MISSISSIPPI RIVER ALLUVIAL AQUIFER SUMMARY, 2017
AQUIFER SAMPLING AND ASSESSMENT PROGRAM

APPENDIX 8 TO THE 2018 TRIENNIAL SUMMARY REPORT

PARTIAL FUNDING PROVIDED BY THE CWA

Contents

BACKGROUND

The Louisiana Department of Environmental Quality's (LDEQ) Aquifer Sampling and Assessment Program (ASSET) is an ambient monitoring program established to determine and monitor the quality of groundwater produced from Louisiana's major freshwater aquifers. The ASSET Program samples approximately 200 water wells located in 14 aquifers across the state. The sampling process is designed so that all 14 aquifers are monitored on a rotating basis, within a three-year period so that each well is monitored every three years.

In order to better assess the water quality of a particular aquifer, an attempt is made to sample all ASSET Program wells producing from it in a narrow time frame. To more conveniently and economically promulgate those data collected, a summary report on each aquifer is prepared separately. Collectively, these aquifer summaries make up, in part, the ASSET Program's Triennial Summary Report.

Analytical and field data contained in this summary were collected from wells producing from the Mississippi River Alluvial aquifer, during the 2017 state fiscal year (July 1, 2016 - June 30, 2017). This summary will become Appendix 8 of the ASSET Program Triennial Summary Report for 2018.

These data show that from October 2016 through February 2017, 22 wells were sampled which produce from the Mississippi River Alluvial aquifer. Seven of these 22 wells are classified as domestic, seven are classified as irrigation, seven as public supply, and one as an industrial use well. The wells are located in 14 parishes along or near the Mississippi River.

Figure 8-1 shows the geographic locations of the Mississippi River Alluvial aquifer and the associated wells, whereas Table 8-1 lists the wells in the aquifer along with their total depths, use made of produced waters, and date sampled.

Well data for registered water wells were obtained from the Louisiana Department of Natural Resources water well registration data file.

GEOLOGY

Mississippi River alluvium consists of fining upward sequences of gravel, sand, silt, and clay. The aquifer is poorly to moderately well sorted, with fine-grained to medium-grained sand near the top, grading to coarse sand and gravel in the lower portions. It is confined by layers of silt and clay of varying thicknesses and extent. The Mississippi River Alluvial aquifer consists of two distinct components; valley trains and meander-belt deposits which are closely related hydrologically.

HYDROGEOLOGY

The Mississippi River Alluvial aquifer is hydraulically connected with the Mississippi River and its major streams. Recharge is accomplished by direct infiltration of rainfall in the river valley, lateral and upward movement of water from adjacent and underlying aquifers, and overbank stream flooding. The amount of recharge from rainfall depends on the thickness and permeability of the silt and clay layers overlying it. Water levels fluctuate seasonally in response to precipitation trends and river stages. Water levels are generally within 30 to 40 feet of the land surface, and movement is downgradient and toward rivers and streams. Natural discharge occurs by seepage of water into the Mississippi River and its streams, but some water moves into the aquifer when stream stages are above aquifer water levels. The hydraulic conductivity varies between 10 and 530 feet/day.

The maximum depths of occurrence of freshwater in the Mississippi River Alluvial range from 20 feet below sea level to 500 feet below sea level. The range of thickness of the fresh water interval in the Mississippi River Alluvial is 50 to 500 feet. The depths of the Mississippi River Alluvial aquifer wells monitored in conjunction with ASSET program range from 30 feet to 363 feet below land surface, with an average depth of 134 feet.

PROGRAM PARAMETERS

The field parameters checked at each ASSET well sampling site and the list of conventional parameters analyzed in the laboratory are shown in Table 8-2. The inorganic (total metals) parameters analyzed in the laboratory are listed in Table 8-3. These tables also show the field and analytical results determined for each analyte. For quality control, duplicate samples were taken for each parameter at wells AV-126, CT-489, EC-370, MA-248, PC-5515Z, RI-469.

In addition to the field, conventional and inorganic analytical parameters, the target analyte list includes three other categories of compounds: volatiles, semi-volatiles, and pesticides/PCBs. Due to the large number of analytes in these categories, tables were not prepared showing the analytical results for these compounds. A discussion of any detections from any of these three categories, if necessary, can be found in their respective sections. Tables 8-8, 8-9, and 8-10 list the target analytes for volatiles, semi-volatiles and pesticides/PCBs, respectively.

Tables 8-4 and 8-5 provide a statistical overview of field and conventional, and inorganic data for the Mississippi River Alluvial aquifer, listing the minimum, maximum, and average results for these parameters collected in the FY 2017 sampling. Tables 8-6 and 8-7 compare these same parameter averages to historical ASSET-derived data for the Mississippi River Alluvial aquifer, from fiscal years 1996, 1999, 2002, 2005, 2008, 2011, and 2014.

The average values listed in the above referenced tables are determined using all valid, reported results, including those reported as non-detect, or less than the detection limit (< DL). Per Departmental policy concerning statistical analysis, one-half the DL is used in place of zero when non-detects are encountered. However, the minimum value is reported < DL, not one-half the DL. If all values for a particular analyte are reported as < DL, then the minimum, maximum, and average values are all reported as < DL.

Due to the variability in the laboratory's reporting detection limits caused by dilution factors, whenever an analyte in question is not detected, the standard reporting detection limit value for each analytical method is used as the DL when performing statistical calculations.

Charts 8-1 through 8-18 represent the trend of the graphed parameter, based on the averaged value of that parameter for each three-year reporting period. Discussion of historical data and related trends is found in the **Water Quality Trends and Comparison to Historical ASSET Data** section.

INTERPRETATION OF DATA

Under the Federal Safe Drinking Water Act, EPA has established primary standards, or maximum contaminant levels (MCLs), for pollutants that may pose a health risk in public drinking water. An MCL is the highest level of a contaminant that EPA allows in public drinking water. MCLs ensure that drinking water does not pose either a short-term or long-term health risk. While not all wells sampled were public supply wells, the ASSET Program does use the MCLs as a benchmark for further evaluation.

EPA has also set secondary standards, which are defined as non-enforceable taste, odor, or appearance guidelines. Field and laboratory data contained in Tables 8-2 and 8-3 show that one or more secondary MCLs (SMCLs) were exceeded in 20 of the 22 wells sampled in the Mississippi River Alluvial aquifer, with 34 SMCLs being exceeded.

Field and Conventional Parameters

Table 8-2 shows the field and conventional parameters for which samples are collected at each well and the analytical results for those parameters. Table 8-4 provides an overview of this data for the Mississippi River Alluvial aquifer, listing the minimum, maximum, and average results for these parameters.

Federal Primary Drinking Water Standards: A review of the analysis listed in Table 8-2 shows that no primary MCL was exceeded for field or conventional parameters for this reporting period. Those ASSET wells reporting turbidity levels greater than 1.0 NTU do not exceed the Primary MCL of 1.0, as this standard applies to public supply water wells that are under the direct influence of surface water. The Louisiana Department of Health has determined that no public water supply well in Louisiana is in this category.

Federal Secondary Drinking Water Standards: A review of the analysis listed in Table 8-2 shows that one well exceeded the SMCL for chloride, two wells exceeded the SMCL for color, three wells exceeded the SMCL for pH, and 10 wells exceeded the SMCL for total dissolved solids. Laboratory results override field results in exceedance determinations, thus only lab results will be counted in determining SMCL exceedance numbers for total dissolved solids. Following is a list of SMCL parameter exceedances with well number and results:

Chloride (SMCL = 250mg/L):

FR-1358 257.0 mg/L

Color (SMCL = 15 color units (PCU)):

EC-370	30 PCU	Duplicate – 20 PCU
WC-527	30 PCU	

pH (SMCL = 6.5 – 8.5 Standard Units):

CT-DENNIS	6.41 SU	
EC-370	6.47 SU	(Original and Duplicate)
MO-871	6.47 SU	

Total Dissolved Solids (SMCL = 500 mg/L or 0.5 g/L):

	LAB RESULTS (in mg/L)	FIELD MEASURES (in g/L)
AV-462	835 mg/L	0.870 g/L
AV-5135Z	620 mg/L	0.645 g/L
CO-YAKEY	650 mg/L	0.720 g/L
CT-489	560 mg/L, Duplicate – 540 mg/L	0.590 g/L (Original and Duplicate)
EB-1299	505 mg/L	0.557 g/L
FR-1358	820 mg/L	0.843 g/L
IB-COM	715 mg/L	0.878 g/L
TS-61	530 mg/L	0.615 g/L
WC-527	755 mg/L	0.828 g/L
WC-91	545 mg/L	0.607g/L

Inorganic Parameters

Table 8-3 shows the inorganic parameters for which samples are collected at each well and the analytical results for those parameters. Table 8-5 provides an overview of inorganic data for the Mississippi River Alluvial aquifer, listing the minimum, average, and maximum results for these parameters.

Federal Primary Drinking Water Standards: A review of the analyses listed on Table 8-3 shows that three wells exceeded the MCL for arsenic:

Arsenic (MCL = 10 µg/L)

EB-1299	64.3 µg/L
IB-363	23.9 µg/L
TS-FORTENB	18.2 µg/L

Federal Secondary Drinking Water Standards: Laboratory data contained in Table 8-3 shows that 18 wells exceeded the secondary MCL for iron:

Iron (SMCL = 300 µg/L)

AV-126	12,400 µg/L	Duplicate	12,100 µg/L	
AV-462	6,840 µg/L			
CO-YAKEY	15,100 µg/L			
CT-489	11,000 µg/L	Duplicate	10,200 µg/L	
EB-1299	3,860 µg/L			
EC-370	15,200 µg/L	Duplicate	16,100 µg/L	
FR-1358	4,980 µg/L			
IB-363	1,400 µg/L			
IB-COM	3,140 µg/L			
MA-248	10,600 µg/L	Duplicate	11,000 µg/L	Resample – 10,800 µg/L
MO-871	8,390 µg/L			
PC-5515Z	5,830 µg/L	Duplicate	5,830 µg/L	
RI-RAYVIL	750 µg/L	Duplicate	735 µg/L	

SMN-33	1,860 µg/L
TS-61	9,430 µg/L
TS-FORTENB	11,7000 µg/L
WC-527	2,940 µg/L
WC-91	938 µg/L

Volatile Organic Compounds

Table 8-8 shows the volatile organic compound (VOC) parameters for which samples are collected at each well. Due to the number of analytes in this category, analytical results are not tabulated; however any detection of a VOC would be discussed in this section.

There were no confirmed detections of any VOC at or above its detection limit during the FY 2017 sampling of the Mississippi River Alluvial aquifer.

Semi-Volatile Organic Compounds

Table 8-9 shows the semi-volatile organic compound (SVOC) parameters for which samples are collected at each well. Due to the number of analytes in this category, analytical results are not tabulated; however, any detection of a SVOC would be discussed in this section.

There were no confirmed detections of any SVOC at or above its detection limit during the FY 2017 sampling of the Mississippi River Alluvial aquifer.

Pesticides and PCBs

Table 8-10 shows the pesticide and PCB parameters for which samples are collected at each well. Due to the number of analytes in this category, analytical results are not tabulated; however, any detection of a pesticide or PCB would be discussed in this section.

No pesticide or PCB was detected at or above its detection limit during the FY 2017 sampling of the Mississippi River Alluvial aquifer.

WATER QUALITY TRENDS AND COMPARISON TO HISTORICAL ASSET DATA

Analytical and field data show that the quality and characteristics of groundwater produced from the Mississippi River Alluvial aquifer exhibit some fluctuations when comparing current data to that of the seven previous sampling rotations. These comparisons can be found in Tables 8-6 and 8-7, and in Charts 8-1 to 8-18 of this summary. Increasing or decreasing trend statements made here are based on an R-square value (slope) of 0.03 or greater. An R-square value of less than 0.03 is considered to have only a slight or no change.

Over the 21-year period, six analytes have shown a slight to general increase in concentration. These analytes are: pH, field specific conductance, salinity, hardness, total phosphorus, and iron. For this same period, seven analytes have demonstrated a decrease in concentrations, which are: temperature, total dissolved solids (field and lab), color, ammonia, total Kjeldahl nitrogen, copper, and zinc. All remaining analytes were stable or continue to be below detection limits.

The number of secondary MCL exceedances has decreased since the previous sampling. In FY 2014, 20 wells reported one or more secondary exceedances with 38 SMCLs exceeded. Sample results for FY 2017 show that there were 34 SMCL exceedances with one or more exceedances in 20 of the 22 wells sampled.

The number of wells exceeding the MCL for arsenic has decreased since FY 2014. In FY 2014 four wells exceeding the primary MCL of 10 µg/L. In FY 2017 three wells reported arsenic exceeding the primary MCL.

SUMMARY AND RECOMMENDATIONS

In summary, the data show that the ground water produced from the Mississippi River Alluvial aquifer is very hard.[1] The data show that this aquifer is of poor quality when considering short-term or long-term health risk guidelines, with three wells exceeding the primary MCL for arsenic. The data also show that this aquifer is of poor quality when considering taste, odor, or appearance guidelines, with 34 secondary MCLs exceeded in 20 of the 22 wells sampled.

Comparison to historical ASSET-derived data shows only moderate fluctuations in the quality or characteristics of the Mississippi River Alluvial aquifer, with six parameters showing increases in concentration and seven parameters decreasing in concentration. This historical comparison shows that the number of wells with SMCL exceedances is the same while the total number of SMCL exceedances have decreased.

The occurrence of arsenic in the Mississippi River Alluvial aquifer has been established by historical activities of this program and with current sampling results supporting those previous findings. Sampling results for this reporting period, show that 14 wells reported detections of arsenic. Of these 14 wells, 11 reported detections below the drinking water MCL of 10 µg/L, with three wells with reporting arsenic levels above the MCL. As standard procedure of the ASSET Program, all well owners receive the results of their well sampling, while those well owners with primary MCL exceedances are given additional information about the particular compound, its health effects and possible treatment methods.

It is recommended that the wells assigned to the Mississippi River Alluvial aquifer be re-sampled as planned, in approximately three years, with continued attention given to the occurrence of arsenic in this aquifer. In addition, several wells should be added to those currently in place to increase the well density for this aquifer.

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[1] Classification based on hardness scale from: Peavy, H. S. et al. *Environmental Engineering.* New York: McGraw-Hill. 1985.

Table 8-1: List of Wells Sampled, Mississippi River Alluvial Aquifer–FY 2017

Well ID	Parish	Date	Owner	Depth (Feet)	Well Use
AV-126	Avoyelles	10/27/2016	Hamburg Mills	155	Domestic
AV-462	Avoyelles	10/27/2016	La Delta Plantation	110	Irrigation
AV-5135Z	Avoyelles	10/27/2016	Private Owner	110	Domestic
CO-YAKEY	Concordia	11/14/2016	Private Owner	150	Domestic
CT-489	Catahoula	11/14/2016	La Delta Plantation	144	Irrigation
CT-DENNIS	Catahoula	11/14/2016	Private Owner	30	Domestic
EB-1299	East Baton Rouge	10/14/2016	La State University	363	Irrigation
EC-370	East Carroll	2/2/2017	Hollybrook Land	119	Irrigation
FR-1358	Franklin	11/17/2016	Macon Ridge Research Station	60	Irrigation
IB-363	Iberville	10/12/2016	Syngenta Crop Protection, Inc.	225	Industrial
IB-COM	Iberville	10/12/2016	Private Owner	185	Domestic
MA-248	Madison	12/14/2016 6/6/2016	Tallulah Water Service	153	Public Supply
MO-871	Morehouse	11/16/2016	Private Owner	80	Irrigation
PC-5515Z	Pointe Coupee	10/13/2016	Private Owner	156	Domestic
RI-469	Richland	11/17/2016	Liddieville Water System	90	Public Supply
RI-730	Richland	11/17/2016	Start Water System	101	Public Supply
RI-RAYVIL	Richland	11/17/2016 6/6/2016	Rayville Water Department	230	Public Supply
SMN-33	St. Martin	10/13/2016	LDOTD/Lafayette District	125	Public Supply
TS-61	Tensas	12/14/2016	Town of St. Joseph	140	Public Supply
TS-FORTENB	Tensas	2/2/2017	Private Owner	33	Domestic
WC-527	West Carroll	12/13/2016	Private Owner	85	Irrigation
WC-91	West Carroll	12/13/2016	New Carroll Water Association	115	Public Supply

Table 8-2: Summary of Field and Conventional Data, Mississippi River Alluvial Aquifer–FY 2017

Well ID	pH SU	Sal ppt	Sp Cond mmhos/cm	Temp Deg C	TDS g/L	Alk mg/L	Cl mg/L	Color PCU	Hard mg/L	Nitrite-Nitrate (as N) mg/L	NH3 mg/L	Tot P mg/L	Sp Cond µmhos/cm	SO4 mg/L	TDS mg/L	TKN mg/L	TSS mg/L	Turb NTU
	Laboratory Reporting Limits →					2	1	5	5	0.05	0.1	0.05	1	1	10	0.1	4	0.1
	Field Parameters					Laboratory Parameters												
AV-126	7.01	0.38	0.767	12.25	0.499	364	14.8	10	398	< DL	0.48	0.89	549	12.9	410	0.53	15	98.0
AV-126*	7.01	0.38	0.767	12.25	0.499	354	14.8	15	386	< DL	0.45	1.00	542	12.4	460	0.45	24	106.0
AV-462	7.01	0.67	1.338	12.00	0.870	413	81.1	10	680	< DL	0.29	0.30	1000	193.0	835	0.18	20	37.0
AV-5135Z	6.99	0.49	0.993	12.46	0.645	275	108.0	10	414	< DL	0.18	0.15	765	74.9	620	0.16	5	0.3
CO-YAKEY	6.91	0.55	1.107	9.04	0.720	571	38.3	10	484	0.49	3.80	1.20	955	< DL	650	4.10	44	166.0
CT-489	6.66	0.45	0.907	11.17	0.590	493	23.6	10	370	< DL	1.70	1.10	903	< DL	560	2.10	28	66.5
CT-489*	6.66	0.45	0.907	11.17	0.590	493	23.6	5	376	< DL	1.70	1.10	821	< DL	540	2.00	27	66.0
CT-DENNIS	6.41	0.10	0.217	10.46	0.141	112	13.8	< DL	90	0.13	< DL	< DL	219	4.1	185	< DL	4	0.67
EB-1299	6.95	0.42	0.856	12.78	0.557	315	13.2	< DL	396	< DL	1.30	0.10	661	< DL	505	2.80	9	12.8
EC-370	6.47	0.37	0.754	8.63	0.490	380	12.6	10	450	< DL	0.87	1.20	659	< DL	430	1.00	34	177.0
EC-370*	6.47	0.37	0.754	8.63	0.490	433	12.5	20	380	< DL	0.88	1.00	665	< DL	405	1.20	34	170.0
FR-1358	6.91	0.65	1.297	11.55	0.843	302	257.0	10	360	< DL	0.27	0.34	1330	19.2	820	0.25	13	63.5
IB-363	7.19	0.24	0.493	11.27	0.321	1000	27.7	5	188	< DL	0.74	0.70	513	17.9	260	0.98	11	8.0
IB-COM	7.43	0.68	1.351	13.67	0.878	295	235.0	10	340	0.07	0.40	0.15	1430	< DL	715	0.45	6	27.6
MA-248	7.27	0.38	0.771	10.14	0.501	381	10.2	5	322	< DL	0.62	0.85	761	2.9	300	1.10	27	92.5
MA-248*	7.27	0.38	0.771	10.14	0.501	381	9.5	5	334	< DL	0.62	0.91	757	2.4	320	0.99	27	61.5
MA-248**	6.54	0.38	0.774	17.25	0.503	CONVENTIONAL PARAMETERS NOT RESAMPLED												
MO-871	6.47	0.33	0.677	10.45	0.440	235	49.8	5	268	< DL	0.33	0.44	628	32.8	425	0.33	14	67.5
PC-5515Z	7.48	0.44	0.893	12.93	0.581	374	46.6	10	366	< DL	0.85	0.39	922	< DL	495	1.30	9	75.5
PC-5515Z*	7.46	0.44	0.894	12.9	0.581	393	46.8	10	372	< DL	1.10	0.52	900	< DL	475	1.30	14	85.5
RI-469	6.94	0.14	0.292	11.95	0.190	45	37.3	< DL	84	5.90	0.12	0.14	280	5.9	225	R	< DL	0.3
RI-469*	6.94	0.14	0.292	11.95	0.190	39	37.3	< DL	84	5.90	0.12	0.24	277	5.8	R	R	< DL	0.2
RI-469**	7.33	0.13	0.276	17.56	0.180	CONVENTIONAL PARAMETERS NOT RESAMPLED												
RI-730	7.73	0.23	0.484	10.48	0.315	146	38.1	< DL	166	1.90	0.36	0.18	467	29.1	290	< DL	< DL	1.0

Well ID	pH SU	Sal ppt	Sp Cond mmhos/cm	Temp Deg C	TDS g/L	Alk mg/L	Cl mg/L	Color PCU	Hard mg/L	Nitrite-Nitrate (as N) mg/L	NH3 mg/L	Tot P mg/L	Sp Cond µmhos/cm	SO4 mg/L	TDS mg/L	TKN mg/L	TSS mg/L	Turb NTU
	Laboratory Reporting Limits →					2	1	5	5	0.05	0.1	0.05	1	1	10	0.1	4	0.1
	Field Parameters					Laboratory Parameters												
RI-RAYVIL	7.56	0.25	0.511	10.73	0.332	246	19.9	< DL	204	< DL	0.39	0.15	479	< DL	285	0.41	< DL	4.8
SMN-33	7.54	0.22	0.462	10.49	0.300	177	23.9	5	178	< DL	0.70	0.45	421	< DL	235	0.93	6	3.3
TS-61	7.19	0.47	0.946	10.29	0.615	466	18.5	15	384	< DL	1.20	0.64	921	< DL	530	1.30	23	88.0
TS-FORTENB	7.04	0.41	0.832	8.62	0.541	475	18.5	15	430	< DL	1.30	1.30	744	1.7	470	1.30	27	108.0
WC-527	6.87	0.64	1.273	9.59	0.828	468	113.0	30	482	0.24	0.22	0.44	1250	37.0	755	0.36	5	38.3
WC-91	7.16	0.46	0.934	9.26	0.607	310	104.0	< DL	374	< DL	0.17	0.13	936	12.8	545	0.56	< DL	4.0

*Duplicate Sample **Resample R-Data Rejected Exceeds EPA Secondary Standards

Table 8-3: Summary of Inorganic Data, Mississippi River Alluvial Aquifer–FY 2017

Well ID	Antimony ug/L	Arsenic ug/L	Barium ug/L	Beryllium ug/L	Cadmium ug/L	Chromium ug/L	Copper ug/L	Iron ug/L	Lead ug/L	Mercury ug/L	Nickel ug/L	Selenium ug/L	Silver ug/L	Thallium ug/L	Zinc ug/L
Laboratory Reporting Limits	1	1	1	0.5	1	1	3	50	1	0.2	1	1	0.5	0.5	5
AV-126	< DL	< DL	396.0	< DL	< DL	< DL	< DL	12400	< DL	< DL	< DL	< DL	< DL	< DL	22.2
AV-126*	< DL	< DL	395.0	< DL	< DL	< DL	< DL	12100	< DL	< DL	< DL	< DL	< DL	< DL	22.2
AV-462	< DL	3.7	85.3	< DL	< DL	< DL	< DL	6840	< DL	< DL	< DL	< DL	< DL	< DL	< DL
AV-5135Z	< DL	1.7	168.0	< DL	< DL	< DL	< DL	218	< DL	< DL	1.9	< DL	< DL	< DL	< DL
CO-YAKEY	< DL	1.4	830.0	< DL	< DL	< DL	< DL	15100	< DL	< DL	< DL	< DL	< DL	< DL	63.0
CT-489	< DL	< DL	425.0	< DL	< DL	< DL	4.3	11000	< DL	< DL	< DL	< DL	< DL	< DL	13.0
CT-489*	< DL	< DL	419.0	< DL	< DL	< DL	< DL	10200	< DL	< DL	< DL	< DL	< DL	< DL	5.9
CT-DENNIS	< DL	< DL	63.9	< DL	< DL	< DL	< DL	57	< DL	< DL	< DL	< DL	< DL	< DL	53.7
EB-1299	< DL	64.3	858.0	< DL	< DL	< DL	< DL	3860	< DL	< DL	< DL	< DL	< DL	< DL	< DL
EC-370	< DL	2.6	613.0	< DL	< DL	< DL	< DL	15200	< DL	< DL	< DL	< DL	< DL	< DL	< DL
EC-370*	< DL	2.7	609.0	< DL	< DL	< DL	< DL	16100	< DL	< DL	< DL	< DL	< DL	< DL	< DL
FR-1358	< DL	< DL	31.9	< DL	< DL	< DL	3.9	4980	1.6	< DL	1.9	< DL	< DL	< DL	18.7
IB-363	< DL	23.9	396.0	< DL	< DL	< DL	< DL	1400	< DL	< DL	< DL	< DL	< DL	< DL	< DL
IB-COM	< DL	6.5	755.0	< DL	< DL	< DL	< DL	3140	< DL	< DL	1.2	< DL	< DL	< DL	79.9
MA-248	< DL	6.4	528.0	< DL	< DL	< DL	< DL	10600	< DL	< DL	< DL	< DL	< DL	< DL	< DL
MA-248*	< DL	6.1	534.0	< DL	< DL	< DL	< DL	11000	< DL	< DL	< DL	< DL	< DL	< DL	< DL
MA-248**	< DL	6.1	512.0	< DL	< DL	< DL	< DL	10800	< DL	< DL	< DL	< DL	< DL	< DL	< DL
MO-871	< DL	1.5	33.3	< DL	< DL	< DL	3.1	8390	< DL	< DL	1.4	< DL	< DL	< DL	13.5
PC-5515Z	< DL	4.8	1330	< DL	< DL	< DL	< DL	5830	< DL	< DL	< DL	< DL	< DL	< DL	5.6
PC-5515Z*	< DL	4.9	1320	< DL	< DL	< DL	< DL	5830	< DL	< DL	< DL	< DL	< DL	< DL	< DL
RI-469	< DL	< DL	31.7	< DL	< DL	4.5	< DL	< DL	< DL	< DL	1.9	< DL	< DL	< DL	9.5
RI-730	< DL	< DL	26.3	< DL	< DL	< DL	< DL	262	1.4	< DL	1.4	< DL	< DL	< DL	17.7
RI-RAYVIL	< DL	< DL	162.0	< DL	< DL	< DL	< DL	750	< DL	< DL	< DL	< DL	< DL	< DL	< DL
RI-RAYVIL*	< DL	< DL	168.0	< DL	< DL	< DL	< DL	735	< DL	< DL	< DL	< DL	< DL	< DL	5.0
SMN-33	< DL	3.7	577.0	< DL	< DL	< DL	< DL	1860	< DL	< DL	< DL	< DL	< DL	< DL	14.7
TS-61	< DL	< DL	815.0	< DL	< DL	< DL	< DL	9430	< DL	< DL	< DL	< DL	< DL	< DL	< DL

Well ID	Antimony ug/L	Arsenic ug/L	Barium ug/L	Beryllium ug/L	Cadmium ug/L	Chromium ug/L	Copper ug/L	Iron ug/L	Lead ug/L	Mercury ug/L	Nickel ug/L	Selenium ug/L	Silver ug/L	Thallium ug/L	Zinc ug/L
Laboratory Reporting Limits	1	1	1	0.5	1	1	3	50	1	0.2	1	1	0.5	0.5	5
TS-FORTENB	< DL	18.2	480.0	< DL	< DL	< DL	< DL	11700	< DL	< DL	< DL	< DL	< DL	< DL	< DL
WC-527	< DL	1.7	432.0	< DL	< DL	< DL	< DL	2940	< DL	< DL	< DL	< DL	< DL	< DL	< DL
WC-91	< DL	7.5	154.0	< DL	< DL	< DL	12.3	938	1.2	< DL	< DL	< DL	< DL	< DL	7.8

*Duplicate Sample **Resample Exceeds EPA Primary Standard Exceeds EPA Secondary Standards

Table 8-4: FY 2017 Field and Conventional Statistics, ASSET Wells

	PARAMETER	MINIMUM	MAXIMUM	AVERAGE
FIELD	pH (SU)	6.41	7.73	7.03
	Salinity (ppt)	0.10	0.68	0.39
	Specific Conductance (mmhos/cm)	0.217	1.351	0.786
	Temperature (^{O}C)	8.62	17.56	11.40
	Total Dissolved Solids (g/L)	0.141	0.878	0.511
LABORATORY	Alkalinity (mg/L)	39	1000	355
	Chloride (mg/L)	9.5	257.0	51.8
	Color (PCU)	< DL	30	9
	Hardness (mg/L)	84	680	334
	Nitrite - Nitrate, as N (mg/L)	< DL	5.90	0.54
	Ammonia, as N (mg/L)	< DL	3.80	0.76
	Total Phosphorus (mg/L)	< DL	1.30	0.57
	Specific Conductance (µmhos/cm)	219	1430	741
	Sulfate (mg/L)	< DL	193.0	16.8
	Total Dissolved Solids (mg/L)	185	835	472
	Total Kjeldahl Nitrogen (mg/L)	< DL	0.16	1.04
	Total Suspended Solids (mg/L)	< DL	44	16
	Turbidity (NTU)	0.2	177.0	58.2

Table 8-5: FY 2017 Inorganic Statistics, ASSET Wells

PARAMETER	MINIMUM	MAXIMUM	AVERAGE
Antimony (µg/L)	< DL	< DL	< DL
Arsenic (µg/L)	< DL	64.3	6.0
Barium (µg/L)	26.3	1330	453.4
Beryllium (µg/L)	< DL	< DL	< DL
Cadmium (µg/L)	< DL	< DL	< DL
Chromium (µg/L)	< DL	4.5	< DL
Copper (µg/L)	< DL	12.3	2.5
Iron (µg/L)	< DL	16100	6679
Lead (µg/L)	< DL	1.6	< DL
Mercury (µg/L)	< DL	< DL	< DL
Nickel (µg/L)	< DL	1.9	< DL
Selenium (µg/L)	< DL	< DL	< DL
Silver (µg/L)	< DL	< DL	< DL
Thallium (µg/L)	< DL	< DL	< DL
Zinc (µg/L)	< DL	79.9	13.4

Table 8-6: Triennial Field and Conventional Statistics, ASSET Wells

	PARAMETER	AVERAGE VALUES BY FISCAL YEAR							
		FY 1996	FY 1999	FY 2002	FY 2005	FY 2008	FY 2011	FY 2014	FY 2017
FIELD	pH (SU)	6.70	6.63	6.91	6.98	7.22	7.35	7.22	7.03
FIELD	Salinity (ppt)	0.35	0.39	0.41	0.40	0.44	0.40	0.40	0.39
FIELD	Specific Conductance (mmhos/cm)	0.760	0.790	0.810	0.800	0.890	0.811	0.816	0.786
FIELD	Temperature (^{O}C)	19.09	20.60	20.13	19.62	20.40	19.13	18.76	11.40
FIELD	Total Dissolved Solids (g/L)	-	-	-	0.520	0.580	0.530	0.530	0.511
LABORATORY	Alkalinity (mg/L)	306	328	316	347	336	240	312	355
LABORATORY	Chloride (mg/L)	68.2	55.2	44.8	48.6	75.2	54.9	63.0	51.8
LABORATORY	Color (PCU)	26	16	48	38	17	5	16	9
LABORATORY	Hardness (mg/L)	300	310	304	298	341	294	286	334
LABORATORY	Nitrite - Nitrate, as N (mg/L)	0.31	0.29	0.72	0.19	0.29	0.21	0.29	0.54
LABORATORY	Ammonia, as N (mg/L)	1.26	1.00	0.95	1.10	0.85	0.85	0.98	0.76
LABORATORY	Total Phosphorus (mg/L)	0.49	0.54	0.54	0.59	0.48	0.57	0.66	0.57
LABORATORY	Specific Conductance (µmhos/cm)	769	804	770	766	872	709	818	741
LABORATORY	Sulfate (mg/L)	7.7	25.2	24.8	22.5	30.9	17.0	20.3	16.8
LABORATORY	Total Dissolved Solids (mg/L)	674	495	482	489	521	577	577	472
LABORATORY	Total Kjeldahl Nitrogen (mg/L)	1.34	1.43	1.27	1.36	0.99	1.24	1.41	1.04
LABORATORY	Total Suspended Solids (mg/L)	19	15	12	16	14	12	13	16
LABORATORY	Turbidity (NTU)	6.7	6.6	6.9	7.0	7.2	7.4	7.2	58.2

Table 8-7: Triennial Inorganic Statistics, ASSET Wells

PARAMETER	AVERAGE VALUES BY FISCAL YEAR							
	FY 1996	FY 1999	FY 2002	FY 2005	FY 2008	FY 2011	FY 2014	FY 2017
Antimony (µg/L)	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL
Arsenic (µg/L)	12.7	14.6	9.2	14.3	9.5	10.5	5.7	6.0
Barium (µg/L)	474	412	404	524	404	403	457	453
Beryllium (µg/L)	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL
Cadmium (µg/L)	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL
Chromium (µg/L)	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL
Copper (µg/L)	9.9	8.6	6.2	< DL	< DL	< DL	2.2	2.5
Iron (µg/L)	5022	4690	6008	8726	5985	5045	6143	6679
Lead (µg/L)	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL
Mercury (µg/L)	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL
Nickel (µg/L)	< DL	< DL	< DL	< DL	< DL	5.1	1.9	< DL
Selenium (µg/L)	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL
Silver (µg/L)	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL
Thallium (µg/L)	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL
Zinc (µg/L)	43.5	177.2	48.3	29.6	28.0	61.8	40.0	13.4

Table 8-8: Volatile Organic Compound List

VOC ANAYTICAL PARAMETERS	METHOD	REPORTING LIMIT (µg/L)
1,1,1-TRICHLOROETHANE	624	0.50
1,1,2,2-TETRACHLOROETHANE	624	0.50
1,1,2-TRICHLOROETHANE	624	0.50
1,1-DICHLOROETHANE	624	0.50
1,1-DICHLOROETHENE	624	0.50
1,2-DICHLOROBENZENE	624	0.50
1,2-DICHLOROETHANE	624	0.50
1,2-DICHLOROPROPANE	624	0.50
1,3-DICHLOROBENZENE	624	0.50
1,4-DICHLOROBENZENE	624	0.50
BENZENE	624	0.50
BROMODICHLOROMETHANE	624	0.50
BROMOFORM	624	0.50
BROMOMETHANE	624	1.0
CARBON TETRACHLORIDE	624	0.50
CHLOROBENZENE	624	0.50
CHLOROETHANE	624	0.50
CHLOROFORM	624	0.50
CHLOROMETHANE	624	1.0
CIS-1,3-DICHLOROPROPENE	624	1.0
DIBROMOCHLOROMETHANE	624	0.50
ETHYL BENZENE	624	0.50
METHYLENE CHLORIDE	624	1.0
O-XYLENE (1,2-DIMETHYLBENZENE)	624	0.50
STYRENE	624	0.50
TERT-BUTYL METHYL ETHER	624	0.50
TETRACHLOROETHYLENE (PCE)	624	0.50
TOLUENE	624	0.50
TRANS-1,2-DICHLOROETHENE	624	0.50
TRANS-1,3-DICHLOROPROPENE	624	0.50
TRICHLOROETHYLENE (TCE)	624	0.50
TRICHLOROFLUOROMETHANE (FREON-11)	624	0.50
VINYL CHLORIDE	624	0.50
XYLENES, M & P	624	1.0

Table 8-9: Semi-Volatile Organic Compound List

SVOC ANAYTICAL PARAMETERS	METHOD	REPORTING LIMIT (µg/L)
1,2,4-TRICHLOROBENZENE	625	5.0
2,4,6-TRICHLOROPHENOL	625	5.0
2,4-DICHLOROPHENOL	625	5.0
2,4-DIMETHYLPHENOL	625	5.0
2,4-DINITROPHENOL	625	20.0
2,4-DINITROTOLUENE	625	5.0
2,6-DINITROTOLUENE	625	5.0
2-CHLORONAPHTHALENE	625	5.0
2-CHLOROPHENOL	625	5.0
2-NITROPHENOL	625	5.0
3,3'-DICHLOROBENZIDINE	625	5.0
4,6-DINITRO-2-METHYLPHENOL	625	10.0
4-BROMOPHENYL PHENYL ETHER	625	5.0
4-CHLORO-3-METHYLPHENOL	625	5.0
4-CHLOROPHENYL PHENYL ETHER	625	5.0
4-NITROPHENOL	625	20.0
ACENAPHTHENE	625	0.20
ACENAPHTHYLENE	625	0.20
ANTHRACENE	625	0.20
BENZIDINE	625	20.0
BENZO(A)ANTHRACENE	625	0.20
BENZO(A)PYRENE	625	0.20
BENZO(B)FLUORANTHENE	625	0.20
BENZO(G,H,I)PERYLENE	625	0.20
BENZO(K)FLUORANTHENE	625	0.20
BENZYL BUTYL PHTHALATE	625	5.0
BIS(2-CHLOROETHOXY) METHANE	625	5.0
BIS(2-CHLOROETHYL) ETHER (2-CHLOROETHYL ETHER)	625	5.0
BIS(2-ETHYLHEXYL) PHTHALATE	625	5.0
CHRYSENE	625	0.20
DIBENZ(A,H)ANTHRACENE	625	0.20
DIETHYL PHTHALATE	625	5.0
DIMETHYL PHTHALATE	625	5.0
DI-N-BUTYL PHTHALATE	625	5.0
DI-N-OCTYLPHTHALATE	625	5.0
FLUORANTHENE	625	0.20
FLUORENE	625	0.20

SVOC ANAYTICAL PARAMETERS	METHOD	REPORTING LIMIT (µg/L)
HEXACHLOROBENZENE	625	5.0
HEXACHLOROBUTADIENE	625	5.0
HEXACHLOROCYCLOPENTADIENE	625	10.0
HEXACHLOROETHANE	625	5.0
INDENO(1,2,3-C,D)PYRENE	625	0.20
ISOPHORONE	625	5.0
NAPHTHALENE	625	0.20
NITROBENZENE	625	5.0
N-NITROSODIMETHYLAMINE	625	5.0
N-NITROSODI-N-PROPYLAMINE	625	5.0
N-NITROSODIPHENYLAMINE	625	5.0
PENTACHLOROPHENOL	625	5.00
PHENANTHRENE	625	0.20
PHENOL	625	5.0
PYRENE	625	0.20

Table 8-10: Pesticides and PCB List

Pest/PCB Analytical Parameters	METHOD	REPORTING LIMIT (µg/L)
ALDRIN	608	0.025
ALPHA BHC (ALPHA HEXACHLOROCYCLOHEXANE)	608	0.025
ALPHA ENDOSULFAN	608	0.025
ALPHA-CHLORDANE	608	0.025
BETA BHC (BETA HEXACHLOROCYCLOHEXANE)	608	0.025
BETA ENDOSULFAN	608	0.025
CHLORDANE	608	0.20
DELTA BHC (DELTA HEXACHLOROCYCLOHEXANE)	608	0.025
DIELDRIN	608	0.025
ENDOSULFAN SULFATE	608	0.025
ENDRIN	608	0.025
ENDRIN ALDEHYDE	608	0.025
ENDRIN KETONE	608	0.025
GAMMA-CHLORDANE	608	0.025
HEPTACHLOR	608	0.025
HEPTACHLOR EPOXIDE	608	0.025
METHOXYCHLOR	608	0.25
P,P'-DDD	608	0.025
P,P'-DDE	608	0.025
P,P'-DDT	608	0.025
PCB-1016 (AROCHLOR 1016)	608	0.80
PCB-1221 (AROCHLOR 1221)	608	0.80
PCB-1232 (AROCHLOR 1232)	608	0.80
PCB-1242 (AROCHLOR 1242)	608	0.80
PCB-1248 (AROCHLOR 1248)	608	0.80
PCB-1254 (AROCHLOR 1254)	608	0.80
PCB-1260 (AROCHLOR 1260)	608	0.80
TOXAPHENE	608	1.0

Figure 8-1: Location Plat, Mississippi River Alluvial Aquifer

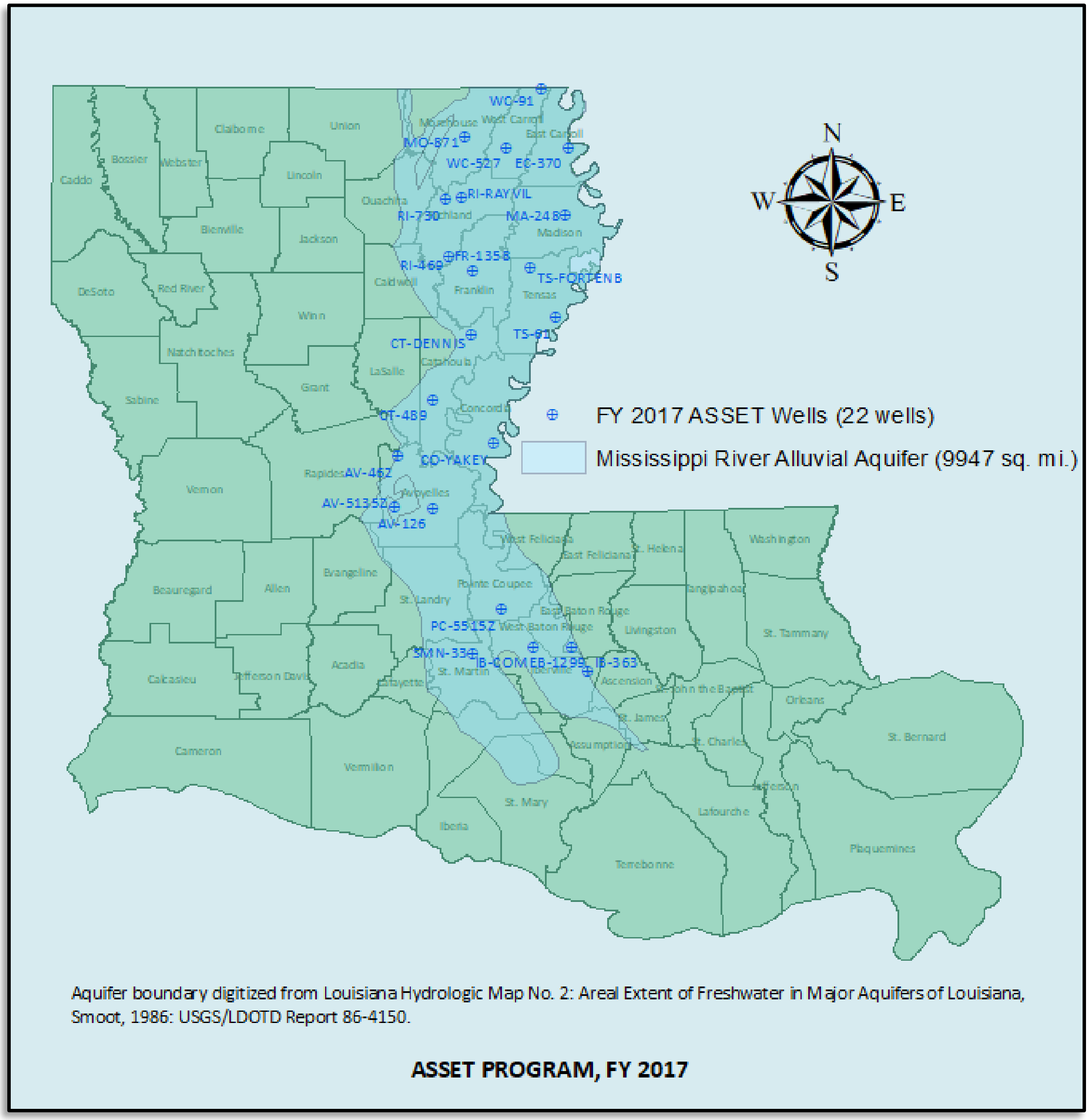

Chart 8-1: Temperature Trend

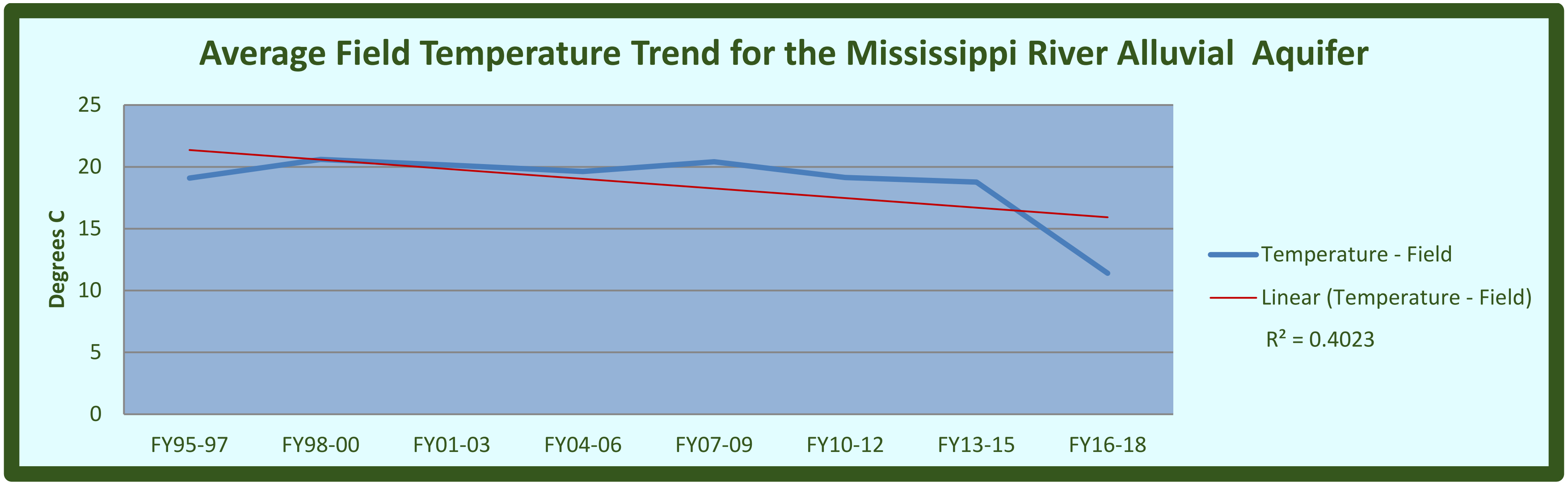

Chart 8-2: pH Trend

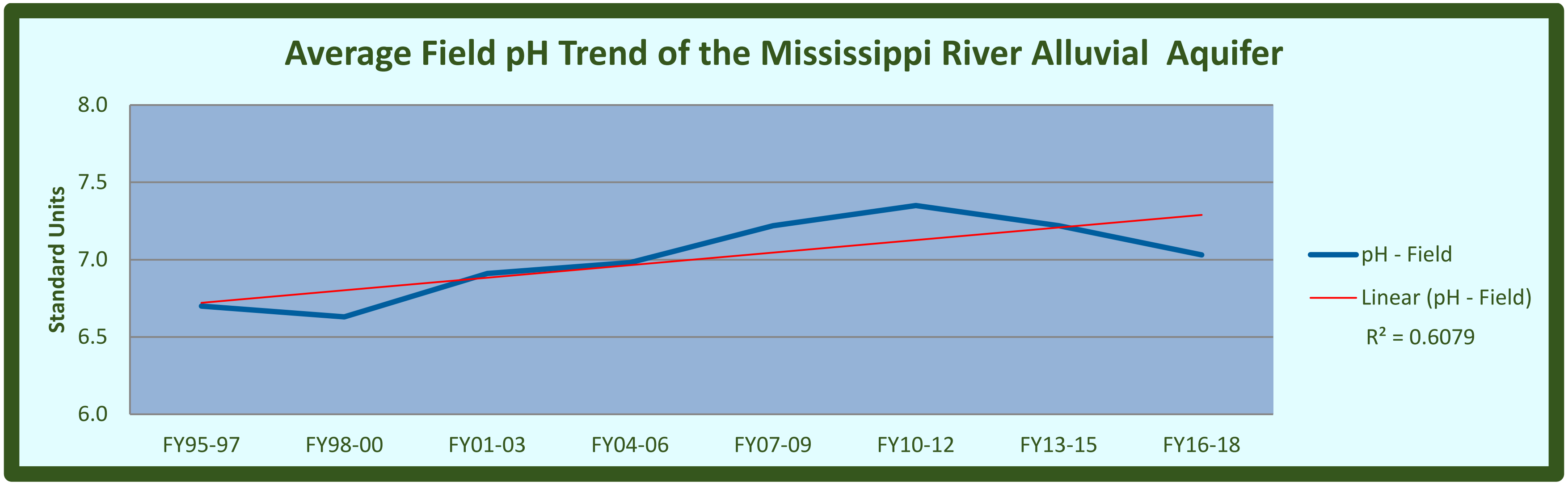

Chart 8-3: Specific Conductance Trend

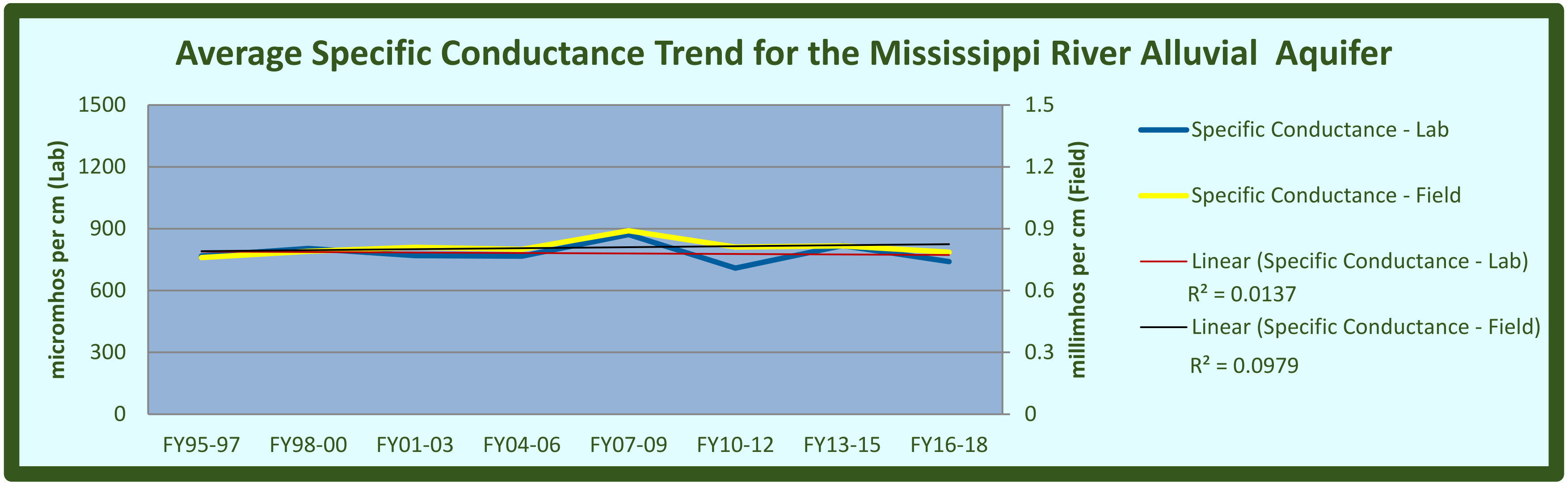

Chart 8-4: Field Salinity Trend

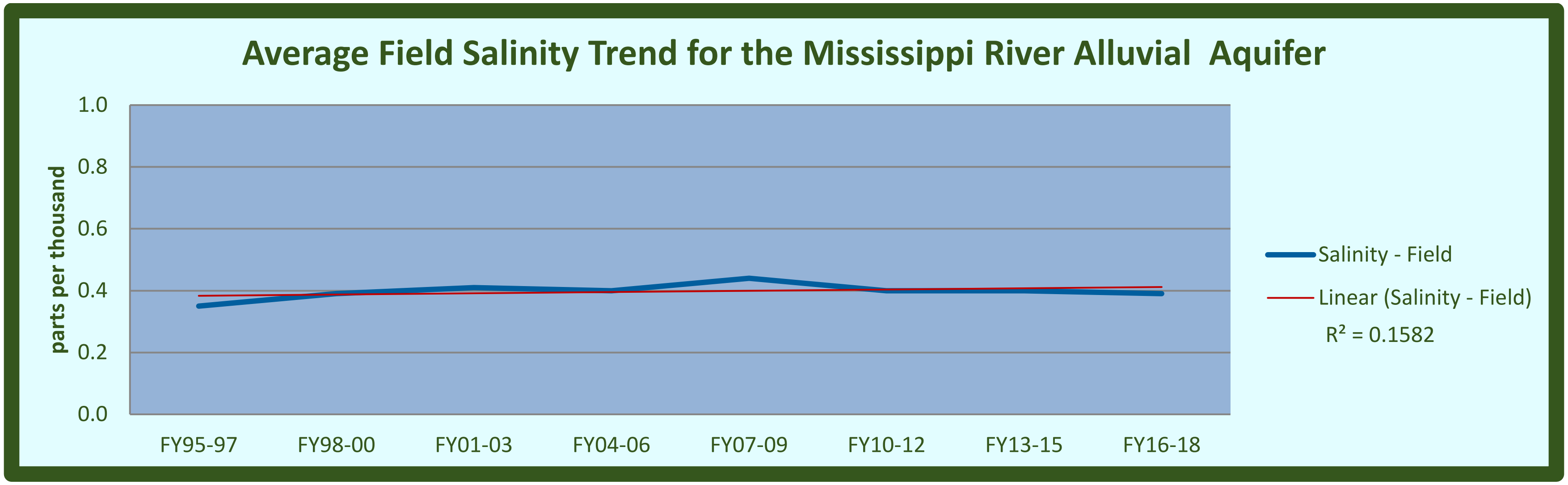

Chart 8-5: Chloride Trend

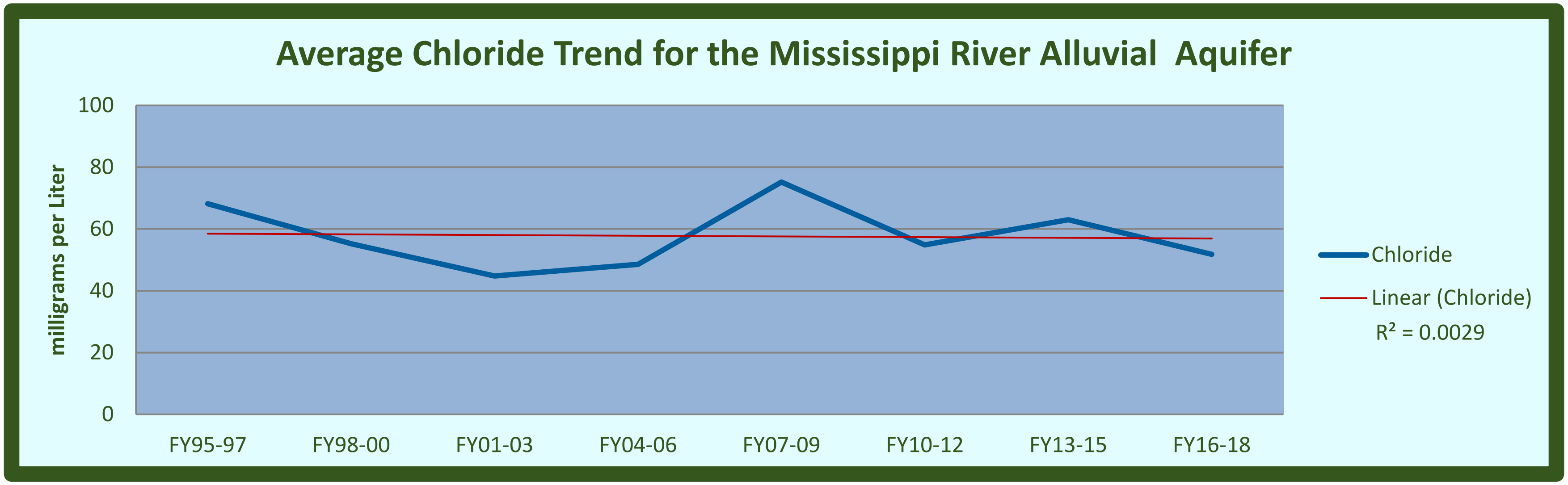

Chart 8-6: Total Dissolved Solids

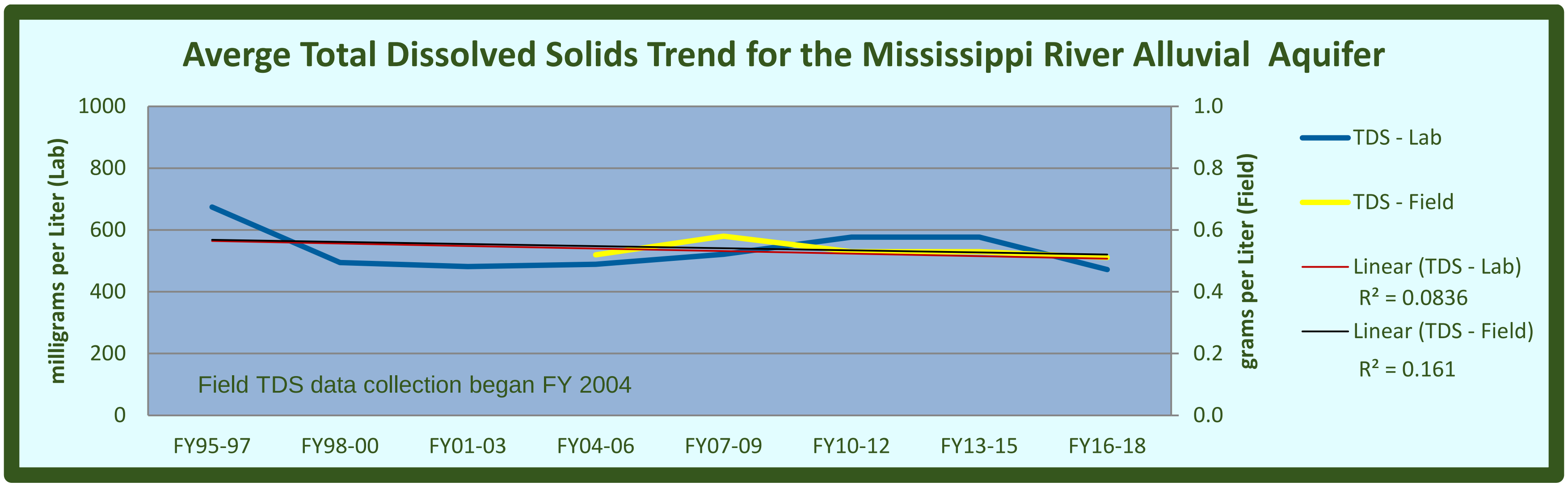

Chart 8-7: Alkalinity Trend

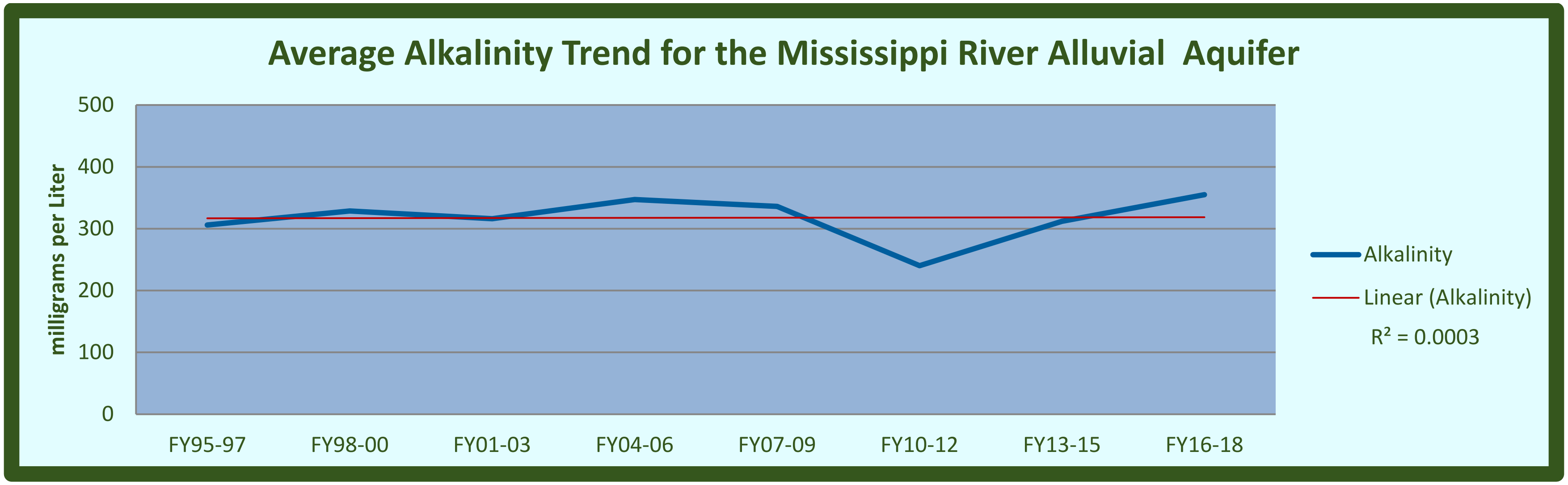

Chart 8-8: Hardness Trend

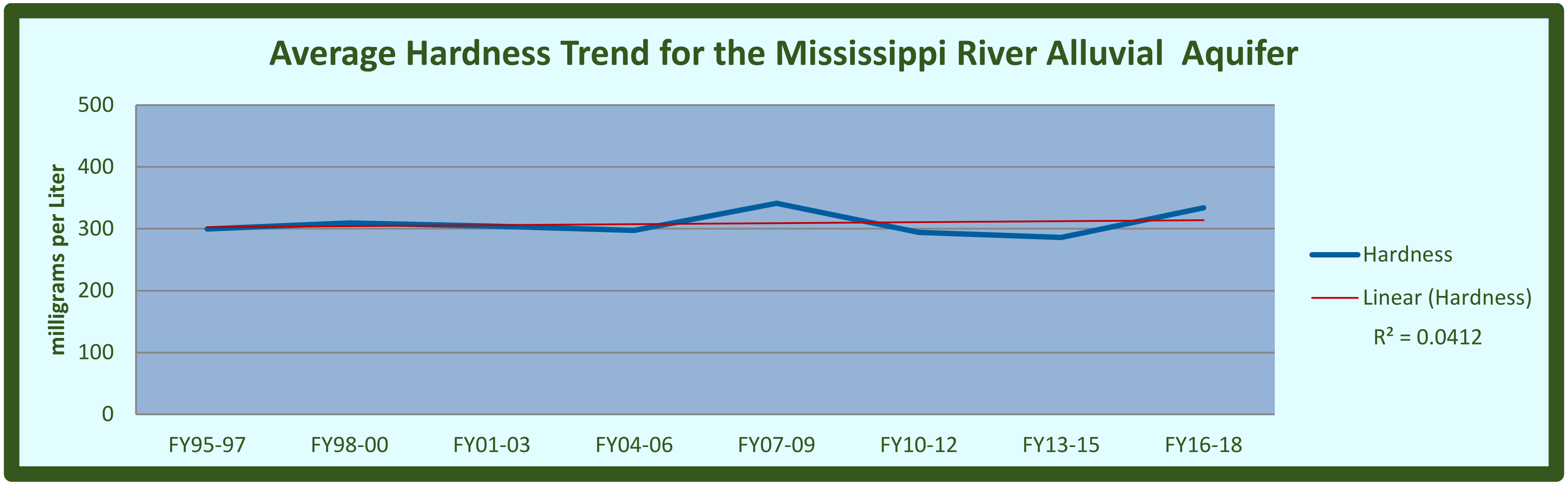

Chart 8-9: Sulfate Trend

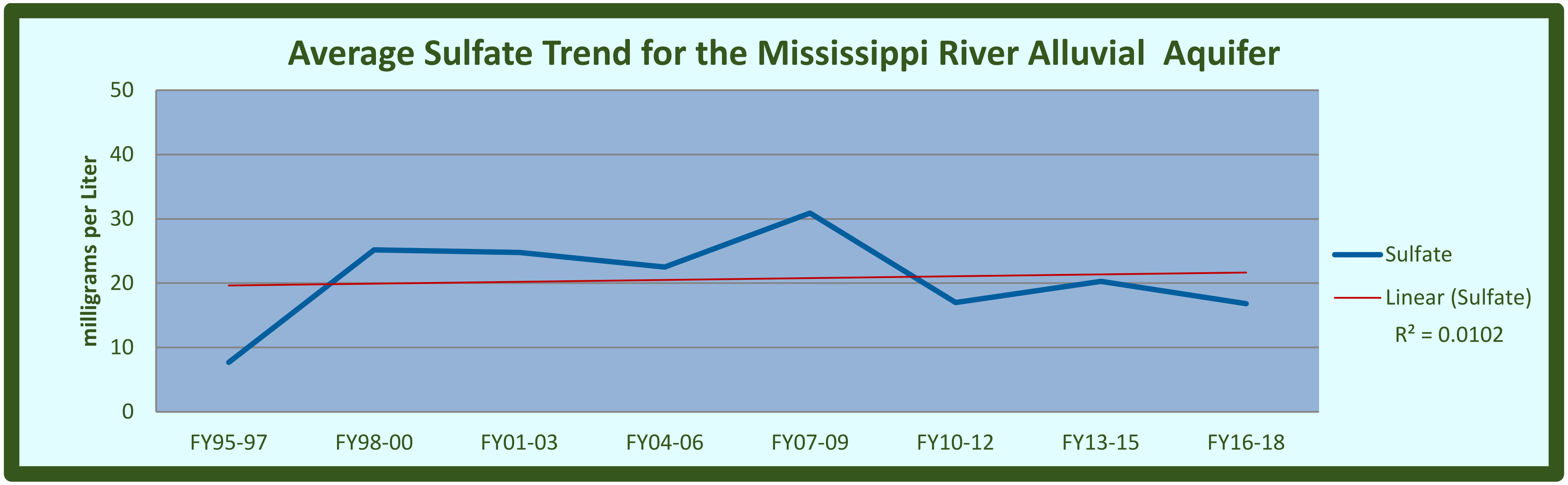

Chart 8-10: Color Trend

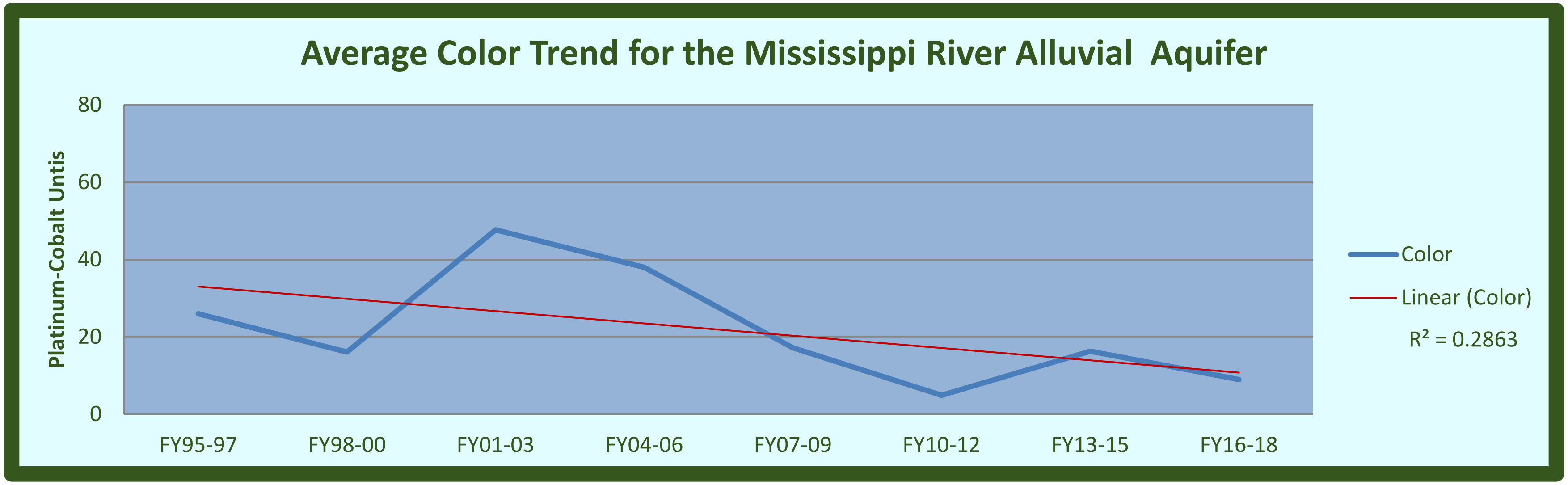

Chart 8-11: Ammonia Trend

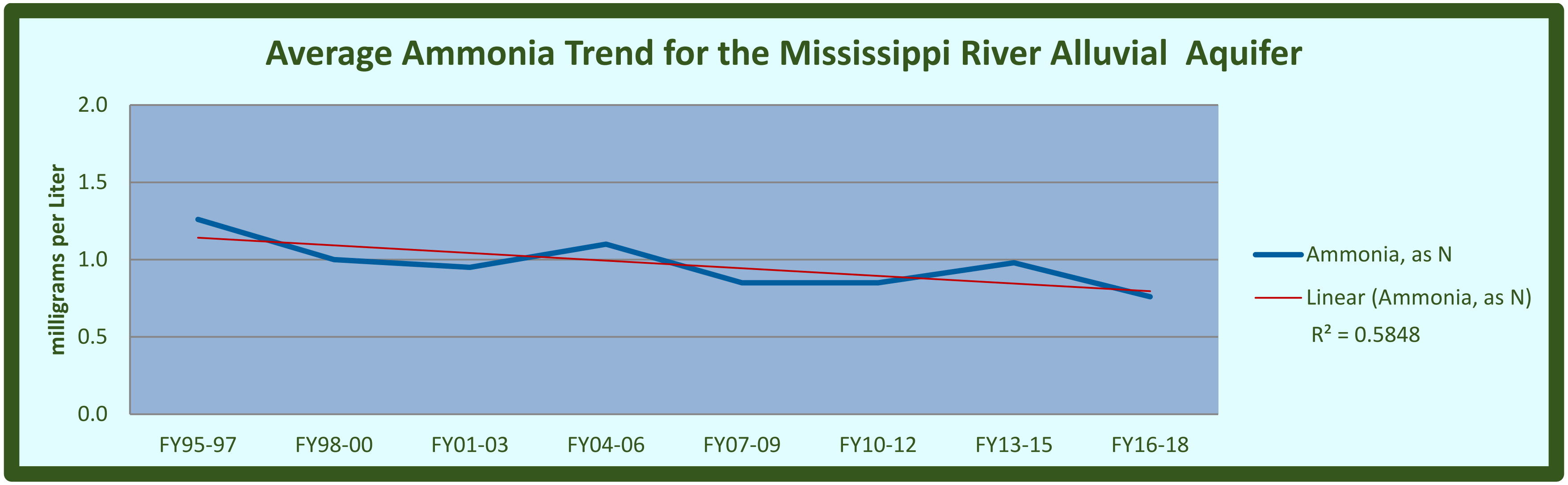

Chart 8-12: Nitrite – Nitrate Trend

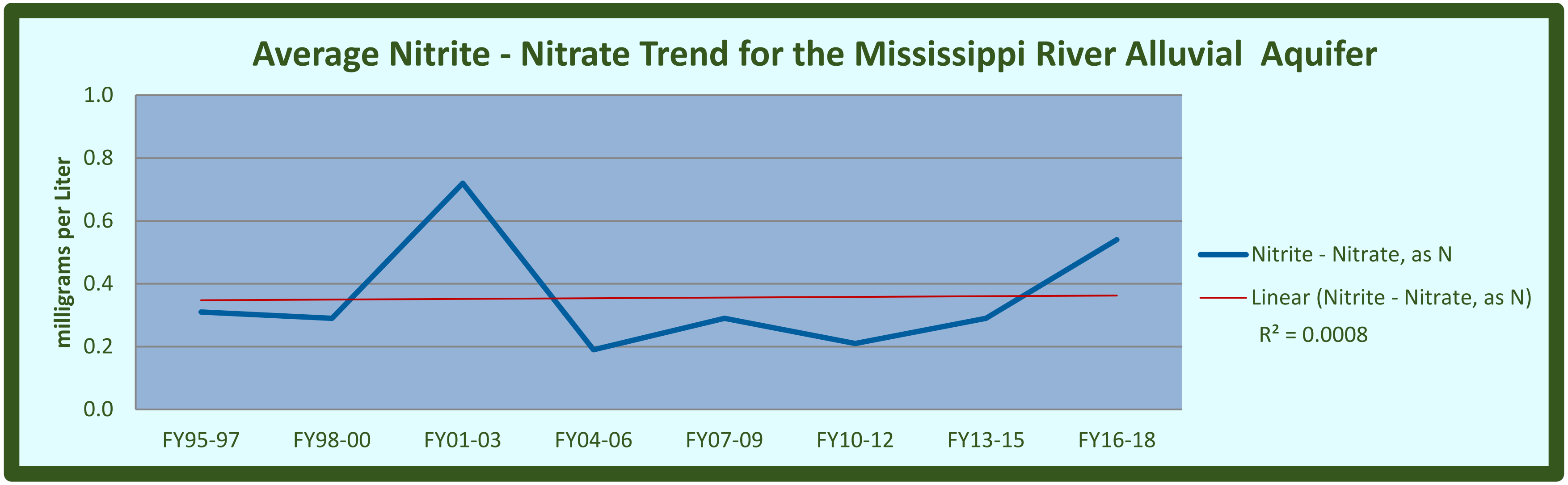

Chart 8-13: Total Kjeldahl Nitrogen Trend

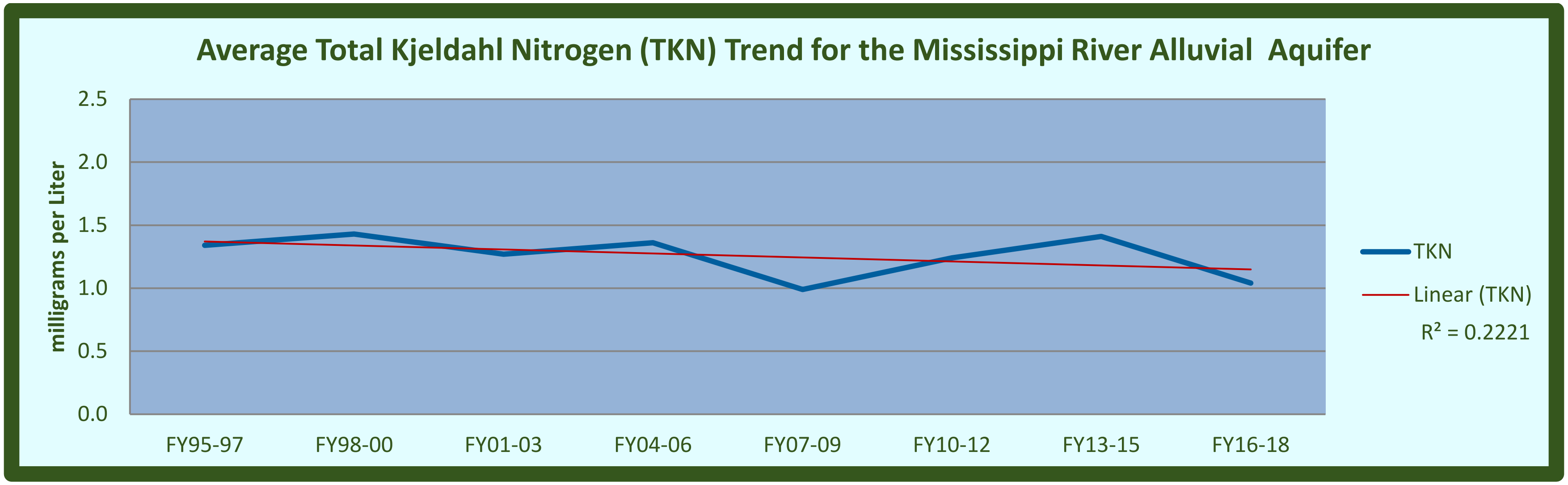

Chart 8-14: Total Phosphorus Trend

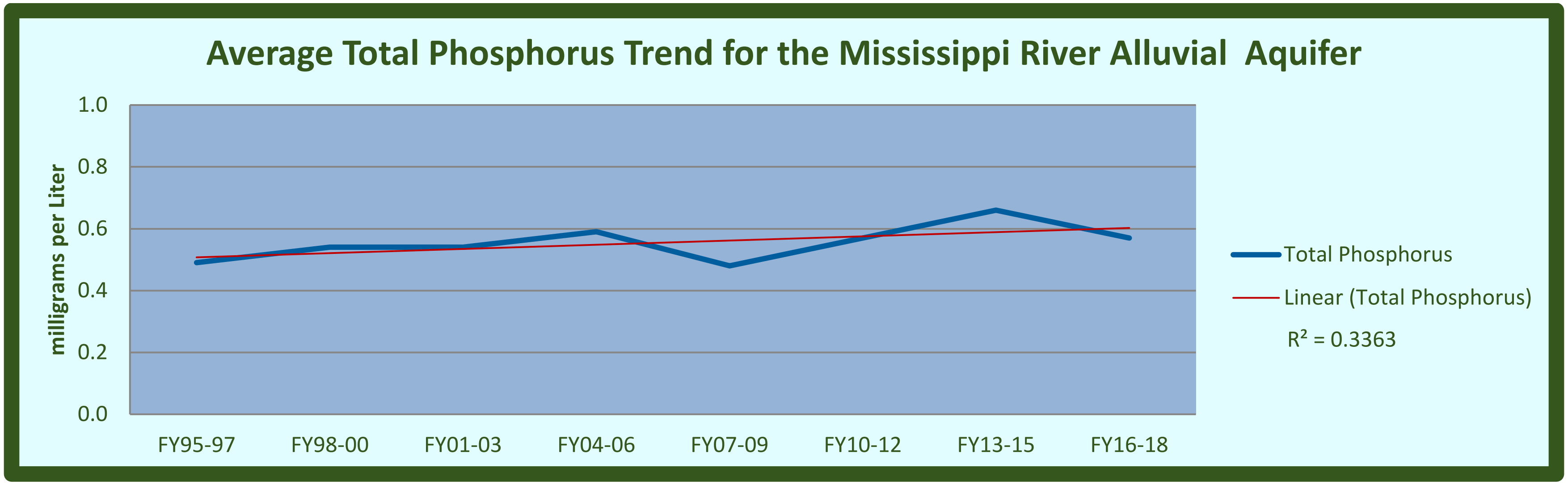

Chart 8-15: Barium Trend

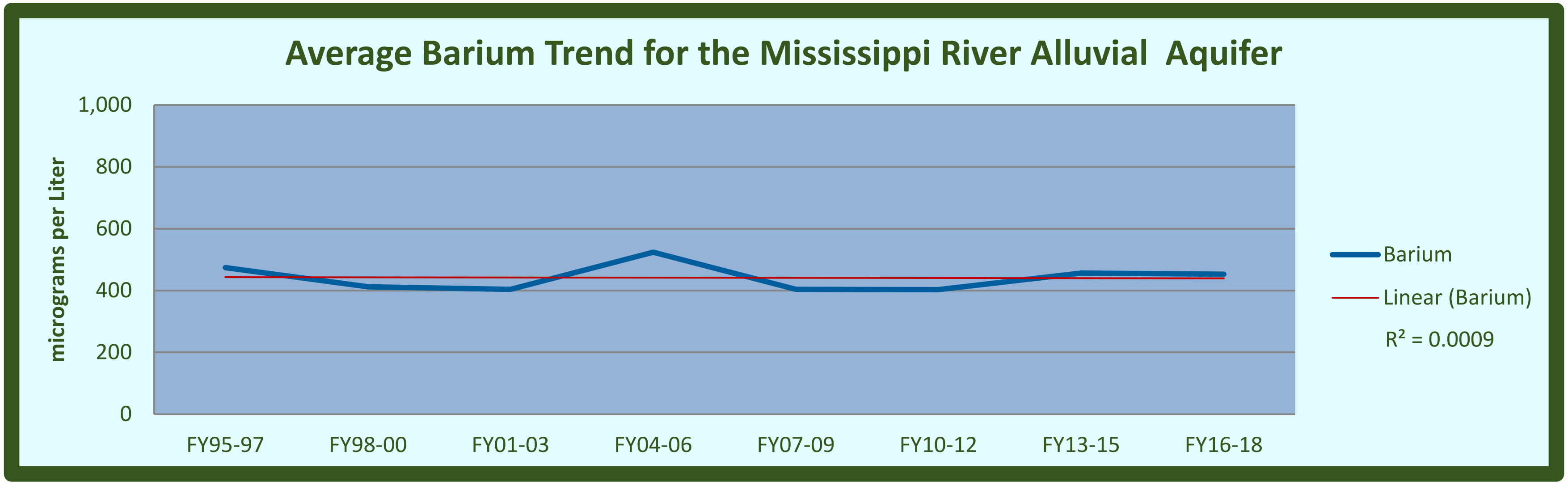

Chart 8-16: Copper Trend

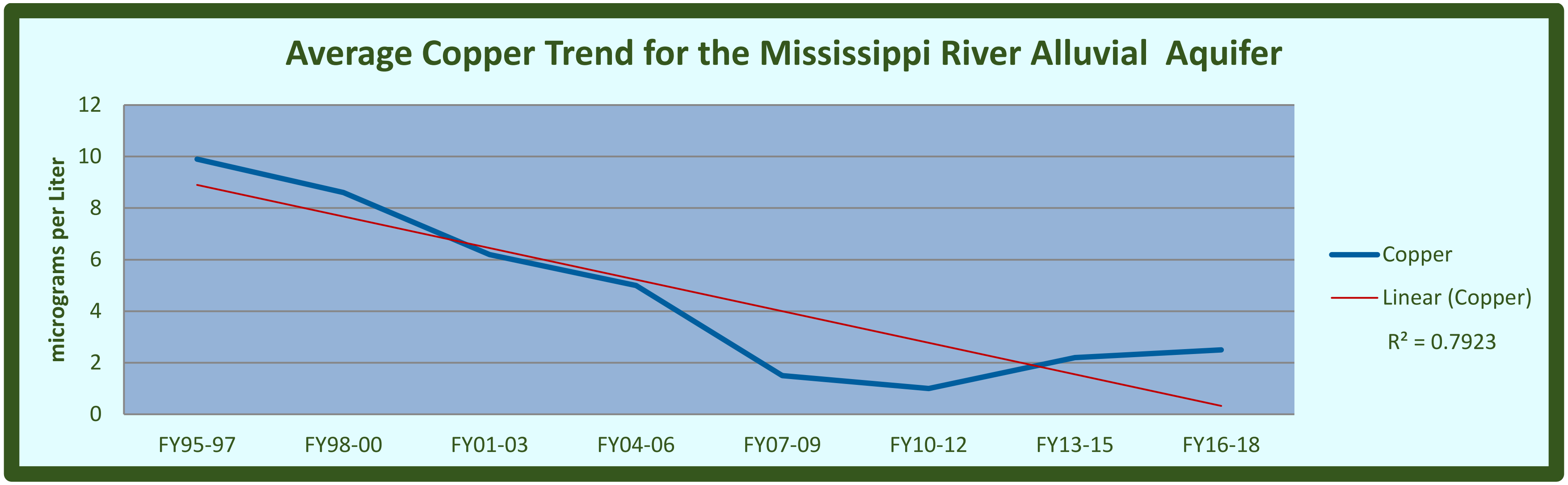

Chart 8-17: Iron Trend

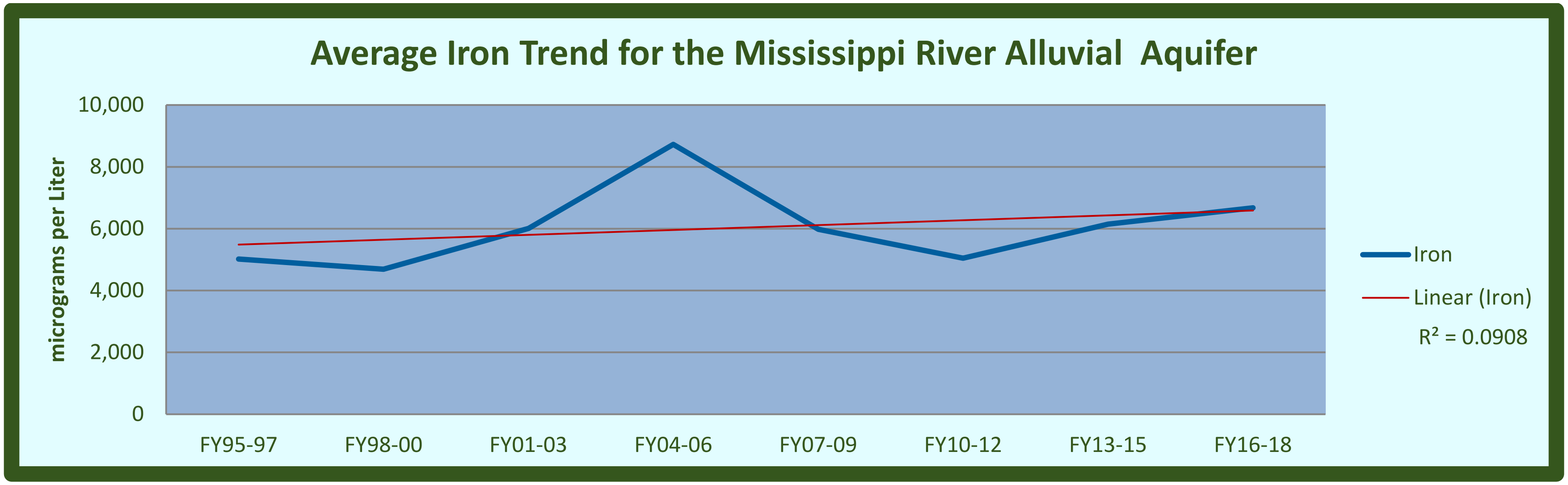

Chart 8-18: Zinc Trend