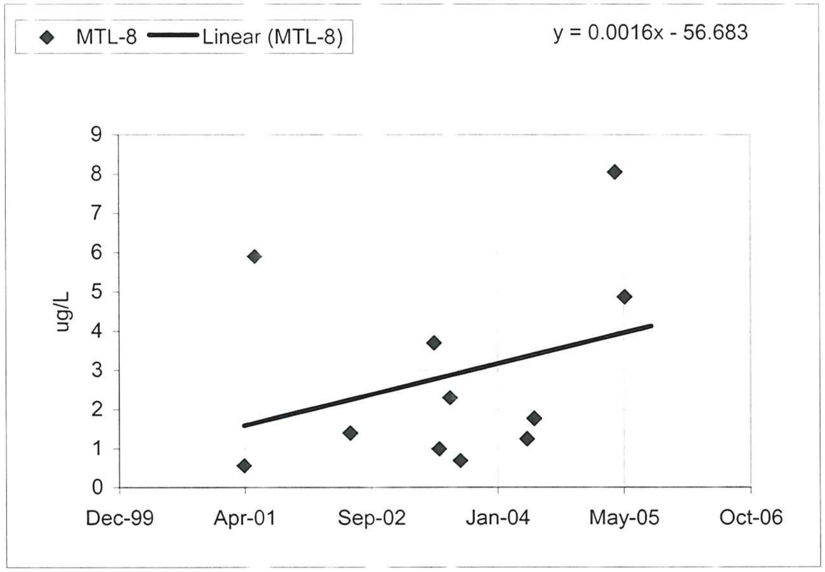

MTL-33-0
Linear (MTL-33-0)
y = 4E-06x + 0.819
ug/L
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Oct-06

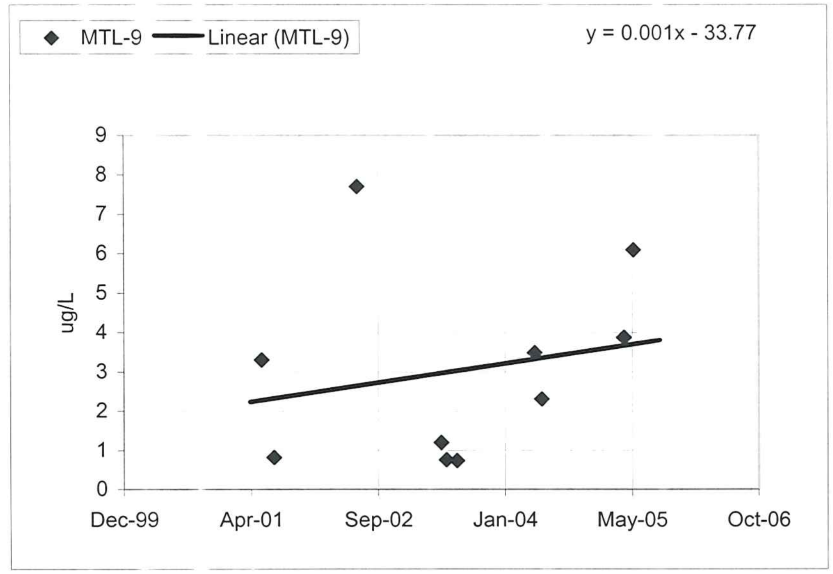

MTL-66-0
Linear (MTL-66-0)
y = 6E-05x - 1.1438
ug/L
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Oct-06

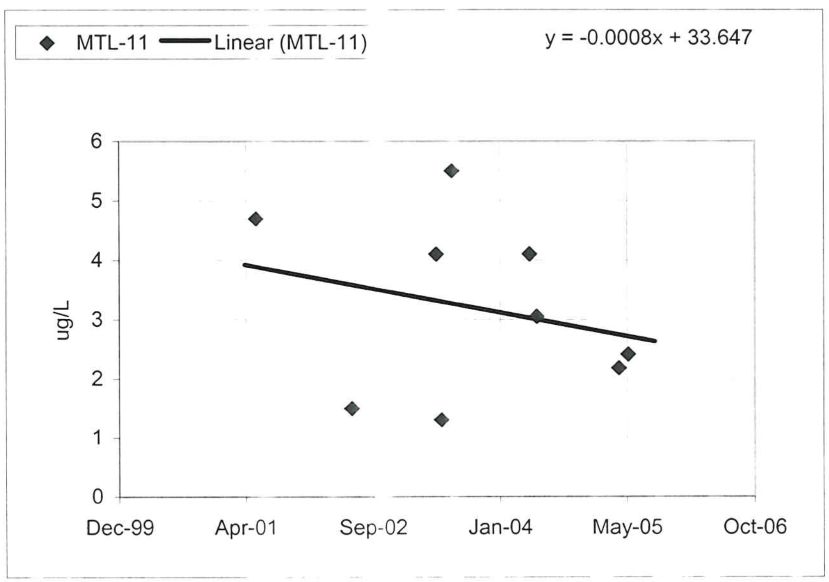

MTL-77-0
Linear (MTL-77-0)
y = 6E-05x - 1.5734
ug/L
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Oct-06

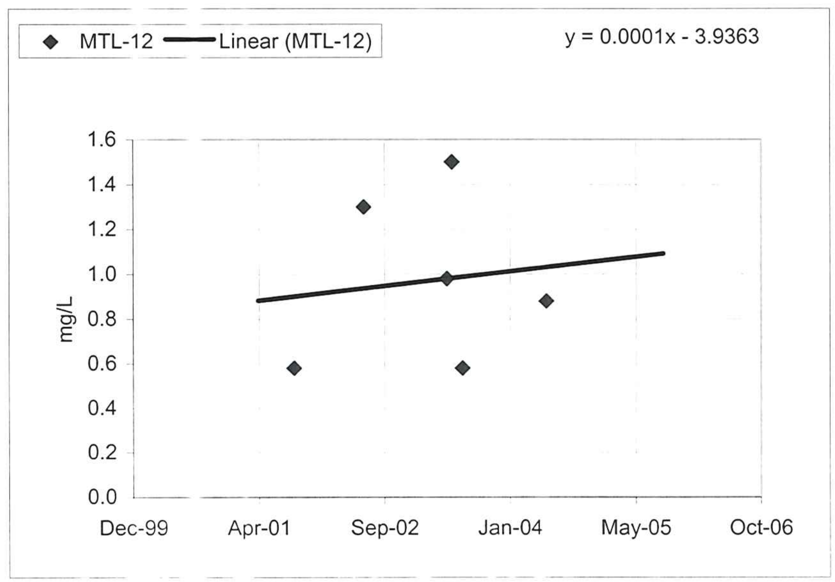

MTL-5
Linear (MTL-5)
y = 0.0018x - 62.771
uh/L
16
14
12
10
8
6
4
2
0
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Oct-06

Atrazine

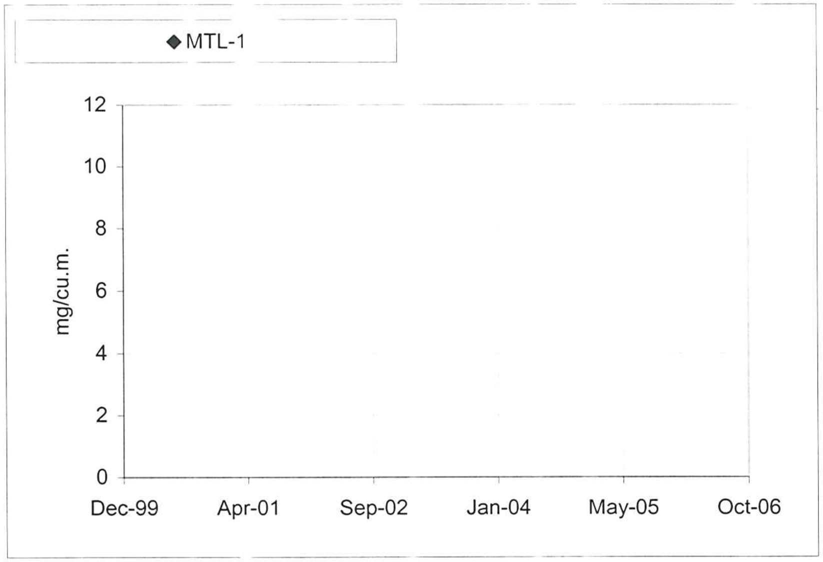

MTL-8 Linear (MTL-8)
y = 0.0016x - 56.683
ug/L
9
8
7
6
5
4
3
2
1
0
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Oct-06

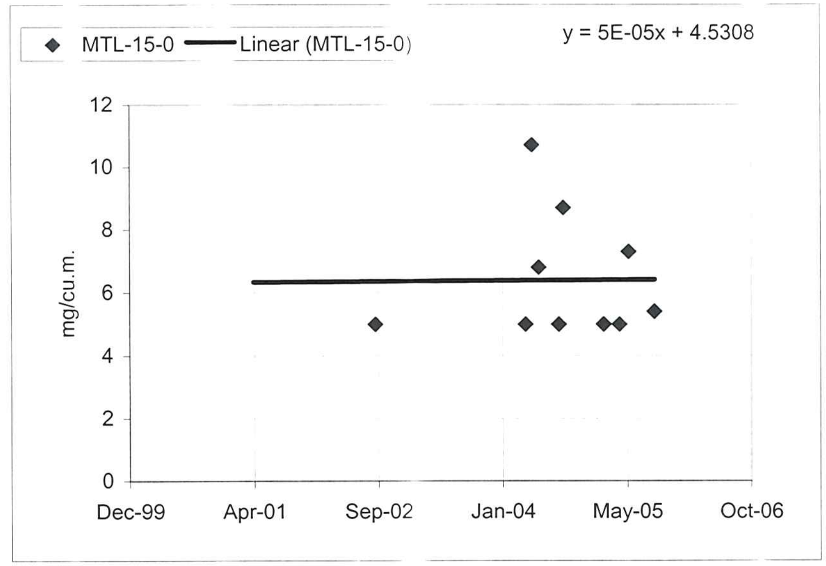

MTL-9 Linear (MTL-9)
y = 0.001x - 33.77
ug/L
9
8
7
6
5
4
3
2
1
0
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Oct-06

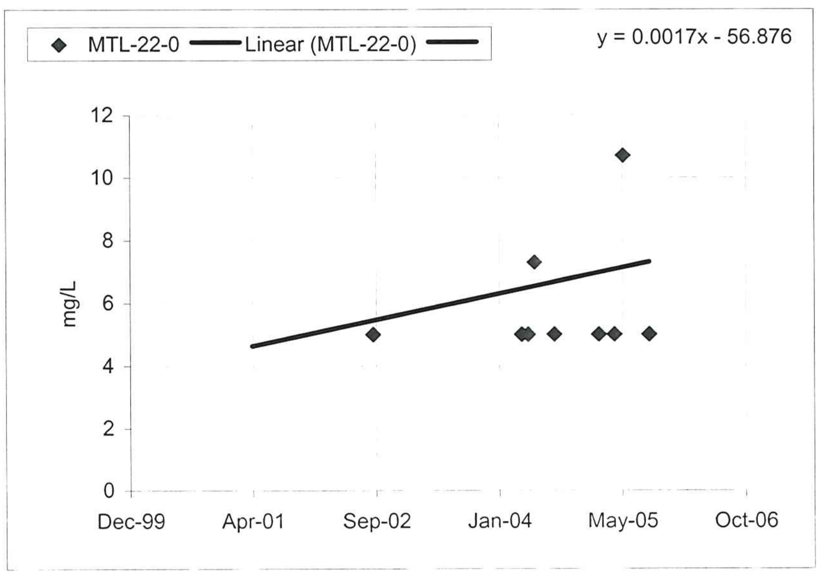

MTL-11 Linear (MTL-11)
y = -0.0008x + 33.647
ug/L
6
5
4
3
2
1
0
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Oct-06

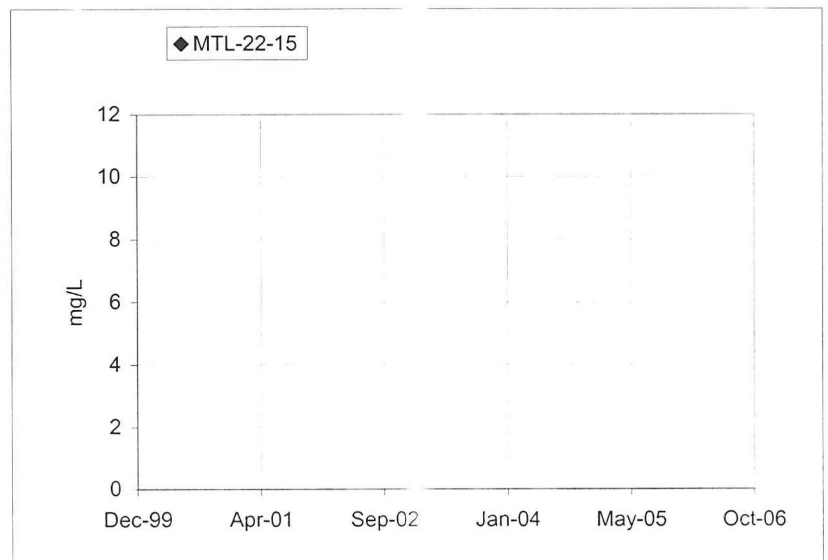

MTL-12 Linear (MTL-12)
y = 0.0001x - 3.9363
mg/L
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Oct-06

Chlorophyll

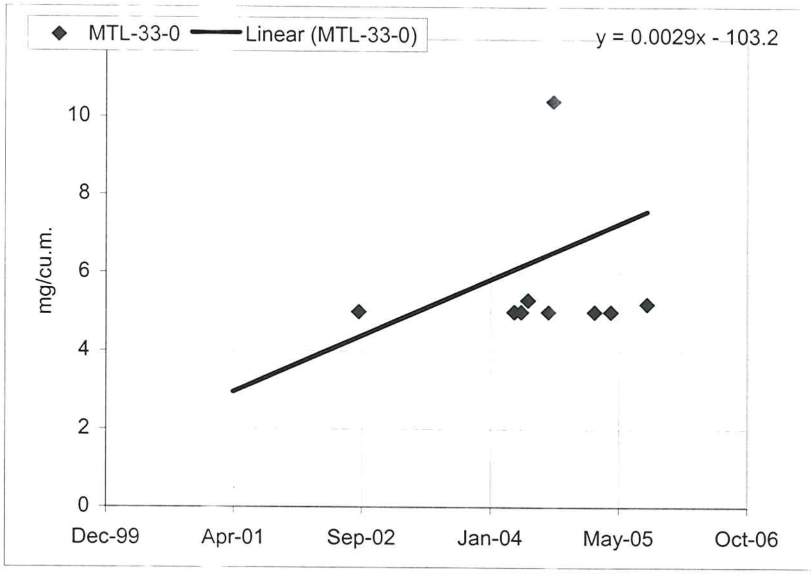


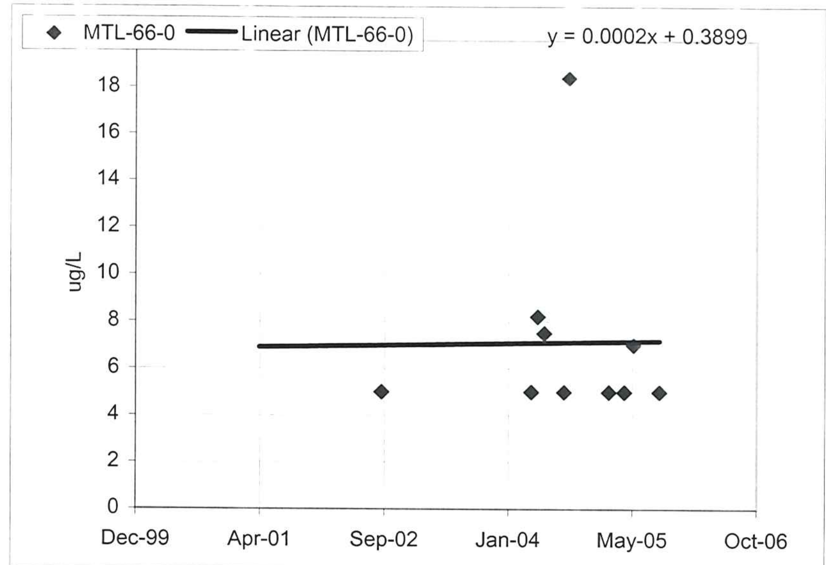


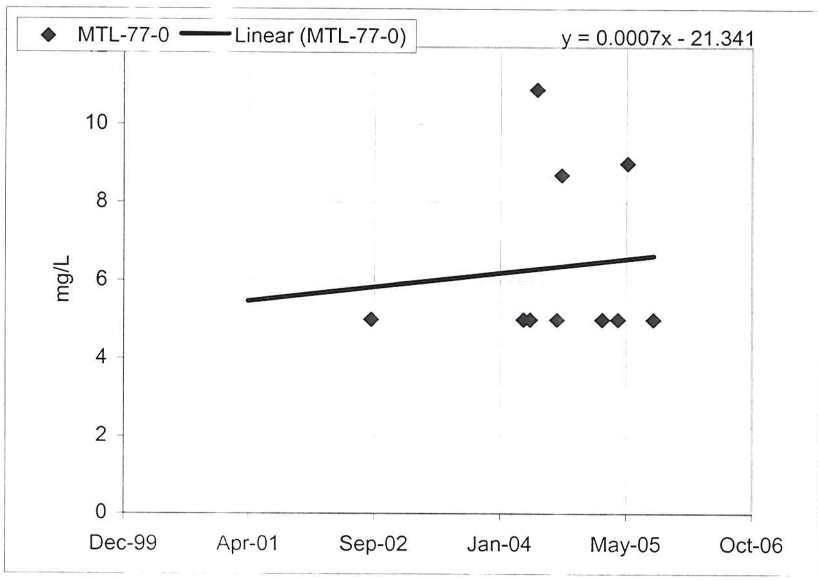




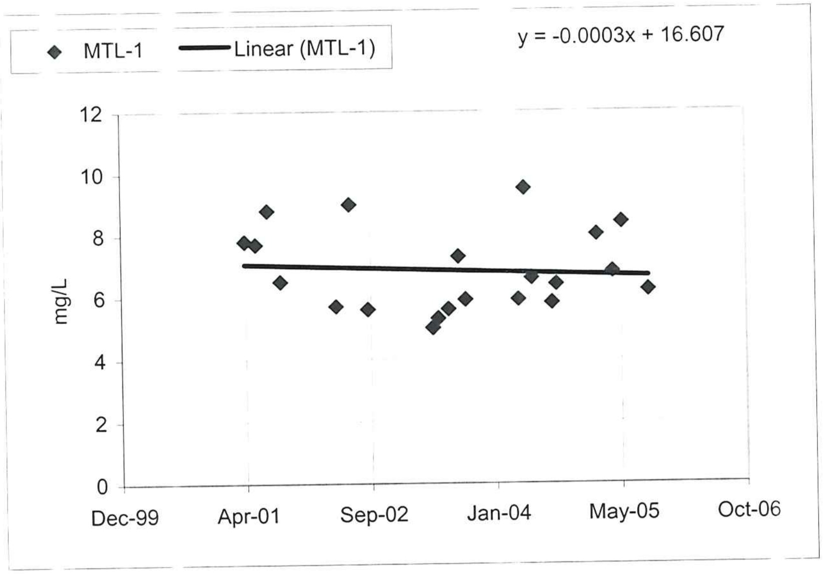
Chlorophyll

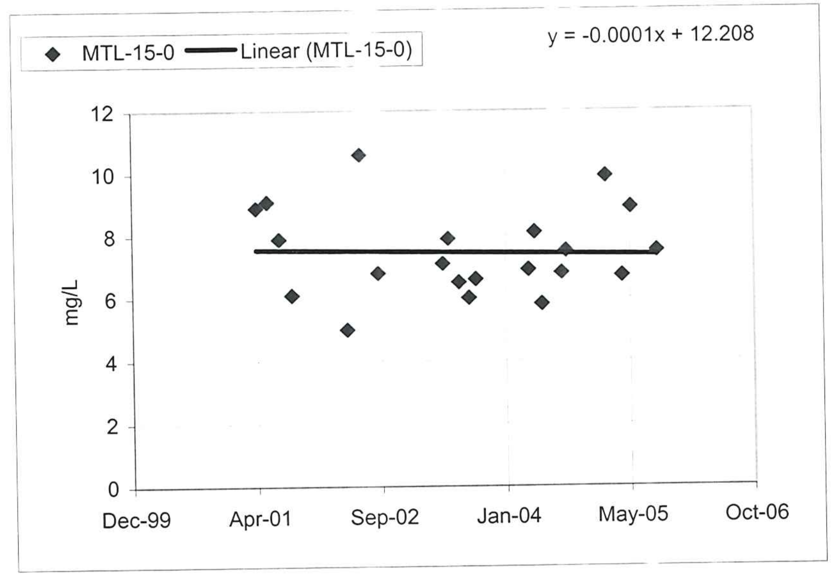


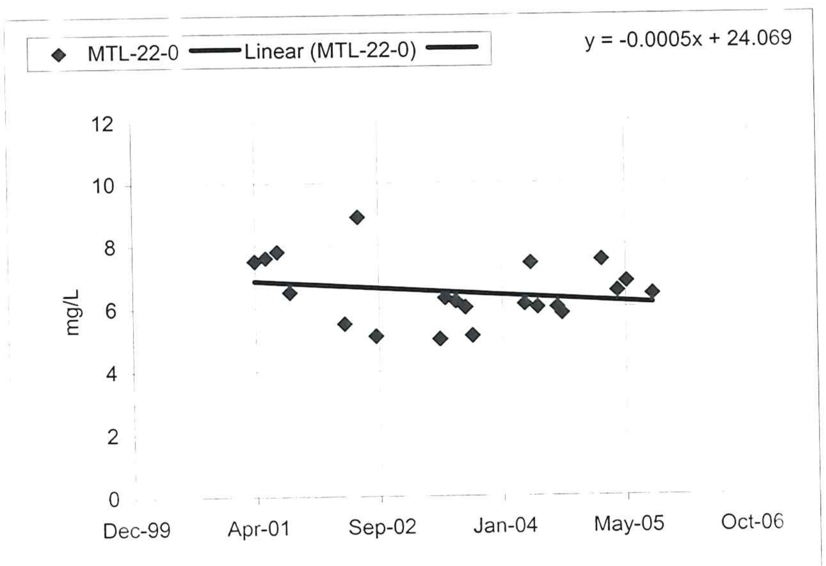


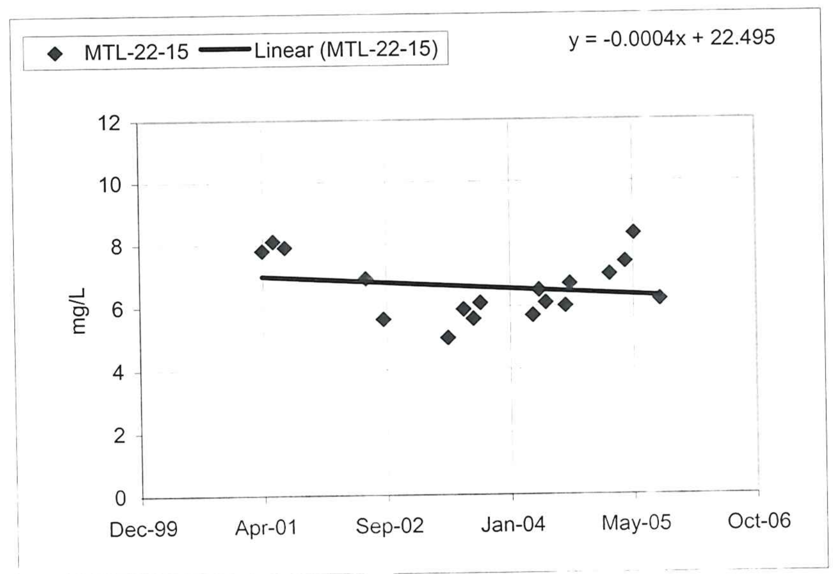


Total Organic Carbon (TOC)

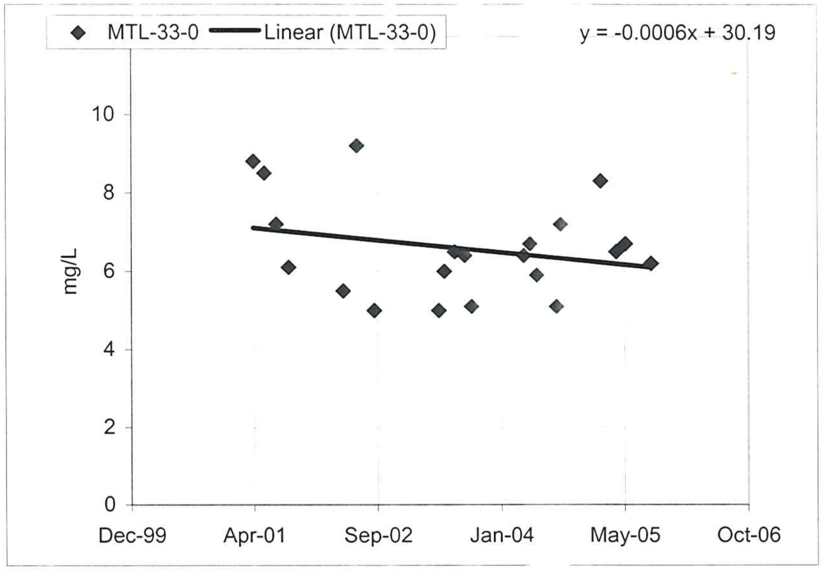


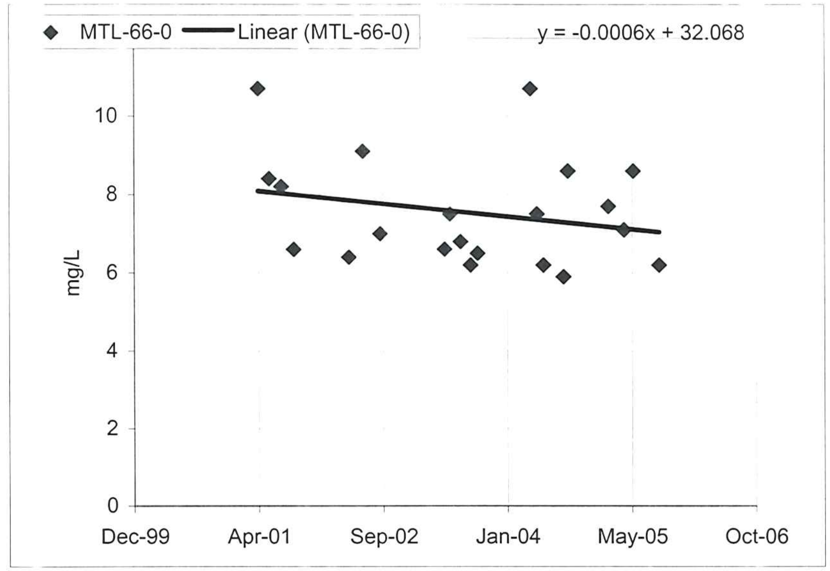


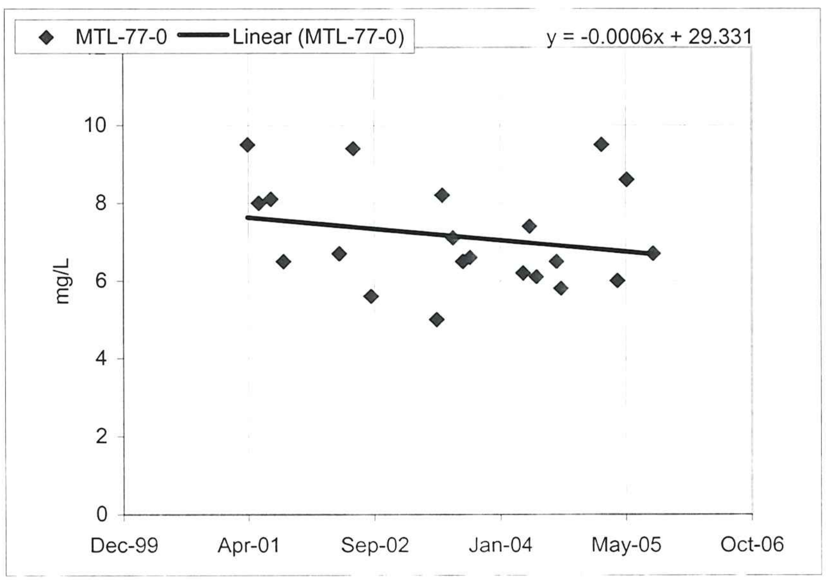


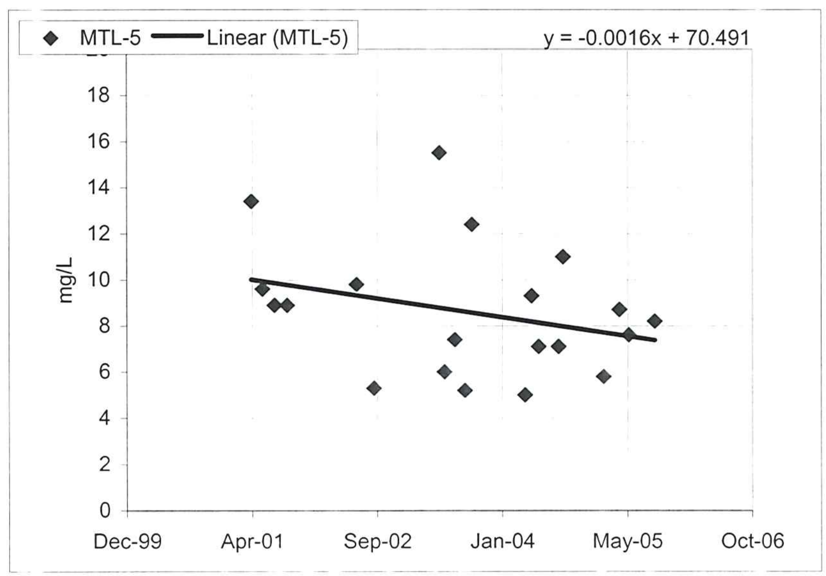


Total Organic Carbon (TOC)









Total Organic Carbon (TOC)