

40-Year Surface Water Quality Report (1984-2024)

Prepared for

**Township of Stillwater, New Jersey
Environmental Commission**

Prepared by

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ACKNOWLEDGEMENTS

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ACRONYMS AND ABBREVIATIONS

C1	Category One waters are those waters designated in the tables in N.J.A.C. 7:9B-1.15(c) through (i), for purposes of implementing the antidegradation policies set forth at N.J.A.C. 7:9B-1.5(d), for protection from measurable changes in water quality based on exceptional ecological significance, exceptional recreational significance, exceptional water supply significance or exceptional fisheries resource(s) to protect their aesthetic value (color, clarity, scenic setting) and ecological integrity (habitat, water quality and biological functions).
DQO	Data Quality Objectives. Defined by the USEPA as a systematic planning process for collecting environmental data that is of known quality and quantity to support decision-making. The DQO process is a tool to ensure that the data collected and analyzed for a project meets the requirements of the project's goals.
FW2	Fresh Water 2; means the general surface water classification applied to those fresh waters that are not designated as FW1 or Pinelands Waters.
M-K	Mann-Kendall test (non-parametric statistical trend test).
NJDEP	New Jersey Department of Environmental Protection
OLS	Ordinary Least Squares regression (parametric statistical trend test).
SLs	Screening Levels developed as described in this report for the parameters analyzed as part of the SWMP.
STV	Statistical Threshold Value means the value that approximates the 90th percentile of the water quality distribution and is not exceeded by more than 10 percent of the samples used to calculate the geometric mean for the purposes of bacterial quality criteria.
SWMP	Surface Water Monitoring Program initiated in 1984 by Township of Stillwater Environmental Commission
SWQC	NJDEP Surface Water Quality Criteria means those parameters of the Surface Water Quality Standards, expressed as constituent concentrations, levels, or narrative statements, representing a quality of water that is protective for supporting the designated use.
SWQS	NJDEP Surface Water Quality Standards means the NJDEP regulations (N.J.A.C. 7:9B), which set forth designated uses, use classifications, and

water quality criteria for the State's waters based upon such uses, and the policies concerning these uses, classifications and criteria.

su	Standard units for pH
TAN	Total Ammonia Nitrogen; aka, "Nitrogen (Ammonia)"
TKN	Total Kjeldahl Nitrogen
TM	Trout Maintenance.
TP	Trout Production.
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
UCL	Upper Confidence Limit
WMW	Wilcoxon-Mann-Whitney
WQDE	NJDEP Water Quality Data Exchange

Executive Summary

This report summarizes surface water data collected by the Township of Stillwater Environmental Commission aka “the Township” or “Stillwater”) as part of a surface water monitoring program (SWMP) initiated in 1984 that includes periodic collection of surface water samples for laboratory analysis from up to 10 Sample Stations (aka “Stations”) located at eight small streams or brooks and the Paulins Kill (aka Paulinskill River). The sampling was performed on an approximately biennial basis from 1984 through 2024. In aggregate, a total of approximately 209 samples were collected and analyzed over the 40-year period since 1984, with most Sample Stations being represented by analytical data for over 20 samples. The SWMP surface water quality sample analytical parameters included:

- Alkalinity
- Aluminum
- E. coli
- Fecal Coliforms
- Lead
- Nitrogen (Ammonia)
- Nitrate, Nitrogen
- Nitrite, Nitrogen
- Total Kjeldahl Nitrogen (TKN)
- Orthophosphate
- Phosphorus (Total)
- pH
- Specific Conductivity
- Total Dissolved Solids (TDS)
- Total Suspended Solids (TSS)

The SWMP employed relatively consistent protocols and methods for sampling locations, sampling frequency, sample analytical parameters, and the use of certified laboratories for sample analysis. As a result, the SWMP Data (i.e., sample analytical results from 1984 to 2024) represent a robust data set for statistical analysis and comparison of water quality data with New Jersey Department of Environmental Protection (NJDEP) regulations (i.e., primarily the NJDEP Surface Water Quality Standards [SWQS]).

Most of the streams in the 28-square-mile Township are tributary to the Paulins Kill, some directly or via various ponds and lakes (e.g., Paulinskill Lake, Swartswood Lake), while some streams feed into Blair Creek which has its confluence with the Paulins Kill downstream about 5 miles to the southwest of the Township. Basic land use and

demographic information reflect the rural nature, low population, and corresponding quality of the natural free-flowing surface waterbodies in Stillwater. According to the SWQS, the Paulins Kill and most of its tributary streams are designated as Category One (C1) waterways by NJDEP, with several reaches classified as FW2 Trout Production or Trout Maintenance. Under the SWQS regulations, C1 waterways are afforded special protection to maintain their water quality, aesthetic value, and ecological integrity and to prevent measurable changes in water quality due to their Exceptional Ecological Significance, Exceptional Water Supply, Exceptional Recreation, and Exceptional Fisheries. NJDEP's anti-degradation policies are a primary mechanism in the SWQS to preserve C1 waterways.

The SWMP Data provide a distinct opportunity to assess the provisions of the SWQS C1 designation and related policies quantitatively, rather than only qualitatively, which is the case where robust water quality data are lacking and for parameters without promulgated SWQC.¹ Documentation and summaries of the quantitative statistical analysis performed to evaluate the SWMP Data for this report, (e.g., time series trend analysis, 95% Upper Confidence Levels, data distribution, data correlation, etc.) are included. In addition, relevant provisions of the SWQS are summarized and referenced in the following report sections, as deemed necessary to support the discussion and provide context.

Based on this review, the overall surface water quality is within acceptable NJDEP SWQC and Screening Levels (SLs) developed as described in this report for the parameters analyzed as part of the SWMP, and long-term water quality is generally stable, with minor exceptions, as noted in the report. The large number of samples and consistency in collection frequency and quality facilitated robust statistical analysis of the SWMP Data. Long-term water quality conditions established by statistical analysis of 40 years of water quality data represent an opportunity to set benchmarks for quantitative comparison of water quality data to assess compliance with the SWQS policy for the protection of C1 waters from "measurable change." While the SWMP Data are sufficient for this review, some uncertainties and data quality issues related to sample methods, handling, and parameter selection were identified and are discussed in this report.

Preliminary recommendations are provided for consideration, including:

- Revisions to SWMP Data Quality and Analytical Methods
 - Update Analytical Parameters and Methods

¹ Other data sets (e.g., NJDEP GeoWeb WQDE) are sparse and cover a relatively short duration. Also, the SWQS do not include criteria for several of the SWMP Parameters.

- Establish Data Quality Objectives (DQOs), Data Use and Reporting
- Use of Field Meters for Analyze-Immediately Parameters
- Standardize Data Documentation and Curation (e.g., use of a database)
- Review of SWMP Objectives
 - Consider Establishing C1 Benchmarks for future data comparative analysis
 - Compare SWMP Data with other data sources (e.g., NJDEP Data, NGO Data)
 - Collaborate with adjacent and nexus communities and NGOs
 - Revise Sample Collection Frequency
 - Consider Focused Short-term Investigations
 - Evaluate Seasonal Variability
 - Consider Additional Parameters

1.0 Introduction

The Township of Stillwater Environmental Commission (“the Township” or “Stillwater”) monitored surface water quality in several local streams during the period from 1984 to 2024. The surface water monitoring included collecting over 200 samples for laboratory analysis at 8 to 10 surface water Sample Stations from 1984 to 2024, resulting in up to 26 samples for each of the 10 Stations. The Sample Stations are shown in Figure 1 and photographs of the approximate Station locations are provided as Attachment 1.

Most of the samples were collected in the fall on a biennial basis (i.e., every other year), except for two sampling events in the spring that occurred in 2002. In addition, a Stream Quality Survey was conducted for 8 of the 10 stations in circa 2004 that provided water quality ratings for each of the Stations based on macroinvertebrate counts and physical observations. For this report, the prior surface water quality monitoring and survey conducted from 1984 to 2024 noted above are collectively referred to as the Stillwater Surface Water Monitoring Program (SWMP).

1.1 Scope and Limitations

This report focuses on the analytical results from the SWMP and provides:

- a summary of the existing water quality data generated from the SWMP from 1984 through 2024,
- a characterization of water quality based on statistical analysis,
- discussion regarding the relevance of the various analytical parameters compared to New Jersey Department of Environmental Protection (NJDEP) Surface Water Quality Standards (SWQS) and related criteria, and
- findings and conclusions.

The sampling and investigations conducted as part of the SWMP included in this report are limited to lotic environments (e.g., brooks, creeks, streams, rivers). Lentic environments (e.g., ponds, lakes) were not included. However, some of the sample locations may provide insight into lake water quality via data from lake tributaries and data from surface waters downstream from lake outflow points.

Biological index survey data and various other information collected as part of the SWMP are described in a 2004 surface water report entitled, *Stream Surface Water Sampling – Chemical Data and Biological Analysis through Macroinvertebrates*, prepared for the Stillwater Township Environmental Commission in 2004 (S. Grodsky, 2004; a.k.a., “2004

SW Report”)² However, the prior biological survey data and related information in the 2004 SW Report are beyond the scope and not summarized in this report.

The NJDEP SWQS and any related laws, regulations, guidance, policies, etc. are intricate and are not all addressed in this report. However, selected parts of the SWQS are included to assist with understanding how salient portions of the SWQS may apply or may be used to interpret the SWMP data. Nothing in this report is intended to represent a determination of compliance or applicability with any laws or regulations, or legal advice. Regulations excerpts and references are provided for convenience; however, the full text of the SWQS should be consulted directly as the final authority regarding a determination of regulatory applicability and compliance.

1.2 Sample Analytical Parameters and Surface Water Quality Standards

The surface water samples collected as part of the SWMP were analyzed for the following parameters (aka SWMP Parameters):

- Alkalinity
- Aluminum
- Ammonia
- Conductivity
- E. coli
- Fecal Coliforms
- Total Kjeldahl Nitrogen (TKN)
- Lead
- Nitrate, Nitrogen
- Nitrite, Nitrogen
- Orthophosphate
- pH
- Phosphorus (Total)
- Total Dissolved Solids (TDS)
- Total Suspended Solids (TSS)

The NJDEP Surface Water Quality Standards (SWQS) are promulgated regulations that provide both narrative and numerical surface water quality criteria (SWQC) that apply to

² S.Grodsky, 2004. *Stream Surface Water Sampling – Chemical Data and Biological Analysis through Macroinvertebrates*. Prepared for the Stillwater Township Environmental Commission. 2004.

specific water bodies based on categories assigned to water bodies that define the level of protection each is to receive (N.J.A.C.7:9B).³ The SWQS include SWQC for some but not all of the SWMP Parameters. The SWQS also include lists of waterbody names and categories that account for virtually all surface water bodies in the state. It should be noted that some of the stream names in the SWQS are not consistent with those historically used in the SWMP. Therefore, an effort was made in this report to reconcile the stream names to facilitate comparison with the SWQS regulations. The prior stream names and sample Stations from the 2004 SW Report are included for reference in Appendix A).

A list of the SWMP Sample Stations and stream names and related location information adopted for this report to facilitate consistency with the NJDEP SWQS waterbody names and categories is provided as follows:

Sample Stations - Location Identifiers (LOC ID)	NJSWQS Classification	Sample Site Location Description	State Plane Coordinates	
			SP_X	SP_Y
Site 01 - Blair Ck	FW2-NT(C1)	Sand Pond Road Bridge at end of Old Schoolhouse Rd, below confluence of North and South branch of Blair Creek.	371267	808760
Site 02 - Trout Bk (Fairview Lake Rd.)	FW2-TP(C1)	Fairview Lake Rd.; 365 Feet NW from intersection with Owassa Rd.	383584	819167
Site 03 - Trout Bk (Middleville)	FW2-TP(C1)	Middleville Rd. and Pond Brook Rd.	392415	809709
Site 04 - Swartswood CK (Quick Pond)	FW2-TM(C1)	a.k.a., Spring Brook; Mount Benevolence Rd. near Crandon Lodge.	395873	827994
Site 05 - Swartswood Ck UNT (Crandon Lk.)	FW2-TM(C1)	UNT; (a.k.a., Spring Bk); Hampton Rd. Bridge; 1875 Feet NE from intersection with Mt. Benevolence Rd.	396537	830135
Site 06 - Swartswood Ck	FW2-TM(C1)	a.k.a., Spring Brook; Swartswood Rd. Bridge	401983	820234
Site 07 - Paulins Kill (Main St. Bridge)	FW2-TM(C1)	Stillwater Rd.; Main St. Bridge	388967	801425
Site 08 - Pond Bk (Keen's Mill)	FW2-NT	a.k.a., Keen's Mill; Off of Rt. 521 next to Keen's Mill.	394745	810960
Site 09 - Paulins Kill (Lake Outfall Below Dam)	FW2-TM(C1)	Below the Paulins Kill Lake Dam	401881	808492
Site 10 - Pond Bk (VMP Bridge)	FW2-NT	Veteran's Memorial Park (VMP) bridge.	393880	807728

Footnotes: (Consult NJDEP SWSQ for clarification)

"C1" means Category One waters.

"FW2" means the general surface water classification applied to those fresh waters that are not designated as FW1 or Pinelands Waters.

"NT" means nontrout waters.

"TM" means trout maintenance (for the support of trout throughout the year).

"TP" means trout production (for use by trout for spawning or nursery purposes during their first summer).

"UNT" means unnamed tributary.

Key definitions and statements of policy in the SWQS relevant to the SWMP data evaluation presented in this report are summarized below.

³ N.J.A.C. = New Jersey Administrative Code found at [CHAPTER 9B SURFACE WATER QUALITY STANDARDS \(nj.gov\)](https://www.nj.gov/njstate/treasury/finance/standards/CHAPTER_9B_SURFACE_WATER_QUALITY_STANDARDS_(nj.gov)) ; last amended 2023.

Category one (C1) waters are defined as those waters designated by the NJDEP in the SWQS (N.J.A.C. 7:9B) for purposes of implementing the antidegradation policies, for protection from measurable changes in water quality based on exceptional ecological, recreational significance, water supply significance or fisheries resource(s) to protect their aesthetic value (color, clarity, scenic setting) and ecological integrity (habitat, water quality and biological functions). (See NJAC7:9B-1.4.)

“Primary contact recreation” means water-related recreational activities that involve significant ingestion risks and includes, but is not limited to, wading, swimming, diving, surfing, and water skiing. (See NJAC7:9B-1.4.)

“Secondary contact recreation” means recreational activities where the probability of water ingestion is minimal and includes, but is not limited to, boating and fishing. (See NJAC7:9B-1.4.)

Category One Waters shall be protected from any measurable changes (including calculable or predicted changes) to the existing water quality. Water quality characteristics that are generally worse than the water quality criteria except as due to natural conditions, shall be improved to maintain or provide for the designated uses where this can be accomplished without adverse impacts on organisms, communities, or ecosystems of concern. (See NJAC7:9B-1.5.)

General SWQS technical policies are as follows [see NJAC7:9B-1.5(e)]:

- Natural water quality may be used in place of the SWQC.
- Water quality criteria are expected to be maintained when stream flows are at or greater than the statistically low flow conditions (e.g., MA7CD10 flow), with some limited exceptions [see NJAC7:9B-1.5(e)].
- Maintenance of water quality criteria is expected in intermittent streams during all natural flow conditions, or immediately downstream when intermittent stream natural flow is insufficient to determine water quality.
- All analytical data to be incorporated by the Department in water quality monitoring shall be from laboratories certified by the NJDEP for the analytical parameters being tested.
- Use Geometric mean and statistical threshold values (STV) for implementing bacterial quality criteria where applicable.

Antidegradation policies applicable to all surface waters of the State are as follows [see NJAC7:9B-1.5(d)]:

- Existing uses and designations shall be maintained and protected.
- Maintenance, migration, and propagation of threatened or endangered species.
- No irreversible changes may be made to existing water quality.
- No changes shall be allowed in waters which constitute an outstanding National or State resource or in waters that may affect these outstanding resource waters.
- Ensure higher classification/antidegradation water quality and uses are not impinged upon by lower classification waters.

In all FW2 waters⁴ the designated uses are [see NJAC7:9B-1.12(c)]:

- Maintenance, migration, and propagation of the natural and established biota;
- Primary contact recreation;
- Industrial and agricultural water supply;
- Public potable water supply after conventional filtration treatment (a series of processes including filtration, flocculation, coagulation, and sedimentation, resulting in substantial particulate removal but no consistent removal of chemical constituents) and disinfection; and
- Any other reasonable uses.

Excerpted pages from the SWQS that include relevant SWQC for the SWMP analytical parameters are attached for reference as Appendix B. For more detailed information, see the SWQS (NJAC7:9B) or visit the NJDEP SWQS website at <https://www.nj.gov/dep/wms/bears/swqs-overview.htm>.

1.3 Summary of Stillwater Township Demographics and Land Use

Natural water quality is inextricably linked to the co-located landscape including geology, soils, and land use/land cover, the latter of which are affected by human population density and related development and infrastructure.

Water naturally falls as rain and snow upon all land areas washing over exposed surfaces of natural and man-made materials. It runs in sheets and channels washing across the various surfaces eroding the earth and rock and carrying dissolved substances – both natural and synthetic. The runoff from rain and snow melt enters water bodies - sometimes in trickles and at times in torrents - carrying remnants of the land it crosses along the way.

⁴ “FW2 waters” refers to the NJDEP general freshwater classification for most freshwater bodies in NJ.

On average New Jersey receives roughly 45 inches (i.e., nearly 4 feet) of precipitation (snow and rain) annually. Approximately 25% (~1-foot) of the average annual precipitation soaks into the ground and migrates to groundwater where it may be stored for hours to years before it is lost via evapotranspiration, pumped from wells, or eventually discharges to surface water. Most of the remaining annual precipitation (~75%) becomes stormwater runoff, with some seasonal loss to evapotranspiration. This summary is very general and is not intended to account for regional variability or all aspects of the hydrological cycle. However, it serves to illustrate two key concepts that are not only generally applicable, but that apply specifically to Stillwater: (1) surface water bodies receive a large percentage of the annual precipitation in the form of runoff, and (2) land use, precipitation, surface water, and groundwater are interconnected.

The Township of Stillwater is home to roughly 4,000 people and covers approximately 28 square miles or about 18,000 acres of land area.⁵ As one of the least densely populated municipalities in the state, Stillwater has a relatively low percentage of impermeable cover (e.g., structures, parking lots, paved roads) and a limited number of properties zoned for commercial use. Large portions of the Township are preserved as farmland or open space, and farmland accounts for a significant amount of the land area.

While some large areas are used for agriculture, there are no major industrial sites and very few NJDEP Known Contaminated Sites (i.e., six) or contaminated areas, with none identified in the immediate vicinity of the SWMP Sample Stations, as indicated by NJGeoWeb map information (Appendix C). Notwithstanding, the Paulins Kill receives discharges from upstream sewage treatment plants located outside of Stillwater (USEPA, 1976)⁶ that can impact water quality in Paulinskill Lake and the Stillwater reach of the Paulins Kill.

The NJDEP SWQS identifies five streams in the Township of Stillwater in (Blair Creek, Paulins Kill, Pond Brook, Swartwood Creek, and Trout Brook) with a nexus to related tributaries and several lakes. However, this does not include many small tributaries and rivulets that exist in many areas throughout the Township. The SWMP sampling did not include lakes and wetlands. Thus, the water quality of Township lakes and wetlands is beyond the scope of this report. NJDEP land-use maps indicating the aerial extent of Stillwater Township, surface, water bodies, wetland areas, etc. from the New Jersey GeoWeb database are provided in Appendix C.

⁵ NJDEP GeoWeb <https://www.nj.gov/dep/gis/geoweb splash.htm> [accessed 01/20/2024]

⁶ USEPA, 1976. Report on Paulinskill Lake, Sussex County, New Jersey: EPA Region II. Working Paper No. 371. U.S. Environmental Protection Agency.

In general, surface water quality is a function of the local and/or regional geology, hydrogeology, topography, soil and land use. Surface water quality is also subject to impacts from point-source and non-point source discharges, and groundwater or surface water runoff may be impacted by human land-use activities, such as industrial operations, agriculture, construction, roadways, public sanitary sewerage systems, septic systems, etc. While a review of the SWMP Sample Stations relative to land-use mapping may be informative, it is beyond the scope of this report, and may be considered for future evaluation of the Township surface water quality.

1.4 Geology and Environmental Setting

New Jersey has four distinct physiographic provinces, including (listed from the south to the north) the Atlantic Coastal Plain Province, the Piedmont Province, the Highlands Province, and the Ridge and Valley Province. Stillwater is located within the Ridge and Valley Province, which is the smallest of the four physiographic provinces and is confined to the northwest corner of the state. The Ridge and Valley Province includes the Kittatinny Valley, which is part of the Great Appalachian Valley that contains some of the oldest rocks of the province. One prominent geologic formation is the Martinsburg shale (composed of limestone) that formed during the Ordovician period. At the edge of this valley is the Kittatinny Ridge which rises above 1,000 feet above mean sea level. The Kittatinny Ridge is oriented along a northeast–southwest axis.

Bedrock deposits influence the conditions of the local soils, surface water, and groundwater. The regional bedrock geology includes carbonate bedrock formations primarily composed of limestone and dolomite that make up over one-third of the bedrock in Stillwater.

Large portions of Stillwater are identified by the NJDEP as areas of groundwater recharge replenishing aquifers that serve as important groundwater resources for local and regional water supply. The recharge to groundwater occurs from seepage of surface water that ultimately derives from precipitation (snow and rain) and related stormwater runoff. The groundwater recharge in the Ridge and Valley Province derives entirely from precipitation. (This is why the quality of runoff water from roads, parking lots, and areas of pesticide and fertilizer use are concerns for protection of groundwater quality.) However, the interaction between surface water bodies (e.g., lakes, ponds, rivers, streams, etc.) and shallow groundwater zones is variable, and often groundwater seeps into surface water bodies in the form of springs or as constant stream base flow depending on the season

and elevation of the groundwater, among other factors (e.g., local geology, local water use, etc.).⁷

Based on the above, the quality of the surface water is very closely related to local and regional groundwater quality and conditions of one can and does influence the other. The SWMP implemented over the past four decades focused on surface water quality and groundwater quality was not evaluated and is beyond the scope of this report. However, the SWMP Data may serve as an indicator for local or regional groundwater quality due to the physical interconnection of surface water and groundwater and the potential influence of the water quality of each for future study.

⁷ For additional information see Environmental Resource Inventory Updates (2014/2015)
<https://stillwatertownshipnj.com/government/boards-and-commissions/environmental-commission/>

2.0 Summary of SWMP Laboratory Analytical Results

As noted in Section 1 above, the SWMP included collecting over 200 samples for laboratory analysis at 10 surface water Sample Stations from 1984 to 2024, resulting in data for up to 26 samples for each of the 10 Stations for most of the SWMP Parameters. The SWMP laboratory sample analytical results (aka SWMP Data) for all samples, parameters, and Stations are provided in Tables 1 through 10. Summary statistics and discussion of the SWMP Data including statistical analysis and comparisons to SWQC are included in the following sections below, with supporting details, information, and documentation attached as appendices. Statistical analysis, noted below where applicable, was performed using the US Environmental Protection Agency's ProUCL statistical software (ProUCL, Version 5.2).⁸

2.1 Overview of Surface Water Sample Analytical Results

As an initial overview evaluation, summary statistics of the entire SWMP Data set (min., max., mean, sample size, etc.) are listed below, along with a high-level comparison of SWQC. For this level review, summary statistics and comparisons are presented for each SWMP Parameter and data are not separated by Sample Station. As noted below, the SWQS include SWQC for only 6 of the 13 SWMP Parameters. Screening Levels (SLs) based on the SWQC or assembled from other sources were adopted as needed to facilitate this review. The sources and references that support SWQC and SLs used for comparison in this report are included in Appendix B.

The SWMP data used for this evaluation relied on the laboratory results only. During the October 2024 sampling event, pH and temperature were measured for surface water samples at each of the 10 Stations in the field using a portable Fisher Scientific Accumet AP115 pH /temperature meter. The pH and temperature field measurements were not used in the statistical analysis, but are discussed in the following sections, where appropriate.

⁸ USEPA 2022. ProUCL Version 5.2. *Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations*. Office of Research and Development, EPA/600/R-07/041. October 2015 (Updated June 2022). <https://www.epa.gov/land-research/proucl-software>

		SWQC/SL (1)				Site Data Summary				Frequency					
Parameter	Units	Acute Biota	Chronic Biota	Human Health	General	Min. Conc.	Max. Conc.	Mean Conc.	SD	# Samples (n)	# Detected	# > Acute	# > Chronic	# > Human Health	# > General
Alkalinity, Total (2)	mg/l	--	--	--	200	5.52	190	45	44	209	209	--	--	--	0
Aluminum (2)	mg/l	0.98	0.38	--	--	0	0.906	0.99	0.1	134	97	0	8	--	--
E. coli	col/100ml	--	--	--	100	0	620	78	140	25	22	--	--	--	3
Fecal Coliforms (3)	col/100ml	--	--	--	100	0	900	51	96	207	182	--	--	--	20
Lead	mg/l	0.038	0.0054	0.005	--	0	0.088	0.009	0.016	145	104	8	27	27	--
Nitrogen, Ammonia (3)	mg/l	2.4	0.54	--	--	0	0.9	0.1	0.1	201	143	0	4	--	--
Nitrogen, Nitrate	mg/l	--	--	10	--	0	2.28	0.19	0.28	209	146	--	--	0	0
Nitrogen, Nitrite (2)	mg/l	--	--	--	1	0	0.26	0.02	0.05	200	132	--	--	--	0
Nitrogen, Total Kjeldahl (TKN) (2)	mg/l	--	--	--	6	0	21	0.64	1.58	200	148	--	--	--	1
pH	su	--	--	--	6.5-8.5	5.92	8.47	7.17	0.54	209	209	--	--	--	27
Phosphate, Ortho (3)	mg/l	--	--	--	0.1	0	0.1	0.03	0.03	208	163	--	--	--	0
Phosphorus	mg/l	--	--	--	0.1	0	0.54	0.048	0.077	200	167	--	--	--	13
Specific Conductivity (2)	umhos/cm	--	--	--	500	63.4	642	196	131	209	209	--	--	--	6
Total Dissolved Solids (TDS) (5)	mg/l	--	--	--	500	48	360	137	92	19	19	--	--	--	0
Total Suspended Solids (TSS)	mg/l	--	--	--	25/40	0	65	4.19	7.94	201	150	--	--	--	4

(1) Values are NJ Surface Water Quality Criteria (SWQC) in NJAC 7:9B, unless otherwise noted as Screening Levels (SL).

(2) Screening Levels adapted from sources other than NJ Surface Water Quality Standards NJAC 7:9B. (See Appendix B).

(3) SWQC are estimates calculated based on SWQS in NJAC 7:9B. (See Appendix B).

(4) SWQC in NJAC 7:9B require background or whole effluent toxicity testing to establish compliance.

(5) SL for TDS uses NJ Drinking Water TDS MCL. (See Appendix B).

The parameter concentrations in the above summary are not intended for compliance with the SWQS and do not necessarily represent non-compliance with the SWQC, as many of the above criteria are adapted from SWQC and/or are SLs developed for this report. In addition, some of the Site data represent legacy conditions, and SWQC have changed over the years. Thus, for strict determination, the older results would need to be compared to their contemporaneous SWQC, which is beyond the scope of this report. However, the above data summary serves as a high-level screening step to guide further evaluation.

In general, the frequency of detection above SWQC and Screening Levels (SLs) is relatively low for all SWMP Parameters. Aluminum and lead concentrations are skewed by historical conditions and elevated detection limits associated with older data from prior

to 2002. The concentrations of aluminum and lead are all either Not Detected (ND) or below the SWQC and SLs in the more recent surface water data (2003 through 2012) from over 40 samples obtained from Stations 1 through 9.

The parameters with the highest detection frequencies above SLs, *E. coli*, exhibit detection frequencies above SWQC of 12% ($3/25=0.12$). However, the samples size for *E. coli* is low (i.e., $n=25$ samples) compared to most of the other parameters, which include larger sample sizes (e.g., $n=209$). A detection frequency of 13% is noted for pH measurements below the lower SWQC pH range of 6.5-8.5 standard units (su). However, since 2012 pH measurements at all Stations have consistently been within the SWQC range for pH (6.5-8.5). The frequency of detection above SWQC or SLs for Fecal coliforms, ammonia nitrogen, phosphorus, specific conductivity, TKN and TSS are all less than 10%. TKN was detected at 21 mg/L in the October 2024 sample from Site 2. However, this is an outlier compared to the TKN data for both Site 2 and the entire SWMP data set. The TKN data otherwise are all well below the SL of 6 mg/L.

Based on the overview data summary presented above, most of the data are within SWQC and SLs with exceptions as noted above. However, the SWMP Data represent a 40-year period and surface water quality can change over time. For example, elevated detection frequencies for some of the SWMP Parameters may be caused by data from samples collected many years ago and that may not represent current or prevailing conditions at a particular Station. Therefore, further evaluation of the SWMP Data was performed to identify potential trends in water quality, to calculate 95UCLs for consideration as benchmarks for use in evaluation of future sample data, and to identify Stations that exhibit elevated parameter concentrations.

2.2 Overview of Statistical Analysis

Further detailed evaluation of the SWMP Data is included below with a focused discussion of the SWMP Parameters supported by statistical and comparative analysis, noted where applicable.

The statistical trend analysis employed hypothesis tests (Ordinary Least Squares regression or “OLS” parametric tests and Mann-Kendall or “M-K” non-parametric tests) for evidence of statistically significant increasing or decreasing long-term trends over the monitoring period (i.e., 1984-2024) for each SWMP parameter at each Station.

Ninety-five (95) percent upper confidence limits of the mean (“95%UCL” or “95UCL”) were calculated for each SWMP parameter at each Station. The 95UCLs are summarized in Section 2, below, and included in Appendix D).

Focused statistical analysis was also performed using OLS and M-K to test for potential correlation among some selected SWMP parameters (Alkalinity, pH, Fecal Coliforms, *E. coli*,).

Finally, parametric and non-parametric, two-sample hypothesis tests (Student t-Tests and Wilcoxon-Mann-Whitney or “WMW”) were completed to test for significant differences among groups of data from selected Stations and SWMP Parameters.

Descriptions of the specific statistical tests, results, and references to the attached documentation are provided below, where appropriate.

2.2.1 Time Series Trend Analysis

The long-term trend analysis performed for this report indicates that the water quality is generally stable with no statistical evidence of increasing or decreasing trends ($p > 0.05$) for most SWMP parameters at most Stations. Statistical evidence of decreasing trends ($p < 0.05$) was noted for the following Parameters and Stations:

Parameters with Statistical Evidence of Decreasing Long-Term Trends	Sample Station Nos.
Aluminum	2, 3, 4, 5, 7
Ammonia	1 through 7
Fecal Coliforms	4, 5, 7
Lead	1, 5, 7
Nitrate	1, 2
Nitrite	9
Orthophosphate	1, 2, 4, 5, 6, 7
Phosphorus	3, 4, 7
TSS	2, 3, 4, 6

Statistical evidence of increasing trends ($P < 0.05$) was identified for Alkalinity at Station 5 and Specific Conductivity at Stations 5 and 6. However, the maximum and average (aka “mean”) Alkalinity concentrations at Station 5 and 6 are all below the SL of 200 mg/L, and the trend slope is low (i.e., < 1). Similarly, relatively minimal increases in Specific Conductivity measurements (i.e., from roughly 100 to 200 umhos/cm) over 40 years are not a concern, especially given there is no SWQC for Specific Conductivity (note that 500 umhos/cm is a SL not a SWQC).

The trend graphs with statistical parameters and critical values (e.g., P-values) for all SWMP Parameters and Stations are included in Appendix D.

2.2.2 95UCLs

The 95UCLs represent well-established baseline conditions for comparative analysis due to the consistency, methods, and frequency employed over the long-term (i.e., 40 year) SWMP sampling period for most Stations. The 95UCLs may also have applicability for quantitative implementation of anti-degradation policies afforded C1 waters pursuant to the SWQS.

A summary of the range of 95UCLs calculated for the SWMP Parameters at each Station is provided as follows:

Summary 95UCLs Calculated from SWMP Data (1984-2024)

Parameter (units)	Sample Stations										SWQC/SL (1)
	1	2	3	4	5	6	7	8	9*	10*	
Alkalinity (mg/L)	20.8	14.8	25.4	22.4	35.5	31.9	137.1	77.3	149.3	N/A	200
Aluminum (mg/L)	0.14	0.14	0.15	0.18	0.27	0.09	0.16	N/A	0.16	N/A	0.38
Fecal Coliforms (col/100ml)	60	57	36	19	84	31	181	24	158	355	100
Lead (mg/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	N/A	0.005
Nitrogen, Ammonia (mg/L)	0.17	0.23	0.13	0.16	0.12	0.11	0.11	0.07	0.15	N/A	0.54
Nitrate (mg/L)	0.20	0.23	0.17	0.22	0.23	0.20	0.64	0.20	0.51	N/A	10
Nitrite (mg/L)	0.037	0.035	0.035	0.047	0.035	0.036	0.039	0.047	0.096	N/A	1
TKN (mg/L)	0.86	0.68**	0.80	0.52	0.78	0.72	0.85	1.03	0.57	N/A	6
pH (su)	6.9	6.8	7.2	7.1	7.2	7.3	8.0	7.8	8.0	N/A	6.5 - 8.5
Orthophosphate (mg/L)	0.04	0.04	0.03	0.04	0.03	0.03	0.04	0.04	0.05	N/A	0.1
Phosphorus (mg/L)	0.07	0.10	0.07	0.06	0.06	0.06	0.07	0.09	0.13	N/A	0.1
Specific Conductivity (umhos/cm)	118	131	134	132	201	168	456	245	554	N/A	500
TSS (mg/L)	6.6	4.0	2.8	4.3	9.4	3.4	6.6	16.9	15.9	N/A	25

Notes:

* 95UCL qualified due to low sample size (n<10).

** Calculated with outlier removed; see Report text for TKN.

N/A = not applicable; 95UCL not calculated due to low detection frequency.

ND = Not Detected above detection limit or SWQC; 95UCL not calculated due to low detection frequency.

(1) SWQC/SL = Most stringent Surface Water Quality Criteria or Screening Level developed for the SWMP.

Yellow highlighted values are above SWQCs or SLs.

Based on the 95UCLs listed above, the concentrations for most SWMP Parameters representing long-term water quality conditions for all Sampling Stations are well below the SWQC and SLs adopted for evaluation in this report. While this review is not intended to indicate strict compliance with SWQC or SLs, it does imply further surface water quality

evaluation may be warranted for Fecal coliforms⁹ and Specific Conductivity at selected Stations. However, the elevated 95UCL above the SL for Specific Conductivity downstream from Paulins Kill Lake (Station 9) is of less concern as there are no applicable SWQC (i.e., the value of 500 umhos/cm in the “SWQC/SL” column noted above is a SL; see discussion regarding SWQC and SLs) and there are no increasing trends for Specific Conductivity, as noted above.

Supporting data and documentation for the 95UCL calculations are included in Appendix D.

2.3 Detailed Review and Discussion of SWMP Parameters

SWMP Parameters that are chemically related are grouped together in the following sections to facilitate the evaluation narrative and aid the presentation.

2.3.1 Alkalinity and pH

Alkalinity

Alkalinity is a property of water that provides a measure of the buffering capacity for surface water to resist fluctuations in pH in an aquatic environment (i.e., resistance to changes in acidic or basic conditions). Therefore, Alkalinity and pH are discussed together.

The alkalinity concentrations measured in 209 surface water samples range from 5.5 to 190 mg/L with an average of 45 mg/L. The 95UCLs for alkalinity range from about 15 mg/L to 150 mg/L. The SWQS do not include SWQC for Alkalinity and all alkalinity concentrations are within the desired SL range of 20 mg/L to 200 mg/L listed above, the concentrations for most SWMP Parameters representing long-term water quality conditions for all Sampling Stations are well below the SWQC and SLs adopted for evaluation in this report. These concentrations are consistent with Stillwater’s limestone-dominated geography. Limestone contributes to naturally occurring alkalinity concentrations, which provides a buffering capacity that facilitates natural stability of pH in the range of 6.5 to 8.5 su around a neutral pH range of roughly 7 su.

While all alkalinity concentration is within the SL range, the alkalinity concentrations from the two Sample Stations located along Paulins Kill (Stations 7 and 9) are significantly

⁹ Future biological quality evaluation should focus on E.coli and not fecal coliforms for consistency with current USEPA and NJDEP water quality criteria.

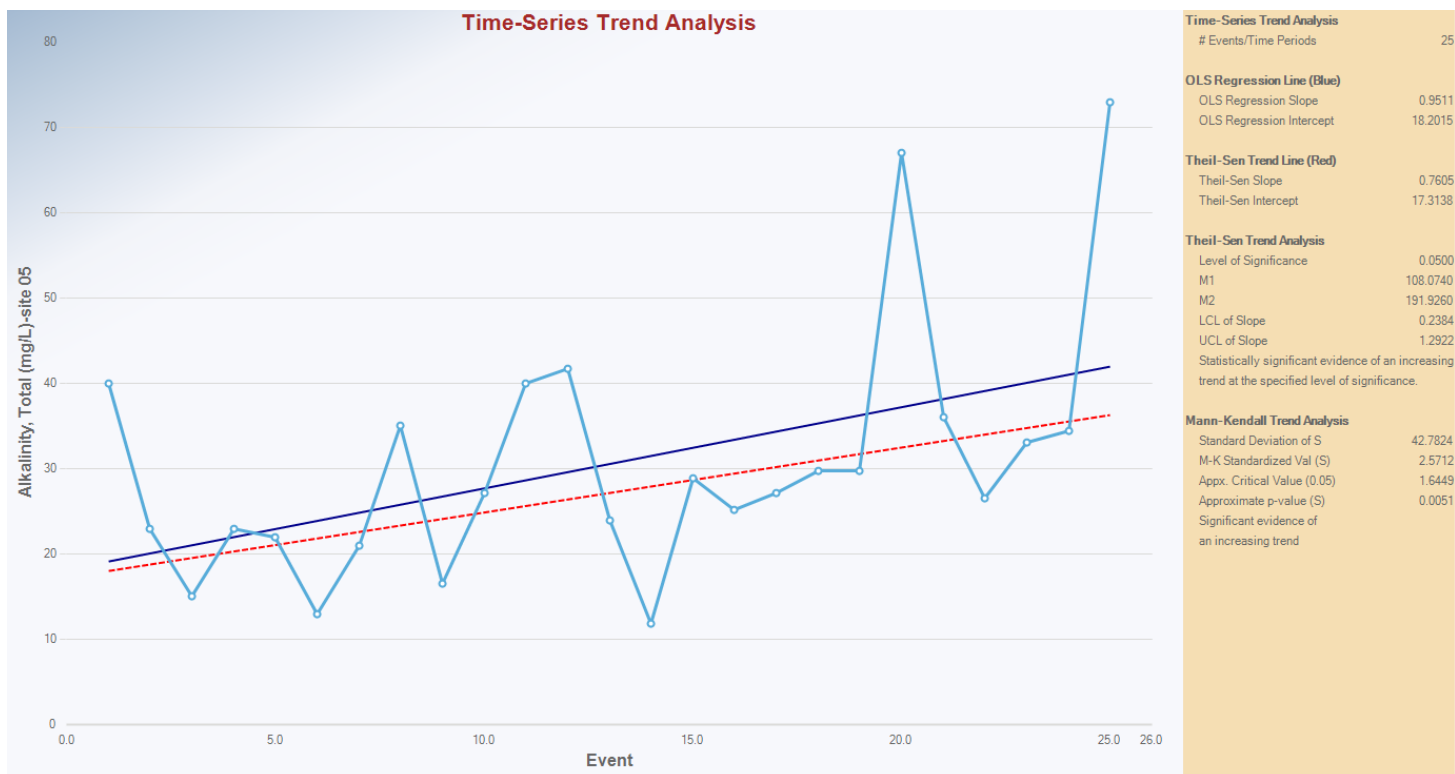
higher than the alkalinity concentrations at the other Tributary Stations (i.e., all SWMP Sample Stations other than 7 and 9).

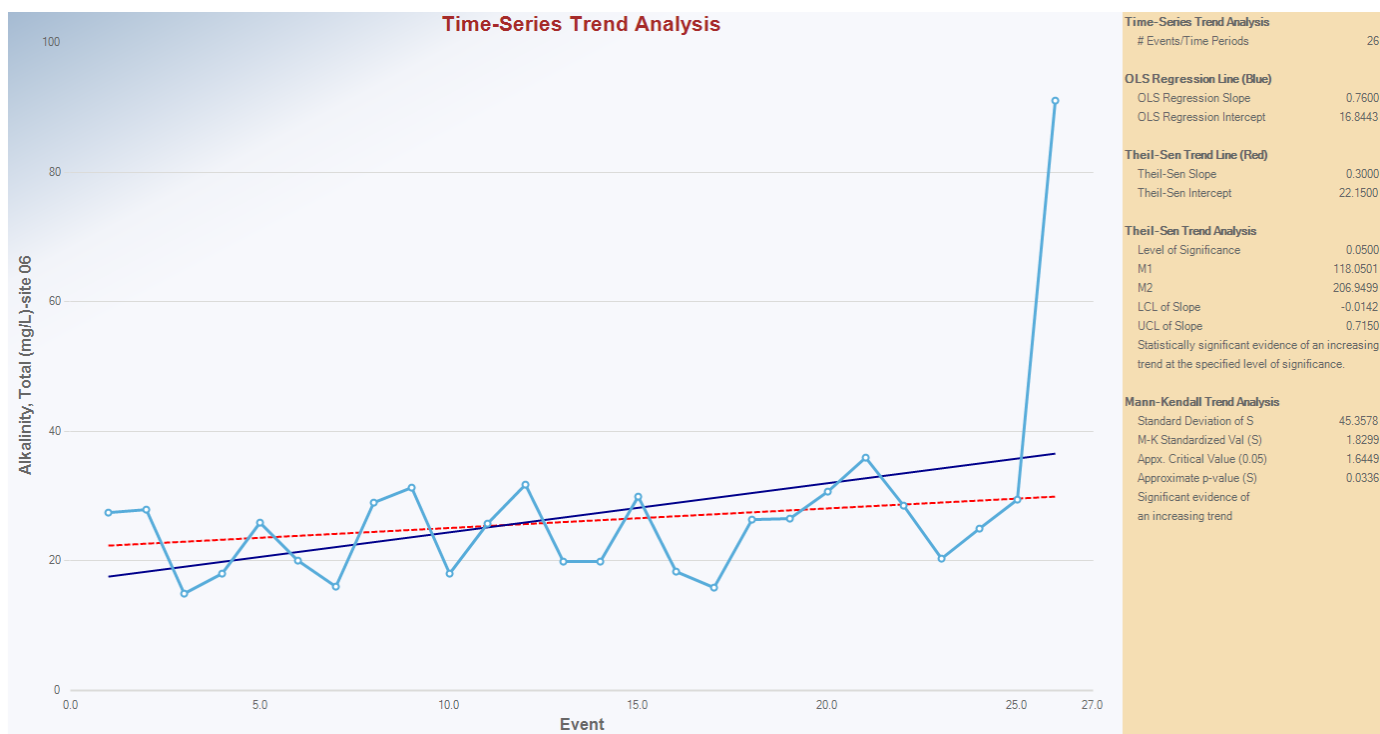
Summary Statistics for Alkalinity in Surface Water Stations on Paulins Kill vs. other Stations

	Paulins Kill Data Summary (Stations 7 and 9)					Data Summary (Stations 1-6, 8 and 10)				
Parameter (mg/l)	n (site)	Min. Conc.	Max. Conc.	Mean Conc.	SD	n (bkg)	Min. Conc.	Max. Conc.	Mean Conc.	SD
Alkalinity, Total	173	5.52	98	27.2	19.7	36	86.8	190	128	29.4

The differences in alkalinity concentrations from Stations along Paulins Kill and other Stations are statistically significant ($p < 0.05$), based on two sample hypothesis statistical tests (see Appendix E).

As noted above, statistical analysis of long-term trends indicates alkalinity concentrations are stable in surface water at Stations 1 through 9 (see Appendix D), with slightly increasing trends identified as statistically significant at Station 5 and at Station 6 ($P < 0.05$).





The alkalinity concentrations from the October 2024 sampling event are elevated compared to the historical alkalinity concentrations for all Stations. In some cases, the alkalinity concentration in the samples from October 2024 appear anomalously high (e.g., see trend graph above for Station 06 showing alkalinity in the most recent sample at more than double the highest historical alkalinity concentration.) While the cause is not certain, the generally higher alkalinity concentrations may be related to the severe drought conditions that existed at the time of the October 2024 sampling. Under the drought conditions, essentially 100% of the surface water is made up of groundwater, which would be expected to exhibit higher alkalinity based on the local geology (i.e., limestone parent material). Notwithstanding, even the highest alkalinity concentrations are within the acceptable SLs.

pH

The laboratory pH measurements are generally within the SWQC range of 6.5-8.5 su, with some limited exceptions. During the period from 1988 to 2012, pH was measured below 6.5 (between 5.9 and 6.5) in 27 samples from Stations 1 through 6. However, since 2012, pH measurements have all been within the SWQC range of 6.5-8.5.

The samples collected during the October 2024 sampling event were analyzed by the laboratory for pH and temperature, in addition to the other SWMP Parameters. However, pH and temperature measurements are time sensitive. Therefore, as noted above, pH and temperature measurements were also obtained in the field with a portable meter

during the October 2024 sampling event to address data quality concerns related to the time delay for the measurement of these parameters by the laboratory and potential to impact current and existing (past) data. The field and laboratory pH and temperature measurements for the samples collected in October 2024 are presented below.

**Lab vs. Field Measured pH in Surface Water
Stations 1 through 10
Sampled October 2024**

Station No.	pH (su)		Temperature (Degrees C)	
	Laboratory Report	Field Measured	Laboratory Report	Field Measured
1	7.2	6.54	21.9	10.2
2	6.8	6.93	22.2	8.2
3	6.8	7.93	22.3	9.8
4	6.6	7.43	22.3	9.7
5	7.0	7.38	21.7	8.4
6	7.4	7.86	21.7	8.6
7	7.6	8.45	22.2	10.8
8	7.3	7.55	21.7	10.4
9	7.8	8.44	21.7	14.5
10	7.1	8.07	22.5	9.3

Although the correlation is poor, the pH data are all within the SWQC range (6.5-8.5) for regardless of whether the measurements were performed on site in the field or later in the laboratory. However, the field-measured results are considered more accurate as they were obtained within 15-minutes of sample collection, pursuant to NJDEP requirements, and changes to pH may occur over a period of hours to days. Thus, the differences in the above pH field vs. laboratory data may be attributable to the delay in the time of measurement by the laboratory.

Regarding the temperature measurements, while modern pH meters typically correct pH measurements for temperature (i.e., pH data are not impacted by the differences in temperature), the difference in the temperature measurements noted above is significant. The laboratory reporting of sample temperature is reflective of the room temperature in the lab, which is irrelevant for the SWMP data evaluation. In contrast, the field temperatures are much lower than the lab-reported temperatures measured for all Stations on October 16, 2024. Further discussion of the impact of pH and temperature is addressed below for ammonia nitrogen.

Notwithstanding, pH data quality issues noted later in this report related to the timing from sample collection to sample pH measurement, the pH data obtained during the SWMP are considered reasonably accurate for screening against SWQC and conducting trend analysis.

Alkalinity concentrations exhibit a weak positive correlation with pH in surface water at several Stations based on statistical OLS trend analysis (see Appendix E).

2.3.2 Aluminum and Lead

The SWMP included periodic sampling and analysis for aluminum and lead from Stations 1 through 8 for the period 1984 through 2012. Aluminum is a common element in the earth's crust and is typically found at relatively high percentage levels in local earthen material (e.g., native rock, mineral soil, and clay). Lead is less common and not naturally abundant, with lower natural concentrations in soil. Thus, while aluminum at low concentrations may be expected, the presence of lead in surface water samples is less likely to be linked to natural background conditions.

The aluminum concentrations measured in 134 surface water samples range from not detected (ND) to 0.9 mg/L with an average of about 0.14 mg/L. The 95UCLs for aluminum range from about 0.09 mg/L to 0.27 mg/L. The SWQS do not include SWQC for aluminum and all aluminum concentrations are below the SL of 0.38 mg/L. As noted above, the aluminum concentrations exhibit statistically significant decreasing trends at several Stations for data collected through 2012, and aluminum concentrations in samples obtained after 2003 are much lower than from the pre-2003 sampling.

The lead concentrations measured in 145 surface water samples range from not detected (ND) to 0.09 mg/L with an average of about 0.016 mg/L. The 95UCLs for lead calculated using all the SWMP lead data range from about 0.004 mg/L to 0.023 mg/L. However, the lead data from samples collected after 2002 from Stations 1 through 9 are mostly not detected (ND), with detectable lead concentrations of 0.002 mg/L (below the most stringent SWQC of 0.005 mg/L) in only 2 of 43 samples. Thus, 95UCLs were not calculated using the more representative lead data (i.e., from post-2002), as these data do not meet UCL test assumptions due to the high incidence of non-detectable analytical results for lead during that period.

Based on this review, the historical aluminum and lead concentrations do not warrant further evaluation given the more recent data are all below applicable SWQC.

2.3.3 Fecal Coliforms and E. coli

Although not directly applicable, the SWMP Fecal coliforms and E. coli data were combined and compared to the SWQC for E. coli to provide a general understanding of the water quality among the various Stations over time.

Fecal coliforms were included as a test parameter for the entire SWMP, while analysis for E. coli was only recently added on a limited basis in 2015 through 2024. Therefore, the ability to use statistics or make comparisons to SWQC for E. coli is limited given the small number of samples. In addition, due to the NJDEP's past revisions to the SWQS, the Bacterial quality SWQC specifies E. coli as the test parameter for freshwater regimes, like those in Stillwater (i.e., all FW2 waters), and Fecal coliform as a test parameter only for saline waters (e.g., ocean water).

The SWMP Data are not strictly comparable to the Bacterial quality SWQC because:

1. the SWQC requires a statistically robust data set to establish 90-day geometric mean and Statistical Threshold Values (STV) (see Appendix B), and
2. the SWQC for E. coli only apply to fresh waters designated for Primary Contact Recreation (see definition in Section 1). (Note that while "Primary Contact Recreation" is a designated use for all Class FW2 water, the human exposure scenarios assumed do not comport with realistic use/exposure scenarios for many of the Stations due to the physical conditions [e.g., small stream size, accessibility, etc.]).

Therefore, for this review, the SWQC for E. coli are adopted as SLs. However, to address the dearth of E. coli results due to the small number of samples analyzed (i.e., n=25) and lack of historical data, correlation and statistical hypothesis tests were completed using the coincident E. coli and Fecal coliform SWMP Data to confirm the use of the Fecal coliform data as a surrogate for evaluating the Bacterial Quality for this review.

The summary statistics for the two sets of paired coincident data are provided below.

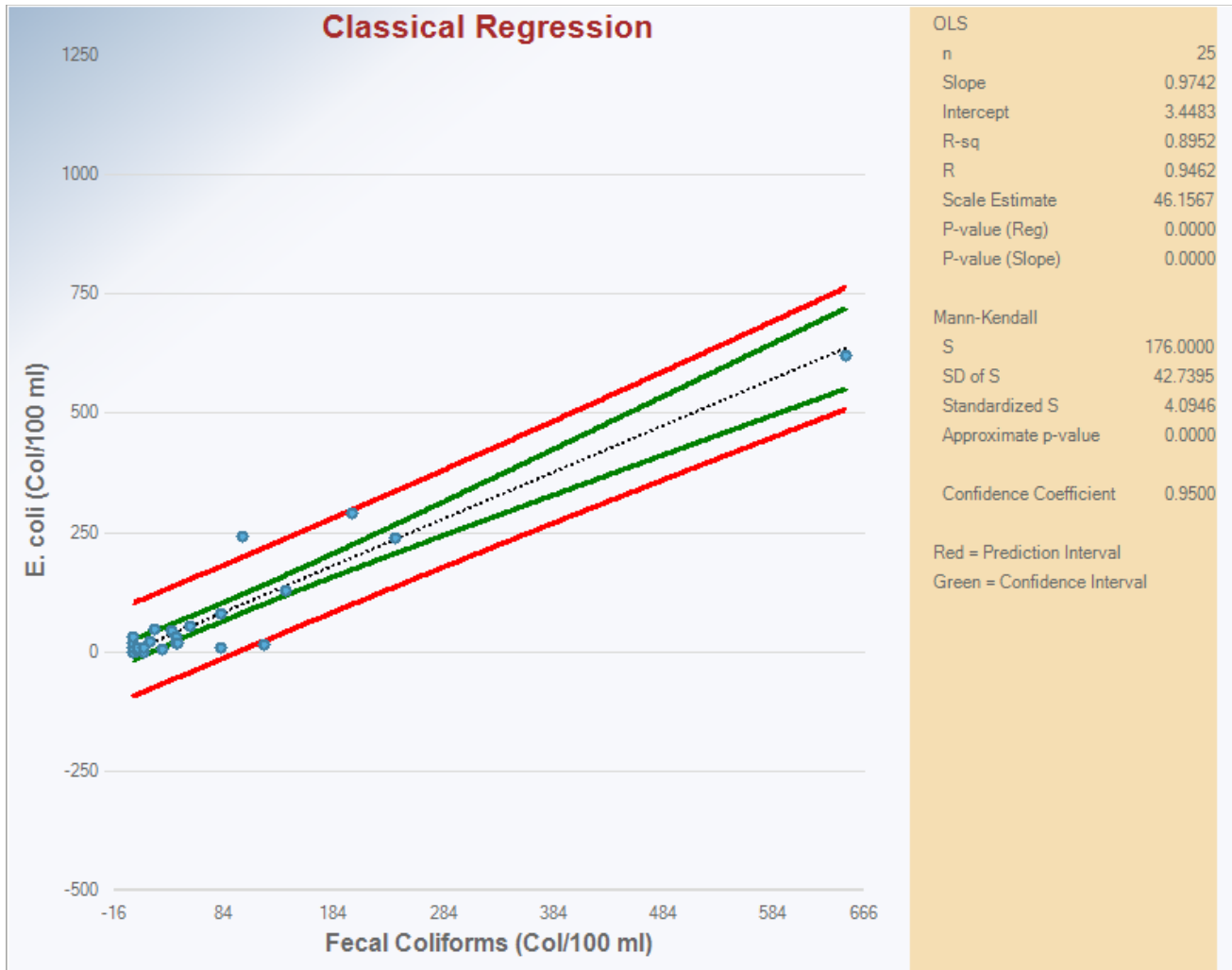
Summary Statistics - *E.coli* and Fecal coliform Coincident Data

	Site Data Summary					Frequency
Parameter (col/100ml)	n (samples)	Min. Conc.	Max. Conc.	Mean Conc.	SD	# Detected
<i>E. coli</i>	25	0	620	78	140	22
Fecal Coliform	25	0	650	77	136	20

Notes:

Coincident data represent paired analytical results from Stations 1-10 in 2015, and Station 10 from 2016, 2018, 2020, 2022 and 2024.

As listed above, the summary statistics of the paired coincident maximum, mean, standard deviation and detection frequencies for *E. coli* and Fecal coliform are very similar. The statistical analysis shows a significant positive correlation exists between the *E. coli* and Fecal coliform paired data ($R^2=0.895$; $P<0.05$) and the two data sets are not statistically different (WMW test; $P=0.89$) (Appendix E).



These findings are consistent with the US Environmental Protection Agency's (USEPA's) adoption of *E. coli* as an indicator of fecal coliform contamination (Appendix B). However, for this report, the most stringent SWQCs for *E. coli* (i.e., 100 col/100ml) is used as SLs in this report for evaluation of the larger Fecal coliform data set, without performing geometric mean and STV analysis due to the limited number of samples required for such analysis.

The *E. coli* concentrations in 25 surface water samples range from not detected (ND) to 620 col/100 ml, with an average of about 78 col/100 ml. The detection frequencies of *E. coli* above the SLs of 100 col/100ml is 12% (3/25=0.12). The *E. coli* sample size is too small for trend analysis and calculation of 95UCLs at each Station. However, these calculations were completed for Fecal coliform data, as noted above.

The Fecal coliform concentrations measured in 207 surface water samples range from not detected (ND) to 900 col/100ml, with an average of about 51 col/100ml. The 95UCLs for Fecal coliform range from 19 to 355 col/100ml. As noted per the 95UCL evaluation above, Fecal coliform 95UCLs are above the SL of 100 col/100ml at Stations 7, 9, and 10. Fecal coliform 95UCLs are below the SL of 100 col/100ml at all other Stations.

The trend analysis shows Fecal coliform concentrations exhibit statistically significant decreasing trends at Stations 4, 5, and 7, and are otherwise stable at the other Stations.

Based on this review, future monitoring for Fecal coliforms is not warranted due to the adoption of *E. coli* as the SWQS Bacterial quality indicator parameter for freshwater regimes. In addition, any future monitoring for Bacterial quality should include establishing appropriate Data Quality Objectives (DQOs) and updating sampling and analysis methods accordingly. Particular attention should be given to whether Stations and/or other locations comport with scenarios assumed for the SWQC (e.g., Primary Contact Recreation [see definition in Section 1]) to promote including realistic conceptual models and use/exposure scenarios that align with actual use and physical conditions (e.g., small stream size, accessibility, etc.).

2.3.4 Nitrogen Compounds

Nitrogen is a nutrient that is present in surface water and occurs naturally in several forms. Common analyses for nitrogen in surface water include ammonia (aka “Ammonia Nitrogen” or “Nitrogen, ammonia”), nitrate, nitrite, and Total Kjeldahl Nitrogen (TKN), which measures both organic and inorganic nitrogen including nitrate, nitrite, and ammonia nitrogen. The overview evaluation above indicates nitrogen compounds are below the SWQC and SLs except for ammonia. Therefore, the following discussion is focused on ammonia with a summary discussion of TKN as a measure of total nitrogen.

Ammonia Nitrogen

Ammonia or ammonia nitrogen is a form of nitrogen measured and reported as total ammonia nitrogen (aka TAN). The SWQS require the calculation of Site-specific SWQC for ammonia in freshwater bodies using sample pH and temperature. The ammonia nitrogen data are not strictly applicable for determining compliance with SWQC because sample pH and temperature measurements were not obtained immediately at the time of sampling (see Data Quality and Usability section, below). In addition, samples and related pH and temperature data were not obtained in the warmest weather conditions. Based on the formulae used for establishing ammonia SWQC, the ammonia SWQC decreases (i.e.,

becomes more stringent) as pH and/or temperature increase. Thus, the most stringent ammonia SWQC occur at the highest pH and temperatures.

Acute and chronic ammonia SLs of 2.4 mg/L and 0.54 mg/L, respectively, were developed for this report as conservative screening levels using field pH and temperature measurements obtained in October 2024, as noted above. The recent pH and temperature measurements from October 2024 serve as surrogates for the prior pH and temperature data used in SWQS equations to calculate SWQC for ammonia (see Appendix B).

The SWMP Data Ammonia Nitrogen concentrations range from not detected (ND) to 0.9 mg/L with an average of about 0.1 mg/L. Ammonia Nitrogen concentrations are all below the acute SWQC of 2.4 mg/L and only exceeded the chronic SWQC of 0.54 mg/L in 4 of 201 samples representing a detection frequency above the SWQC of 2%. Three of the 4 exceedances occurred in 1985 or earlier, and one in 2024 at Station 10 at 0.57 mg/L. Ammonia Nitrogen concentrations at Stations 1 through 7 exhibit statistically significant decreasing trends ($p < 0.05$).

Total Kjeldahl Nitrogen (TKN)

As noted above, TKN represents the combined forms of inorganic and organic nitrogen combined. From the overview of SWMP Data in Section 2 above, concentrations of the inorganic components of TKN (i.e., nitrate and nitrite) in surface water samples are well below their respective SWQC and SLs of 10 mg/L and 1 mg/L, respectively. Based on the trend analysis noted above, concentrations of nitrate and nitrite are mostly stable at all Stations, other than statistically significant decreasing nitrate concentrations observed over time at Stations 1 and 2.

The TKN concentrations measured in 200 surface water samples range from not detected (ND) to 21 mg/L with an average of about 0.64 mg/L. However, as noted previously, TKN was detected at 21 mg/L in the October 2024 sample from Site 2, which is more than an order of magnitude above the highest TKN concentration previously reported for Site 2 (i.e., 1.55 mg/L). The laboratory report indicates the sample required dilution to complete the TKN analysis for Site 2 only, and no other samples required such dilution. The TKN value of 21 mg/L is an outlier due to the need for dilution by the laboratory and based on comparison to the historical TKN concentrations for both Site 2 and the entire SWMP data set. Removing the 21 mg/L value from the data as an outlier is warranted since it is not representative of the water quality at Site 2 based on the robust historical data set. The TKN data otherwise are all well below the SL of 6 mg/L. The 95UCLs for TKN range from about 0.52 mg/L to 1.03 mg/L. The SWQS do not include SWQC for TKN and, absent the

one noted outlier, all TKN concentrations are below the SL of 6 mg/L. Long-term trend analysis indicates the TKN concentrations are stable and do not exhibit statistically significant trends.

2.3.5 *Orthophosphate and Phosphorus*

Phosphorus is a naturally occurring element in rock and soil that is an important food chain nutrient and a limiting nutrient in surface water that can cause eutrophication at high concentrations.

The SWMP Parameters include analysis of Total Phosphorus and Orthophosphate. Total Phosphorus, reported as “Phosphorus”, includes all forms of phosphorus including organic phosphorus and inorganic phosphorus, such as Orthophosphate, which is an inorganic, available form of phosphate. Although the SWQS include a SWQC for Phosphorus and not for Orthophosphate, theoretically, the latter is captured by the analysis of Phosphorus. This relationship is demonstrated with statistical correlation and hypothesis tests comparing all the SWMP Phosphorus and Orthophosphate concentrations for Stations 1 through 9 (Station 10 excluded due to small sample size). The concentrations of Orthophosphate from all Stations 1 through 9 are generally lower than the Phosphorus concentrations, but differences are not statistically significant (WMW test; $P > 0.05$). Also, Phosphorus and Orthophosphate concentrations from all 9 Stations exhibit a statistically significant correlation (OLS regression; $p < 0.05$), as shown below in the example regression graph for Site 1 (see Appendix E).



Phosphorus concentrations in the SWMP Data range from not detected (ND) to 0.54 mg/L with an average of about 0.05 mg/L. Phosphorus only exceeded the SWQC of 0.1 mg/L in 13 of 200 samples representing a detection frequency above the SWQC of 6.5%. However, this frequency may be artificially inflated since 10 of the 16 “exceedances” appear to be entered as reporting limits and not actual detected concentrations, as the same exact value is entered for Phosphorus for all Stations in 2020. Thus, the number of exceedances is likely much lower. The remaining 6 exceedances were reported for sampling dates in 2003 and earlier, and other than the 2020 data, all Phosphorus concentrations after 2003 are below the SWQC of 0.1 mg/L. The 95UCLs for Phosphorus range from about 0.06 mg/L to 0.13 mg/L. However, the latter 95UCL is likely exaggerated due to the apparent use of the reporting limit for 2020 data as noted above.

There are no SWQC for orthophosphate; a SL of 0.1 mg/L consistent with the SWQC for phosphorus was adopted for this evaluation. Orthophosphate concentrations range from not detected (ND) to 0.1 mg/L with an average of about 0.03 mg/L, below the SL of 0.1 mg/L. The 95UCLs for Orthophosphate range from about 0.03 mg/L to 0.05 mg/L. Based on the results of this review and the statistical analysis noted above, the Orthophosphate data corroborates the findings above regarding the relatively low frequency of exceedances.

Phosphate and/or Orthophosphate concentrations at Stations 1, 2, 3, 4, 7 exhibit statistically significant decreasing trends ($p < 0.05$), and otherwise phosphate and orthophosphate exhibit stable concentrations at most other Stations.

2.3.6 Specific Conductivity and Total Dissolved Solids (TDS)

Specific Conductivity is the measure of electrical current that will pass through water, which increases with the kinds and amounts of dissolved substances in water. Thus, Specific Conductivity is a function of the TDS in water and these parameters are commonly linked together.

Specific Conductivity was detected in all 209 SWMP Samples ranging from 63.4 to 642 umhos/cm with an average of 196 umhos/cm. Six samples exhibit Specific Conductivity above the SL of 500 umhos/cm, all of which were obtained from Stations 7 and 9 on Paulins Kill. The 95UCLs for Specific Conductivity range from about 118 to 554 umhos/cm. There is no SWQC for Specific Conductivity and the frequency of detection above the SL (6/209) is about 3%. Evidence of statistically significant increasing trends was identified for Specific Conductivity at Stations 5 and 6 ($p < 0.05$). However, the Specific Conductivity measurements at these two Stations are well below the SL.

TDS was only analyzed for 9 samples obtained from Sites 1 through 9 in 2022, and for 10 samples from Sites 1 through 10 in 2024 (total $n = 19$). The TDS concentrations range from approximately 48 ppm to 360 ppm with an average of 137. The SWQC for TDS require establishing background and comparison to results of whole effluent toxicity test data, which are not available and are beyond the scope of this report. In addition, further evaluation of TDS may not be warranted due to the generally low concentrations of TDS. Due to the limited number of SWMP sample events (i.e., two events in 2022 and 2024), TDS data are too few and too recent for evaluation of a long-term baseline concentration for TDS for each Station.

TDS can be roughly estimated from Specific Conductivity using the equation:

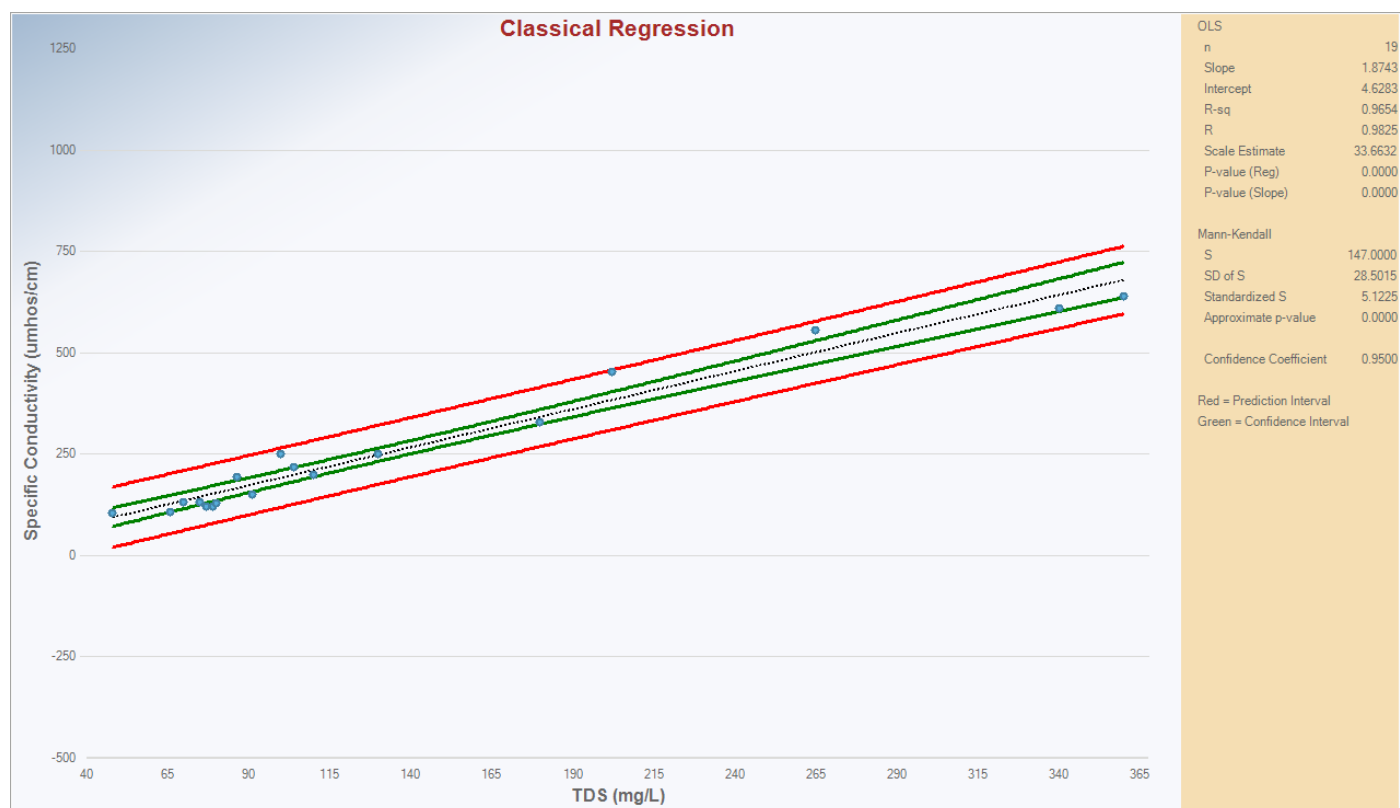
$$\text{Specific Conductivity} \times 0.65 = \text{TDS}_{\text{sc}}$$

Where,

- Specific Conductivity is in (umohs/cm; aka uS/cm)
- TDS_{sc} is in mg/L

Paired Specific conductivity and TDS data from the 2022 and 2024 sampling events were further evaluated using statistical analysis for evidence of correlation and the potential to estimate historical TDS concentrations from Specific Conductivity data. Using the above

equation, the Specific Conductivity data from 2022 and 2024 were converted to TDS (TDSsc) and compared to the coincident TDS data from 2022 and 2024. The results of the statistical analysis indicate a statistically significant correlation between the Specific Conductivity data and TDS data ($R^2 = 0.97$; $p < 0.05$), and TDS data are not statistically different from the data converted from Specific Conductivity results (TDSsc) (hypothesis t-test; $P = 0.3$) (Appendix E).



2.3.7 Total Suspended Solids (TSS)

TSS concentrations range from not detected (ND) to 65 mg/L, with an average TSS concentration of 4.2. TSS was detected above the lower SWQCs of 25 mg/L in four of 201 samples (2%), 3 of which were also above the upper SWQC of 40 mg/L (1.5%). The 95UCLs for TSS range from about 2.8 to 16.9 mg/L, below the more stringent SWQC of 25 mg/L. All samples with elevated TSS concentrations were obtained from Stations 1, 5, and 8 during 1993 through 2012, and TSS concentrations after 2012 are within the SWQC. TSS concentrations at Stations 2, 3, 4 and 6 exhibit statistically significant decreasing trends ($p < 0.05$), and otherwise concentrations are stable.

3.0 Laboratory Data Usability and Limitations

There are several data quality issues that should be noted as they potentially impact data usability, especially for comparison to the SWQC and screening levels.

The SWMP did not include a quality assurance project plan (QAPP) and Data Quality Objectives (DQO's) were not defined. Based on the data quality issues described below there is some uncertainty regarding accuracy associated with the SWMP Data. Therefore, use of the SWMP for determining strict compliance with SWQC is not appropriate. However, comparison of the SWMP Data to the SWCS as a screening tool, rather than for determining compliance with SWQC, is informative. The general consistency of the sampling frequencies, methods, and Stations over such a long time (i.e., 40 years) promotes good precision and relative long-term reliability for most parameters. Reasonable uses of the SWMP data include, but are not limited to, statistical analysis, trend analysis, establishing long-term baseline averages, projections, and informing future studies and sampling programs, and comparison to other data sets collected by others (e.g., NJDEP, local and regional lake associations, etc.).

The stream flow conditions were not recorded and are not available for the SWMP Sample dates, which limits the ability to confirm consistency with SWQS and SWQC that require consideration of stream flow rate for use (e.g., statistical low-flow conditions).

Pursuant to the NJDEP regulations (NJAC7:18), temperature and pH are “analyze-immediately” parameters, meaning they should be measured in the field at the sampling site within 15 minutes of sample collection. However, the SWMP Sample temperature and pH were measured at the laboratory up to several days after sample collection. For example, the laboratory analysis report for the SWMP Samples collected in 2022 indicates temperature and pH were measured 5 to 6 days after sample collection. Thus, the reported temperature values likely represent laboratory room temperature and not the actual surface water in-stream conditions at the time of sampling and are qualified as not usable. Temperature data were not included in this report. The pH data are included and, while qualified due to the lag-time from sample collection to time of measurement, pH data are acceptable for screening level evaluation. Significant pH changes in Samples maintained by the laboratory are not likely, especially for clean water samples and due to the buffering capacity of natural water against shifts in pH (i.e., alkalinity). Therefore, the pH data are deemed usable for qualified data quality objectives as screening data.

As noted earlier in this report, the SWQS require calculation of Site-specific SWQC for ammonia in freshwater bodies using sample pH and temperature. The ammonia nitrogen data are not strictly useable for determining compliance with SWQC because sample pH

and temperature measurements were not obtained by a NJ certified laboratory immediately at the time of sampling. However, as noted in the discussion of the ammonia data earlier in this report, ammonia SW SLs were estimated using pH and temperature values measured in the field during the October 16, 2024 sampling event as a conservative surrogate to represent reasonable worst case conditions regarding the evaluation of ammonia concentrations for this review.

The SWMP lead data are not strictly comparable to the aquatic life protection criteria (i.e., acute and chronic SWQC) because they represent total recoverable lead concentrations, and the SWMP Samples were not analyzed for dissolved lead. The SWQC for lead include aquatic life protection criteria (acute at 0.038 mg/L and chronic at 0.0054 mg/L) that are comparable to dissolved lead concentrations, and human health criteria are comparable to total recoverable lead concentrations. Further, simple comparison of the SWMP lead data to the human health SWQC for lead is not appropriate due to the consideration of human exposure scenarios assumed in the development of the SWQC (e.g., Primary Contact Recreation [see definition in Section 1]), which may not comport with realistic use/exposure scenarios for many of the Stations due to the physical conditions (e.g., small stream size, accessibility, etc.). Therefore, comparison of the lead data from the SWMP to the acute and chronic SWQC is very conservative.

4.0 Comparison of SWMP Data with Other Data Sources

During the preparation of this report, other sources of biological and chemical data were identified outside the SWMP Data. Most notably, the NJDEP's Water Quality Data Exchange (WQDE) includes chemistry data from surface water sampling conducted within Stillwater at several locations nearly co-located with some of the SWMP Stations and for some of the same parameters. The WQDE data represent only a few samples collected during the period from 2012 to 2018. The WQDE data are sparse and do not represent a robust data set, i.e., there are too few data to perform statistical analysis. Although a detailed comparison is beyond the scope of this report, the values reported in the WQDE for water chemistry parameters are consistent with the SWMP data (NJGeoWeb – see Appendix F).

Another source of water quality information is NJDEP's NJ Integrated Water Quality Assessment Report 2022 and related NJGeoWeb database:

<https://dep.nj.gov/wms/bears/integrated-wq-assessment-report-2022/#surface-water-quality-standards>

Other sources of data may be available from various NGOs and lake associations that are potential sources of additional water quality data for Stillwater and the vicinity.

5.0 Conclusions and Recommendations

5.1 Conclusions

Most of the surface water bodies in the Township are classified as Category 1 (C1) waters and many are identified as either FW2 Trout Maintenance (TM) or Trout Production (TP) in the SWQS. Thus, in addition to having to meet numerical criteria for FW2 waters, the C1 designation ascribes more stringent requirements including application of anti-degradation and “no measurable change” policies of the SWQS.

While some large areas are used for agriculture, there are no major industrial sites and very few NJDEP Known Contaminated Sites or contaminated areas, with none identified in the immediate vicinity of the SWMP Sample Stations, as indicated by NJGeoWeb map information. Demographic and land use NJGeoWeb mapping also indicate a relatively low population density and low amount of development over large portions of the Township. These conditions generally facilitate good water quality.

The large number of samples and consistency in collection frequency and quality (i.e., analysis performed by NJDEP Certified Laboratories) support robust statistical analysis of the SWMP Data.

The analytical data collected from the SWMP indicate the overall water quality is good among the 10 Sample Stations, and the SWMP data appear to generally comport with data from the NJDEP WQDE for similar parameters at 3 locations. However, *E. coli* represents a potential concern at limited Stations, which may be considered for future evaluation.

5.2 Recommendations

The following recommendations are provided based on the review of the SWMP analytical data above in the prior sections of this report.

Preliminary recommendations:

- Revisions to SWMP Data Quality and Analytical Methods
 - Update Analytical Parameters and Methods
 - Establish Data Quality Objectives (DQOs), Data Use and Reporting
 - Use of Field Meters for Analyze-Immediately Parameters
 - Standardize Data Documentation and Curation

- Review of SWMP Objectives
 - Consider Establishing C1 Benchmarks for future data comparative analysis
 - Compare SWMP Data with other data sources (e.g., NJDEP Data, NGO Data)
 - Collaborate with adjacent and nexus communities and NGOs
 - Revise Sample Collection Frequency
 - Consider Focused Short-term Investigations
 - Evaluate Seasonal Variability
 - Consider Additional Parameters

Other considerations for future study:

- Surface water salinity survey in waterways downstream and adjacent to roadways treated with salt during winter months.
- Survey for the presence/absence of herbicides/pesticides in waterways downstream and adjacent to agricultural land.
- To promote data usability and to avoid the potential for rejection of data due to poor data quality, any future sampling should incorporate field analysis for analyze-immediately parameters (DO, pH, temperature) using properly calibrated instruments in accordance with substantive requirements of the NJDEP Certified Laboratory regulations (NJAC 7:18).
- Lakes water quality survey.
- Mapping locations along surface waterways with risk of Septic system discharges.
- Design and implement periodic SWMP to evaluate/document conformance with SWQS goals and objectives. For example, five-year updates to compare against established baseline water quality, Repeat rapid bio-assessment study.
- Toxic Algal Blooms evaluation.
- Survey of high-risk areas for Stormwater runoff impacts.
- Citizens Science and Environmental education initiatives to raise awareness about local watersheds, land use, and water quality.

6.0 References

Environmental Resource Inventory Update 2014 for Township of Stillwater, County of Sussex (NJ) (Draft). Prepared by The Land Conservancy of New Jersey for Township of Stillwater Environmental Commission. Draft March 27, 2014.

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FIGURE 1
Site Location Map
Surface Water Monitoring Stations (1984 - 2024)
Water Quality Monitoring Program - Stillwater Township, New Jersey

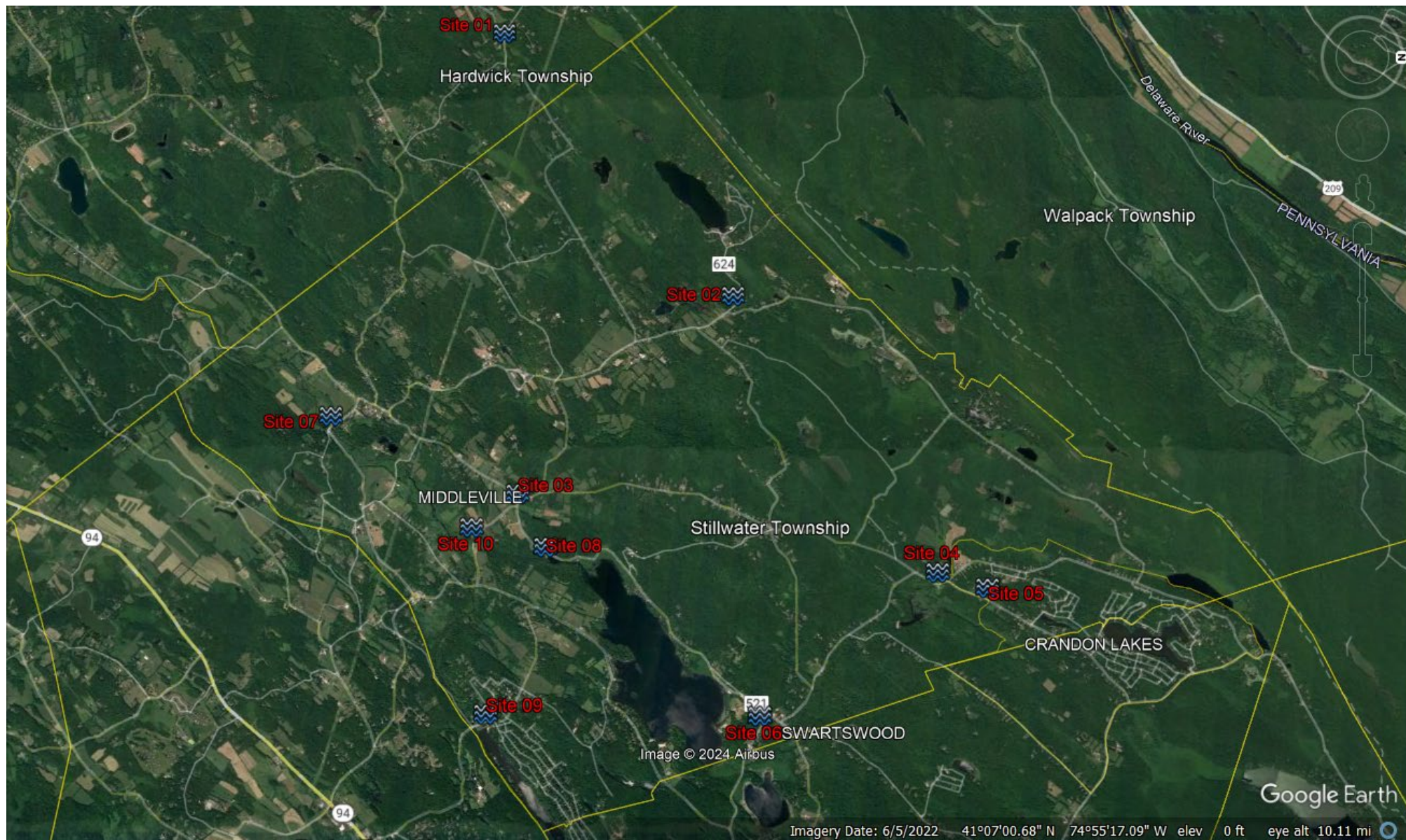


Table 1
General Chemistry Parameters in Surface Water (1984-2024)
Surface Water Monitoring Program - Stillwater, NJ
Site 01 - Blair Creek

Sample No.:		Site 01	Site 01	Site 01	Site 01	Site 01	Site 01
Date Sampled:		10/1/1984	10/1/1985	10/1/1986	10/1/1987	10/1/1988	10/1/1989
Parameter	CAS No.	Units					
Alkalinity, Total	SRP48	mg/l	17.5	21	23	18	10
Aluminum	7429-90-5	mg/l	0.029	0.063	0.088	0.5	0.01
E. coli	68583-22-2	col/100ml	NA	NA	NA	NA	NA
Fecal Coliforms	SRP151	col/100ml	80	NA	30	36	70
Lead	7439-92-1	mg/l	0.003	0.006	0.009	0.004	0.004
Nitrogen, Ammonia	7664-41-7	mg/l	0.24	0.8	0.1	0.1	0.2
Nitrogen, Nitrate	14797-55-8	mg/l	0.016	0.07	0.14	0.1	0.2
Nitrogen, Nitrite	14797-65-0	mg/l	0.01	0.02	0.02	0.01	0.02
Nitrogen, Total Kjeldahl (TKN)	SRP167	mg/l	0.264	0.9	0.1	0.1	NA
pH	SRP6	su	6.83	6.35	7.05	6.89	6.75
Phosphate, Ortho	14265-44-2	mg/l	0.065	0.03	0.03	0.03	0.05
Phosphorous	7723-14-0	mg/l	0.065	0.03	0.03	0.03	0.05
Specific Conductivity	SRP54	umhos/cm	140	110	125	90	67
Temperature	SRP38	deg c	NA	NA	NA	NA	NA
Total Dissolved Solids	SRP31	mg/l	NA	NA	NA	NA	NA
Total Suspended Solids	SRP32	mg/l	0.3	1.7	1	0.7	2

NA = Not Analyzed

ND = Not Detected

H = Sample was analyzed outside of hold time.

J = Estimated value below sample reporting limit

MDL = Method Detection Limit

U = Compound not detected above MDL

Sample dates are approximate.

Table 1
General Chemistry Parameters in Surface Water (1984-2024)
Surface Water Monitoring Program - Stillwater, NJ
Site 01 - Blair Creek

Sample No.: Date Sampled:		Site 01 10/1/1990	Site 01 10/1/1993	Site 01 10/1/1996	Site 01 10/1/1997	Site 01 10/1/1998	Site 01 10/1/2001
Parameter	CAS No.	Units					
Alkalinity, Total	SRP48	mg/l	18	34	14.4	12.5	33.8
Aluminum	7429-90-5	mg/l	0.1	NA	0.05	0.25	0.183
E. coli	68583-22-2	col/100ml	NA	NA	NA	NA	NA
Fecal Coliforms	SRP151	col/100ml	20	32	37	56	70
Lead	7439-92-1	mg/l	0.004	0.05	0.05	0.008	0.005
Nitrogen, Ammonia	7664-41-7	mg/l	0.2	0.2	0.05	0.05	0.1
Nitrogen, Nitrate	14797-55-8	mg/l	0.5	0.5	0.046	0.052	0.5
Nitrogen, Nitrite	14797-65-0	mg/l	0.05	0.05	0.01	0.01	0.2
Nitrogen, Total Kjeldahl (TKN)	SRP167	mg/l	0.5	0.88	1.07	1.26	1
pH	SRP6	su	7.09	7.4	5.98	6.87	7.04
Phosphate, Ortho	14265-44-2	mg/l	0.05	0.05	0.01	0.007	0.05
Phosphorous	7723-14-0	mg/l	0.023	0.105	0.04	0.014	0.129
Specific Conductivity	SRP54	umhos/cm	95	102	72	158	152
Temperature	SRP38	deg c	NA	NA	NA	NA	NA
Total Dissolved Solids	SRP31	mg/l	NA	NA	NA	NA	NA
Total Suspended Solids	SRP32	mg/l	2	43	1	15	2

NA = Not Analyzed

ND = Not Detected

H = Sample was analyzed outside of hold time.

J = Estimated value below sample reporting limit

MDL = Method Detection Limit

U = Compound not detected above MDL

Sample dates are approximate.

Table 1
General Chemistry Parameters in Surface Water (1984-2024)
Surface Water Monitoring Program - Stillwater, NJ
Site 01 - Blair Creek

		Sample No.:	Site 01	Site 01	Site 01	Site 01	Site 01	Site 01
		Date Sampled:	4/1/2002	10/1/2002	10/1/2003	10/1/2006	10/1/2008	10/1/2010
Parameter	CAS No.	Units						
Alkalinity, Total	SRP48	mg/l	12.9	9.5	13.9	10.1	7.97	12
Aluminum	7429-90-5	mg/l	ND U	0.133	ND U	0.0424	ND U	0.0494
E. coli	68583-22-2	col/100ml	NA	NA	NA	NA	NA	NA
Fecal Coliforms	SRP151	col/100ml	60	10	10	10 U	10 U	90
Lead	7439-92-1	mg/l	0.005	0.005	ND U	ND U	ND U	0.0028
Nitrogen, Ammonia	7664-41-7	mg/l	0.1	0.1	ND U	ND U	ND U	ND U
Nitrogen, Nitrate	14797-55-8	mg/l	0.5	0.5	ND U	ND U	ND U	ND U
Nitrogen, Nitrite	14797-65-0	mg/l	ND U	0.02	ND U	ND U	ND U	ND U
Nitrogen, Total Kjeldahl (TKN)	SRP167	mg/l	1	1	ND U	ND U	ND U	ND U
pH	SRP6	su	7.13	7.26	6.65	6.68	6.44	6.34
Phosphate, Ortho	14265-44-2	mg/l	0.05	0.01	ND U	0.029	ND U	0.05
Phosphorous	7723-14-0	mg/l	ND U	0.01	ND U	ND U	ND U	0.021
Specific Conductivity	SRP54	umhos/cm	82.4	102	72.3	63.4	71.4	85.1
Temperature	SRP38	deg c	NA	NA	NA	NA	NA	NA
Total Dissolved Solids	SRP31	mg/l	NA	NA	NA	NA	NA	NA
Total Suspended Solids	SRP32	mg/l	3	ND U	ND U	ND U	ND U	ND U

NA = Not Analyzed
ND = Not Detected
H = Sample was analyzed outside of hold time.
J = Estimated value below sample reporting limit
MDL = Method Detection Limit
U = Compound not detected above MDL
Sample dates are approximate.

Table 1
General Chemistry Parameters in Surface Water (1984-2024)
Surface Water Monitoring Program - Stillwater, NJ
Site 01 - Blair Creek

		Sample No.:	Site 01	Site 01	Site 01	Site 01	Site 01	Site 01
		Date Sampled:	10/1/2012	10/1/2014	10/1/2015	4/1/2016	10/1/2018	10/1/2020
Parameter	CAS No.	Units						
Alkalinity, Total	SRP48	mg/l	21.1	26.4	25.2	17.9	11.4	8
Aluminum	7429-90-5	mg/l	0.0353	NA	NA	NA	NA	NA
E. coli	68583-22-2	col/100ml	NA	NA	10 U	NA	NA	NA
Fecal Coliforms	SRP151	col/100ml	10 U	10	10 U	64	20	12
Lead	7439-92-1	mg/l	ND U	NA	NA	NA	NA	NA
Nitrogen, Ammonia	7664-41-7	mg/l	ND U	0.05	ND U	NA	0.02	0.25
Nitrogen, Nitrate	14797-55-8	mg/l	ND U	ND U	ND U	ND U	0.036	0.013
Nitrogen, Nitrite	14797-65-0	mg/l	ND U	ND U	0.0148	0.0111	0.05	0.05
Nitrogen, Total Kjeldahl (TKN)	SRP167	mg/l	0.83	0.44	0.51	NA	0.2	1
pH	SRP6	su	6.34	7.03	7.08	6.74	6.8	6.9
Phosphate, Ortho	14265-44-2	mg/l	ND U	ND U	0.014	0.028	0.02	0.1
Phosphorous	7723-14-0	mg/l	0.011	0.02	0.034	NA	0.011	0.31
Specific Conductivity	SRP54	umhos/cm	71.4	101	125	83.5	66	241
Temperature	SRP38	deg c	NA	NA	NA	NA	NA	NA
Total Dissolved Solids	SRP31	mg/l	NA	NA	NA	NA	NA	NA
Total Suspended Solids	SRP32	mg/l	2	ND U	ND U	2	4	3.3

NA = Not Analyzed

ND = Not Detected

H = Sample was analyzed outside of hold time.

J = Estimated value below sample reporting limit

MDL = Method Detection Limit

U = Compound not detected above MDL

Sample dates are approximate.

Table 1
General Chemistry Parameters in Surface Water (1984-2024)
Surface Water Monitoring Program - Stillwater, NJ
Site 01 - Blair Creek

		Sample No.:	Site 01	Site 01
		Date Sampled:	10/1/2022	10/16/2024
Parameter	CAS No.	Units		
Alkalinity, Total	SRP48	mg/l	15.1	37
Aluminum	7429-90-5	mg/l	NA	NA
E. coli	68583-22-2	col/100ml	NA	130 H
Fecal Coliforms	SRP151	col/100ml	40	140 H
Lead	7439-92-1	mg/l	NA	NA
Nitrogen, Ammonia	7664-41-7	mg/l	0.1	0.054 J
Nitrogen, Nitrate	14797-55-8	mg/l	0.1	0.04 U
Nitrogen, Nitrite	14797-65-0	mg/l	NA	0.015 U
Nitrogen, Total Kjeldahl (TKN)	SRP167	mg/l	1	0.75 U
pH	SRP6	su	6.8	7.2 H
Phosphate, Ortho	14265-44-2	mg/l	0.008	0.028
Phosphorous	7723-14-0	mg/l	0.1	0.05 U
Specific Conductivity	SRP54	umhos/cm	104	120
Temperature	SRP38	deg c	NA	21.9 H
Total Dissolved Solids	SRP31	mg/l	48	79
Total Suspended Solids	SRP32	mg/l	NA	2.8 J

NA = Not Analyzed

ND = Not Detected

H = Sample was analyzed outside of hold time.

J = Estimated value below sample reporting limit

MDL = Method Detection Limit

U = Compound not detected above MDL

Sample dates are approximate.

Table 2
General Chemistry Parameters in Surface Water (1984-2024)
Surface Water Monitoring Program - Stillwater, NJ
Site 02 - Trout Brook (Fairview Lake Rd.)

Sample No.:		Site 02	Site 02	Site 02	Site 02	Site 02	Site 02	
Date Sampled:		10/1/1984	10/1/1985	10/1/1986	10/1/1987	10/1/1988	10/1/1989	
Parameter	CAS No.	Units						
Alkalinity, Total	SRP48	mg/l	12.5	15	15	10	12	9
Aluminum	7429-90-5	mg/l	0.029	0.094	0.163	0.5	0.04	0.1
E. coli	68583-22-2	col/100ml	NA	NA	NA	NA	NA	NA
Fecal Coliforms	SRP151	col/100ml	20	NA	10	23	12	70
Lead	7439-92-1	mg/l	0.003	0.003	0.01	0.004	0.004	0.004
Nitrogen, Ammonia	7664-41-7	mg/l	0.62	0.9	0.1	0.1	0.2	0.2
Nitrogen, Nitrate	14797-55-8	mg/l	0.01	0.07	0.7	0.1	0.2	0.2
Nitrogen, Nitrite	14797-65-0	mg/l	0.003	0.002	0.006	0.01	0.02	0.02
Nitrogen, Total Kjeldahl (TKN)	SRP167	mg/l	0.26	0.9	0.1	0.1	0.5	0.5
pH	SRP6	su	6.58	6.31	6.74	6.88	5.92	6.49
Phosphate, Ortho	14265-44-2	mg/l	0.06	0.03	0.03	0.03	0.05	0.05
Phosphorous	7723-14-0	mg/l	0.06	0.03	0.05	0.03	0.02	0.05
Specific Conductivity	SRP54	umhos/cm	110	110	180	100	154	77
Temperature	SRP38	deg c	NA	NA	NA	NA	NA	NA
Total Dissolved Solids	SRP31	mg/l	NA	NA	NA	NA	NA	NA
Total Suspended Solids	SRP32	mg/l	6.7	3.8	6.5	2.2	3	2

NA = Not Analyzed

ND = Not Detected

H = Sample was analyzed outside of hold time.

J = Estimated value below sample reporting limit

MDL = Method Detection Limit

U = Compound not detected above MDL

Sample dates are approximate.

Table 2
General Chemistry Parameters in Surface Water (1984-2024)
Surface Water Monitoring Program - Stillwater, NJ
Site 02 - Trout Brook (Fairview Lake Rd.)

Sample No.:			Site 02		Site 02		Site 02		Site 02		Site 02			
Date Sampled:			10/1/1990		10/1/1993		10/1/1996		10/1/1997		10/1/1998		10/1/2001	
Parameter	CAS No.	Units												
Alkalinity, Total	SRP48	mg/l	8		19.5		11.3		11.5		16		21.8	
Aluminum	7429-90-5	mg/l	0.1		NA		0.05		0.25		0.1		ND	U
E. coli	68583-22-2	col/100ml	NA		NA		NA		NA		NA		NA	
Fecal Coliforms	SRP151	col/100ml	80		80		32		66		236		40	
Lead	7439-92-1	mg/l	0.004		0.05		0.05		0.014		0.004		0.005	
Nitrogen, Ammonia	7664-41-7	mg/l	0.2		0.2		0.5		0.03		0.03		0.1	
Nitrogen, Nitrate	14797-55-8	mg/l	0.5		0.5		0.04		0.05		0.042		0.5	
Nitrogen, Nitrite	14797-65-0	mg/l	0.05		0.05		0.01		0.01		0.008		0.2	
Nitrogen, Total Kjeldahl (TKN)	SRP167	mg/l	0.5		0.5		0.54		1.55		0.57		1	
pH	SRP6	su	6.65		7.25		6		6.71		6.65		7.08	
Phosphate, Ortho	14265-44-2	mg/l	0.05		0.05		0.01		0.01		0.006		0.05	
Phosphorous	7723-14-0	mg/l	0.02		0.05		0.54		0.01		0.023		0.05	
Specific Conductivity	SRP54	umhos/cm	69		104		138		199		149		182	
Temperature	SRP38	deg c	NA		NA		NA		NA		NA		NA	
Total Dissolved Solids	SRP31	mg/l	NA		NA		NA		NA		NA		NA	
Total Suspended Solids	SRP32	mg/l	2		2		2		11		1		ND	U

NA = Not Analyzed

ND = Not Detected

H = Sample was analyzed outside of hold time.

J = Estimated value below sample reporting limit

MDL = Method Detection Limit

U = Compound not detected above MDL

Sample dates are approximate.

Table 2
General Chemistry Parameters in Surface Water (1984-2024)
Surface Water Monitoring Program - Stillwater, NJ
Site 02 - Trout Brook (Fairview Lake Rd.)

Sample No.:		Site 02	Site 02	Site 02	Site 02	Site 02	Site 02
Date Sampled:		4/1/2002	10/1/2002	10/1/2003	10/1/2006	10/1/2008	10/1/2010
Parameter	CAS No.	Units					
Alkalinity, Total	SRP48	mg/l	10	6.9	10.9	5.52	7.66
Aluminum	7429-90-5	mg/l	ND U	ND U	ND U	0.0668	ND U
E. coli	68583-22-2	col/100ml	NA	NA	NA	NA	NA
Fecal Coliforms	SRP151	col/100ml	50	10	10	20	10 U
Lead	7439-92-1	mg/l	0.005	0.005	ND U	ND U	ND U
Nitrogen, Ammonia	7664-41-7	mg/l	0.1	0.1	ND U	ND U	ND U
Nitrogen, Nitrate	14797-55-8	mg/l	0.5	0.5	ND U	ND U	ND U
Nitrogen, Nitrite	14797-65-0	mg/l	ND U	0.02	ND U	ND U	ND U
Nitrogen, Total Kjeldahl (TKN)	SRP167	mg/l	1	1	ND U	ND U	ND U
pH	SRP6	su	6.83	7.06	6.45	6.56	6.46
Phosphate, Ortho	14265-44-2	mg/l	0.05	0.01	ND U	ND U	ND U
Phosphorous	7723-14-0	mg/l	ND U	0.01	0.066	0.017	0.025
Specific Conductivity	SRP54	umhos/cm	141	134	90.2	71.1	94.5
Temperature	SRP38	deg c	NA	NA	NA	NA	NA
Total Dissolved Solids	SRP31	mg/l	NA	NA	NA	NA	NA
Total Suspended Solids	SRP32	mg/l	2	12	ND U	ND U	ND U

NA = Not Analyzed

ND = Not Detected

H = Sample was analyzed outside of hold time.

J = Estimated value below sample reporting limit

MDL = Method Detection Limit

U = Compound not detected above MDL

Sample dates are approximate.

Table 2
General Chemistry Parameters in Surface Water (1984-2024)
Surface Water Monitoring Program - Stillwater, NJ
Site 02 - Trout Brook (Fairview Lake Rd.)

Sample No.: Date Sampled:		Site 02 10/1/2012	Site 02 10/1/2014	Site 02 10/1/2015	Site 02 4/1/2016	Site 02 10/1/2018	Site 02 10/1/2020
Parameter	CAS No.	Units					
Alkalinity, Total	SRP48	mg/l	13.6	11.8	21.3	12.8	11.5
Aluminum	7429-90-5	mg/l	0.0405	NA	NA	NA	NA
E. coli	68583-22-2	col/100ml	NA	NA	20	NA	NA
Fecal Coliforms	SRP151	col/100ml	10	30	40	36	24
Lead	7439-92-1	mg/l	ND	U	NA	NA	NA
Nitrogen, Ammonia	7664-41-7	mg/l	ND	U	ND	U	0.02
Nitrogen, Nitrate	14797-55-8	mg/l	ND	U	ND	U	0.05
Nitrogen, Nitrite	14797-65-0	mg/l	ND	U	0.0146	0.0099	0.05
Nitrogen, Total Kjeldahl (TKN)	SRP167	mg/l	0.61	0.54	0.32	NA	1
pH	SRP6	su	6.24	6.95	7.12	6.6	7
Phosphate, Ortho	14265-44-2	mg/l	ND	U	0.012	0.026	0.1
Phosphorous	7723-14-0	mg/l	ND	U	0.012	0.014	0.31
Specific Conductivity	SRP54	umhos/cm	80.4	147	143	109	87.8
Temperature	SRP38	deg c	NA	NA	NA	NA	NA
Total Dissolved Solids	SRP31	mg/l	NA	NA	NA	NA	NA
Total Suspended Solids	SRP32	mg/l	ND	U	2	ND	U

NA = Not Analyzed
 ND = Not Detected
 H = Sample was analyzed outside of hold time.
 J = Estimated value below sample reporting limit
 MDL = Method Detection Limit
 U = Compound not detected above MDL
 Sample dates are approximate.

Table 2
General Chemistry Parameters in Surface Water (1984-2024)
Surface Water Monitoring Program - Stillwater, NJ
Site 02 - Trout Brook (Fairview Lake Rd.)

		Sample No.:	Site 02	Site 02
		Date Sampled:	10/1/2022	10/16/2024
Parameter	CAS No.	Units		
Alkalinity, Total	SRP48	mg/l	14.8	32
Aluminum	7429-90-5	mg/l	NA	NA
E. coli	68583-22-2	col/100ml	NA	79 H
Fecal Coliforms	SRP151	col/100ml	10	80 H
Lead	7439-92-1	mg/l	NA	NA
Nitrogen, Ammonia	7664-41-7	mg/l	0.1	0.053 J
Nitrogen, Nitrate	14797-55-8	mg/l	0.1	0.04 U
Nitrogen, Nitrite	14797-65-0	mg/l	NA	0.015 U
Nitrogen, Total Kjeldahl (TKN)	SRP167	mg/l	1	21
pH	SRP6	su	6.9	6.8 H
Phosphate, Ortho	14265-44-2	mg/l	0.014	0.006 J
Phosphorous	7723-14-0	mg/l	0.1	0.05 U
Specific Conductivity	SRP54	umhos/cm	108	120
Temperature	SRP38	deg c	NA	22.2 H
Total Dissolved Solids	SRP31	mg/l	66	77
Total Suspended Solids	SRP32	mg/l	NA	1 U

NA = Not Analyzed

ND = Not Detected

H = Sample was analyzed outside of hold time.

J = Estimated value below sample reporting limit

MDL = Method Detection Limit

U = Compound not detected above MDL

Sample dates are approximate.

Table 3
General Chemistry Parameters in Surface Water (1984-2024)
Surface Water Monitoring Program - Stillwater, NJ
Site 03 - Trout Brook (Middleville)

Sample No.: Date Sampled:		Site 03 10/1/1984	Site 03 10/1/1985	Site 03 10/1/1986	Site 03 10/1/1987	Site 03 10/1/1988	Site 03 10/1/1989
Parameter	CAS No.	Units					
Alkalinity, Total	SRP48	mg/l	22.5	23	15	15	11
Aluminum	7429-90-5	mg/l	0.029	0.125	0.1	0.5	0.1
E. coli	68583-22-2	col/100ml	NA	NA	NA	NA	NA
Fecal Coliforms	SRP151	col/100ml	40	NA	80	30	27
Lead	7439-92-1	mg/l	0.003	0.003	0.01	0.004	0.004
Nitrogen, Ammonia	7664-41-7	mg/l	0.05	0.5	0.1	0.1	0.2
Nitrogen, Nitrate	14797-55-8	mg/l	0.009	0.07	0.07	0.1	0.02
Nitrogen, Nitrite	14797-65-0	mg/l	0.001	0.002	0.002	0.01	0.02
Nitrogen, Total Kjeldahl (TKN)	SRP167	mg/l	0.06	0.5	0.6	0.3	0.5
pH	SRP6	su	6.9	6.81	7.42	7.44	6.99
Phosphate, Ortho	14265-44-2	mg/l	0.065	0.03	0.03	0.03	0.02
Phosphorous	7723-14-0	mg/l	0.065	0.03	0.03	0.03	0.02
Specific Conductivity	SRP54	umhos/cm	100	115	180	100	141
Temperature	SRP38	deg c	NA	NA	NA	NA	NA
Total Dissolved Solids	SRP31	mg/l	NA	NA	NA	NA	NA
Total Suspended Solids	SRP32	mg/l	4.1	2.1	6.5	0.8	2

NA = Not Analyzed
 ND = Not Detected
 H = Sample was analyzed outside of hold time.
 J = Estimated value below sample reporting limit
 MDL = Method Detection Limit
 U = Compound not detected above MDL
 Sample dates are approximate.

Table 3
General Chemistry Parameters in Surface Water (1984-2024)
Surface Water Monitoring Program - Stillwater, NJ
Site 03 - Trout Brook (Middleville)

Sample No.: Date Sampled:		Site 03 10/1/1990	Site 03 10/1/1993	Site 03 10/1/1996	Site 03 10/1/1997	Site 03 10/1/1998	Site 03 10/1/2001
Parameter	CAS No.	Units					
Alkalinity, Total	SRP48	mg/l	15	31	11.2	19.1	37.7
Aluminum	7429-90-5	mg/l	0.1	NA	0.2	0.27	ND U
E. coli	68583-22-2	col/100ml	NA	NA	NA	NA	NA
Fecal Coliforms	SRP151	col/100ml	4	110	63	18	10
Lead	7439-92-1	mg/l	0.004	0.05	0.05	0.004	0.005
Nitrogen, Ammonia	7664-41-7	mg/l	0.2	0.2	0.05	0.03	0.1
Nitrogen, Nitrate	14797-55-8	mg/l	0.05	0.54	0.03	0.052	0.5
Nitrogen, Nitrite	14797-65-0	mg/l	0.05	0.05	0.01	0.01	0.008
Nitrogen, Total Kjeldahl (TKN)	SRP167	mg/l	0.5	0.5	0.27	0.42	3.68
pH	SRP6	su	7.25	7.46	6.12	7.23	7.5
Phosphate, Ortho	14265-44-2	mg/l	0.025	0.05	0.049	0.007	0.007
Phosphorous	7723-14-0	mg/l	0.023	0.015	0.064	0.014	0.016
Specific Conductivity	SRP54	umhos/cm	92	133	89	132	134
Temperature	SRP38	deg c	NA	NA	NA	NA	NA
Total Dissolved Solids	SRP31	mg/l	NA	NA	NA	NA	NA
Total Suspended Solids	SRP32	mg/l	2	2	2	10	3
							ND U

NA = Not Analyzed

ND = Not Detected

H = Sample was analyzed outside of hold time.

J = Estimated value below sample reporting limit

MDL = Method Detection Limit

U = Compound not detected above MDL

Sample dates are approximate.

Table 3
General Chemistry Parameters in Surface Water (1984-2024)
Surface Water Monitoring Program - Stillwater, NJ
Site 03 - Trout Brook (Middleville)

Sample No.:		Site 03	Site 03	Site 03	Site 03	Site 03	Site 03
Date Sampled:		4/1/2002	10/1/2002	10/1/2003	10/1/2006	10/1/2008	10/1/2010
Parameter	CAS No.	Units					
Alkalinity, Total	SRP48	mg/l	13.9	23.9	24.9	18.4	21
Aluminum	7429-90-5	mg/l	ND U	ND U	ND U	0.0465	0.0245
E. coli	68583-22-2	col/100ml	NA	NA	NA	NA	NA
Fecal Coliforms	SRP151	col/100ml	20	10	10	10 U	10
Lead	7439-92-1	mg/l	0.005	0.005	ND U	ND U	ND U
Nitrogen, Ammonia	7664-41-7	mg/l	0.1	0.1	ND U	ND U	ND U
Nitrogen, Nitrate	14797-55-8	mg/l	0.5	0.5	ND U	ND U	ND U
Nitrogen, Nitrite	14797-65-0	mg/l	ND U	0.02	ND U	ND U	ND U
Nitrogen, Total Kjeldahl (TKN)	SRP167	mg/l	1	1	ND U	ND U	ND U
pH	SRP6	su	7.31	7.46	6.85	6.9	6.45
Phosphate, Ortho	14265-44-2	mg/l	ND U	0.01	ND U	ND U	0.05
Phosphorous	7723-14-0	mg/l	0.05	0.01	0.206	0.011	0.021
Specific Conductivity	SRP54	umhos/cm	122	178	114	95.2	124
Temperature	SRP38	deg c	NA	NA	NA	NA	NA
Total Dissolved Solids	SRP31	mg/l	NA	NA	NA	NA	NA
Total Suspended Solids	SRP32	mg/l	3	ND U	ND U	ND U	ND U

NA = Not Analyzed

ND = Not Detected

H = Sample was analyzed outside of hold time.

J = Estimated value below sample reporting limit

MDL = Method Detection Limit

U = Compound not detected above MDL

Sample dates are approximate.

Table 3
General Chemistry Parameters in Surface Water (1984-2024)
Surface Water Monitoring Program - Stillwater, NJ
Site 03 - Trout Brook (Middleville)

Sample No.:		Site 03	Site 03	Site 03	Site 03	Site 03	Site 03	
Date Sampled:		10/1/2012	10/1/2014	10/1/2015	4/1/2016	10/1/2018	10/1/2020	
Parameter	CAS No.	Units						
Alkalinity, Total	SRP48	mg/l	24	30.5	37.1	23.9	13.3	22.6
Aluminum	7429-90-5	mg/l	0.0356	NA	NA	NA	NA	NA
E. coli	68583-22-2	col/100ml	NA	NA	30	NA	NA	NA
Fecal Coliforms	SRP151	col/100ml	10 U	10	40	8	20	22
Lead	7439-92-1	mg/l	ND U	NA	NA	NA	NA	NA
Nitrogen, Ammonia	7664-41-7	mg/l	ND U	0.05	ND U	NA	0.02	0.25
Nitrogen, Nitrate	14797-55-8	mg/l	ND U	ND U	ND U	0.0898	0.064	0.026
Nitrogen, Nitrite	14797-65-0	mg/l	ND U	ND U	0.0128	0.0093	0.05	0.05
Nitrogen, Total Kjeldahl (TKN)	SRP167	mg/l	ND U	0.44	0.5	NA	0.2	1
pH	SRP6	su	6.38	7.47	8	6.73	7.1	7.5
Phosphate, Ortho	14265-44-2	mg/l	ND U	ND U	0.019	0.026	0.02	0.1
Phosphorous	7723-14-0	mg/l	ND U	ND U	0.027	NA	0.0055	0.31
Specific Conductivity	SRP54	umhos/cm	100	153	151	121	93	107
Temperature	SRP38	deg c	NA	NA	NA	NA	NA	NA
Total Dissolved Solids	SRP31	mg/l	NA	NA	NA	NA	NA	NA
Total Suspended Solids	SRP32	mg/l	2	ND U	ND U	ND U	4	3.3

NA = Not Analyzed

ND = Not Detected

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J = Estimated value below sample reporting limit

MDL = Method Detection Limit

U = Compound not detected above MDL

Sample dates are approximate.

Table 3
General Chemistry Parameters in Surface Water (1984-2024)
Surface Water Monitoring Program - Stillwater, NJ
Site 03 - Trout Brook (Middleville)

		Sample No.:	Site 03	Site 03
		Date Sampled:	10/1/2022	10/16/2024
Parameter	CAS No.	Units		
Alkalinity, Total	SRP48	mg/l	23.6	47
Aluminum	7429-90-5	mg/l	NA	NA
E. coli	68583-22-2	col/100ml	NA	21 H
Fecal Coliforms	SRP151	col/100ml	48	16 H
Lead	7439-92-1	mg/l	NA	NA
Nitrogen, Ammonia	7664-41-7	mg/l	0.1	0.05 U
Nitrogen, Nitrate	14797-55-8	mg/l	0.1	0.04 U
Nitrogen, Nitrite	14797-65-0	mg/l	NA	0.015 U
Nitrogen, Total Kjeldahl (TKN)	SRP167	mg/l	1	0.75 U
pH	SRP6	su	7	6.8 H
Phosphate, Ortho	14265-44-2	mg/l	0.043	0.017 J
Phosphorous	7723-14-0	mg/l	0.1	0.05 U
Specific Conductivity	SRP54	umhos/cm	132	150
Temperature	SRP38	deg c	NA	22.3 H
Total Dissolved Solids	SRP31	mg/l	75	91
Total Suspended Solids	SRP32	mg/l	NA	1.2 U

NA = Not Analyzed

ND = Not Detected

H = Sample was analyzed outside of hold time.

J = Estimated value below sample reporting limit

MDL = Method Detection Limit

U = Compound not detected above MDL

Sample dates are approximate.

Table 4
General Chemistry Parameters in Surface Water (1984-2024)
Surface Water Monitoring Program - Stillwater, NJ
Site 04 - Swartswood Creek (Quick Pond)

Sample No.:		Site 04	Site 04	Site 04	Site 04	Site 04	Site 04
Date Sampled:		10/1/1984	10/1/1985	10/1/1986	10/1/1987	10/1/1988	10/1/1989
Parameter	CAS No.	Units					
Alkalinity, Total	SRP48	mg/l	35	20	13	10	18
Aluminum	7429-90-5	mg/l	0.029	0.484	0.125	0.5	0.1
E. coli	68583-22-2	col/100ml	NA	NA	NA	NA	NA
Fecal Coliforms	SRP151	col/100ml	10	NA	10	13	21
Lead	7439-92-1	mg/l	0.003	0.003	0.009	0.004	0.004
Nitrogen, Ammonia	7664-41-7	mg/l	0.5	0.4	0.1	0.1	0.2
Nitrogen, Nitrate	14797-55-8	mg/l	0.009	0.07	0.07	0.01	0.2
Nitrogen, Nitrite	14797-65-0	mg/l	0.001	0.002	0.002	0.001	0.02
Nitrogen, Total Kjeldahl (TKN)	SRP167	mg/l	0.06	1.1	0.4	0.1	0.5
pH	SRP6	su	6.99	6.39	7.33	7.24	7.05
Phosphate, Ortho	14265-44-2	mg/l	0.065	0.03	0.03	0.03	0.05
Phosphorous	7723-14-0	mg/l	0.065	0.03	0.06	0.03	0.05
Specific Conductivity	SRP54	umhos/cm	90	100	110	100	99
Temperature	SRP38	deg c	NA	NA	NA	NA	NA
Total Dissolved Solids	SRP31	mg/l	NA	NA	NA	NA	NA
Total Suspended Solids	SRP32	mg/l	4.7	2.1	17.4	2.4	3

NA = Not Analyzed

ND = Not Detected

H = Sample was analyzed outside of hold time.

J = Estimated value below sample reporting limit

MDL = Method Detection Limit

U = Compound not detected above MDL

Sample dates are approximate.

Table 4
General Chemistry Parameters in Surface Water (1984-2024)
Surface Water Monitoring Program - Stillwater, NJ
Site 04 - Swartswood Creek (Quick Pond)

Sample No.:		Site 04	Site 04	Site 04	Site 04	Site 04	Site 04
Date Sampled:		10/1/1990	10/1/1993	10/1/1996	10/1/1997	10/1/1998	10/1/2001
Parameter	CAS No.	Units					
Alkalinity, Total	SRP48	mg/l	26	20.5	19.6	37.1	21.9
Aluminum	7429-90-5	mg/l	0.1	NA	0.2	0.25	0.1
E. coli	68583-22-2	col/100ml	NA	NA	NA	NA	NA
Fecal Coliforms	SRP151	col/100ml	16	30	23	7	42
Lead	7439-92-1	mg/l	0.004	0.05	0.05	0.008	0.0045
Nitrogen, Ammonia	7664-41-7	mg/l	0.2	0.2	0.05	0.03	0.03
Nitrogen, Nitrate	14797-55-8	mg/l	0.5	0.5	0.01	0.052	0.116
Nitrogen, Nitrite	14797-65-0	mg/l	0.05	0.05	0.01	0.01	0.008
Nitrogen, Total Kjeldahl (TKN)	SRP167	mg/l	0.5	0.5	0.14	0.14	0.57
pH	SRP6	su	7.45	7.22	6.34	7.35	7.12
Phosphate, Ortho	14265-44-2	mg/l	0.05	0.05	0.027	0.001	0.006
Phosphorous	7723-14-0	mg/l	0.017	0.025	0.081	0.014	0.016
Specific Conductivity	SRP54	umhos/cm	120	102	140	191	105
Temperature	SRP38	deg c	NA	NA	NA	NA	NA
Total Dissolved Solids	SRP31	mg/l	NA	NA	NA	NA	NA
Total Suspended Solids	SRP32	mg/l	2	2	4	11	1

NA = Not Analyzed

ND = Not Detected

H = Sample was analyzed outside of hold time.

J = Estimated value below sample reporting limit

MDL = Method Detection Limit

U = Compound not detected above MDL

Sample dates are approximate.

Table 4
General Chemistry Parameters in Surface Water (1984-2024)
Surface Water Monitoring Program - Stillwater, NJ
Site 04 - Swartswood Creek (Quick Pond)

Sample No.: Date Sampled:		Site 04 4/1/2002	Site 04 10/1/2002	Site 04 10/1/2003	Site 04 10/1/2005	Site 04 10/1/2006	Site 04 10/1/2008
Parameter	CAS No.	Units					
Alkalinity, Total	SRP48	mg/l	10.9	19.9	22.9	NA	10.5
Aluminum	7429-90-5	mg/l	ND U	ND U	ND U	NA	0.0617
E. coli	68583-22-2	col/100ml	NA	NA	NA	NA	NA
Fecal Coliforms	SRP151	col/100ml	40	10	10	NA	10 U
Lead	7439-92-1	mg/l	0.005	0.005	ND U	NA	ND U
Nitrogen, Ammonia	7664-41-7	mg/l	0.1	0.1	ND U	ND U	NA
Nitrogen, Nitrate	14797-55-8	mg/l	0.5	0.5	ND U	NA	ND U
Nitrogen, Nitrite	14797-65-0	mg/l	ND U	0.02	ND U	NA	ND U
Nitrogen, Total Kjeldahl (TKN)	SRP167	mg/l	1	1	ND U	NA	ND U
pH	SRP6	su	7	7.41	6.81	NA	6.77
Phosphate, Ortho	14265-44-2	mg/l	0.05	0.01	ND U	NA	ND U
Phosphorous	7723-14-0	mg/l	ND U	0.01	ND U	NA	0.011
Specific Conductivity	SRP54	umhos/cm	119	148	116	NA	89.8
Temperature	SRP38	deg c	NA	NA	NA	NA	NA
Total Dissolved Solids	SRP31	mg/l	NA	NA	NA	NA	NA
Total Suspended Solids	SRP32	mg/l	2	ND U	ND U	NA	ND U

NA = Not Analyzed

ND = Not Detected

H = Sample was analyzed outside of hold time.

J = Estimated value below sample reporting limit

MDL = Method Detection Limit

U = Compound not detected above MDL

Sample dates are approximate.

Table 4
General Chemistry Parameters in Surface Water (1984-2024)
Surface Water Monitoring Program - Stillwater, NJ
Site 04 - Swartswood Creek (Quick Pond)

		Sample No.:	Site 04	Site 04	Site 04	Site 04	Site 04	Site 04
		Date Sampled:	10/1/2010	10/1/2012	10/1/2014	10/1/2015	4/1/2016	10/1/2018
Parameter	CAS No.	Units						
Alkalinity, Total	SRP48	mg/l	15.5	21.2	20.4	24	17	11.3
Aluminum	7429-90-5	mg/l	0.157	0.0402	NA	NA	NA	NA
E. coli	68583-22-2	col/100ml	NA	NA	NA	30	NA	NA
Fecal Coliforms	SRP151	col/100ml	10 U	10 U	10 U	10 U	4	20
Lead	7439-92-1	mg/l	ND U	ND U	NA	NA	NA	NA
Nitrogen, Ammonia	7664-41-7	mg/l	ND U	ND U	0.088	ND U	NA	0.034
Nitrogen, Nitrate	14797-55-8	mg/l	ND U	ND U	0.27	ND U	ND U	0.098
Nitrogen, Nitrite	14797-65-0	mg/l	ND U	ND U	ND U	0.0145	0.0085	0.05
Nitrogen, Total Kjeldahl (TKN)	SRP167	mg/l	ND U	ND U	0.5	ND U	NA	0.2
pH	SRP6	su	6.4	6.35	7.25	7.41	6.67	7
Phosphate, Ortho	14265-44-2	mg/l	0.05	ND U	ND U	0.019	0.026	0.02
Phosphorous	7723-14-0	mg/l	0.035	ND U	ND U	0.027	NA	0.013
Specific Conductivity	SRP54	umhos/cm	125	101	144	162	128	101
Temperature	SRP38	deg c	NA	NA	NA	NA	NA	NA
Total Dissolved Solids	SRP31	mg/l	NA	NA	NA	NA	NA	NA
Total Suspended Solids	SRP32	mg/l	2	ND U	ND U	ND U	8	4

NA = Not Analyzed

ND = Not Detected

H = Sample was analyzed outside of hold time.

J = Estimated value below sample reporting limit

MDL = Method Detection Limit

U = Compound not detected above MDL

Sample dates are approximate.

Table 4
General Chemistry Parameters in Surface Water (1984-2024)
Surface Water Monitoring Program - Stillwater, NJ
Site 04 - Swartwood Creek (Quick Pond)

		Sample No.:	Site 04	Site 04	Site 04
		Date Sampled:	10/1/2020	10/1/2022	10/16/2024
Parameter	CAS No.	Units			
Alkalinity, Total	SRP48	mg/l	14.5	17.6	33
Aluminum	7429-90-5	mg/l	NA	NA	NA
E. coli	68583-22-2	col/100ml	NA	NA	3 H
Fecal Coliforms	SRP151	col/100ml	8	4	5 H
Lead	7439-92-1	mg/l	NA	NA	NA
Nitrogen, Ammonia	7664-41-7	mg/l	0.25	0.1	0.05 U
Nitrogen, Nitrate	14797-55-8	mg/l	0.09	0.1	0.2
Nitrogen, Nitrite	14797-65-0	mg/l	0.05	NA	0.015 U
Nitrogen, Total Kjeldahl (TKN)	SRP167	mg/l	1	1	0.75 U
pH	SRP6	su	7.3	7.1	6.6 H
Phosphate, Ortho	14265-44-2	mg/l	0.1	0.012	0.013 J
Phosphorous	7723-14-0	mg/l	0.31	0.1	0.05 U
Specific Conductivity	SRP54	umhos/cm	116	131	130
Temperature	SRP38	deg c	NA	NA	22.3 H
Total Dissolved Solids	SRP31	mg/l	NA	70	80
Total Suspended Solids	SRP32	mg/l	1.5	NA	1 U

NA = Not Analyzed

ND = Not Detected

H = Sample was analyzed outside of hold time.

J = Estimated value below sample reporting limit

MDL = Method Detection Limit

U = Compound not detected above MDL

Sample dates are approximate.

Table 5
General Chemistry Parameters in Surface Water (1984-2024)
Surface Water Monitoring Program - Stillwater, NJ
Site 05 - Swartswood Creek UNT (Crandon Lk.)

Sample No.:		Site 05	Site 05	Site 05	Site 05	Site 05	Site 05
Date Sampled:		10/1/1984	10/1/1985	10/1/1986	10/1/1987	10/1/1988	10/1/1989
Parameter	CAS No.	Units					
Alkalinity, Total	SRP48	mg/l	40	23	15	23	22
Aluminum	7429-90-5	mg/l	NA	0.906	0.113	0.5	0.04
E. coli	68583-22-2	col/100ml	NA	NA	NA	NA	NA
Fecal Coliforms	SRP151	col/100ml	30	NA	100	70	60
Lead	7439-92-1	mg/l	0.006	0.006	0.009	0.004	0.004
Nitrogen, Ammonia	7664-41-7	mg/l	0.05	0.3	0.1	0.1	0.2
Nitrogen, Nitrate	14797-55-8	mg/l	0.009	0.002	0.07	0.1	0.2
Nitrogen, Nitrite	14797-65-0	mg/l	0.001	0.002	0.005	0.01	0.02
Nitrogen, Total Kjeldahl (TKN)	SRP167	mg/l	0.06	1.3	0.3	0.1	0.5
pH	SRP6	su	6.93	6.42	7.26	7.18	6.58
Phosphate, Ortho	14265-44-2	mg/l	0.065	0.03	0.03	0.03	0.03
Phosphorous	7723-14-0	mg/l	0.065	0.03	0.04	0.03	0.01
Specific Conductivity	SRP54	umhos/cm	140	110	120	110	152
Temperature	SRP38	deg c	NA	NA	NA	NA	NA
Total Dissolved Solids	SRP31	mg/l	NA	NA	NA	NA	NA
Total Suspended Solids	SRP32	mg/l	2.7	2.8	3.3	2.2	3

NA = Not Analyzed

ND = Not Detected

H = Sample was analyzed outside of hold time.

J = Estimated value below sample reporting limit

MDL = Method Detection Limit

U = Compound not detected above MDL

Sample dates are approximate.

Table 5
General Chemistry Parameters in Surface Water (1984-2024)
Surface Water Monitoring Program - Stillwater, NJ
Site 05 - Swartswood Creek UNT (Crandon Lk.)

Sample No.:		Site 05	Site 05	Site 05	Site 05	Site 05	Site 05
Date Sampled:		10/1/1990	10/1/1993	10/1/1996	10/1/1997	10/1/1998	10/1/2001
Parameter	CAS No.	Units					
Alkalinity, Total	SRP48	mg/l	21	35.05	16.5	27.1	41.7
Aluminum	7429-90-5	mg/l	0.1	NA	0.2	0.25	ND U
E. coli	68583-22-2	col/100ml	NA	NA	NA	NA	NA
Fecal Coliforms	SRP151	col/100ml	248	23	70	2	136
Lead	7439-92-1	mg/l	0.004	0.05	0.05	0.016	0.0043
Nitrogen, Ammonia	7664-41-7	mg/l	0.2	0.2	0.05	0.03	0.1
Nitrogen, Nitrate	14797-55-8	mg/l	0.5	0.88	0.01	0.052	0.042
Nitrogen, Nitrite	14797-65-0	mg/l	0.05	0.05	0.01	0.01	0.008
Nitrogen, Total Kjeldahl (TKN)	SRP167	mg/l	0.5	0.5	0.27	0.14	3.68
pH	SRP6	su	7.58	7.23	6.54	7.43	6.99
Phosphate, Ortho	14265-44-2	mg/l	0.05	0.05	0.025	0.007	0.006
Phosphorous	7723-14-0	mg/l	0.016	0.03	0.034	0.014	0.016
Specific Conductivity	SRP54	umhos/cm	103	164	112	152	152
Temperature	SRP38	deg c	NA	NA	NA	NA	NA
Total Dissolved Solids	SRP31	mg/l	NA	NA	NA	NA	NA
Total Suspended Solids	SRP32	mg/l	2	65	1	14	2

NA = Not Analyzed

ND = Not Detected

H = Sample was analyzed outside of hold time.

J = Estimated value below sample reporting limit

MDL = Method Detection Limit

U = Compound not detected above MDL

Sample dates are approximate.

Table 5
General Chemistry Parameters in Surface Water (1984-2024)
Surface Water Monitoring Program - Stillwater, NJ
Site 05 - Swartswood Creek UNT (Crandon Lk.)

Sample No.:		Site 05	Site 05	Site 05	Site 05	Site 05	Site 05
Date Sampled:		4/1/2002	10/1/2002	10/1/2003	10/1/2006	10/1/2008	10/1/2010
Parameter	CAS No.	Units					
Alkalinity, Total	SRP48	mg/l	23.9	11.9	28.9	25.2	29.8
Aluminum	7429-90-5	mg/l	ND U	ND U	ND U	0.058	0.171
E. coli	68583-22-2	col/100ml	NA	NA	NA	NA	NA
Fecal Coliforms	SRP151	col/100ml	40	10	10	10	70
Lead	7439-92-1	mg/l	0.005	0.005	ND U	ND U	ND U
Nitrogen, Ammonia	7664-41-7	mg/l	0.1	0.1	ND U	0.1	ND U
Nitrogen, Nitrate	14797-55-8	mg/l	0.5	0.5	ND U	ND U	ND U
Nitrogen, Nitrite	14797-65-0	mg/l	ND U	0.02	ND U	ND U	ND U
Nitrogen, Total Kjeldahl (TKN)	SRP167	mg/l	1	1	ND U	ND U	ND U
pH	SRP6	su	7.31	7.25	7.04	6.96	6.54
Phosphate, Ortho	14265-44-2	mg/l	ND U	0.01	ND U	ND U	0.05
Phosphorous	7723-14-0	mg/l	0.05	0.01	ND U	0.015	0.018
Specific Conductivity	SRP54	umhos/cm	174	133	141	133	179
Temperature	SRP38	deg c	NA	NA	NA	NA	NA
Total Dissolved Solids	SRP31	mg/l	NA	NA	NA	NA	NA
Total Suspended Solids	SRP32	mg/l	3	ND U	ND U	ND U	2.8

NA = Not Analyzed

ND = Not Detected

H = Sample was analyzed outside of hold time.

J = Estimated value below sample reporting limit

MDL = Method Detection Limit

U = Compound not detected above MDL

Sample dates are approximate.

Table 5
General Chemistry Parameters in Surface Water (1984-2024)
Surface Water Monitoring Program - Stillwater, NJ
Site 05 - Swartswood Creek UNT (Crandon Lk.)

Sample No.:		Site 05	Site 05	Site 05	Site 05	Site 05	Site 05
Date Sampled:		10/1/2012	10/1/2014	10/1/2015	4/1/2016	10/1/2018	10/1/2020
Parameter	CAS No.	Units					
Alkalinity, Total	SRP48	mg/l	NA	29.8	67	36	33.1
Aluminum	7429-90-5	mg/l	NA	NA	NA	NA	NA
E. coli	68583-22-2	col/100ml	NA	NA	10 U	NA	NA
Fecal Coliforms	SRP151	col/100ml	NA	90	10	32	34
Lead	7439-92-1	mg/l	ND U	NA	NA	NA	NA
Nitrogen, Ammonia	7664-41-7	mg/l	ND U	ND U	ND U	NA	0.25
Nitrogen, Nitrate	14797-55-8	mg/l	ND U	ND U	ND U	0.083	0.098
Nitrogen, Nitrite	14797-65-0	mg/l	ND U	ND U	0.013	0.0091	0.05
Nitrogen, Total Kjeldahl (TKN)	SRP167	mg/l	ND U	0.63	ND U	NA	1
pH	SRP6	su	NA	7.49	7.75	6.85	7.5
Phosphate, Ortho	14265-44-2	mg/l	NA	ND U	0.018	0.024	0.1
Phosphorous	7723-14-0	mg/l	NA	ND U	0.029	NA	0.31
Specific Conductivity	SRP54	umhos/cm	NA	181	399	263	202
Temperature	SRP38	deg c	NA	NA	NA	NA	NA
Total Dissolved Solids	SRP31	mg/l	NA	NA	NA	NA	NA
Total Suspended Solids	SRP32	mg/l	2.8	ND U	ND U	2	1.2

NA = Not Analyzed

ND = Not Detected

H = Sample was analyzed outside of hold time.

J = Estimated value below sample reporting limit

MDL = Method Detection Limit

U = Compound not detected above MDL

Sample dates are approximate.

Table 5
General Chemistry Parameters in Surface Water (1984-2024)
Surface Water Monitoring Program - Stillwater, NJ
Site 05 - Swartswood Creek UNT (Crandon Lk.)

		Sample No.:	Site 05	Site 05
		Date Sampled:	10/1/2022	10/16/2024
Parameter	CAS No.	Units		
Alkalinity, Total	SRP48	mg/l	34.4	73
Aluminum	7429-90-5	mg/l	NA	NA
E. coli	68583-22-2	col/100ml	NA	8 H
Fecal Coliforms	SRP151	col/100ml	12	5 H
Lead	7439-92-1	mg/l	NA	NA
Nitrogen, Ammonia	7664-41-7	mg/l	0.05	0.05 U
Nitrogen, Nitrate	14797-55-8	mg/l	0.1	0.04 U
Nitrogen, Nitrite	14797-65-0	mg/l	NA	0.015 U
Nitrogen, Total Kjeldahl (TKN)	SRP167	mg/l	0.56	0.75 U
pH	SRP6	su	7.3	7 H
Phosphate, Ortho	14265-44-2	mg/l	0.029	0.006 U
Phosphorous	7723-14-0	mg/l	0.1	0.05 U
Specific Conductivity	SRP54	umhos/cm	219	330
Temperature	SRP38	deg c	NA	21.7 H
Total Dissolved Solids	SRP31	mg/l	104	180
Total Suspended Solids	SRP32	mg/l	NA	8.4

NA = Not Analyzed

ND = Not Detected

H = Sample was analyzed outside of hold time.

J = Estimated value below sample reporting limit

MDL = Method Detection Limit

U = Compound not detected above MDL

Sample dates are approximate.

Table 6
General Chemistry Parameters in Surface Water (1984-2024)
Surface Water Monitoring Program - Stillwater, NJ
Site 06 - Swartswood Creek

Sample No.:		Site 06	Site 06	Site 06	Site 06	Site 06	Site 06
Date Sampled:		10/1/1984	10/1/1985	10/1/1986	10/1/1987	10/1/1988	10/1/1989
Parameter	CAS No.	Units					
Alkalinity, Total	SRP48	mg/l	27.5	28	15	18	20
Aluminum	7429-90-5	mg/l	NA	0.078	0.088	0.05	0.01
E. coli	68583-22-2	col/100ml	NA	NA	NA	NA	NA
Fecal Coliforms	SRP151	col/100ml	30	NA	60	11	75
Lead	7439-92-1	mg/l	0.003	0.003	0.009	0.004	0.004
Nitrogen, Ammonia	7664-41-7	mg/l	0.05	0.2	0.1	0.1	0.2
Nitrogen, Nitrate	14797-55-8	mg/l	0.005	0.07	0.07	0.1	0.2
Nitrogen, Nitrite	14797-65-0	mg/l	0.001	0.002	0.004	0.021	0.02
Nitrogen, Total Kjeldahl (TKN)	SRP167	mg/l	0.06	0.9	0.5	0.2	0.5
pH	SRP6	su	6.91	6.92	6.93	7.33	7.17
Phosphate, Ortho	14265-44-2	mg/l	0.06	0.03	0.03	0.03	0.05
Phosphorous	7723-14-0	mg/l	0.065	0.03	0.03	0.03	0.05
Specific Conductivity	SRP54	umhos/cm	95	100	250	100	100
Temperature	SRP38	deg c	NA	NA	NA	NA	NA
Total Dissolved Solids	SRP31	mg/l	NA	NA	NA	NA	NA
Total Suspended Solids	SRP32	mg/l	3	2.1	6.8	2.4	1

NA = Not Analyzed

ND = Not Detected

H = Sample was analyzed outside of hold time.

J = Estimated value below sample reporting limit

MDL = Method Detection Limit

U = Compound not detected above MDL

Sample dates are approximate.

Table 6
General Chemistry Parameters in Surface Water (1984-2024)
Surface Water Monitoring Program - Stillwater, NJ
Site 06 - Swartswood Creek

Sample No.:		Site 06	Site 06	Site 06	Site 06	Site 06	Site 06
Date Sampled:		10/1/1990	10/1/1993	10/1/1996	10/1/1997	10/1/1998	10/1/2001
Parameter	CAS No.	Units					
Alkalinity, Total	SRP48	mg/l	16	29	31.4	18.1	25.8
Aluminum	7429-90-5	mg/l	0.01	NA	0.2	0.25	0.1
E. coli	68583-22-2	col/100ml	NA	NA	NA	NA	NA
Fecal Coliforms	SRP151	col/100ml	32	50	45	1	18
Lead	7439-92-1	mg/l	0.004	0.05	0.05	0.014	0.0073
Nitrogen, Ammonia	7664-41-7	mg/l	0.2	0.2	0.05	0.03	0.1
Nitrogen, Nitrate	14797-55-8	mg/l	0.5	0.5	0.01	0.052	0.042
Nitrogen, Nitrite	14797-65-0	mg/l	0.05	0.05	0.01	0.01	0.008
Nitrogen, Total Kjeldahl (TKN)	SRP167	mg/l	0.5	0.5	0.4	0.14	2.83
pH	SRP6	su	7.43	7.53	6.46	7.37	7.01
Phosphate, Ortho	14265-44-2	mg/l	0.05	0.05	0.01	0.01	0.006
Phosphorous	7723-14-0	mg/l	0.016	0.015	0.037	0.014	0.016
Specific Conductivity	SRP54	umhos/cm	85	132	143	160	121
Temperature	SRP38	deg c	NA	NA	NA	NA	NA
Total Dissolved Solids	SRP31	mg/l	NA	NA	NA	NA	NA
Total Suspended Solids	SRP32	mg/l	2	2	2	15	1

NA = Not Analyzed

ND = Not Detected

H = Sample was analyzed outside of hold time.

J = Estimated value below sample reporting limit

MDL = Method Detection Limit

U = Compound not detected above MDL

Sample dates are approximate.

Table 6
General Chemistry Parameters in Surface Water (1984-2024)
Surface Water Monitoring Program - Stillwater, NJ
Site 06 - Swartswood Creek

Sample No.: Date Sampled:		Site 06 4/1/2002	Site 06 10/1/2002	Site 06 10/1/2003	Site 06 10/1/2006	Site 06 10/1/2008	Site 06 10/1/2010
Parameter	CAS No.	Units					
Alkalinity, Total	SRP48	mg/l	19.9	19.9	29.9	18.3	26.4
Aluminum	7429-90-5	mg/l	ND U	ND U	ND U	0.054	0.0385
E. coli	68583-22-2	col/100ml	NA	NA	NA	NA	NA
Fecal Coliforms	SRP151	col/100ml	10	10	10	20	20
Lead	7439-92-1	mg/l	0.005	0.005	ND U	ND U	ND U
Nitrogen, Ammonia	7664-41-7	mg/l	0.1	0.1	ND U	ND U	ND U
Nitrogen, Nitrate	14797-55-8	mg/l	0.5	0.5	ND U	ND U	ND U
Nitrogen, Nitrite	14797-65-0	mg/l	ND U	0.02	ND U	ND U	ND U
Nitrogen, Total Kjeldahl (TKN)	SRP167	mg/l	1	1	ND U	ND U	ND U
pH	SRP6	su	7.5	7.28	7.14	6.94	6.53
Phosphate, Ortho	14265-44-2	mg/l	ND U	0.01	ND U	ND U	0.05
Phosphorous	7723-14-0	mg/l	0.05	0.044	ND U	0.017	0.021
Specific Conductivity	SRP54	umhos/cm	145	183	135	111	176
Temperature	SRP38	deg c	NA	NA	NA	NA	NA
Total Dissolved Solids	SRP31	mg/l	NA	NA	NA	NA	NA
Total Suspended Solids	SRP32	mg/l	2	5	2	ND U	ND U

NA = Not Analyzed
ND = Not Detected
H = Sample was analyzed outside of hold time.
J = Estimated value below sample reporting limit
MDL = Method Detection Limit
U = Compound not detected above MDL
Sample dates are approximate.

Table 6
General Chemistry Parameters in Surface Water (1984-2024)
Surface Water Monitoring Program - Stillwater, NJ
Site 06 - Swartswood Creek

Sample No.:		Site 06	Site 06	Site 06	Site 06	Site 06	Site 06
Date Sampled:		10/1/2012	10/1/2014	10/1/2015	4/1/2016	4/1/2017	10/1/2018
Parameter	CAS No.	Units					
Alkalinity, Total	SRP48	mg/l	26.6	30.7	36	28.6	20.4
Aluminum	7429-90-5	mg/l	0.0279	NA	NA	NA	NA
E. coli	68583-22-2	col/100ml	NA	NA	10 U	NA	NA
Fecal Coliforms	SRP151	col/100ml	60	10	10 U	16	40
Lead	7439-92-1	mg/l	ND U	NA	NA	NA	NA
Nitrogen, Ammonia	7664-41-7	mg/l	ND U	ND U	ND U	NA	0.02
Nitrogen, Nitrate	14797-55-8	mg/l	ND U	ND U	ND U	0.0772	0.072
Nitrogen, Nitrite	14797-65-0	mg/l	ND U	ND U	0.0123	0.0082	0.05
Nitrogen, Total Kjeldahl (TKN)	SRP167	mg/l	ND U	0.59	0.39	NA	0.2
pH	SRP6	su	6.45	7.58	7.75	NA	7.2
Phosphate, Ortho	14265-44-2	mg/l	ND U	ND U	0.008	0.024	0.02
Phosphorous	7723-14-0	mg/l	ND U	0.02	0.023	NA	0.0092
Specific Conductivity	SRP54	umhos/cm	136	182	227	190	136
Temperature	SRP38	deg c	NA	NA	NA	NA	NA
Total Dissolved Solids	SRP31	mg/l	NA	NA	NA	NA	NA
Total Suspended Solids	SRP32	mg/l	ND U	ND U	ND U	ND U	4

NA = Not Analyzed

ND = Not Detected

H = Sample was analyzed outside of hold time.

J = Estimated value below sample reporting limit

MDL = Method Detection Limit

U = Compound not detected above MDL

Sample dates are approximate.

Table 6
General Chemistry Parameters in Surface Water (1984-2024)
Surface Water Monitoring Program - Stillwater, NJ
Site 06 - Swartswood Creek

		Sample No.:	Site 06	Site 06	Site 06
		Date Sampled:	10/1/2020	10/1/2022	10/16/2024
Parameter	CAS No.	Units			
Alkalinity, Total	SRP48	mg/l	25	29.5	91
Aluminum	7429-90-5	mg/l	NA	NA	NA
E. coli	68583-22-2	col/100ml	NA	NA	17 H
Fecal Coliforms	SRP151	col/100ml	20	1	42 H
Lead	7439-92-1	mg/l	NA	NA	NA
Nitrogen, Ammonia	7664-41-7	mg/l	0.25	0.1	0.05 U
Nitrogen, Nitrate	14797-55-8	mg/l	0.016	0.1	0.04 U
Nitrogen, Nitrite	14797-65-0	mg/l	0.05	NA	0.015 U
Nitrogen, Total Kjeldahl (TKN)	SRP167	mg/l	1	1	0.75 U
pH	SRP6	su	7.5	7.3	7.4 H
Phosphate, Ortho	14265-44-2	mg/l	0.1	0.033	0.006 J
Phosphorous	7723-14-0	mg/l	0.31	0.1	0.05 U
Specific Conductivity	SRP54	umhos/cm	153	194	200
Temperature	SRP38	deg c	NA	NA	21.7 H
Total Dissolved Solids	SRP31	mg/l	NA	86.5	110
Total Suspended Solids	SRP32	mg/l	3.3	NA	1 U

NA = Not Analyzed

ND = Not Detected

H = Sample was analyzed outside of hold time.

J = Estimated value below sample reporting limit

MDL = Method Detection Limit

U = Compound not detected above MDL

Sample dates are approximate.

Table 7
General Chemistry Parameters in Surface Water (1984-2024)
Surface Water Monitoring Program - Stillwater, NJ
Site 07 - Paulins Kill (Main St. Bridge)

Sample No.: Date Sampled:		Site 07 10/1/1984	Site 07 10/1/1985	Site 07 10/1/1986	Site 07 10/1/1987	Site 07 10/1/1988	Site 07 10/1/1989
Parameter	CAS No.	Units					
Alkalinity, Total	SRP48	mg/l	170	110	138	100	127
Aluminum	7429-90-5	mg/l	NA	0.156	0.063	0.5	0.054
E. coli	68583-22-2	col/100ml	NA	NA	NA	NA	NA
Fecal Coliforms	SRP151	col/100ml	100	NA	70	220	20
Lead	7439-92-1	mg/l	0.009	0.011	0.088	0.004	0.004
Nitrogen, Ammonia	7664-41-7	mg/l	0.05	0.3	0.1	0.1	0.2
Nitrogen, Nitrate	14797-55-8	mg/l	0.028	0.57	0.08	0.2	0.11
Nitrogen, Nitrite	14797-65-0	mg/l	0.05	0.015	NA	0.01	0.02
Nitrogen, Total Kjeldahl (TKN)	SRP167	mg/l	0.09	0.9	0.6	0.4	0.54
pH	SRP6	su	8.05	7.91	7.95	7.66	7.71
Phosphate, Ortho	14265-44-2	mg/l	0.065	0.031	NA	0.041	0.051
Phosphorous	7723-14-0	mg/l	0.065	0.05	0.13	0.05	0.05
Specific Conductivity	SRP54	umhos/cm	380	350	450	300	488
Temperature	SRP38	deg c	NA	NA	NA	NA	NA
Total Dissolved Solids	SRP31	mg/l	NA	NA	NA	NA	NA
Total Suspended Solids	SRP32	mg/l	0.1	4.9	3.2	2.1	2

NA = Not Analyzed

ND = Not Detected

H = Sample was analyzed outside of hold time.

J = Estimated value below sample reporting limit

MDL = Method Detection Limit

U = Compound not detected above MDL

Sample dates are approximate.

Table 7
General Chemistry Parameters in Surface Water (1984-2024)
Surface Water Monitoring Program - Stillwater, NJ
Site 07 - Paulins Kill (Main St. Bridge)

Sample No.: Date Sampled:		Site 07 10/1/1990	Site 07 10/1/1993	Site 07 10/1/1996	Site 07 10/1/1997	Site 07 10/1/1998	Site 07 10/1/2001
Parameter	CAS No.	Units					
Alkalinity, Total	SRP48	mg/l	102	155	86.8	166	169
Aluminum	7429-90-5	mg/l	0.1	NA	0.2	0.25	ND
E. coli	68583-22-2	col/100ml	NA	NA	NA	NA	NA
Fecal Coliforms	SRP151	col/100ml	56	240	391	96	90
Lead	7439-92-1	mg/l	0.004	0.05	0.05	0.004	0.0202
Nitrogen, Ammonia	7664-41-7	mg/l	0.2	0.2	0.05	0.03	0.1
Nitrogen, Nitrate	14797-55-8	mg/l	0.5	0.5	0.19	0.949	2.28
Nitrogen, Nitrite	14797-65-0	mg/l	0.05	0.05	0.01	0.013	0.008
Nitrogen, Total Kjeldahl (TKN)	SRP167	mg/l	0.5	0.57	0.67	0.98	3.68
pH	SRP6	su	7.97	8.24	7.3	8.47	8.11
Phosphate, Ortho	14265-44-2	mg/l	0.051	0.051	0.011	0.007	0.006
Phosphorous	7723-14-0	mg/l	0.045	0.045	0.0148	0.039	0.008
Specific Conductivity	SRP54	umhos/cm	314	447	321	508	409
Temperature	SRP38	deg c	NA	NA	NA	NA	NA
Total Dissolved Solids	SRP31	mg/l	NA	NA	NA	NA	NA
Total Suspended Solids	SRP32	mg/l	2	14	10	19	4

NA = Not Analyzed

ND = Not Detected

H = Sample was analyzed outside of hold time.

J = Estimated value below sample reporting limit

MDL = Method Detection Limit

U = Compound not detected above MDL

Sample dates are approximate.

Table 7
General Chemistry Parameters in Surface Water (1984-2024)
Surface Water Monitoring Program - Stillwater, NJ
Site 07 - Paulins Kill (Main St. Bridge)

Sample No.:		Site 07	Site 07	Site 07	Site 07	Site 07	Site 07	
Date Sampled:		4/1/2002	10/1/2002	10/1/2003	10/1/2006	10/1/2008	10/1/2010	
Parameter	CAS No.	Units						
Alkalinity, Total	SRP48	mg/l	97.5	133	155	105	88.3	108
Aluminum	7429-90-5	mg/l	0.15	ND U	ND U	0.0587	ND U	0.0512
E. coli	68583-22-2	col/100ml	NA	NA	NA	NA	NA	NA
Fecal Coliforms	SRP151	col/100ml	70	10	10	10	110	80
Lead	7439-92-1	mg/l	0.0062	0.005	ND U	ND U	ND U	ND U
Nitrogen, Ammonia	7664-41-7	mg/l	0.1	0.1	ND U	ND U	ND U	ND U
Nitrogen, Nitrate	14797-55-8	mg/l	0.5	1.15	0.8	0.58	ND U	ND U
Nitrogen, Nitrite	14797-65-0	mg/l	ND U	0.02	ND U	ND U	ND U	ND U
Nitrogen, Total Kjeldahl (TKN)	SRP167	mg/l	1	1	ND U	ND U	ND U	ND U
pH	SRP6	su	7.91	8.25	7.89	8.19	7.63	7.85
Phosphate, Ortho	14265-44-2	mg/l	0.05	0.01	ND U	ND U	ND U	0.05
Phosphorous	7723-14-0	mg/l	ND U	0.01	ND U	0.025	0.039	0.022
Specific Conductivity	SRP54	umhos/cm	395	479	478	331	348	397
Temperature	SRP38	deg c	NA	NA	NA	NA	NA	NA
Total Dissolved Solids	SRP31	mg/l	NA	NA	NA	NA	NA	NA
Total Suspended Solids	SRP32	mg/l	8	4	ND U	2.3	6.5	2.8

NA = Not Analyzed

ND = Not Detected

H = Sample was analyzed outside of hold time.

J = Estimated value below sample reporting limit

MDL = Method Detection Limit

U = Compound not detected above MDL

Sample dates are approximate.

Table 7
General Chemistry Parameters in Surface Water (1984-2024)
Surface Water Monitoring Program - Stillwater, NJ
Site 07 - Paulins Kill (Main St. Bridge)

Sample No.:		Site 07	Site 07	Site 07	Site 07	Site 07	Site 07
Date Sampled:		10/1/2012	10/1/2014	10/1/2015	4/1/2016	10/1/2018	10/1/2020
Parameter	CAS No.	Units					
Alkalinity, Total	SRP48	mg/l	132	134	146	118	92
Aluminum	7429-90-5	mg/l	0.0632	NA	NA	NA	NA
E. coli	68583-22-2	col/100ml	NA	NA	10	NA	NA
Fecal Coliforms	SRP151	col/100ml	90	10	80	120	30
Lead	7439-92-1	mg/l	ND	U	NA	NA	NA
Nitrogen, Ammonia	7664-41-7	mg/l	ND	U	ND	U	0.017
Nitrogen, Nitrate	14797-55-8	mg/l	0.592	0.0191	0.189	0.168	0.55
Nitrogen, Nitrite	14797-65-0	mg/l	ND	U	0.0164	0.012	0.05
Nitrogen, Total Kjeldahl (TKN)	SRP167	mg/l	ND	U	0.93	0.44	NA
pH	SRP6	su	7.47	8.09	8.33	7.92	7.7
Phosphate, Ortho	14265-44-2	mg/l	ND	U	0.03	0.012	0.028
Phosphorous	7723-14-0	mg/l	ND	U	0.037	0.025	NA
Specific Conductivity	SRP54	umhos/cm	383	464	618	438	314
Temperature	SRP38	deg c	NA	NA	NA	NA	NA
Total Dissolved Solids	SRP31	mg/l	NA	NA	NA	NA	NA
Total Suspended Solids	SRP32	mg/l	2	8	5	10	4.4

NA = Not Analyzed
ND = Not Detected
H = Sample was analyzed outside of hold time.
J = Estimated value below sample reporting limit
MDL = Method Detection Limit
U = Compound not detected above MDL
Sample dates are approximate.

Table 7
General Chemistry Parameters in Surface Water (1984-2024)
Surface Water Monitoring Program - Stillwater, NJ
Site 07 - Paulins Kill (Main St. Bridge)

		Sample No.:	Site 07	Site 07
		Date Sampled:	10/1/2022	10/16/2024
Parameter	CAS No.	Units		
Alkalinity, Total	SRP48	mg/l	116	190
Aluminum	7429-90-5	mg/l	NA	NA
E. coli	68583-22-2	col/100ml	NA	46
Fecal Coliforms	SRP151	col/100ml	13	36
Lead	7439-92-1	mg/l	NA	NA
Nitrogen, Ammonia	7664-41-7	mg/l	0.053	0.05 U
Nitrogen, Nitrate	14797-55-8	mg/l	0.42	0.22
Nitrogen, Nitrite	14797-65-0	mg/l	NA	0.015 U
Nitrogen, Total Kjeldahl (TKN)	SRP167	mg/l	0.69	0.75 U
pH	SRP6	su	8	7.6 H
Phosphate, Ortho	14265-44-2	mg/l	0.012	0.0065 J
Phosphorous	7723-14-0	mg/l	0.1	0.05 U
Specific Conductivity	SRP54	umhos/cm	454	610
Temperature	SRP38	deg c	NA	22.2 H
Total Dissolved Solids	SRP31	mg/l	202	340
Total Suspended Solids	SRP32	mg/l	NA	1 U

NA = Not Analyzed
 ND = Not Detected
 H = Sample was analyzed outside of hold time.
 J = Estimated value below sample reporting limit
 MDL = Method Detection Limit
 U = Compound not detected above MDL
 Sample dates are approximate.

Table 8
General Chemistry Parameters in Surface Water (1984-2024)
Surface Water Monitoring Program - Stillwater, NJ
Site 08 - Pond Brook (Keen's Mill)

Sample No.:		Site 08	Site 08	Site 08	Site 08	Site 08	Site 08
Date Sampled:		10/1/1998	10/1/2001	4/1/2002	10/1/2002	10/1/2003	10/1/2006
Parameter	CAS No.	Units					
Alkalinity, Total	SRP48	mg/l	70	83.6	57.7	73.6	67
Aluminum	7429-90-5	mg/l	0.1	ND U	ND U	ND U	0.0272
E. coli	68583-22-2	col/100ml	NA	NA	NA	NA	NA
Fecal Coliforms	SRP151	col/100ml	2	20	10	10	10 U
Lead	7439-92-1	mg/l	0.004	0.005	0.005	ND U	ND U
Nitrogen, Ammonia	7664-41-7	mg/l	0.03	0.1	0.1	ND U	ND U
Nitrogen, Nitrate	14797-55-8	mg/l	0.08	0.5	0.5	ND U	ND U
Nitrogen, Nitrite	14797-65-0	mg/l	0.01	0.2	ND U	0.02	ND U
Nitrogen, Total Kjeldahl (TKN)	SRP167	mg/l	2.83	1	1	ND U	ND U
pH	SRP6	su	7.65	7.7	7.9	8.12	7.75
Phosphate, Ortho	14265-44-2	mg/l	0.01	0.05	0.05	0.01	ND U
Phosphorous	7723-14-0	mg/l	0.192	0.05	ND U	0.01	ND U
Specific Conductivity	SRP54	umhos/cm	172	258	240	252	211
Temperature	SRP38	deg c	NA	NA	NA	NA	NA
Total Dissolved Solids	SRP31	mg/l	NA	NA	NA	NA	NA
Total Suspended Solids	SRP32	mg/l	59	20	2	2	3.3

NA = Not Analyzed

ND = Not Detected

H = Sample was analyzed outside of hold time.

J = Estimated value below sample reporting limit

MDL = Method Detection Limit

U = Compound not detected above MDL

Sample dates are approximate.

Table 8
General Chemistry Parameters in Surface Water (1984-2024)
Surface Water Monitoring Program - Stillwater, NJ
Site 08 - Pond Brook (Keen's Mill)

		Sample No.:	Site 08	Site 08	Site 08	Site 08	Site 08	Site 08
		Date Sampled:	10/1/2008	10/1/2010	10/1/2012	10/1/2014	10/1/2015	4/1/2016
Parameter	CAS No.	Units						
Alkalinity, Total	SRP48	mg/l	68		73.2		71	
Aluminum	7429-90-5	mg/l	ND	U	0.233		NA	
E. coli	68583-22-2	col/100ml	NA		NA		20	
Fecal Coliforms	SRP151	col/100ml	20		100		10	U
Lead	7439-92-1	mg/l	ND	U	0.002		NA	
Nitrogen, Ammonia	7664-41-7	mg/l	ND	U	ND	U	ND	U
Nitrogen, Nitrate	14797-55-8	mg/l	ND	U	ND	U	ND	U
Nitrogen, Nitrite	14797-65-0	mg/l	ND	U	ND	U	0.0128	0.0089
Nitrogen, Total Kjeldahl (TKN)	SRP167	mg/l	ND	U	1.63		0.67	NA
pH	SRP6	su	7.52		6.93		7.94	
Phosphate, Ortho	14265-44-2	mg/l	ND	U	0.05		ND	U
Phosphorous	7723-14-0	mg/l	0.014		0.013		ND	U
Specific Conductivity	SRP54	umhos/cm	221		212		220	
Temperature	SRP38	deg c	NA		NA		NA	
Total Dissolved Solids	SRP31	mg/l	NA		NA		NA	
Total Suspended Solids	SRP32	mg/l	5		4.4		2	ND

NA = Not Analyzed
ND = Not Detected
H = Sample was analyzed outside of hold time.
J = Estimated value below sample reporting limit
MDL = Method Detection Limit
U = Compound not detected above MDL
Sample dates are approximate.

Table 8
General Chemistry Parameters in Surface Water (1984-2024)
Surface Water Monitoring Program - Stillwater, NJ
Site 08 - Pond Brook (Keen's Mill)

		Sample No.:	Site 08	Site 08	Site 08	Site 08
		Date Sampled:	10/1/2018	10/1/2020	10/1/2022	10/16/2024
Parameter	CAS No.	Units				
Alkalinity, Total	SRP48	mg/l	75.3	72.2	74.4	98
Aluminum	7429-90-5	mg/l	NA	NA	NA	NA
E. coli	68583-22-2	col/100ml	NA	NA	NA	9 H
Fecal Coliforms	SRP151	col/100ml	10 U	5	1	10 H
Lead	7439-92-1	mg/l	NA	NA	NA	NA
Nitrogen, Ammonia	7664-41-7	mg/l	0.02	0.15	0.068	0.14
Nitrogen, Nitrate	14797-55-8	mg/l	0.13	0.037	0.1	0.04 U
Nitrogen, Nitrite	14797-65-0	mg/l	0.05	0.05	NA	0.015 U
Nitrogen, Total Kjeldahl (TKN)	SRP167	mg/l	0.19	1	0.68	0.75 U
pH	SRP6	su	7.7	7.9	7.7	7.3 H
Phosphate, Ortho	14265-44-2	mg/l	0.02	0.1	0.02	0.024
Phosphorous	7723-14-0	mg/l	0.018	0.31	0.1	0.05 U
Specific Conductivity	SRP54	umhos/cm	247	238	250	250
Temperature	SRP38	deg c	NA	NA	NA	21.7 H
Total Dissolved Solids	SRP31	mg/l	NA	NA	100	130
Total Suspended Solids	SRP32	mg/l	4	2.2	NA	3.1

NA = Not Analyzed

ND = Not Detected

H = Sample was analyzed outside of hold time.

J = Estimated value below sample reporting limit

MDL = Method Detection Limit

U = Compound not detected above MDL

Sample dates are approximate.

Table 9
General Chemistry Parameters in Surface Water (1984-2024)
Surface Water Monitoring Program - Stillwater, NJ
Site 09 - Paulins Kill (Lake Outfall Below Dam)

Sample No.: Date Sampled:		Site 09 10/1/2008	Site 09 10/1/2010	Site 09 10/1/2012	Site 09 10/1/2014	Site 09 10/1/2015	Site 09 4/1/2016
Parameter	CAS No.	Units					
Alkalinity, Total	SRP48	mg/l	89.4	111	152	161	140
Aluminum	7429-90-5	mg/l	0.141	0.0806	0.067	NA	NA
E. coli	68583-22-2	col/100ml	NA	NA	NA	10	NA
Fecal Coliforms	SRP151	col/100ml	210	140	10 U	10 U	4 U
Lead	7439-92-1	mg/l	ND U	ND U	ND U	NA	NA
Nitrogen, Ammonia	7664-41-7	mg/l	0.1	0.13	ND U	0.15	0.08
Nitrogen, Nitrate	14797-55-8	mg/l	0.501	ND U	0.799	0.0919	0.138
Nitrogen, Nitrite	14797-65-0	mg/l	ND U	ND U	ND U	0.0073	0.0181
Nitrogen, Total Kjeldahl (TKN)	SRP167	mg/l	ND U	ND U	ND U	1.01	0.34
pH	SRP6	su	7.36	7.68	7.62	8.2	8.14
Phosphate, Ortho	14265-44-2	mg/l	ND U	0.05	0.01	0.067	0.038
Phosphorous	7723-14-0	mg/l	0.051	0.045	0.02	0.096	0.04
Specific Conductivity	SRP54	umhos/cm	385	437	466	580	614
Temperature	SRP38	deg c	NA	NA	NA	NA	NA
Total Dissolved Solids	SRP31	mg/l	NA	NA	NA	NA	NA
Total Suspended Solids	SRP32	mg/l	7	4.4	4	22	13

NA = Not Analyzed
ND = Not Detected
H = Sample was analyzed outside of hold time.
J = Estimated value below sample reporting limit
MDL = Method Detection Limit
U = Compound not detected above MDL
Sample dates are approximate.

Table 9
General Chemistry Parameters in Surface Water (1984-2024)
Surface Water Monitoring Program - Stillwater, NJ
Site 09 - Paulins Kill (Lake Outfall Below Dam)

		Sample No.:	Site 09	Site 09	Site 09	Site 09
		Date Sampled:	10/1/2018	10/1/2020	10/1/2022	10/16/2024
Parameter	CAS No.	Units				
Alkalinity, Total	SRP48	mg/l	104	107	134	190
Aluminum	7429-90-5	mg/l	NA	NA	NA	NA
E. coli	68583-22-2	col/100ml	NA	NA	NA	5 H
Fecal Coliforms	SRP151	col/100ml	10	390	58	27
Lead	7439-92-1	mg/l	NA	NA	NA	NA
Nitrogen, Ammonia	7664-41-7	mg/l	0.02	0.25	0.12	0.1
Nitrogen, Nitrate	14797-55-8	mg/l	0.69	0.56	0.49	0.04 U
Nitrogen, Nitrite	14797-65-0	mg/l	0.05	0.05	NA	0.26
Nitrogen, Total Kjeldahl (TKN)	SRP167	mg/l	0.21	0.8	0.57	0.75 U
pH	SRP6	su	7.7	8	7.9	7.8 H
Phosphate, Ortho	14265-44-2	mg/l	0.02	0.1	0.028	0.035
Phosphorous	7723-14-0	mg/l	0.022	0.31	0.1	0.05 U
Specific Conductivity	SRP54	umhos/cm	365	438	557	640
Temperature	SRP38	deg c	NA	NA	NA	21.7 H
Total Dissolved Solids	SRP31	mg/l	NA	NA	265	360
Total Suspended Solids	SRP32	mg/l	4	3.1	NA	24

NA = Not Analyzed
 ND = Not Detected
 H = Sample was analyzed outside of hold time.
 J = Estimated value below sample reporting limit
 MDL = Method Detection Limit
 U = Compound not detected above MDL
 Sample dates are approximate.

Table 10
General Chemistry Parameters in Surface Water (1984-2024)
Surface Water Monitoring Program - Stillwater, NJ
Site 10 - Pond Brook (VMP Bridge)

		Sample No.:	Site 10	Site 10	Site 10	Site 10	Site 10	Site 10
		Date Sampled:	4/1/2015	10/1/2015	10/1/2016	10/1/2018	10/1/2020	10/1/2022
Parameter	CAS No.	Units						
Alkalinity, Total	SRP48	mg/l	NA	NA	NA	NA	65.7	NA
E. coli	68583-22-2	col/100ml	240	290	48	15.8	620	55
Fecal Coliforms	SRP151	col/100ml	240	N	200	20	650	52
Nitrogen, Ammonia	7664-41-7	mg/l	NA	NA	NA	NA	0.25	NA
Nitrogen, Nitrate	14797-55-8	mg/l	NA	NA	NA	NA	NA	NA
Nitrogen, Nitrite	14797-65-0	mg/l	NA	NA	NA	NA	0.05	NA
Nitrogen, Total Kjeldahl (TKN)	SRP167	mg/l	NA	NA	NA	NA	0.51	NA
pH	SRP6	su	NA	NA	NA	NA	7.9	NA
Phosphate, Ortho	14265-44-2	mg/l	NA	NA	NA	NA	0.1	NA
Phosphorous	7723-14-0	mg/l	NA	NA	NA	NA	0.31	NA
Specific Conductivity	SRP54	umhos/cm	NA	NA	NA	NA	223	NA
Temperature	SRP38	deg c	NA	NA	NA	NA	NA	NA
Total Dissolved Solids	SRP31	mg/l	NA	NA	NA	NA	NA	NA
Total Suspended Solids	SRP32	mg/l	NA	NA	NA	NA	2.7	NA

NA = Not Analyzed

ND = Not Detected

H = Sample was analyzed outside of hold time.

J = Estimated value below sample reporting limit

MDL = Method Detection Limit

U = Compound not detected above MDL

Sample dates are approximate.

Table 10
General Chemistry Parameters in Surface Water (1984-2024)
Surface Water Monitoring Program - Stillwater, NJ
Site 10 - Pond Brook (VMP Bridge)

Sample No.: Site 10
Date Sampled: 10/16/2024

Parameter	CAS No.	Units		
Alkalinity, Total	SRP48	mg/l	90	
E. coli	68583-22-2	col/100ml	243	H
Fecal Coliforms	SRP151	col/100ml	100	H
Nitrogen, Ammonia	7664-41-7	mg/l	0.57	
Nitrogen, Nitrate	14797-55-8	mg/l	0.15	
Nitrogen, Nitrite	14797-65-0	mg/l	0.015	U
Nitrogen, Total Kjeldahl (TKN)	SRP167	mg/l	0.75	U
pH	SRP6	su	7.1	H
Phosphate, Ortho	14265-44-2	mg/l	0.01	J
Phosphorous	7723-14-0	mg/l	0.05	U
Specific Conductivity	SRP54	umhos/cm	250	
Temperature	SRP38	deg c	22.5	H
Total Dissolved Solids	SRP31	mg/l	130	
Total Suspended Solids	SRP32	mg/l	1	U

NA = Not Analyzed
ND = Not Detected
H = Sample was analyzed outside of hold time.
J = Estimated value below sample reporting limit
MDL = Method Detection Limit
U = Compound not detected above MDL
Sample dates are approximate.

Attachment 1

Sampling Station Photograph Log

40 Year Water Quality Report (1984-2024)
Environmental Commission - Township of Stillwater, NJ

Station 01- Blair Creek



21 Jan 2023, 15:22:32

Attachment 1

Sampling Station Photograph Log

40 Year Water Quality Report (1984-2024)
Environmental Commission - Township of Stillwater, NJ

Site 2 - Trout Brook (Fairview Lake Rd.)



Attachment 1

Sampling Station Photograph Log

40 Year Water Quality Report (1984-2024)
Environmental Commission - Township of Stillwater, NJ

Station 3 - Trout Bk (Middleville)



Attachment 1

Sampling Station Photograph Log

40 Year Water Quality Report (1984-2024)
Environmental Commission - Township of Stillwater, NJ

Station 4 - Swartswood Ck (Quick Pond)



Attachment 1

Sampling Station Photograph Log

40 Year Water Quality Report (1984-2024)
Environmental Commission - Township of Stillwater, NJ

Station 5 - Swartswood Ck - UNT (Crandon Lk.)



Attachment 1

Sampling Station Photograph Log

40 Year Water Quality Report (1984-2024)
Environmental Commission - Township of Stillwater, NJ

Station 6 - Swartswood Ck



Attachment 1

Sampling Station Photograph Log

40 Year Water Quality Report (1984-2024)
Environmental Commission - Township of Stillwater, NJ

Station 7 - Paulins Kill (Main St. Bridge)



Attachment 1

Sampling Station Photograph Log

40 Year Water Quality Report (1984-2024)
Environmental Commission - Township of Stillwater, NJ

Station 8 - Pond Bk (Keen's Mill)



Attachment 1

Sampling Station Photograph Log

40 Year Water Quality Report (1984-2024)
Environmental Commission - Township of Stillwater, NJ

Station 9 - Paulinskill Lake Dam



Attachment 1

Sampling Station Photograph Log

40 Year Water Quality Report (1984-2024)
Environmental Commission - Township of Stillwater, NJ

Station 10 - Pond Bk (VMP Bridge)



APPENDICES

40 Year Water Quality Report (1984-2024)

**Environmental Commission
Township of Stillwater, New Jersey**

<u>Appendix No.</u>	<u>Description</u>
A	Prior Stream Names and Stations Excerpted from the 2004 Surface Water Report
B	NJDEP SWQS Excerpts, Screening Levels and References
C	NJDEP GeoWeb Map Information Excerpts
D	Summary of 95UCL and Statistical Trend Analysis Results
E	Miscellaneous Statistical Analysis Graphs and
F	Calculations NJDEP Water Quality Data Exchange Selected Site Data

Appendix A

Prior Stream Names and Stations Excerpted from the 2004 Surface Water Report*

*S.Grotsky, 2004. Stream Surface Water Sampling – Chemical Data and Biological Analysis through Macroinvertebrates. Prepared for the Stillwater Township Environmental Commission. 2004.

Stillwater Township

Stream Surface Water Sampling – Chemical Data and Biological Analysis
through Macroinvertebrates

Prepared For
The Stillwater Township
Environmental Commission

By
Steve Grodsky

Sampling Stations and Dates

Sampling stations were selected in four watersheds within Stillwater Township at the following locations to evaluate trends in water quality:

Station Number	Sampling Station	Trout Identification	Location
1	Blair Creek	Trout Maintenance	Off of Old Schoolhouse Rd – along dirt road below confluence of North and South branch of Blair Creek
2	Trout Brook	Trout Production	Owassa Rd. at the junction with Fairview lake Rd.
3	Trout Brook	Trout Production	Middleville Rd. and Pond Brook Rd.
4	Spring Brook (Quick Pond)	Trout Maintenance	Mount Benevolence Rd. near Crandon Lodge
5	Spring Brook (Crandon)	Trout Maintenance	Hampton Rd. Bridge
6	Spring Brook	Trout Maintenance	Swartswood Rd. Bridge
7	Paulinskill River	Trout Maintenance	Stillwater Rd. – Main St. Bridge
8	Keen's Mill	Trout Maintenance	Off of Rt. 521 - next to Keen's Mill

Dates of sampling range from the beginning of the project in the spring of 1984 to present, the most recent sampling being the fall of 2003. All water samples were collected in accordance with the New Jersey Department of Environmental Protection (NJDEP) "Field Procedures Manual for Water Data Acquisition" (NJDEP Division of Water Resources) and were remanded to a licensed environmental laboratory (QC Laboratories - Southampton, PA) for analysis.

*No sampling took place during the years of 1991, 1992, 1994, and 1995. As a result, the graphical representation of the data will exclude these time periods.

Appendix B

NJDEP SWQS Excerpts, Screening Levels and References

40 Year Water Quality Report (1984-2024)
Environmental Commission - Township of Stillwater, NJ

Summary of Surface Water Quality Criteria (SWQC) and Screening Levels (SLs) used for 2024 SWMP Report

Parameter	Units	General	Acute	Chronic	HH	TP	TM	NT	Notes	Source
Alkalinity	mg/L	20 - 200							(1) (1A)	USEPA; NMSU
Aluminum	mg/L		0.75	0.087					(2)	CDC_ASTDR
E. coli	Counts/100 ml	100 GM; 320 STV			100				(3)	NJAC 7:9B
Fecal Coliforms	Counts/100 ml	100 GM; 320 STV							(3A)	NJAC 7:9B
Lead (ug/L)	mg/L		0.038(d)(s)	0.0054(d)(s)	0.005(h)(T)					NJAC 7:9B
Nitrogen, Ammonia	mg/L		2.4	0.54					(4)	NJAC 7:9B
Nitrate (as N)	mg/L				10(h)					NJAC 7:9B
Nitrite (as N)	mg/L				1				(5)	NJAC 7:10
Nitrogen, Total Kjeldhal (TKN)	mg/L	6							(6)	USEPA
Ortho Phosphate as P	mg/L	0.1							(7)	
Phosphorus (Total)	mg/L	0.1								NJAC 7:9B
pH	su	6.5-8.5								NJAC 7:9B
Specific Conductance	umhos/cm	500							(8)	USEPA
Total Dissolved Solids (TDS)	mg/L								(9)	NJAC 7:9B; NJAC 7:10
Total Suspended Solids (TSS)	mg/L					25	25	40		NJAC 7:9B

Notes:

(d) Criterion is expressed as a function of the Water Effect Ratio (WER). For criterion in the table, WER equates to the default value of 1.0

(h) Human health noncarcinogen

(s) Dissolved criterion

(T) Total recoverable criterion

(1) <https://www.epa.gov/wqc/national-recommended-water-quality-criteria-aquatic-life-criteria-table> (accessed 03/22/2024)

(1A) [https://aces.nmsu.edu/pubs/Cooperative Extension Service Guide W-104](https://aces.nmsu.edu/pubs/Cooperative%20Extension%20Service%20Guide%20W-104) (accessed 09/01/2024)

(2) CDC_ASTDR Toxicological Profiles; www.atsdr.cdc.gov/ToxProfiles/tp22-c8.pdf

(3) See NJAC7:9B. Primary Contact Recreation;

Max E. coli geometric mean of 100/100 ml per 90-day period and STV of 320/100 ml with no greater than 10 percent excursion frequency over 90-days.

(3A) SWQC-based screening level for E.coli used for Fecal coliform SWMP data (see report for basis and background).

(4) Calculated per NJAC 7:9B using field measured pH (8.45) and temp (14.5 c) from October 16, 2024 sampling event.

(5) Screening Level (SL) based on NJDEP Safe Drinking Water MCL per NJAC 7:10.

(6) USEPA "Total Nitrogen" <https://nepis.epa.gov> (accessed 09/01/2024)

(7) Phosphorus SWQC adopted as SL.

(8) <https://archive.epa.gov/water/archive/web/html/vms59.html> (accessed 09/01/2024)

(9) Screening Level (SL) based on NJDEP Safe Drinking Water Secondary Standards per NJAC 7:10; Background evaluation and WET test data unavailable for SWQC.

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NEW JERSEY ADMINISTRATIVE CODE.

7:9B-1.14(d) General Surface Water Quality Criteria for FW2, SE and SC Waters:
(Expressed as Maximum concentrations unless otherwise noted)

Substance	Criteria	Classifications
1. Bacterial quality (Counts/100 ml)	<ul style="list-style-type: none"> i. Shellfish Harvesting: Bacterial Indicators shall not exceed, in all shellfish waters, the standard for approved shellfish waters as established by the National Shellfish Sanitation Program as set forth in its current manual of operations. ii. Primary Contact Recreation: <ul style="list-style-type: none"> (1) Enterococci levels shall not exceed a geometric mean of 30/100 ml over a 90-day period and a Statistical Threshold Value of 110/100 ml, which shall not be greater than 10 percent excursion frequency over a 90-day period. (2) <i>E. coli</i> levels shall not exceed a geometric mean of 100/100 ml over a 90-day period and a Statistical Threshold Value of 320/100 ml, which shall not be greater than 10 percent excursion frequency over a 90-day period. iii. Secondary Contact Recreation: <ul style="list-style-type: none"> (1) Fecal coliform levels shall not exceed a geometric mean of 770/100 ml. (2) Fecal coliform levels shall not exceed a geometric mean of 1500/100ml. 	<ul style="list-style-type: none"> Shellfish Waters SE1 and SC All FW2 SE2 SE3
2. Dissolved oxygen (mg/L)	<ul style="list-style-type: none"> i. Not less than 7.0 at any time; ii. 24 hour average not less than 6.0. Not less than 5.0 at any time (see paragraph viii below); 	<ul style="list-style-type: none"> FW2-TP FW2-TM

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7:9B-1.14(d) General Surface Water Quality Criteria for FW2, SE and SC Waters:
(Expressed as Maximum concentrations unless otherwise noted)

Substance	Criteria	Classifications
	iii. 24 hour average not less than 5.0, but not less than 4.0 at any time (see paragraph viii below);	FW2-NT (except as in iv below), SE1
	iv. Not less than 4.0 at any time;	Tidal portions of FW2-NT tributaries to the Delaware River, between Rancocas Creek and Big Timber Creek inclusive.
	v. Not less than 5.0 at any time;	SC
	vi. Not less than 4.0 at any time;	SE2
	vii. Not less than 3.0 at any time; and	SE3
	viii. Supersaturated dissolved oxygen values shall be expressed as their corresponding 100 percent saturation values for purposes of calculating 24 hour averages.	FW2-TM, FW2-NT, SE1
3. Floating, colloidal, color and settleable solids; petroleum hydrocarbons and other oils and grease	i. None noticeable in the water or deposited along the shore or on the aquatic substrata in quantities detrimental to the natural biota. None which would render the waters unsuitable for the designated uses.	All Classifications

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7:9B-1.14(d) General Surface Water Quality Criteria for FW2, SE and SC Waters:
(Expressed as Maximum concentrations unless otherwise noted)

Substance	Criteria	Classifications
4. Nutrients	<p>i. Except as due to natural conditions, nutrients shall not be allowed in concentrations that render the waters unsuitable for the existing or designated uses due to objectionable algal densities, nuisance aquatic vegetation, diurnal fluctuations in dissolved oxygen or pH indicative of excessive photosynthetic activity, detrimental changes to the composition of aquatic ecosystems, or other indicators of use impairment caused by nutrients.</p> <p>ii. Phosphorus (mg/L)*</p> <p>(1) Non Tidal Streams: Concentrations of total P shall not exceed 0.1 in any stream, unless site-specific criteria or watershed-specific translators are established pursuant to N.J.A.C. 7:9B-1.5(g)2 or if the Department determines that concentrations do not render the waters unsuitable in accordance with (d)4i. above.</p> <p>(2) Lakes: Concentrations of total P shall not exceed 0.05 in any lake, pond or reservoir, or in a tributary at the point where it enters such bodies of water, unless site-specific criteria or watershed-specific translators are developed pursuant to N.J.A.C. 7:9B-1.5(g)2 or if the Department determines that concentrations do not render the waters unsuitable in accordance with (d)4i. above.</p>	<p>All Classifications</p> <p>FW2</p> <p>FW2</p>

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7:9B-1.14(d) General Surface Water Quality Criteria for FW2, SE and SC Waters:
(Expressed as Maximum concentrations unless otherwise noted)

Substance	Criteria	Classifications
5. pH (Standard Units)	<ul style="list-style-type: none"> i. 6.5-8.5 ii. 4.5 – 7.5 iii. Natural pH conditions shall prevail. 	<p>FW2 waters listed at 1.15(d), (f), (g) and (i), All SE</p> <p>FW2 waters listed at 1.15(c), (e) and (h)</p> <p>SC</p>
6. Radioactivity	<ul style="list-style-type: none"> i. Prevailing regulations including all amendments and future supplements thereto adopted by the U.S. Environmental Protection Agency pursuant to Sections 1412, 1445, and 1450 of the Public Health Services Act, as amended by the Safe Drinking Water Act (PL 93-523) 	All Classifications
7. Solids, Suspended (mg/L) (Non-filterable residue)	<ul style="list-style-type: none"> i. 25.0 ii. 40.0 iii. None of which would render the water unsuitable for the designated uses. 	<p>FW2-TP, FW2-TM</p> <p>FW2-NT</p> <p>All SE, SC</p>
8. Solids, Total Dissolved (mg/L) (Filterable Residue)	<ul style="list-style-type: none"> i. No increase in background which may adversely affect the survival, growth or propagation of the aquatic biota. Compliance with water quality-based WET limitations or $LC_{50} \geq 50$ percent, whichever is more stringent, shall be deemed to meet this requirement. 	FW2

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7:9B-1.14(d) General Surface Water Quality Criteria for FW2, SE and SC Waters:
(Expressed as Maximum concentrations unless otherwise noted)

Substance	Criteria	Classifications
9.	<div>ii. No increase in background which would interfere with the designated or existing uses, or 500 mg/L, whichever is more stringent.</div>	FW2
	<div>iii. None which would render the water unsuitable for the designated uses.</div>	All SE
10.	Sulfate (mg/L)	i.
	Taste and odor producing substances	i.
	250	FW2
	None offensive to humans or which would produce offensive taste or odors in water supplies and biota used for human consumption. None which would render the water unsuitable for the designated uses.	All Classifications
11.	Temperature	i.
	Temperatures shall not exceed a daily maximum of 22 degrees Celsius or rolling seven-day average of the daily maximum of 19 degrees Celsius, unless due to natural conditions	FW2-TP
	ii.	FW2-TM
	Temperatures shall not exceed a daily maximum of 25 degrees Celsius or rolling seven-day average of the daily maximum of 23 degrees Celsius, unless due to natural conditions	
	iii.	FW2-NT
	Temperatures shall not exceed a daily maximum of 31 degrees Celsius or rolling seven-day average of the daily maximum of 28 degrees Celsius, unless due to natural conditions	
	iv.	SE
	No thermal alterations which would cause temperatures to exceed 29.4 degrees Celsius (85 degree Fahrenheit) Summer seasonal average	

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7:9B-1.14(d) General Surface Water Quality Criteria for FW2, SE and SC Waters:
(Expressed as Maximum concentrations unless otherwise noted)

Substance	Criteria	Classifications
12. Toxic Substances (general)	v. No thermal alterations which would cause temperatures to exceed 26.7 degrees Celsius (80 degree Fahrenheit) Summer seasonal average	SC
	i. None, either alone or in combination with other substances, in such concentrations as to affect humans or be detrimental to the natural aquatic biota, produce undesirable aquatic life, or which would render the waters unsuitable for the designated uses.	All Classifications
	ii. None which would cause standards for drinking water to be exceeded after appropriate treatment.	FW2
	iii. Toxic substances shall not be present in concentrations that cause acute or chronic toxicity to aquatic biota, or bioaccumulate within an organism to concentrations that exert a toxic effect on that organism or render it unfit for consumption.	All Classifications
	iv. The concentrations of nonpersistent toxic substances in the State's waters shall not exceed one-twentieth (0.05) of the acute definitive LC ₅₀ or EC ₅₀ value, as determined by appropriate bioassays conducted in accordance with N.J.A.C. 7:18.	All Classifications
	v. The concentration of persistent toxic substances in the State's waters shall not exceed one-hundredeth (0.01) of the acute definitive LC ₅₀ or EC ₅₀ value, as determined by appropriate bioassays conducted in accordance with N.J.A.C. 7:18.	All Classifications

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7:9B-1.14(d) General Surface Water Quality Criteria for FW2, SE and SC Waters:
(Expressed as Maximum concentrations unless otherwise noted)

Substance	Criteria	Classifications
13. Turbidity (Nephelometric Turbidity Unit-NTU)	i. Maximum 30-day average of 15 NTU, a maximum of 50 NTU at any time.	FW2, SE3
	ii. Maximum 30-day average of 10 NTU, a maximum of 30 NTU at any time.	SE1, SE2
	iii. Levels shall not exceed 10.0 NTU.	SC

* See N.J.A.C. 7:9B-1.14(g) for site-specific criteria.

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(e) Surface Water Quality Criteria for Ammonia are derived in accordance with the formulas set forth below. Acute criteria are expressed as three-hour average using MA1CD10 flow and chronic criteria are expressed as 30-day average using MA30CD10 flow. No exceedance of criteria shall be permitted at or above the design flows specified.

<u>CAS Number</u>	<u>Criteria</u>	<u>Classification</u>
1. Ammonia, un-ionized (mg NH ₃ -N/L)	7664-41-7	
	i. at pH < 8.30	PL
	$0.238 \times 10^{0.026(\text{Temp}-20) + 0.41 (\text{pH}-7.80)}$ (acute)	
	$0.061 \times 10^{0.026(\text{Temp}-20) + 0.41 (\text{pH}-7.80)}$ (chronic)	
	ii. 0.115 (acute); 0.030 (chronic)	All SE
	iii. 0.094 (acute); 0.024 (chronic)	SC
2. Ammonia, Total (mg TAN/L) - Acute criteria are expressed as one-hour average using MA1CD10 flow, chronic criteria are expressed as 30-day rolling average using MA30CD10 flow and the highest four-day average within the 30-day averaging period should not be more than 2.5 times of chronic criteria. No exceedance of criteria shall be permitted at or above the design flows specified.		

<u>CAS Number</u>	<u>Criteria applicable in FW2 waters</u>	<u>Classifications</u>
3. Ammonia, total (mg TAN/L)	7664-41-7	
	i.	FW2-TP, FW2-TM
	$\text{MIN} \left(\left(\frac{0.275}{1 + 10^{7.204 - \text{pH}}} + \frac{39.0}{1 + 10^{\text{pH} - 7.204}} \right), \left(0.7249 \times \left(\frac{0.0114}{1 + 10^{7.204 - \text{pH}}} + \frac{1.6181}{1 + 10^{\text{pH} - 7.204}} \right) \times (23.12 \times 10^{0.036 \times (20 - T)}) \right) \right) \text{ (acute)}$	
	ii.	FW2-NT
	$0.7249 \times \left(\frac{0.0114}{1 + 10^{7.204 - \text{pH}}} + \frac{1.6181}{1 + 10^{\text{pH} - 7.204}} \right) \times \text{MIN}(51.93, 23.12 \times 10^{0.036 \times (20 - T)}) \text{ (acute)}$	
	iii.	All FW2
	$0.8876 \times \left(\frac{0.0278}{1 + 10^{7.688 - \text{pH}}} + \frac{1.1994}{1 + 10^{\text{pH} - 7.688}} \right) \times (2.126 \times 10^{0.028 \times (20 - \text{MAX}(T, 7))}) \text{ (chronic)}$	

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- (f) Surface Water Quality Criteria for Toxic Substances are as follows:
1. Acute aquatic life protection criteria are determined with no exceedance at or above the MA1CD10 flow and expressed as one-hour average except,
 - i. for copper the criteria are expressed as 24-hour average, and
 - ii. for cadmium, chromium, lead, mercury, nickel, silver, and zinc the criteria are expressed as 6-hour average.
 2. Chronic aquatic life protection criteria are determined with no exceedance at or above the MA7CD10 flow and expressed as four-day average.
 3. Freshwater aquatic criteria for cadmium, chromium III, copper, nickel, silver, and zinc are expressed as a function of water hardness. Criteria can be calculated at any hardness using these equations as listed below. Criteria thus calculated are multiplied by appropriate conversion factor (CF) to convert total recoverable metal into dissolved metal and by the default Water Effect Ratio (WER) of 1.0.

$$\text{General formula} \quad WER [e^{(V[\ln(\text{hardness})] + \ln A - V[\ln Z])}] CF$$

where:

V = pooled slope

A = FAV at given hardness

Z = selected value of hardness

Cadmium:

$$\text{Acute dissolved criterion} \quad WER [e^{(1.0166 (\ln [\text{hardness}]) - 3.924)}] 0.651$$

$$\text{Chronic dissolved criterion} \quad WER [e^{(0.7409 (\ln [\text{hardness}]) - 4.719)}] 0.651$$

Chromium III:

$$\text{Acute dissolved criterion} \quad WER [e^{(0.819 (\ln [\text{hardness}]) + 3.7256)}] 0.277$$

$$\text{Chronic dissolved criterion} \quad WER [e^{(0.819 (\ln [\text{hardness}]) + 0.6848)}] 0.277$$

Copper:

$$\text{Acute dissolved criterion} \quad WER [e^{(0.9422 (\ln [\text{hardness}]) - 1.7)}] 0.908$$

$$\text{Chronic dissolved criterion} \quad WER [e^{(0.8545 (\ln [\text{hardness}]) - 1.702)}] 0.908$$

Nickel:

$$\text{Acute dissolved criterion} \quad WER [e^{(0.846 (\ln [\text{hardness}]) + 2.255)}] 0.846$$

$$\text{Chronic dissolved criterion} \quad WER [e^{(0.846 (\ln [\text{hardness}]) + 0.0584)}] 0.846$$

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Silver:

$$\text{Acute dissolved criterion} \quad WER [e^{(1.72 (\ln [\text{hardness}]) - 6.59)}] 0.85$$

Zinc:

$$\text{Acute or dissolved criterion} \quad WER [e^{(0.8473 (\ln [\text{hardness}]) + 0.884)}] 0.950$$

$$\text{Chronic dissolved criterion} \quad WER [e^{(0.8473 (\ln [\text{hardness}]) + 0.884)}] 0.950$$

4. Freshwater criteria for pentachlorophenol are expressed as a function of pH. Criteria are derived in accordance with the formula set forth below:

$$\text{Acute criterion} = e^{(1.005[\text{pH}] - 4.869)}$$

$$\text{Chronic criterion} = e^{(1.005[\text{pH}] - 5.134)}$$

5. Human health noncarcinogenic effect-based criteria are expressed as a 30-day average with no frequency of exceedance at or above the MA7CD10 flow.
6. Human health carcinogenic effect-based criteria are based on a risk level of one-in-one-million and are expressed as a 70-year average with no frequency of exceedance at or above the design flow as specified at N.J.A.C. 7:9B-1.5(c)2iii.

7. SURFACE WATER QUALITY CRITERIA FOR TOXIC SUBSTANCES:
(µg/L)

Toxic Substance	CAS Number	Fresh Water (FW2) Criteria			Saline Water (SE & SC) Criteria		
		Aquatic		Human Health	Aquatic		Human Health
		Acute	Chronic		Acute	Chronic	
Acenaphthene	83-32-9			670(h)			990(h)
Acrolein	107-02-8			6.1(h)			9.3(h)
Acrylonitrile	107-13-1			0.051(hc)			0.25(hc)
Aldrin	309-00-2	3.0		0.000049(hc)	1.3		0.000050(hc)
Ammonia, un-ionized	7664-41-7	See N.J.A.C. 7:9B-1.14(e)			See N.J.A.C. 7:9B-1.14(e)		
Anthracene	120-12-7			8,300(h)			40,000(h)
Antimony	7440-36-0			5.6(h)(T)			640(h)(T)
Arsenic	7440-38-2	340(d)(s)	150(d)(s)	0.017(hc)(T)	69(d)(s)	36(d)(s)	0.061(hc)(T)
Asbestos	1332-21-4			7x10 ⁶ fibers/L >10µm(h)			
Barium	7440-39-3			2,000(h)(T)			
Benz(a)anthracene	56-55-3			0.038(hc)			0.18(hc)
Benzene	71-43-2			0.15(hc)			3.3(hc)
Benzidine	92-87-5			0.000086(hc)			0.00020(hc)
3,4-Benzofluoranthene (Benzo(b)fluoranthene)	205-99-2			0.038(hc)			0.18(hc)
Benzo(k)fluoranthene	207-08-9			0.38(hc)			1.8(hc)
Benzo(a)pyrene (BaP)	50-32-8			0.0038(hc)			0.018(hc)
Beryllium	7440-41-7			6.0(h)(T)			42(h)(T)
alpha-BHC (alpha-HCH)	319-84-6			0.0026(hc)			0.0049(hc)
beta-BHC (beta-HCH)	319-85-7			0.0091(hc)			0.017(hc)
gamma-BHC (gamma-HCH/Lindane)	58-89-9	0.95		0.98(h)	0.16		1.8(h)
Bis(2-chloroethyl) ether	111-44-4			0.030(hc)			0.53(hc)
Bis(2-chloroisopropyl) ether	108-60-1			1,400(h)			65,000(h)
Bis(2-ethylhexyl) phthalate	117-81-7			1.2(hc)			2.2(hc)
Bromodichloromethane (Dichlorobromomethane)	75-27-4			0.55(hc)			17(hc)
Bromoform	75-25-2			4.3(hc)			140(hc)
Butyl benzyl phthalate	85-68-7			150(h)			190(h)
Cadmium	7440-43-9	(a)	(a)	3.4(h)(T)	40(d)(s)	8.8(d)(s)	16(h)(T)
Carbon tetrachloride	56-23-5			0.33(hc)			2.3(hc)
Chlordane	57-74-9	2.4	0.0043	0.00010(hc)	0.09	0.0040	0.00011(hc)

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Toxic Substance	CAS Number	Fresh Water (FW2) Criteria			Saline Water (SE & SC) Criteria		
		Aquatic		Human Health	Aquatic		Human Health
		Acute	Chronic		Acute	Chronic	
Chloride	16887-00-6	860,000	230,000	250,000(ol)			
Chlorine Produced Oxidants (CPO)	7782-50-5	19	11		13	7.5	
Chlorobenzene	108-90-7			210(h)			2,500(h)
Chloroform	67-66-3			68(h)			2,100(h)
2-Chloronaphthalene	91-58-7			1,000(h)			1,600(h)
2-Chlorophenol	95-57-8			81(h)			150(h)
Chlorpyrifos	2921-88-2	0.083	0.041		0.011	0.0056	
Chromium	7440-47-3			92(h)(T)			750(h)(T)
Chromium ⁺³	16065-83-1	(a)	(a)				
Chromium ⁺⁶	18540-29-9	15(d)(s)	10(d)(s)		1,100(d)(s)	50(d)(s)	
Chrysene	218-01-9			3.8(hc)			18(hc)
Copper*	7440-50-8	(a)	(a)	1,300(h)(T)	4.8(d)(s)	3.1(d)(s)	
Cyanide (Total)	57-12-5	22(fc)	5.2(fc)	140(h)	2.7(fc)	2.7(fc)	140(h)
4,4'-DDD (p,p'-TDE)	72-54-8			0.00031(hc)			0.00031(hc)
4,4'-DDE	72-55-9			0.00022(hc)			0.00022(hc)
4,4'-DDT	50-29-3	1.1	0.0010	0.00022(hc)	0.13	0.0010	0.00022(hc)
Demeton	8065-48-3		0.1			0.1	
Dibenz(a,h)anthracene	53-70-3			0.0038(hc)			0.018(hc)
Dibromochloromethane (Chlorodibromomethane)	124-48-1			0.40(hc)			13(hc)
Di-n-butyl phthalate	84-74-2			2,000(h)			4,500(h)
1,2-Dichlorobenzene	95-50-1			2,000(h)			6,200(h)
1,3-Dichlorobenzene	541-73-1			2,200(h)			8,300(h)
1,4-Dichlorobenzene	106-46-7			550(h)			2,200(h)
3,3'-Dichlorobenzidine	91-94-1			0.021(hc)			0.028(hc)
1,2-Dichloroethane	107-06-2			0.29(hc)			28(hc)
1,1-Dichloroethylene	75-35-4			4.7(h)			100(h)
trans-1,2-Dichloroethylene	156-60-5			590(h)			43,000(h)
2,4-Dichlorophenol	120-83-2			77(h)			290(h)
1,2-Dichloropropane	78-87-5			0.50(hc)			15(hc)
1,3-Dichloropropene (cis and trans)	542-75-6			0.34(hc)			21(hc)

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Toxic Substance	CAS Number	Fresh Water (FW2) Criteria			Saline Water (SE & SC) Criteria		
		Aquatic		Human Health	Aquatic		Human Health
		Acute	Chronic		Acute	Chronic	
Dieldrin	60-57-1	0.24	0.056	0.000052(hc)	0.71	0.0019	0.000054(hc)
Diethyl phthalate	84-66-2			17,000(h)			44,000(h)
2,4-Dimethyl phenol	105-67-9			380(h)			850(h)
4,6-Dinitro-o-cresol	534-52-1			13(h)			280(h)
2,4-Dinitrophenol	51-28-5			69(h)			5,300(h)
2,4-Dinitrotoluene	121-14-2			0.11(hc)			3.4(hc)
1,2-Diphenylhydrazine	122-66-7			0.036(hc)			0.20(hc)
Endosulfans (alpha and beta)	115-29-7	0.22	0.056	62(h)	0.034	0.0087	89(h)
Endosulfan sulfate	1031-07-8			62(h)			89(h)
Endrin	72-20-8	0.086	0.036	0.059(h)	0.037	0.0023	0.060(h)
Endrin aldehyde	7421-93-4			0.059(h)			0.060(h)
Ethylbenzene	100-41-4			530(h)			2,100(h)
Fluoranthene	206-44-0			130(h)			140(h)
Fluorene	86-73-7			1,100(h)			5,300(h)
Guthion	86-50-0		0.01			0.01	
Heptachlor	76-44-8	0.52	0.0038	0.000079(hc)	0.053	0.0036	0.000079(hc)
Heptachlor epoxide	1024-57-3	0.52	0.0038	0.000039(hc)	0.053	0.0036	0.000039(hc)
Hexachlorobenzene	118-74-1			0.00028(hc)			0.00029(hc)
Hexachlorobutadiene	87-68-3			0.44(hc)			18(hc)
Hexachlorocyclopentadiene	77-47-4			40(h)			1,100(h)
Hexachloroethane	67-72-1			1.4(hc)			3.3(hc)
Indeno(1,2,3-cd)pyrene	193-39-5			0.038(hc)			0.18(hc)
Isophorone	78-59-1			35(hc)			960(hc)
Lead	7439-92-1	38(d)(s)	5.4(d)(s)	5.0(h)(T)	210(d)(s)	24(d)(s)	
Malathion	121-75-5		0.1			0.1	
Manganese	7439-96-5						100(h)(T)
Mercury	7439-97-6	1.4(d)(s)	0.77(d)(s)	0.050(h)(T)	1.8(d)(s)	0.94(d)(s)	0.051(h)(T)
Methoxychlor	72-43-5		0.03	40(h)		0.03	
Methyl bromide (bromomethane)	74-83-9			47(h)			1,500(h)
Methyl t-butyl ether (MTBE)	1634-04-4			70(h)			

Federal and NJ State Primary and Secondary Drinking Water Standards as of June 2020

Volatile Organic Compounds

Contaminants	Maximum Contaminant Levels [MCL] [µg/l or ppb]
Benzene	1*
Carbon Tetrachloride	2*
1,2-Dichlorobenzene	600
1,3-Dichlorobenzene	600*
1,4-Dichlorobenzene	75
1,1-Dichloroethane	50*
1,2-Dichloroethane	2*
1,1-Dichloroethylene	2*
cis-1,2-Dichloroethylene	70
trans-1,2-Dichloroethylene	100
1,2-Dichloropropane	5
Ethylbenzene	700
Methyl tertiary Butyl Ether	70*
Methylene Chloride	3*
Monochlorobenzene	50*
Napthalene	300*
Styrene	100
1,1,2,2-Tetrachloroethane	1*
Tetrachloroethylene	1*
Toluene	1,000
1,2,4-Trichlorobenzene	9*
1,1,1-Trichloroethane	30*
1,1,2-Trichloroethane	3*
Trichloroethylene	1*
Vinyl Chloride	2
Xylenes [Total]	1,000*

Radionuclides

Contaminants	Maximum Contaminant Levels [MCL]
Combined radium 226/228	5 pCi/L
Gross alpha particles	15 pCi/L
Beta/photon emitters	4 mrem/year
Uranium	30 µg/L

Other Contaminants

Turbidity No more than 5% of the samples may exceed 0.3 NTU, nor any sample exceed 1 NTU.

Coliform bacteria standards are based on an MCL for *E. coli*, and uses *E. coli* and total coliforms to initiate a “find and fix” approach to address fecal contamination that could enter into the distribution system. It requires public water systems to perform assessments to identify sanitary defects and subsequently take action to correct them.

Inorganic Chemicals

Contaminants	Maximum Contaminant Levels [MCL] [µg/l or ppb]
Antimony	6
Arsenic	5 *
Asbestos	7 x 10 ⁶ fibers/l > 10 µm
Barium	2,000
Beryllium	4
Cadmium	5
Chromium	100
Copper	1,300*[AL]
Cyanide	200
Fluoride	4,000
Lead	15**[AL]
Mercury	2
Nickel	+
Nitrate [as nitrogen]	10,000
Nitrite	1,000
[combined nitrate/nitrite]	10,000
Selenium	50
Thallium	2

Disinfection Byproducts

Contaminants	Maximum Contaminant Levels [MCL] µg/L or ppb (as running annual averages per group)
As	5
Cd	5
Cr	5
Pb	5
Se	5
Ag	5
Al	5
Co	5
Cu	5
Fe	5
Mn	5
Ni	5
Sn	5
V	5
Zn	5

Synthetic Organic Compounds

Contaminants	Maximum Contaminant Levels [MCL] [µg/l or ppb]
Aldichlor	2
Aldicarb	+
Aldicarb Sulfone	+
Aldicarb Sulfoxide	+
Altrazine	3
Benzo[a]pyrene	0.2
Carbofuran	40
Chlordane	0.5*
Dalapon	200
Dibromochloropropane [DBCP]	0.2
Di[2-ethylhexyl]adipate	400
Di[2-ethylhexyl]phthalate	6
Dinoseb	7
Diquet	20
Endothall	100
Endrin	2
Ethylene dibromide [EDB]	0.05
Glyphosate	700
Heptachlor	0.4
Heptachlor Epoxide	0.2
Hexachlorobenzene	1
Hexachlorocyclopentadiene	50
Lindane	0.2
Methoxychlor	40
Oxamyl	200
PCBs	0.5
Pentachlorophenol	1
Perfluorooctanoic acid (PFNA)	0.013*
Perfluorooctanoic acid (PFOA)	0.014*
Perfluorooctane sulfonic acid (PFOS)	0.013*
Picloram	500
Slimazine	4
Toxaphene	3
2,3,7,8-TCDD [Dioxin]	3x10 ⁻⁵
2,4-D	70

Secondary Standards

Physical Characteristics		Recommended Upper Limit or Optimum Range	
Color		10 color units (standard cobalt scale)	
pH		6.5 to 8.5 (optimum range)	
Odor		3 Threshold odor number	
Taste		No objectionable taste	
Chemical Characteristics		Recommended Upper Limit [mg/l or ppm]	
ABS/L.A.S.		0.5	
Aluminum Chloride		0.2	
Fluoride		250	
Hardness (as CaCO ₃)		2	
Iron		2.50	
		0.3	
Manganese		0.05	
Silver		0.1	
Sodium Sulfate		50	
		250	
Total Dissolved Solids (TDS)		500	
Zinc		5	

Key:
 * N.J. MCL [A-280]
 ** An [A.] action level is not an MCL. It is a trigger point at which remedial action is to take place
 + No MCL – Monitoring Required

One milligram per liter [mg/l] = one part per million = one cent in \$10,000 or one second in 12 days.
One microgram per liter [µg/l] = one part per billion = one cent in \$10,000,000 or one second in 32 years.



New Jersey Department of Environmental Protection

Division of Water Supply and Geoscience

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New Jersey Surface Water Quality Standards Antidegradation Designations

July 2017

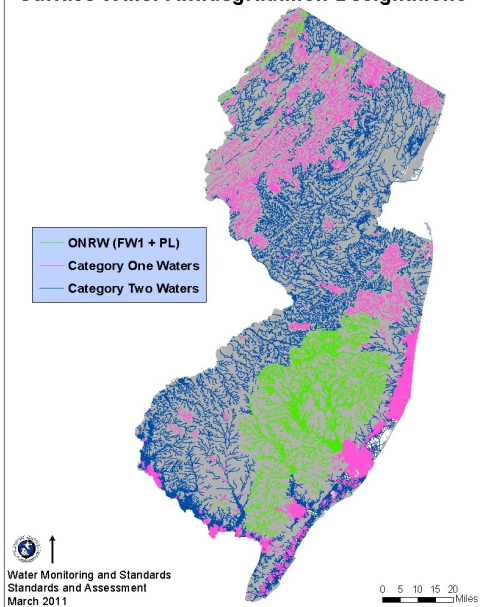
Antideg. (Page 1 of 2)



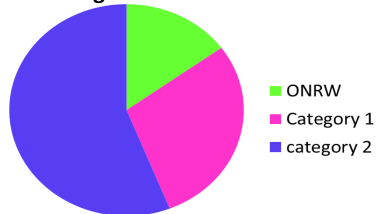
Three Tiers of Antidegradation

- **Outstanding National Resource Waters (ONRW)**
 - Freshwater 1 (FW1)
 - Pinelands (PL)
- **Category One (C1)**-
Exceptional Resource waters
- **Category Two (C2)**-All other waters

Surface Water Antidegradation Designations



NJ Surface Water Antidegradation
Designations



The **Surface Water Quality Standards** (SWQS) establish antidegradation policies for all surface waters of the State at N.J.A.C. 7:9B. The SWQS require that all existing and designated uses shall be maintained and protected for all surface waters of the State. Impaired waters must be restored to meet SWQS. Existing water quality shall be maintained. The three tiers of antidegradation designations are described below.

The most protective tier of antidegradation designation is **Outstanding National Resource Waters** (ONRW) which include surface waters classified as FW1 and PL. These waters are set aside for posterity because of their unique significance. The Department cannot approve any activity which might alter existing water quality in these waters.

The second tier of antidegradation designation is **Category One** (C1). C1 waters are designated through rulemaking for protection from measurable changes in water quality because of their Exceptional Ecological Significance, Exceptional Water Supply, Exceptional Recreation, and Exceptional Fisheries to protect and maintain their water quality, aesthetic value, and ecological integrity.

All waters not designated in the SWQS as ONRW (FW1 or PL) or C1 are designated as **Category Two** (C2). The same criteria apply in C1 and C2 waters. In all cases, existing and designated uses must be maintained and protected. Waterbodies that are generally not meeting criteria must be improved to meet water quality criteria.

The SWQS operate in conformance with the Federal Clean Water Act at 33 U.S.C. 1313(c) and the Federal Water Quality Standards Regulations at 40 C.F.R. 131. New Jersey's statutory authority is granted by the Water Pollution Control Act at N.J.S.A. 58:10A and the Water Quality Planning Act at N.J.S.A. 58:11A.



New Jersey Surface Water Quality Standards Antidegradation Designations: Category One

Antideg. (Page 2 of 2)



Category One (C1) designation provides additional protection to waterbodies that help prevent water quality degradation and discourage development where it would impair or destroy natural resources and water quality. The maintenance of water quality is important to all residents, particularly to the many communities that depend upon surface waters for drinking water supplies, recreation, fishing, and shellfish harvesting.



Category One waters were originally designated in 1985 based on parks, wildlife management areas, and trout production waters. After 1985, additional streams upgraded to FW2-trout production were routinely designated as C1. In 2002, the Department began an intensive effort to identify additional waters that warranted enhanced protections afforded by this designation. The Department adopted new definitions of Exceptional Ecological Significance, Exceptional Fisheries Resource(s), and Exceptional Water Supply Significance to clarify data requirements for a waterbody to be designated as C1.



Under the definition of Exceptional Ecological Significance, the Department considers those waterbodies supporting certain aquatic-dependent T&E (bog turtles and mussels) or exceptional aquatic community can qualify for C1. Waterbodies that support unimpaired benthic macroinvertebrates and indicate exceptional value for only two of the four data sources: habitat, physical/chemical water quality data, fish assemblage, and low impervious surface can qualify under exceptional aquatic community.



Under the definition of Exceptional Fisheries Resource(s), trout production waters classified as FW2-TP and approved shellfish harvesting waters can qualify for C1.



Under the definition of Exceptional Water Supply Significance, waterbodies that are part of the water supply system that serves a population greater than 100,000, including any reservoirs and streams that directly flow into those reservoirs can qualify for C1. See <http://www.state.nj.us/dep/wms/bears/c1waters.htm>.



Implementation of Category One Waters

- **New Jersey Pollutant Discharge Elimination System (NJPDES) Rules at N.J.A.C. 7:14A:** New or expanded wastewater discharges must maintain the existing water quality of the receiving stream. If the discharge is located above a C1 segment the applicant must meet "no measurable change" at the C1 boundary. See www.nj.gov/dep/dwq/.
- **Flood Hazard Area Control Act Rules at N.J.A.C. 7:13:** 300 foot riparian zones are imposed through Flood Hazard Area Control Act rule permits to all C1 waters and their upstream tributaries within the same sub-watershed or HUC 14. See www.nj.gov/dep/landuse/.

For additional information, please see <http://www.state.nj.us/dep/wms/bears/c1waters.htm>.

Acute	Chronic	Classification
2.35	0.54	FW2-TM,TP
5.80	0.54	FW2-NT
	0.54	FW2

FW2-TM,TP

FW2-TM,TP

pH

Temp (C)

2.35

8.45

14.5

Used field measured pH and temp from October 16, 2024 sampling event

Acute

2.35

FW2-TM,TP	pH	
2.58	8.45	14.5
0.72	0.72	
0.01	0.01	
1.00		
0.06	8.45	
1.62	0.09	
1.00		
17.62	8.45	
23.12		
36.47	36.47	14.5
FW2-TM,TP	2.58	

Acute

2.58

FW2-NT	pH	
5.80	8.45	14.5
0.72	0.72	
0.01	0.01	
1.00		
0.06	8.45	
1.62	0.09	
1.00		
17.62	8.45	
51.93		
81.93	81.93	14.5
FW2-NT	5.80	

Acute

5.80

FW2	pH	
0.54	8.45	14.5
0.89	0.89	
0.03	0.02	
1.00		
0.17	8.45	
1.20	0.18	
1.00		
5.78	8.45	
2.13		
3.03	3.03	14.5
FW2	0.54	

Chronic

0.54

3. Ammonia, total
(mg TAN/L)

7664-41-7

i.

$$\text{MIN} \left(\left(\frac{0.275}{1 + 10^{7.204 - pH}} + \frac{39.0}{1 + 10^{pH - 7.204}} \right), \left(0.7249 \times \left(\frac{0.0114}{1 + 10^{7.204 - pH}} + \frac{1.6181}{1 + 10^{pH - 7.204}} \right) \times (23.12 \times 10^{0.036 \times (20 - T)}) \right) \right) \text{ (acute)}$$

FW2-TP,

FW2-TM

ii.

$$0.7249 \times \left(\frac{0.0114}{1 + 10^{7.204 - pH}} + \frac{1.6181}{1 + 10^{pH - 7.204}} \right) \times \text{MIN}(51.93, 23.12 \times 10^{0.036 \times (20 - T)}) \text{ (acute)}$$

FW2-NT

iii.

$$0.8876 \times \left(\frac{0.0278}{1 + 10^{7.688 - pH}} + \frac{1.1994}{1 + 10^{pH - 7.688}} \right) \times (2.126 \times 10^{0.028 \times (20 - \text{MAX}(T, 7))}) \text{ (chronic)}$$

All FW2

Parameter Units CAS No.
Ammonia mg TAN/L 7664-41-7

Acute	Chronic	Classification
0.98	0.25	FW2-TM,TP
2.21	0.25	FW2-NT
	0.25	FW2

FW2-TM,TP

FW2-TM,TP	pH	Temp (C)
2.14	8.5	25
0.275	0.26	
1.00		
0.05	8.5	
39.00	1.88	
1.00		
19.77	8.5	
FW2-TM,TP	2.14	

Acute 2.14

FW2-TM,TP	pH	
0.98	8.5	25
0.72	0.72	
0.01	0.01	
1.00		
0.05	8.5	
1.62	0.08	
1.00		
19.77	8.5	
23.12		
15.28	15.28	25
FW2-TM,TP	0.98	

Acute 0.98

FW2-NT

FW2-NT	pH	
2.21	8.5	25
0.72	0.72	
0.01	0.01	
1.00		
0.05	8.5	
1.62	0.08	
1.00		
19.77	8.5	
51.93		
34.31	34.31	25
FW2-NT	2.21	

Acute 2.21

Chronic

FW2	pH
-----	----

			0.25	8.5	25
		0.89	0.89		
		0.03	0.02		
		1.00			
		0.15		8.5	
		1.20	0.16		
		1.00			
		6.49		8.5	
		2.13			
		1.54	1.54		25
Chronic	0.25	FW2	0.25		

Source: NJAC 7:9B Dec-23

3. Ammonia, total
(mg TAN/L)

7664-41-7

i.

$$\text{MIN} \left(\left(\frac{0.275}{1 + 10^{7.204 - pH}} + \frac{39.0}{1 + 10^{pH - 7.204}} \right), \left(0.7249 \times \left(\frac{0.0114}{1 + 10^{7.204 - pH}} + \frac{1.6181}{1 + 10^{pH - 7.204}} \right) \times (23.12 \times 10^{0.036 \times (20 - T)}) \right) \right) \text{ (acute)}$$

FW2-TP,
FW2-TM

ii.

$$0.7249 \times \left(\frac{0.0114}{1 + 10^{7.204 - pH}} + \frac{1.6181}{1 + 10^{pH - 7.204}} \right) \times \text{MIN}(51.93, 23.12 \times 10^{0.036 \times (20 - T)}) \text{ (acute)}$$

FW2-NT

iii.

$$0.8876 \times \left(\frac{0.0278}{1 + 10^{7.688 - pH}} + \frac{1.1994}{1 + 10^{pH - 7.688}} \right) \times (2.126 \times 10^{0.028 \times (20 - \text{MAX}(T, 7))}) \text{ (chronic)}$$

All FW2



Aquatic Life Ambient Water Quality Criteria for Ammonia - Freshwater (2013)

Summary

EPA has published national recommended ambient water quality criteria for the protection of aquatic life from the toxic effects of ammonia, a constituent of nitrogen pollution. These recommended criteria will help States, Territories, and authorized Tribes update their water quality standards with concentration levels for ammonia in surface waters at or below which aquatic organisms will be protected, if not exceeded more frequently than once every three years on average. Acute and chronic criteria were developed to protect organisms from both immediate effects, such as mortality, and longer-term effects on reproduction, growth and survival, respectively.

EPA's final *Aquatic Life Ambient Water Quality Criteria for Ammonia – Freshwater* (2013) incorporate scientific views received on EPA's 2009 draft updated ammonia criteria and supersede EPA's previously recommended 1999 ammonia criteria.

What are national recommended aquatic life ambient water quality criteria?

Ambient water quality criteria for the protection of aquatic life are numeric concentrations of pollutants, with specific associated duration and frequency information, in surface waters that are protective of aquatic life designated uses. Under Clean Water Act section 304(a), EPA is required to develop and publish water quality criteria that reflect the latest scientific knowledge. Water quality criteria are based solely on data and scientific judgments about the relationship between pollutant concentrations and potential environmental and human health effects. EPA's recommended water quality criteria are not rules, nor do they automatically become part of a state's water quality standards. States must adopt into their standards water quality criteria that protect the designated uses of the water bodies

within their area. These can include scientifically defensible site-specific criteria that are different from EPA's national recommended criteria, as long as the site-specific criteria are protective of the designated use. Water quality criteria are not effective under the Clean Water Act until they have been adopted into a state's water quality standards and approved by EPA.

What is ammonia?

Ammonia is one of several forms of nitrogen that exist in aquatic environments. Unlike other forms of nitrogen, which can cause nutrient over-enrichment of a water body at elevated concentrations and indirect effects on aquatic life, ammonia causes direct toxic effects on aquatic life.

Ammonia is produced for commercial fertilizers and other industrial applications. Natural sources of ammonia include the decomposition or breakdown of organic waste matter, gas exchange with the atmosphere, forest fires, animal and human waste, and nitrogen fixation processes.

How does ammonia enter surface waters?

Ammonia can enter the aquatic environment via direct means such as municipal effluent discharges and the excretion of nitrogenous wastes from animals, and indirect means such as nitrogen fixation, air deposition, and runoff from agricultural lands.

How does ammonia affect aquatic life?

When ammonia is present in water at high enough levels, it is difficult for aquatic organisms to sufficiently excrete the toxicant, leading to toxic buildup in internal tissues and blood, and potentially death. Environmental factors, such as pH and temperature, can affect ammonia toxicity to aquatic animals.

What is the history of EPA's development of ammonia criteria?

EPA first published ammonia criteria for the protection of aquatic life in 1976. The criteria were then updated in 1985 and 1999 to reflect scientific information available at that time. The 1999 recommended aquatic life criteria for ammonia were based on the most sensitive endpoints known at the time: the acute criterion was based on salmonid fish toxicity information, and the chronic criterion was based on bluegill sunfish early life stage toxicity.

In 2003, EPA became aware of new toxicity studies indicating the relative sensitivity of freshwater mussels to ammonia and began to update the 1999 criteria to reflect this new information. In 2009, following external peer review, EPA published draft recommended ammonia criteria, for waters with and without mussels. Since the publication of the draft 2009 ammonia criteria, additional toxicity testing has validated information on the effects of ammonia on sensitive freshwater gill-breathing snail species. In April 2013, EPA finalized the updated ammonia criteria that are applicable nationally, taking into account the latest toxicity information for freshwater species, including unionid mussels and gill-breathing snails. The 2013 criteria incorporate scientific views received on the draft (2009) ammonia criteria and supersede EPA's previously recommended 1999 criteria.

What are the 2013 recommended water quality criteria for ammonia?

EPA recommends an acute criterion magnitude of 17 mg Total Ammonia Nitrogen (TAN) per liter at pH 7 and 20°C for a one-hour average duration, not to be exceeded more than once every three years on average. EPA recommends a chronic criterion magnitude of 1.9 mg TAN/L at pH 7 and 20°C for a 30-day average duration, not to be exceeded more than once every three years on average. In addition, the highest four-day average within a 30-day period should not exceed 2.5 times the chronic criterion magnitude (e.g. $1.9 \text{ mg TAN/L} \times 2.5 = 4.8 \text{ mg TAN/L}$ at pH 7 and 20°C) more than once in three years on average.

How do the 2013 criteria compare to the previously recommended 1999 criteria and the draft 2009 criteria?

The 2013 ammonia criteria recommendations take into account the latest freshwater toxicity information for ammonia, including toxicity studies for sensitive unionid mussels and gill-breathing snails. These new criteria are based on robust toxicity data available for 69 genera (acute) and 16 genera (chronic). The updated criteria magnitudes are more stringent than the previously recommended 1999 criteria magnitudes (see *Table 1*). The duration components of the 1999, 2009 and 2013 criteria remain the same - a one-hour average duration for the acute criterion and 30-day average duration for the chronic criterion. The frequency component for the acute and chronic criteria remains once in three years on average.

Table 1. Comparison of past and current EPA-recommended aquatic life water quality criteria magnitudes for ammonia. Criteria magnitudes are expressed as total ammonia nitrogen (mg TAN/L) at pH 7 and 20°C.

Criterion Duration	1999 Criteria	2009 Draft Updated Criteria	2013 Final Updated Criteria
Acute (1-hour average)	24	19	17
Chronic (30-day rolling average)	4.5*	0.91*	1.9*
*Not to exceed 2.5 times the criterion continuous concentration as a 4-day average within a 30-day period.			
Criteria frequency: Not to be exceeded more than once in three years on average.			

Additional EPA Resources

EPA has developed three supporting documents to aid states considering adoption of the 2013 recommended ammonia criteria.

Flexibilities for States Applying EPA's Ammonia Criteria Recommendations provides an overview of a number of implementation approaches available for state consideration, including the recalculation procedure for site-specific criteria derivation, variances, revisions to designated uses, dilution allowances, and compliance schedules. The document describes how each of these flexibilities fits within a state's water quality standards adoption and implementation processes.

EPA has also developed a *Revised Deletion Process for the Site-Specific Recalculation Procedure for Aquatic Life Criteria* that describes a recalculation procedure and includes a spreadsheet that may be used to derive site-specific water quality criteria for the protection of aquatic life in order to best reflect the organisms that reside at a specific site.

A third document, which EPA expects to publish in 2013, *Technical Support Document for Conducting and Reviewing Freshwater Mussel Studies for the Development of Site-specific Water Quality Criteria for Ammonia*, will help states determine if sensitive freshwater mussels are present in their waters. Commonly-used mussel sampling methods will be described and an overview will be provided of various study approaches, considerations, and limitations, including real-life examples.

How to View the Criteria Document and Supporting Information

EPA has established an official public docket for this action under Docket ID No. EPA-HQ-OW-2009-0921, accessed at www.regulations.gov. You may also download the document and supporting information from <http://water.epa.gov/scitech/swguidance/standards/criteria/aqlife/ammonia/index.cfm>.

For More Information

Contact Lisa Huff by telephone at (202) 566-0787, by email at huff.lisa@epa.gov, or by mail at U.S. EPA, MC: 4304T, 1200 Pennsylvania Ave., N.W., Washington, D.C. 20460.

Understanding Water Quality Parameters to Better Manage Your Pond

Rossana Sallenave¹

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INTRODUCTION

Successful pond management requires an understanding of the role of nutrients and other water quality parameters, as well as regular monitoring of environmental conditions within the pond's ecosystem. Water quality is often overlooked



in pond management, and poor water quality can lead to common problems, such as excessive algal blooms, overgrowth of plants, noxious smells, or dead and dying fish. In order to prevent these problems, an understanding of basic water chemistry and other physical parameters is necessary. This publication describes the most important water quality factors that influence the health of ponds. Some factors that are particularly important in recreational fish ponds to ensure fish health and pond productivity are also discussed. A basic understanding of how these factors interact with one another will help pond owners maintain good water quality and a healthy pond ecosystem. Many companies produce kits and other materials to monitor water quality on your own, or you can send water samples to commercial laboratories for analysis.

DISSOLVED OXYGEN

Dissolved oxygen (DO) is probably the single most important water quality factor for pond owners. Oxygen is needed by fish and other aquatic organisms, and levels of DO will determine the ability of ponds and other water bodies to support aquatic life. Oxygen dissolves in water at very low concentrations measured in parts per million (ppm, which can be used interchangeably with milligrams per liter [mg/L]). Ponds will rarely have more than 10 ppm DO. Most oxygen in water is produced by algae and green plants through photosynthesis, the process whereby green plants use solar energy to convert water and carbon dioxide (CO₂) to oxygen and carbohydrates. Oxygen is also naturally incorporated into water from the atmosphere through surface diffusion and turbulence caused by wind.

Daily fluctuations and seasonal changes in DO

Dissolved oxygen levels can vary dramatically in a 24-hour period. During the day, DO concentrations generated by photosynthesis will increase. During the

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night, DO levels will decline as oxygen is removed from water through respiration, the process whereby plants and animals consume oxygen and release carbon dioxide as they convert organic material to energy. For this reason, DO levels are typically highest at dusk and lowest just before dawn. There is also a strong relationship between temperature and DO: the warmer the water, the less oxygen it can hold. For example, water at 52°F (11°C) can hold 40% more oxygen than water at 80°F (27°C). Warm water increases the metabolism of fish and therefore increases their consumption of oxygen. Bacteria also consume oxygen as they decompose organic matter. Therefore, during the summer months, DO levels will be lower because of increased oxygen demands of fish, warmer water that holds less oxygen, and increased bacterial decomposition of dead plant and algal material toward the end of the growing season.

Effects of low DO

Oxygen depletion occurs when the demands for oxygen are greater than what is being produced. Oxygen depletion can occur for different reasons. Situations typically associated with oxygen depletion are

- Hot, cloudy, and still (windless) days;
- Pond stratification followed by turnovers (the mixing of stratified layers, which develop during the summer in ponds 8 ft deep or greater);
- After a sudden algal bloom die-off (from natural causes or after a chemical application); and
- Organic waste decomposition (oxygen depletion will occur in the presence of excessive organic matter from waste products, such as uneaten feed).

Whenever DO levels fall below 3 to 4 ppm, oxygen stress will occur. Lack of adequate dissolved oxygen is the leading cause of fish kills. Normal oxygen content in a healthy pond will range from 5 to 10 ppm. Warmwater fish (e.g., bass, bluegill, catfish) require about 5 ppm and coldwater fish (e.g., trout, salmon) require about 6.5 ppm to maintain good health. Dissolved oxygen levels of less than 3 ppm will kill warmwater fish and levels less than 5 ppm will kill coldwater fish. Fish exposed to low, nonlethal levels of DO over prolonged periods will be chronically stressed, stop eating, and be more susceptible to disease. Low oxygen concentrations also increase the activity of anaerobic bacteria, which create methane and hydrogen sulfide gases during anaerobic decomposition. Ponds with oxygen-poor bottoms and accumulated organic matter can release these gases when the bottom sediment is disturbed. Hydrogen sulfide has a rotten egg smell and is very toxic to fish.

Preventing low DO conditions

To help maintain safe DO levels in ponds, particularly in deeper ponds in which fish are intensively cultured, mechanical aeration is often needed. Aerators help keep pond water mixed so that layering is minimized and the surface

water is well-oxygenated. However, aeration should only be thought of as one of many management tools to help maintain healthy oxygen levels. External nutrient loading is still the critical issue that must be addressed because excessive nutrients can lead to an overabundance of aquatic weeds and algae, which can result in oxygen depletions when they die and decompose.

NUTRIENTS (PHOSPHORUS AND NITROGEN)

It is important to understand the sources and basic pathways of nutrients because there is a direct correlation between available nutrients and populations of algae and aquatic weeds. The most important nutrients in aquatic systems are phosphorus (P) and nitrogen (N) in the forms of phosphates (PO_3) and nitrates (NO_3). These nutrients are critical to the growth of plants and animals in aquatic systems. Phosphorus has been identified as the limiting factor for algal growth in most lakes and, as such, is the largest contributor to aquatic plant growth. One gram of phosphorus will produce 100 grams of algal biomass. Excessive amounts of nutrients will lead to over-fertilization, or eutrophic conditions, which can result in an overabundance of aquatic plants and algal blooms. When the excess plants and/or algae die, they decompose, which leads to a depletion of oxygen that can affect water clarity and smell and can lead to fish kills.

Sources of nutrients

The main sources of nutrients in ponds are bottom silt, dead vegetation, landscape debris, runoff from the surrounding area, poorly functioning septic systems, and wastes from livestock and waterfowl. As aquatic plants and algae grow and die, they sink to the bottom of the pond and provide a source of nutrients for future aquatic growth, a phenomenon known as nutrient cycling. This, along with landscape debris such as grass clippings, leaves, and pine needles, contributes nutrients to ponds, and these nutrients must be managed to prevent eutrophic conditions from developing. Runoff from fertilized fields and lawns in immediate surrounding areas as well as roads, farms, and outlying areas can also be major sources of nutrient enrichment.

Dissolved and particulate phosphorus

Phosphorus in water comes in two forms: dissolved and particulate. Dissolved phosphorus enters the aquatic environment from fertilizers, crop residues, or human or animal wastes, and is the form that is readily available to aquatic plants and algae. Particulate phosphorus is bound to soil particles and minerals that contain aluminum, iron, or calcium, as well as to organic matter, and enters aquatic systems primarily through soil erosion and surface runoff. While it may not be as readily available to aquatic plants, particulate phosphorus can accumulate in sediments and can be a source of slow release of phosphorus into the water for years.

NITROGENOUS WASTE (AMMONIA)

Ammonia is another compound that can affect the health and performance of your pond.

Sources of ammonia

Ammonia is a form of nitrogen found in organic materials and many fertilizers. It is the first form of nitrogen released when organic matter decays and is the main nitrogenous waste excreted by most fish and freshwater invertebrates. It is very unlikely that ammonia levels in your pond will reach levels that are lethal to fish. However, under conditions where fish are cultured intensively and fed protein-rich diets, they can produce high concentrations of ammonia, and fish may be exposed to sub-lethal levels (greater than 0.02 ppm) for extended periods of time. This can lead to reduced growth and increased susceptibility to disease.

Forms of ammonia

Ammonia can exist in two forms: un-ionized ammonia (NH_3) and ionized ammonia, also known as ammonium ion (NH_4^+). The ratio of un-ionized to ionized ammonia depends on pH and water temperature. Un-ionized ammonia (NH_3) is extremely toxic to fish and is the predominant form of ammonia when pH is high. Ionized ammonia (NH_4^+) is nontoxic except at extremely high levels and is the predominant form in water when pH is low. As a general rule, less than 10% of the ammonia will be the toxic un-ionized form when water pH values are lower than 8; however, this proportion increases greatly as pH increases. Water temperature will also affect the equilibrium between NH_3 and NH_4^+ . At any given pH, more toxic NH_3 will be present in warmer water than in cooler water.

Ammonia removal and transformation processes

There are two processes that remove or transform ammonia released into the water. The first is uptake of ammonia by plants and algae, which readily use the nitrogen in ammonia as a nutrient for growth. For this reason, ammonia levels are usually low in ponds during summer months when algae are most productive, but can increase rapidly after the crash of an algal bloom. This is also one of the reasons why ammonia levels will tend to be higher in ponds during the winter months when algal production is low.

The second process, which transforms ammonia, is a step in the nitrogen cycle known as nitrification, the biological conversion of ammonia and ammonium to nitrate nitrogen. Nitrification is a two-step process. First, *Nitrosomonas* bacteria convert ammonia and ammonium to nitrite (NO_2^-). Nitrite, which is also highly toxic to fish, is then converted to nitrate (NO_3^-) by *Nitrobacter* bacteria. These reactions are usually coupled, and nitrite is rapidly converted to nitrate, so nitrite levels are usually low. The rate of nitrification is affected by water temperature. Maximum rates of nitrification occur at water temperatures between 86 and 95°F (30–35°C). At temperatures of 104°F (40°C) and higher, nitrification rates fall to near zero. At temperatures below 68°F (20°C), nitrification proceeds at

a slower rate, but will continue at temperatures of 50°F (10°C) or less. For this reason, ammonia levels tend to be higher in fall and early spring before nitrification rates have increased as a result of increasing temperatures.

pH

The term pH refers to the concentration of hydrogen ions, and is a measure of whether a substance is an acid, a base, or neutral. The “p” in pH stands for “power” and the “H” for hydrogen ions. The scale of pH values ranges from 0 to 14; 7 represents neutral conditions, values less than 7 indicate more acidic conditions, and values above 7 indicate more alkaline or basic conditions.

Daily fluctuations in pH

The pH of freshwater ponds can fluctuate considerably both daily and seasonally; the magnitude of this fluctuation will depend on how well-buffered the freshwater system is. These fluctuations are due to photosynthesis and respiration by plants and animals, which results in the highest pH typically occurring at dusk and the lowest at dawn. This is because during the night respiration increases concentrations of carbon, which interacts with water to produce carbonic acid (H_2CO_3), lowering the pH. During the day, carbon dioxide concentrations decrease because of photosynthesis, driving pH values up.

How pH affects animals and other water quality variables

Optimum pH for fish growth and health is between 6 and 9. If pH is outside this range, fish growth will be reduced. Mortalities will occur when pH values are less than 4.5 or greater than 10. In addition to the direct effects pH can have on fish and other aquatic animals, pH interacts with other water quality variables such as ammonia, hydrogen sulfide, and dissolved metals, affecting their aqueous equilibria and toxicity as well. For example, as previously mentioned, high pH increases the toxicity of ammonia to fish, whereas low pH increases toxicity of aluminum and copper. Hydrogen sulfide (H_2S) is a toxic, colorless gas that can form in pond sediments when bacteria feed on organic debris in areas that are low or depleted of oxygen, giving off a rotten egg smell when the sediments are stirred up. When dissolved in water, H_2S can undergo two chemical steps, which go back and forth depending on the pH. At pH less than 6, most of the hydrogen sulfide will be in the toxic H_2S form, whereas at higher pH (8–12), most of the hydrogen sulfide will be in the less toxic HS^- form.

ALKALINITY

Alkalinity refers to the water’s buffering capacity, or its ability to withstand changes in pH. It is a measure of the total concentration of bases in pond water, including carbonates, bicarbonates, hydroxides, phosphates, and borates, and is expressed in ppm calcium carbonate. All these

bases react with and neutralize acids, which in turn buffers changes in pH. The pH of well-buffered water will normally fluctuate between 6.5 and 9. Carbonates and bicarbonates are the most common and important components of alkalinity. In an established pond, the ideal alkalinity measurement should be around 100 ppm, but readings from 50 to 200 ppm are acceptable. If the alkalinity is low, even a small amount of acid can cause a large change in pH. Alkalinity values greater than 300 ppm will not adversely affect fish, but such high values will render some commonly used chemicals, such as copper sulfate, ineffective. Alkalinity can be increased by adding agricultural limestone [CaCO_3 and $\text{CaMg}(\text{CO}_3)_2$] to ponds.

HARDNESS

Hardness is a measure of divalent salts, or positively charged ions, particularly calcium (Ca^{2+}) and magnesium (Mg^{2+}), in water. Total hardness is the sum of the concentrations of Ca^{2+} and Mg^{2+} , expressed in ppm calcium carbonate. Calcium carbonate hardness is a general term that indicates the total amount of divalent salts present, but it does not specify which salts are causing water hardness. Hardness and alkalinity are often confused because both are expressed using the same term (ppm calcium carbonate), and sometimes both parameters have similar values in a given water body. However, alkalinity measures negative ions (carbonate and bicarbonate) and hardness measures positive ions (calcium and magnesium), and sometimes these values can differ greatly. If limestone (calcium carbonate) is the cause of hardness and alkalinity, these values will be similar or identical. However, if sodium bicarbonate (NaHCO_3) is responsible for high alkalinity, it is possible for water to have high alkalinity and low hardness and calcium. Calcium and magnesium are essential to fish for biological processes such as bone and scale formation. If your pond is used to culture fish, water hardness should be above 50 ppm and can be adjusted by adding agricultural limestone.

SUMMARY

A basic understanding of the chemical components of aquatic ecosystems is important to successfully manage any pond or lake. The interaction between temperature, nutrients, and oxygen plays a critical role in many common problems encountered by pond owners, such as excessive algal growth, oxygen depletion, and fish kills. A healthy pond ecosystem is easier to achieve by understanding this interaction and managing excessive nutrient loading to the pond system. Other parameters, such as pH, alkalinity, and

hardness, can also affect fish growth and survival and can influence toxicity of other compounds, such as ammonia and metals. Water quality testing should be considered if your pond is to be used for intensive fish culture. A variety of methods are available to monitor water quality. Several companies produce kits and materials to monitor water quality, or water samples can be sent off to commercial laboratories for testing.

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Environmental Assessment and Risk Analysis Element



Research Project Summary



May, 2003

Ambient Levels of Metals in New Jersey Soils

Paul F. Sanders, Ph.D.

Abstract

Between 1996 and 2001, three studies were conducted to determine the ambient levels of extractable metals in New Jersey soils. These studies were conducted to gather information to support the development of soil cleanup criteria, which cannot be set below ambient levels. A total of 248 soil samples were taken from the urban Piedmont region, the urban Coastal Plain region, and rural regions of the Valley and Ridge, Highlands, and Coastal Plain provinces. Local or point sources of contamination were avoided by the use of Geographic Information System databases and by following sample location guidelines in the field. Surface soil samples (0-6") were analyzed for acid-extractable Target Analyte List (TAL) metals using USEPA SW-846 methods that are normally used to conduct initial investigations at hazardous waste sites. With one exception, median and 90th percentile concentrations of all metals were below current soil cleanup criteria. The exception was the 90th percentile arsenic concentration from the urban Piedmont study, which slightly exceeded the arsenic criterion. Otherwise, only certain individual samples contained metal concentrations above current criteria. A single rural soil sample yielded a beryllium concentration slightly above the corresponding criterion. For the urban Coastal Plain study, three of the 91 samples contained levels of arsenic above the current criterion. The urban Piedmont study yielded eight samples out of 67 where levels of arsenic or lead exceeded the criteria.

Introduction

Current New Jersey law requires that the NJDEP determine background levels of contaminants in soils and that "Remediation [of contaminated areas] shall not be required below regional natural background levels for any particular contaminant" [N.J.S.A. 58:10B-12(g)(4)]. "Natural background level" is further defined as "...the concentration of a contaminant consistently present in the environment of the region of the site and which has not been influenced by localized human activities...." Therefore, naturally occurring constituents in soil and those resulting from regional deposition are included, but not those from point contamination sources. The concentrations of contaminants included in this definition are referred to as "ambient concentrations." To support the above directive, three studies were conducted to determine ambient levels of metals in several regions of New Jersey (BEM Systems, Inc., 1997, 1998, 2002). The first two studies investigated metal concentrations in the urban Piedmont and urban Coastal Plain regions of New Jersey. These two areas contain a majority of the hazardous waste sites in the state. Furthermore, the high population density and significant industrial activity in these

regions yields an upper estimate of ambient metal concentrations, due to a larger impact of regional atmospheric deposition. The third study focused on rural areas of the Ridge and Valley, Highlands and Coastal Plain provinces, and provided an indication of metals concentrations in areas less impacted by atmospheric deposition.

Methods

A total of 248 soil samples were taken in the three studies: 67 from the urban Piedmont region, 91 from the urban Coastal Plain region, and 90 from the three rural provinces (Figure. 1). The rural soil samples were distributed among the predominant soil types in each of the regions on a rural acreage basis. The sample locations for the urban studies were generally distributed among municipalities classified as "urban" by population density criteria. For the urban Piedmont studies, the criterion usually applied was a population density of 7,500 or more people per square mile, as per the State Development and Redevelopment Plan. For the urban Coastal Plain study, the population density criteria was reduced to 4,000 or more people per square mile because a

higher population density would have resulted in only eight municipalities being sampled. In addition, municipalities were added to both urban studies that did not meet the density criteria because they contained high population density regions or substantial industrial activity. For the urban studies, samples were located in public parks because of ease of access, a likelihood that these soils have been undisturbed for some time, and because they usually met a specified 50% open space (lawn) requirement. This latter requirement was specified because forest cover or other obstructions could reduce the impact of atmospheric deposition. Sports fields or other manicured areas were not acceptable locations because of turf maintenance issues often associated with them, including chemical applications. For the rural study, sampling in forested areas was usually unavoidable since this is the natural vegetation cover of much of New Jersey, and it was desired to avoid areas impacted by human activity. For all studies, sample locations were also required to be specified minimum distances from known hazardous waste sites, roadways, and railroads.

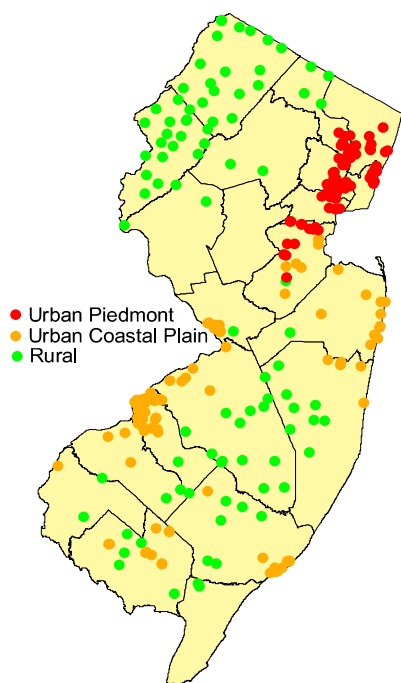


Figure 1. Sample locations

Soil samples were taken from a depth of 0-6 inches after removing surface litter. Samples were analyzed for acid-extractable Target Analyte List (TAL) metals using New Jersey certified laboratories. The methods used were those used to conduct site investigations at hazardous waste sites, specifically

the U.S. Environmental Protection Agency Office of Solid Waste SW-846 methods. The extraction method used was Method 3050. Many metals were analyzed using inductively coupled plasma – atomic emission spectrometry (Method 6010). For certain metals, lower detection limits were desired because of low ambient concentrations or low soil ingestion criteria based on toxicity concerns. Atomic absorption furnace methods were used for arsenic, lead, selenium and thallium (Methods 7060, 7421, 7740 and 7841, respectively). Mercury was analyzed via cold vapor atomic adsorption (Method 7471).

Results

Acid-extractable median and 90th percentile concentrations, and the corresponding method detection limits for the twenty-three target analyte metals in 248 surface soil samples from the three studies were calculated (Table 1). The rural study results are separately presented for each of the three physiographic provinces.

Aluminum, iron, calcium, sodium, potassium, magnesium and manganese are abundant in soils and were frequently measured at several hundred to several thousand mg/kg. (Sodium concentrations are lower because it is largely leached from soils in humid climates.) Barium, chromium, vanadium and zinc are also relatively common in soils and were frequently measured at concentrations between 10 and 100 mg/kg. Zinc showed some indication of anthropogenic contribution in urban areas in that a few samples yielded concentrations in the 150-350 mg/kg range. (Naturally occurring total zinc concentrations in soil do not commonly exceed 100 mg/kg [Kabata-Pendias and Pendias, 1984].)

Nickel, copper, cobalt and lead are somewhat less common. The first three of these metals were generally measured at levels less than 50 mg/kg. Some samples in urban areas had copper concentrations in the 50-150 mg/kg range, while rural samples never exceeded 30 mg/kg. This suggests urban contribution above natural levels. Lead is well known to be elevated in surface soils due to industrial activities and the historical use of leaded gasoline (Kabata-Pendias and Pendias, 1984). Lead concentrations were highest in the urban Piedmont region (several samples in the 300 mg/kg range), somewhat lower in the urban Coastal plain (usually less than 200 mg/kg), and lowest in the rural study (only two samples greater than 125 mg/kg).

Mean total arsenic concentrations in United States soils have been reported to be 5-8 mg/kg (Kabata-Pendias and Pendias, 1984). In this study, median

Table 1. Ambient Concentration of Extractable Metals Measured in 248 New Jersey soil samples.

Urban Piedmont				Urban Coastal Plain				
Method Detection Limit (mg/kg)	No. of detects n=67	Median Concentration (mg/kg)	90th Percentile Concentration (mg/kg)	Method Detection Limit (mg/kg)	No. of detects n=91	Median Concentration (mg/kg)	90th Percentile Concentration (mg/kg)	
Aluminum	1.5	67	10500	14400	20	91	6800	10800
Antimony	1.7	17	<DL	3.48	6	0	<DL	<DL
Arsenic	0.13	67	5.2	24.2	1	82	5.2	13.6
Barium	0.22	67	80.6	168	20	60	28.3	65.8
Beryllium	0.14	65	0.51	0.82	0.5	15	<DL	0.68
Cadmium	0.4	21	<DL	0.67	0.5	5	<DL	<DL
Calcium	11.2	67	1425	3010	500	59	995	2000
Chromium	0.9	67	18.5	29.9	1	91	11.8	34.7
Cobalt	0.5	67	6.3	10.4	5	7	<DL	<DL
Copper	0.52	67	29.5	75.5	2.5	82	9.3	33.3
Iron	2.2	67	14600	20000	10	91	8830	21100
Lead	0.063	67	111	297	10	82	37.6	144
Magnesium	5	67	2190	4614	500	54	673	1870
Manganese	0.21	67	311	859	1.5	91	62.4	206
Mercury	0.1	50	0.18	0.63	0.1	39	<DL	0.21
Nickel	0.9	67	12.4	24.6	4	43	<DL	12.3
Potassium	32	67	693	1524	500	45	<DL	1750
Selenium	0.5	61	0.41	0.71	1	0	<DL	<DL
Silver	0.22	28	<DL	0.86	1	3	<DL	<DL
Sodium	16.4	60	90.1	141	500	0	<DL	<DL
Thallium	0.2	28	<DL	0.25	1	2	<DL	<DL
Vanadium	0.95	67	29.6	41.7	5	86	16	35.5
Zinc	2	67	75.3	162	2	88	39.9	106

Rural Areas of New Jersey

Rural studies	Ridge and Valley Province				Highlands Province			Coastal Plain Province		
	Method	No. of	Median	90th Percentile	No. of	Median	90th Percentile	No. of	Median	90th Percentile
	Detection Limit (mg/kg)	detects n=23	Concentration (mg/kg)	Concentration (mg/kg)	detects n=23	Concentration (mg/kg)	Concentration (mg/kg)	detects n=44	Concentration (mg/kg)	Concentration (mg/kg)
Aluminum	3.23	23	15300	21080	23	16800	28980	44	1375	6760
Antimony	0.42	0	<DL	<DL	0	<DL	<DL	11	<DL	0.56
Arsenic	0.28	23	4.9	7.32	23	4.8	9.96	36	1.15	6.15
Barium	0.09	19	60.2	101.16	22	69.6	96.64	34	7.25	55.31
Beryllium	0.01	8	<DL	0.91	19	0.73	1.08	9	<DL	0.14
Cadmium	0.03	0	<DL	<DL	11	<DL	0.32	9	<DL	0.13
Calcium	41.7	10	<DL	2272	20	1160	4518	33	76.4	341.7
Chromium	0.17	23	14.3	21.2	23	17.7	26.64	44	2.9	11.76
Cobalt	0.18	12	7.3	11.4	18	6.8	12.44	32	0.37	1.18
Copper	0.33	23	17.2	26.04	23	16	28.96	44	4.2	11.43
Iron	4	23	14800	28540	23	18700	27860	44	1795	10587
Lead	0.22	23	31.6	54	23	26.6	59.02	44	17.5	54.05
Magnesium	14.4	19	2600	7182	23	2340	4024	34	79.65	513.2
Manganese	0.27	23	470	1192	23	407	836.8	44	11.65	35.39
Mercury	0.016	22	0.1	0.15	23	0.09	0.18	28	0.04	0.14
Nickel	0.21	20	15.7	22.5	23	11.6	19.04	30	0.84	3.87
Potassium	6.63	17	961	1660	21	955	1456	30	76	328
Selenium	0.49	0	<DL	<DL	10	<DL	0.99	7	<DL	0.68
Silver	0.1	0	<DL	<DL	5	<DL	0.21	0	<DL	<DL
Sodium	6.78	0	<DL	<DL	8	<DL	85.1	28	54.65	91.9
Thallium	0.41	0	<DL	<DL	0	<DL	<DL	1	<DL	<DL
Vanadium	0.07	23	20.7	29.68	23	32.3	52.98	40	7.8	20.68
Zinc	0.18	23	75.8	112.3	23	69.7	111.6	44	6.7	27.64

extractable arsenic concentrations were typically about 5 mg/kg, and concentrations never exceeded 15 mg/kg in the rural study. In the urban studies, the maximum concentration was 83 mg/kg, and 95th percentile values were below 30 mg/kg. These higher concentrations are within the normal ranges for soils, particularly glauconitic soils naturally high in arsenic (Dooley, 2001). Some soil samples in the urban Coastal Plain study were taken from glauconitic soils, and they yielded some of the higher concentrations measured (including the maximum value measured, 83 mg/kg). However, other samples from this study

with elevated arsenic were not from glauconitic regions. Furthermore, the urban Piedmont study did not include glauconitic soils, where a significant percentage of the samples also exhibited elevated levels of arsenic relative to the rural study. This suggests some anthropogenic contribution of arsenic to urban surface soils.

Mean total beryllium concentrations in United States soils are about 1-2 ppm (Kabata-Pendias and Pendias, 1984). Extractable concentrations of beryllium in this study ranged from non-detectable to

3 mg/kg. Total antimony concentrations in United States soils are generally less than 1 ppm (Kabata-Pendias and Pendias, 1984). This study yielded extractable antimony concentrations that ranged from non-detectable levels to 13 mg/kg, with the higher concentrations being associated with the urban Piedmont samples. Thallium, mercury, cadmium, silver and selenium are naturally present at only trace levels in soils (usually less than 1 ppm) in soils (Kabata-Pendias and Pendias, 1984). In this study, thallium and silver were seldom detected, and selenium, cadmium and mercury were either not detected or measured at concentrations that were usually less than 1 mg/kg. A few samples, mostly from urban areas, contained cadmium at concentrations above 0.5 mg/kg or mercury above 1.0 mg/kg, which suggests contribution from industrial activity or regional atmospheric deposition.

Statistically, several metals were found at lower concentrations in the coastal plain regions of the state relative to the remainder of the state. Coastal Plain soils have high sand contents, lower organic carbon contents and lower pH values than soils in the remainder of the state, which decrease their affinity for metals.

Discussion

The metals concentration data collected in these series of studies are useful for determining typical ambient levels of the various metals in the geographical regions studied. Levels significantly above these concentrations may indicate a spill or discharge has occurred. The metals of greatest environmental concern are those in which ambient levels in surface soils equal or exceed concentrations that are considered hazardous to human health. In such cases, regulatory levels applicable for remedial activities at contaminated sites may be limited by prevailing ambient concentrations. The most important example of this situation occurs with arsenic. The health-based soil ingestion criterion for arsenic (0.4 mg/kg) is significantly below observed ambient levels, even in soils unaffected by human activity. All studies except the rural Coastal Plain study yielded median extractable arsenic concentrations of about 5 mg/kg, more than ten times the health-based number. The rural Coastal Plain median concentration (1 mg/kg) was also above the health-based ingestion criteria.

The current soil cleanup criterion for arsenic in soil is 20 mg/kg, based on an earlier assessment of ambient levels. The 90th percentile concentration of arsenic from the urban Piedmont study (26 mg/kg) is somewhat higher than this value. In the urban Coastal Plain study, three of the ninety-one samples

yielded arsenic levels above 20 mg/kg. The rural areas of the state yielded 95th percentile concentrations ranging from 5-10 mg/kg, and no samples exceeded 20 mg/kg.

Total arsenic levels in glauconite-bearing soils in New Jersey have been reported to range from 13-131 mg/kg, with a median of 30 mg/kg (Dooley, 2001). When only extractable arsenic from 0-6" soil samples are considered from the glauconite study, the median, 90th percentile and maximum concentrations are 8.2, 27.5, and 63.3 mg/kg, respectively. These concentrations are only moderately higher than those observed for the urban studies.

The health-based non-residential soil criterion for hexavalent chromium based on soil inhalation is 20 mg/kg, which is below the 90th percentile ambient concentrations reported in this study. However, chromium in soil has been reported to be dominated by the much less toxic trivalent form, so ambient concentrations are not likely to be of concern for this metal. A hexavalent chromium-specific method would be recommended for analysis of soil when this metal is known to be of concern.

With regards to the remaining metals, only one sample yielded a result where current criteria were exceeded. This sample was taken from the urban Piedmont region and yielded a lead concentration of 464 mg/kg, which is slightly greater than the current lead criterion of 400 mg/kg.

Other than arsenic, the only other metal with the current soil criterion set by ambient levels is beryllium (criterion = 2 mg/kg, based on earlier New Jersey data and other literature). In this study, 90th percentile concentrations frequently approached 1 mg/kg (Table 1), 95th percentile concentrations in the rural highlands exceeded 1 mg/kg (1.4 mg/kg), and overall, ten samples out of 248 yielded concentrations between 1 and 2 mg/kg. Only one sample exceeded 2 mg/kg (2.8 mg/kg from the rural Highlands province).

The thallium criterion is currently set by the Practical Quantitation Level (2 mg/kg), since the health-based criteria is lower (zero). Reporting Levels and/or Practical Quantitation Levels for this metal from the two New Jersey certified laboratories used in this study were somewhat lower (1 mg/kg or less), which suggests that analytical capabilities may have improved since the thallium criterion was set.

Metal concentrations reported in this summary were acid-extractable metals, not necessarily total metal concentrations. The extraction method (USEPA

Method 3050) is a vigorous extraction method designed to remove all metals that could become “environmentally available”. In practice, the extraction method likely overestimates metals that could become available, since the sample is refluxed with both concentrated nitric acid and hydrogen peroxide. However, by design, the method will not extract chemicals incorporated in silica minerals, as they are usually not mobile in the environment. Thus, concentrations reported in these studies may be lower than those indicated from analyses using methods designed to measure total metal concentrations, such as x-ray fluorescence methods.

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RESEARCH PROJECT SUMMARY

Fact Sheet: Draft Aquatic Life Ambient Water Quality Criteria for Aluminum in Freshwaters

Summary

EPA published a draft update of aluminum aquatic life ambient water quality criteria for freshwaters under Section 304(a)(1) of the Clean Water Act to reflect the latest scientific knowledge. EPA will accept public comment on the draft criteria for 60 days upon publication of the Federal Register notice. Once final, the criteria will serve as recommendations to states and tribes by defining the concentration of aluminum in water that will protect against harmful effects to aquatic life.

Background

EPA first published criteria for aluminum in 1988 to protect aquatic life from harmful effects of aluminum toxicity in freshwaters. Aluminum can inhibit an aquatic organism's ability to regulate salt concentrations and clog fish gills, potentially resulting in death or affecting growth and reproduction. EPA is updating the aluminum criteria to better reflect the latest science. Unfortunately, there are not enough data to support the development of estuarine/marine criteria at this time.

Unlike the fixed acute and chronic values found in the 1988 document, this draft document provides users the flexibility to develop site-specific criteria based on a site's water chemistry using the *Aluminum Criteria Calculator V.1.0.xlsx* or by using the lookup tables provided in the criteria appendix. Studies have shown that three water chemistry parameters, pH, dissolved organic carbon (DOC), and hardness, can affect the toxicity of aluminum by affecting the bioavailability of aluminum in the water to aquatic species.

What is Aluminum and How Does it Enter the Water?

Aluminum is found in most soils and rocks and is the third most abundant element and the most common metal in the earth's crust. Aluminum can enter the water via natural processes, like weathering of rocks. Aluminum is also released to water by mining, industrial processes using aluminum, and waste water treated with alum, an aluminum compound.

How does Aluminum Affect Aquatic Life?

Aluminum is considered a non-essential metal because fish and other aquatic life don't need it to function. Elevated levels of aluminum can affect some species ability to regulate ions, like salts, and inhibit respiratory functions, like breathing. Aluminum can accumulate on the surface of a fish's gill, leading to respiratory dysfunction, and possibly death. Aquatic plants are generally less sensitive to aluminum than fish and other aquatic life.

What is a Water Quality Parameter and Why is it Important?

Bioavailability is the measure whether a substance in the environment is available to enter living organisms, like fish. The bioavailability of aluminum is dependent on the chemical properties of water, otherwise known as water quality parameters. The more bioavailable the aluminum is, the more likely it is to cause a toxic effect. The water quality parameters that have the greatest impact on aluminum's bioavailability are pH, DOC, and hardness.

- pH: a low pH generally makes it easier for aluminum to be dissolved, and therefore more bioavailable. At higher pH, aluminum speciation changes make it more bioavailable.

- DOC: higher dissolved organic carbon reduces the bioavailability of aluminum because it binds to form aluminum complexes.
- Hardness: higher hardness values mean there are more ions present that compete with aluminum. This makes aluminum less bioavailable.

What is the Recommended Level of Aluminum in Freshwater for the Protection of Aquatic Life?

The recommended level of aluminum in freshwater depends on a site's water quality parameters. Unlike the fixed values found in the 1988 criteria document, these criteria use a Multiple Linear Regression (MLR) model to normalize the data, and the criteria are based on a site's pH, DOC, and hardness. See Table 1 for a comparison of existing and draft criteria values.

For freshwater criteria, users can put their site's water quality parameters into the *Aluminum Criteria Calculator V.1.0.xlsx* or use the lookup tables in the document's appendix. The resulting acute criterion would have an appropriate level of protection if the one-hour average concentration is not exceeded more than once every three years on average. If the four-day average concentration is not exceeded more than once every three years on average, the chronic criterion is protective.

Where can I find more information?

For more information please visit EPA's website at www.epa.gov/wqc/aquatic-life-criteria-aluminum or contact Diana Eignor at Eignor.Diana@epa.gov.

Table 1: 2017 Draft Aluminum Aquatic Life Criteria Compared to Current 1988 Criteria^a

Version	Freshwater Acute (1 day, total aluminum)	Freshwater Chronic (4-day, total aluminum)
2017 Draft AWQC Criteria (MLR normalized to pH = 7, hardness = 100 mg/L, DOC = 1 mg/L)	1,400 µg/L	390 µg/L
1988 AWQC Criteria (pH 6.5 – 9.0, across all hardness and DOC ranges)	750 µg/L	87 µg/L

^a Values are recommended not to be exceeded more than once every three years on average.

Note: Values will be different under differing water chemistry conditions as identified in this document.

2012 Recreational Water Quality Criteria

Summary

EPA has released its 2012 recreational water quality criteria (RWQC) recommendations for protecting human health in all coastal and non-coastal waters designated for primary contact recreation use. EPA provides two sets of recommended criteria. Primary contact recreation is protected if either set of criteria recommendations are adopted into state water quality standards.

These recommendations are intended as guidance to states, territories and authorized tribes in developing water quality standards to protect swimmers from exposure to water that contains organisms that indicate the presence of fecal contamination.

Background

EPA last issued ambient water quality criteria recommendations for recreational waters in 1986. EPA issues such recommendations under the authority of the Clean Water Act (CWA). Amendments to the CWA by the Beaches Environmental Assessment and Coastal Health (BEACH) Act of 2000 direct EPA to conduct studies associated with pathogens and human health, and to publish new or revised criteria recommendations for pathogens and pathogen indicators based on those studies. These 2012 RWQC meet those requirements.

The 2012 RWQC rely on the latest research and science, including studies that show a link between illness and fecal contamination in recreational waters. They are based on the use of two bacterial indicators of fecal contamination, *E. coli* and enterococci. The new criteria are designed to protect primary contact recreation, including swimming, bathing, surfing, water skiing, tubing, water play by children, and similar water contact activities where a high degree of bodily contact with the water, immersion and ingestion are likely.

What are the recommendations?

The 2012 RWQC offer two sets of numeric concentration thresholds, either of which would protect the designated use of primary contact recreation and, therefore, would protect the public from exposure to harmful levels of pathogens. Illness rates upon which these recommendations are based use the National Epidemiological and Environmental Assessment of Recreational Water (NEEAR) definition of gastrointestinal illness, which is not limited to illnesses which exhibit a fever.

The RWQC consist of three components: magnitude, duration and frequency. The magnitude of the bacterial indicators are described by both a geometric mean (GM) and a statistical threshold value (STV) for the bacteria samples. The STV approximates the 90th percentile of the water quality distribution and is intended to be a value that should not be exceeded by more than 10 percent of the samples taken. The table summarizes the magnitude component of the recommendations. All three components are explained in more detail in the sections below.

CRITERIA ELEMENTS	Recommendation 1 Estimated Illness Rate 36/1,000		Recommendation 2 Estimated Illness Rate 32/1,000	
	GM (cfu/100 mL)	STV (cfu/100 mL)	GM (cfu/100 mL)	STV (cfu/100 mL)
Enterococci (marine & fresh)	35	130	30	110
<i>E. coli</i> (fresh)	126	410	100	320

Water quality criteria recommendations are intended as guidance in establishing new or revised water quality standards. They are not regulations themselves. States and authorized tribes have the discretion to adopt, where appropriate, other scientifically defensible water quality criteria that differ from EPA's recommended criteria.

RECOMMENDATION 1: MAGNITUDE

Enterococci: Culturable enterococci at a

geometric mean (GM) of 35 colony forming units (CFU per 100 milliliters (mL) and a statistical threshold value (STV) of 130 cfu per 100 mL, measured using *EPA Method 1600*, or any other equivalent method that measures culturable enterococci.

E. coli: Culturable *E. coli* at a GM of 126 cfu per 100 mL and an STV of 410 cfu per 100 mL measured using *EPA Method 1603*, or any other equivalent method that measures culturable *E. coli*.

RECOMMENDATION 2: MAGNITUDE

Enterococci: Culturable enterococci at a GM of 30 cfu per 100 mL and an STV of 110 cfu per 100 mL, measured using *EPA Method 1600*, or any other equivalent method that measures culturable enterococci.

E. coli: Culturable *E. coli* at a GM of 100 cfu per 100 mL and an STV of 320 cfu per 100 mL measured using *EPA Method 1603*, or any other equivalent method that measures culturable *E. coli*.

FOR BOTH RECOMMENDATIONS

Duration and Frequency: The waterbody GM should not be greater than the selected GM magnitude in any 30-day interval. There should not be greater than a ten percent excursion frequency of the selected STV magnitude in the same 30-day interval.

How are these criteria different from the 1986 criteria?

Similar Protection for Fresh and Marine Waters: The EPA used an analysis of NEEAR water quality data to refine the illness rate estimate for the recommended marine criterion for enterococci. The 2012 RWQC values now protect public health similarly in both marine and fresh waters.

A New Measurement Value: EPA is introducing a new term, Statistical Threshold Value (STV), to be used in conjunction with the recommended GM value.

New Early Alert Tool: In addition to recommending criteria values, EPA is now also

providing states with Beach Action Values (BAVs) for use in notification programs. The BAV is provided for states to use as a precautionary tool to provide an early alert to beachgoers, including families with children.

A Single Level of Beach Use: The 1986 bacteria criteria document included four single sample maximum (SSM) values appropriate for different levels of beach usage (use intensities). In the 2012 RWQC, EPA removed those recommendations and instead provided states with optional, precautionary BAVs for use in monitoring and notification programs.

More Tools for Assessing and Managing Recreational Waters: EPA is providing information on tools for evaluating and managing recreational waters, such as predictive modeling and sanitary surveys. The Agency is also providing tools for developing site-specific criteria such as epidemiological studies, quantitative microbial risk assessment, and use of alternative indicators or methods. The EPA has developed and validated a molecular testing method using quantitative polymerase chain reaction (qPCR) as a rapid analytical technique for the detection of enterococci in recreational water (EPA Method 1611). For the purposes of beach monitoring, a state may use a qPCR method on a site-specific basis.

Where can I find more information?

EPA has put the 2012 RWQC document, support documents, and the Federal Register Notice, in the docket (Docket identification No. EPA-HQ-OW-2011-0466) which can be accessed via EPA's website at <http://water.epa.gov/scitech/swguidance/standards/criteria/health/recreation/index.cfm>.

You can also contact Sharon Nappier at nappier.sharon@epa.gov or (202)566-0740, or contact Tracy Bone at bone.tracy@epa.gov or (202) 564-5257 for more information.



Total Nitrogen

Total Nitrogen is an essential nutrient for plants and animals. However, an excess amount of nitrogen in a waterway can lead to low levels of dissolved oxygen and negatively alter various plant life and organisms. Sources of nitrogen include: wastewater treatment plants, runoff from fertilized lawns and croplands, failing septic systems, runoff from animal manure and storage areas, and industrial discharges that contain corrosion inhibitors.



Storm runoff from a cattle operation can increase Total Nitrogen levels in a water body.

Understanding Total Nitrogen: There are three forms of nitrogen that are commonly measured in water bodies: ammonia, nitrates and nitrites. Total nitrogen is the sum of total kjeldahl nitrogen (organic and reduced nitrogen), ammonia, and nitrate-nitrite. It can be derived by monitoring for total kjeldahl nitrogen (TKN), ammonia and nitrate-nitrite individually and adding the components together. An acceptable range of total nitrogen is 2 mg/L to 6 mg/L, though it is recommended to check tribal, state, or federal standards for an adequate comparison of your data.



Trash areas like this may leach chemicals that can increase Total Nitrogen during a storm event into a water body.

Monitoring Equipment: Depending upon monitoring objectives set forth in an environmental program, the following equipment options are commonly used to collect total nitrogen data from the field.

Readily available and economically priced:

- Total Nitrogen Kits

For each component of total nitrogen, the following can be used and are of greater precision and higher cost:

- Meters
- Multiparameter Probes
- Contract Laboratories (if necessary)

For additional information:

www.epa.gov/owow/monitoring/volunteer/stream

Method 351.2, Revision 2.0: Determination of Total Kjeldahl Nitrogen by Semi-Automated Colorimetry

METHOD 351.2

DETERMINATION OF TOTAL KJELDAHL NITROGEN BY SEMI-AUTOMATED COLORIMETRY

Edited by James W. O'Dell
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Revision 2.0
August 1993

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OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY
CINCINNATI, OHIO 45268**

METHOD 351.2

DETERMINATION OF TOTAL KJELDAHL NITROGEN BY SEMI-AUTOMATED COLORIMETRY

1.0 SCOPE AND APPLICATION

- 1.1 This method covers the determination of total Kjeldahl nitrogen in drinking, ground, and surface waters, domestic and industrial wastes. The procedure converts nitrogen components of biological origin such as amino acids, proteins and peptides to ammonia, but may not convert the nitrogenous compounds of some industrial wastes such as amines, nitro compounds, hydrazones, oximes, semicarbazones and some refractory tertiary amines.
- 1.2 The applicable range is 0.1-20 mg/L TKN. The range may be extended with sample dilution.

2.0 SUMMARY OF METHOD

- 2.1 The sample is heated in the presence of sulfuric acid, H_2SO_4 for two and one half hours. The residue is cooled, diluted to 25 mL and analyzed for ammonia. This digested sample may also be used for phosphorus determination.
- 2.2 Total Kjeldahl nitrogen is the sum of free-ammonia and organic nitrogen compounds which are converted to ammonium sulfate $(\text{NH}_4)_2\text{SO}_4$, under the conditions of digestion described.
- 2.3 Organic Kjeldahl nitrogen is the difference obtained by subtracting the free-ammonia value from the total Kjeldahl nitrogen value.
- 2.4 Reduced volume versions of this method that use the same reagents and molar ratios are acceptable provided they meet the quality control and performance requirements stated in the method.
- 2.5 Limited performance-based method modifications may be acceptable provided they are fully documented and meet or exceed requirements expressed in Section 9.0, Quality Control.

3.0 DEFINITIONS

- 3.1 **Calibration Blank (CB)** -- A volume of reagent water fortified with the same matrix as the calibration standards, but without the analytes, internal standards, or surrogate analytes.
- 3.2 **Calibration Standard (CAL)** -- A solution prepared from the primary dilution standard solution or stock standard solutions and the internal standards and

surrogate analytes. The CAL solutions are used to calibrate the instrument response with respect to analyte concentration.

- 3.3 **Instrument Performance Check Solution (IPC)** -- A solution of one or more method analytes, surrogates, internal standards, or other test substances used to evaluate the performance of the instrument system with respect to a defined set of criteria.
- 3.4 **Laboratory Fortified Blank (LFB)** -- An aliquot of reagent water or other blank matrices to which known quantities of the method analytes are added in the laboratory. The LFB is analyzed exactly like a sample, and its purpose is to determine whether the methodology is in control, and whether the laboratory is capable of making accurate and precise measurements.
- 3.5 **Laboratory Fortified Sample Matrix (LFM)** -- An aliquot of an environmental sample to which known quantities of the method analytes are added in the laboratory. The LFM is analyzed exactly like a sample, and its purpose is to determine whether the sample matrix contributes bias to the analytical results. The background concentrations of the analytes in the sample matrix must be determined in a separate aliquot and the measured values in the LFM corrected for background concentrations.
- 3.6 **Laboratory Reagent Blank (LRB)** -- An aliquot of reagent water or other blank matrices that are treated exactly as a sample including exposure to all glassware, equipment, solvents, reagents, internal standards, and surrogates that are used with other samples. The LRB is used to determine if method analytes or other interferences are present in the laboratory environment, the reagents, or the apparatus.
- 3.7 **Linear Calibration Range (LCR)** -- The concentration range over which the instrument response is linear.
- 3.8 **Material Safety Data Sheet (MSDS)** -- Written information provided by vendors concerning a chemical's toxicity, health hazards, physical properties, fire, and reactivity data including storage, spill, and handling precautions.
- 3.9 **Method Detection Limit (MDL)** -- The minimum concentration of an analyte that can be identified, measured and reported with 99% confidence that the analyte concentration is greater than zero.
- 3.10 **Quality Control Sample (QCS)** -- A solution of method analytes of known concentrations that is used to fortify an aliquot of LRB or sample matrix. The QCS is obtained from a source external to the laboratory and different from the source of calibration standards. It is used to check laboratory performance with externally prepared test materials.

- 3.11 **Stock Standard Solution (SSS)** -- A concentrated solution containing one or more method analytes prepared in the laboratory using assayed reference materials or purchased from a reputable commercial source.

4.0 INTERFERENCES

- 4.1 High nitrate concentrations (10X or more than the TKN level) result in low TKN values. If interference is suspected, samples should be diluted and reanalyzed.
- 4.2 Method interferences may be caused by contaminants in the reagent water, reagents, glassware, and other sample processing apparatus that bias analyte response.

5.0 SAFETY

- 5.1 The toxicity or carcinogenicity of each reagent used in this method have not been fully established. Each chemical should be regarded as a potential health hazard and exposure should be as low as reasonably achievable. Cautions are included for known extremely hazardous materials or procedures.
- 5.2 Each laboratory is responsible for maintaining a current awareness file of OSHA regulations regarding the safe handling of the chemicals specified in this method. A reference file of Material Safety Data Sheets (MSDS) should be made available to all personnel involved in the chemical analysis. The preparation of a formal safety plan is also advisable.
- 5.3 The following chemicals have the potential to be highly toxic or hazardous, consult MSDS.
- 5.3.1 Mercury (Sections 7.2 and 7.3)
- 5.3.2 Sulfuric acid (Sections 7.2, 7.3, and 7.4)
- 5.3.3 Sodium nitroprusside (Section 7.9)

6.0 EQUIPMENT AND SUPPLIES

- 6.1 Balance - Analytical, capable of accurately weighing to the nearest 0.0001 g.
- 6.2 Glassware - Class A volumetric flasks and pipets as required.
- 6.3 Block digester with tubes.
- 6.4 Automated continuous flow analysis equipment designed to deliver and react sample and reagents in the required order and ratios.
- 6.4.1 Sampling device (sampler)

- 6.4.2 Multichannel pump
- 6.4.3 Reaction unit or manifold
- 6.4.4 Colorimetric detector
- 6.4.5 Data recording device

7.0 **REAGENTS AND STANDARDS**

- 7.1 Reagent water: Ammonia free distilled or deionized water, free of the analyte of interest. ASTM Type II or equivalent.
- 7.2 Mercuric sulfate: Dissolve 8 g red mercuric oxide (HgO) (CASRN 21908-53-2) in 50 mL of 1:4 sulfuric acid (10 mL conc. H_2SO_4 ; [CASRN 7664-93-9] 40 mL reagent water) and dilute to 100 mL with reagent water.
- 7.3 Digestion solution: (Sulfuric acid-mercuric sulfate-potassium sulfate solution): Dissolve 133 g of K_2SO_4 (CASRN 7778-80-5) in 700 mL of reagent water and 200 mL of conc. H_2SO_4 . Add 25 mL of mercuric sulfate solution (Section 7.1) and dilute to 1 L.

Note 1: An alternate mercury-free digestion solution can be prepared by dissolving 134 g K_2SO_4 and 7.3 g CuSO_4 in 800 mL reagent water and then adding 134 mL conc. H_2SO_4 and diluting to 1 L. Use 10 mL solution per 25 mL of sample.

- 7.4 Sulfuric Acid solution (4%): Add 40 mL of conc. sulfuric acid to 800 mL of reagent water, cool and dilute to 1 L.

Note 2: If alternate mercury-free digestion solution is used, adjust the above solution to equal the acid concentration of the digested sample (Section 11.6).

- 7.5 Stock Sodium Hydroxide (20%): Dissolve 200 g of sodium hydroxide (CASRN 1310-73-2) in 900 mL of reagent water and dilute to 1 L.
- 7.6 Stock Sodium Potassium Tartrate solution (20%): Dissolve 200 g sodium potassium tartrate (CASRN 6381-59-5) in about 800 mL of reagent water and dilute to 1 L.
- 7.7 Stock Buffer solution: Dissolve 134.0 g of sodium phosphate, dibasic (Na_2HPO_4) (CASRN 7558-79-4) in about 800 mL of reagent water. Add 20 g of sodium hydroxide and dilute to 1 L.
- 7.8 Working Buffer solution: Combine the reagents in the stated order, add 250 mL of stock sodium potassium tartrate solution (Section 7.6) to 200 mL of stock buffer solution (Section 7.7) and mix. Add xx mL sodium hydroxide solution

(Section 7.5) and dilute to 1 L. See concentration ranges, Table 2, for composition of working buffer.

- 7.9 Sodium Salicylate/Sodium Nitroprusside solution: Dissolve 150 g of sodium salicylate (CASRN 54-21-7) and 0.3 g of sodium nitroprusside (CASRN 13755-38-9 or 14402-89-2) in about 600 mL of reagent water and dilute to 1 L.
- 7.10 Sodium Hypochlorite solution: Dilute 6.0 mL sodium hypochlorite solution (CASRN 7681-52-9) (Clorox) to 100 mL with reagent water.
- 7.11 Ammonium chloride, stock solution: Dissolve 3.819 g NH_4Cl (CASRN 12125-02-9) in reagent water and bring to volume in a 1 L volumetric flask. 1 mL = 1.0 mg $\text{NH}_3\text{-N}$.
- 7.12 Teflon boiling chips.

8.0 SAMPLE COLLECTION, PRESERVATION AND STORAGE

- 8.1 Samples should be collected in plastic or glass bottles. All bottles must be thoroughly cleaned and rinsed with reagent water. Volume collected should be sufficient to insure a representative sample, allow for replicate analysis (if required), and minimize waste disposal.
- 8.2 Samples must be preserved with H_2SO_4 to a pH <2 and cooled to 4°C at the time of collection.
- 8.3 Samples should be analyzed as soon as possible after collection. If storage is required, preserved samples are maintained at 4°C and may be held for up to 28 days.

9.0 QUALITY CONTROL

- 9.1 Each laboratory using this method is required to operate a formal quality control (QC) program. The minimum requirements of this program consist of an initial demonstration of laboratory capability, and the periodic analysis of laboratory reagent blanks, fortified blanks and other laboratory solutions as a continuing check on performance. The laboratory is required to maintain performance records that define the quality of the data that are generated.
- 9.2 INITIAL DEMONSTRATION OF PERFORMANCE
 - 9.2.1 The initial demonstration of performance is used to characterize instrument performance (determination of linear calibration ranges and analysis of QCS) and laboratory performance (determination of MDLs) prior to performing analyses by this method.
 - 9.2.2 Linear Calibration Range (LCR) -- The LCR must be determined initially and verified every 6 months or whenever a significant change

in instrument response is observed or expected. The initial demonstration of linearity must use sufficient standards to insure that the resulting curve is linear. The verification of linearity must use a minimum of a blank and three standards. If any verification data exceeds the initial values by $\pm 10\%$, linearity must be reestablished. If any portion of the range is shown to be nonlinear, sufficient standards must be used to clearly define the nonlinear portion.

- 9.2.3 Quality Control Sample (QCS) -- When beginning the use of this method, on a quarterly basis, or as required to meet data-quality needs, verify the calibration standards and acceptable instrument performance with the preparation and analyses of a QCS. If the determined concentrations are not within $\pm 10\%$ of the stated values, performance of the determinative step of the method is unacceptable. The source of the problem must be identified and corrected before either proceeding with the initial determination of MDLs or continuing with on-going analyses.
- 9.2.4 Method Detection Limit (MDL) -- MDLs must be established for all analytes, using reagent water (blank) fortified at a concentration of two to three times the estimated instrument detection limit.⁽⁶⁾ To determine MDL values, take seven replicate aliquots of the fortified reagent water and process through the entire analytical method. Perform all calculations defined in the method and report the concentration values in the appropriate units. Calculate the MDL as follows:

$$\text{MDL} = (t) \times (S)$$

where, t = Student's t value for a 99% confidence level and a standard deviation estimate with $n-1$ degrees of freedom [$t = 3.14$ for seven replicates]
 S = standard deviation of the replicate analyses

MDLs should be determined every six months, when a new operator begins work, or whenever there is a significant change in the background or instrument response.

9.3 ASSESSING LABORATORY PERFORMANCE

- 9.3.1 Laboratory Reagent Blank (LRB) -- The laboratory must analyze at least one LRB with each batch of samples. Data produced are used to assess contamination from the laboratory environment. Values that exceed the MDL indicate laboratory or reagent contamination should be suspected and corrective actions must be taken before continuing the analysis.

- 9.3.2 Laboratory Fortified Blank (LFB) -- The laboratory must analyze at least one LFB with each batch of samples. Calculate accuracy as percent recovery (Section 9.4.2). If the recovery of any analyte falls outside the required control limits of 90-110%, that analyte is judged out of control, and the source of the problem should be identified and resolved before continuing analyses.
- 9.3.3 The laboratory must use LFB analyses data to assess laboratory performance against the required control limits of 90-110%. When sufficient internal performance data become available (usually a minimum of 20-30 analyses), optional control limits can be developed from the percent mean recovery (\bar{x}) and the standard deviation (S) of the mean recovery. These data can be used to establish the upper and lower control limits as follows:

$$\begin{aligned}\text{UPPER CONTROL LIMIT} &= \bar{x} + 3S \\ \text{LOWER CONTROL LIMIT} &= \bar{x} - 3S\end{aligned}$$

The optional control limits must be equal to or better than the required control limits of 90-110%. After each five to ten new recovery measurements, new control limits can be calculated using only the most recent 20-30 data points. Also, the standard deviation (S) data should be used to establish an on-going precision statement for the level of concentrations included in the LFB. These data must be kept on file and be available for review.

- 9.3.4 Instrument Performance Check Solution (IPC) -- For all determinations the laboratory must analyze the IPC (a mid-range check standard) and a calibration blank immediately following daily calibration, after every 10th sample (or more frequently, if required), and at the end of the sample run. Analysis of the IPC solution and calibration blank immediately following calibration must verify that the instrument is within $\pm 10\%$ of calibration. Subsequent analyses of the IPC solution must verify the calibration is still within $\pm 10\%$. If the calibration cannot be verified within the specified limits, reanalyze the IPC solution. If the second analysis of the IPC solution confirms calibration to be outside the limits, sample analysis must be discontinued, the cause determined and/or in the case of drift the instrument recalibrated. All samples following the last acceptable IPC solution must be reanalyzed. The analysis data of the calibration blank and IPC solution must be kept on file with the sample analyses data.

9.4 ASSESSING ANALYTE RECOVERY AND DATA QUALITY

- 9.4.1 Laboratory Fortified Sample Matrix (LFM) -- The laboratory must add a known amount of analyte to a minimum of 10% of the routine samples. In each case the LFM aliquot must be a duplicate of the aliquot used for sample analysis. The analyte concentration must be high enough to

be detected above the original sample and should not be less than four times the MDL. The added analyte concentration should be the same as that used in the laboratory fortified blank.

- 9.4.2 Calculate the percent recovery for each analyte, corrected for concentrations measured in the unfortified sample, and compare these values to the designated LFM recovery range 90-110%. Percent recovery may be calculated using the following equation:

$$R = \frac{C_s - C}{s} \times 100$$

where, R = percent recovery

C_s = fortified sample concentration

C = sample background concentration

s = concentration equivalent of analyte added to sample

- 9.4.3 If the recovery of any analyte falls outside the designated LFM recovery range and the laboratory performance for that analyte is shown to be in control (Section 9.3), the recovery problem encountered with the LFM is judged to be either matrix or solution related, not system related.
- 9.4.4 Where reference materials are available, they should be analyzed to provide additional performance data. The analysis of reference samples is a valuable tool for demonstrating the ability to perform the method acceptably.

10.0 CALIBRATION AND STANDARDIZATION

- 10.1 Prepare a series of at least three standards, covering the desired range, and a blank by diluting suitable volumes of standard solution (Section 7.11) with reagent water.
- 10.2 Process standards and blanks as described in Section 11.0, Procedure.
- 10.3 Set up manifold as shown in Figure 1 and Table 2.
- 10.4 Prepare flow system as described in Section 11.0, Procedure.
- 10.5 Place appropriate standards in the sampler in order of decreasing concentration and perform analysis.
- 10.6 Prepare standard curve by plotting instrument response against concentration values. A calibration curve may be fitted to the calibration solutions concentration/response data using computer or calculator based regression curve fitting techniques. Acceptance or control limits should be established

using the difference between the measured value of the calibration solution and the "true value" concentration.

- 10.7 After the calibration has been established, it must be verified by the analysis of a suitable quality control sample (QCS). If measurements exceed $\pm 10\%$ of the established QCS value, the analysis should be terminated and the instrument recalibrated. The new calibration must be verified before continuing analysis. Periodic reanalysis of the QCS is recommended as a continuing calibration check.

11.0 **PROCEDURE**

- 11.1 Pipet 25.0 mL of sample, standard or blank in the digester tube.
- 11.2 Add 5 mL of digestion solution (Section 7.3) and mix with a vortex mixer (See Note 1).
- 11.3 Add four to eight Teflon boiling chips (Section 7.12). **CAUTION:** An excess of Teflon chips may cause the sample to boil over.
- 11.4 Place tubes in block digester preheated to 160°C and maintain temperature for one hour.
- 11.5 Reset temperature to 380°C and continue to heat for one and one half hour.
(380°C MUST BE MAINTAINED FOR 30 MINUTES)
- 11.6 Remove digestion tubes, cool and dilute to 25 mL with reagent water.
- 11.7 Excluding the salicylate line, place all reagent lines in their respective containers, connect the sample probe to the sampler and start the pump.
- 11.8 Flush the sampler wash receptacle with about 25 mL of 4% sulfuric acid (Section 7.4) (See Note 2).
- 11.9 When reagents have been pumping for at least five minutes, place the salicylate line in its respective container and allow the system to equilibrate. If a precipitate forms after the addition of salicylate, the pH is too low. Immediately stop the proportioning pump and flush the coils with water using a syringe. Before restarting the system, check the concentration of the sulfuric acid solutions and/or the working buffer solution.
- 11.10 To prevent precipitation of sodium salicylate in the waste tray, which can clog the tray outlet, keep the nitrogen flowcell pump tube and the nitrogen Colorimeter "To Waste" tube separate from all other lines or keep tap water flowing in the waste tray.

- 11.11 After a stable baseline has been obtained, start the sampler and perform analysis.

12.0 DATA ANALYSIS AND CALCULATIONS

- 12.1 Prepare a calibration curve by plotting instrument response against standard concentration. Compute sample concentration by comparing sample response with the standard curve. Multiply answer by appropriate dilution factor.
- 12.2 Report only those values that fall between the lowest and the highest calibration standards. Samples exceeding the highest standard should be diluted and reanalyzed.
- 12.3 Report results in mg N/L.

13.0 METHOD PERFORMANCE

- 13.1 In a single laboratory (EMSL-Cincinnati) using sewage samples at concentrations of 1.2, 2.6, and 1.7 mg N/L, the precision was ± 0.07 , ± 0.03 , and ± 0.15 , respectively.
- 13.2 In a single laboratory (EMSL-Cincinnati) using sewage samples at concentrations 4.7 and 8.74 mg N/L, the recoveries were 99% and 99%, respectively.
- 13.3 The interlaboratory precision and accuracy data in Table 1 were developed using a reagent water matrix. Values are in mg N/L.

14.0 POLLUTION PREVENTION

- 14.1 Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operation. The EPA has established a preferred hierarchy of environmental management techniques that places pollution prevention as the management option of first choice. Whenever feasible, laboratory personnel should use pollution prevention techniques to address their waste generation. When wastes cannot be feasibly reduced at the source, the Agency recommends recycling as the next best option.
- 14.2 The quantity of chemicals purchased should be based on expected usage during its shelf life and disposal cost of unused material. Actual reagent preparation volumes should reflect anticipated usage and reagent stability.
- 14.3 For information about pollution prevention that may be applicable to laboratories and research institutions, consult "Less is Better: Laboratory Chemical Management for Waste Reduction", available from the American

15.0 WASTE MANAGEMENT

- 15.1 The Environmental Protection Agency requires that laboratory waste management practices be conducted consistent with all applicable rules and regulations. Excess Reagents and samples and method process wastes should be characterized and disposed of in an acceptable manner. The Agency urges laboratories to protect the air, water, and land by minimizing and controlling all releases from hoods and bench operations, complying with the letter and spirit of any waste discharge permit and regulations, and by complying with all solid and hazardous waste regulations, particularly the hazardous waste identification rules and land disposal restrictions. For further information on waste management consult "The Waste Management Manual for Laboratory Personnel", available from the American Chemical Society at the address listed in Section 14.3.

16.0 REFERENCES

1. McDaniel, W.H., Hemphill, R.N. and Donaldson, W.T., "Automatic Determination of total Kjeldahl Nitrogen in Estuarine Water", Technicon Symposia, pp. 362-367, Vol. 1, 1967.
2. Gales, M.E. and Booth, R.L., "Evaluation of Organic Nitrogen Methods", EPA Office of Research and Monitoring, June, 1972.
3. Gales, M.E. and Booth, R.L., "Simultaneous and Automated Determination of Total Phosphorus and Total Kjeldahl Nitrogen", Methods Development and Quality Assurance Research Laboratory, May 1974.
4. Technicon "Total Kjeldahl Nitrogen and Total Phosphorus BD-40 Digestion Procedure for Water", August 1974.
5. Gales, M.E., and Booth, R.L., "Evaluation of the Technicon Block Digestor System for the Measurement of Total Kjeldahl Nitrogen and Total Phosphorus", EPA-600/4-78-015, Environmental Monitoring and Support Laboratory, Cincinnati, Ohio, 1978.
6. Code of Federal Regulations 40, Ch. 1, Pt. 136, Appendix B.

17.0 TABLES, DIAGRAMS, FLOWCHARTS, AND VALIDATION DATA

TABLE 1. INTERLABORATORY PRECISION AND ACCURACY DATA

Number of Values Reported	True Value (T)	Mean (X)	Residual for X	Standard Deviation (S)	Residual for S
115	0.380	0.3891	-0.0091	0.0750	-0.0135
134	0.451	0.4807	0.0125	0.1181	0.0238
127	1.00	1.0095	-0.0000	0.1170	-0.0227
164	3.10	3.0992	0.0191	0.2821	-0.0310
138	3.50	3.4765	0.0020	0.3973	0.0512
115	5.71	5.6083	-0.0452	0.4869	-0.0417
175	7.00	6.9246	-0.0008	0.6623	0.0272
121	8.00	7.9991	0.0877	0.6283	-0.0894
120	15.0	15.0213	0.2080	1.2495	-0.0462
127	21.0	20.4355	-0.2937	1.7267	-0.0644
164	25.0	24.7157	0.0426	2.0147	-0.1067
175	26.9	26.1464	-0.4000	2.9743	0.6960

REGRESSIONS: $X = 0.986T + 0.024$, $S = 0.083T + 0.057$

TABLE 2. CONCENTRATION RANGES

Range mg/LN	Pump mL/min.		mL NaOH Buffer (Section 7.7)
	Sample	Resample	
0-1.5	0.80	0.32	250
0-5.0	0.16	0.32	120
0-10.0	0.16	0.16	80

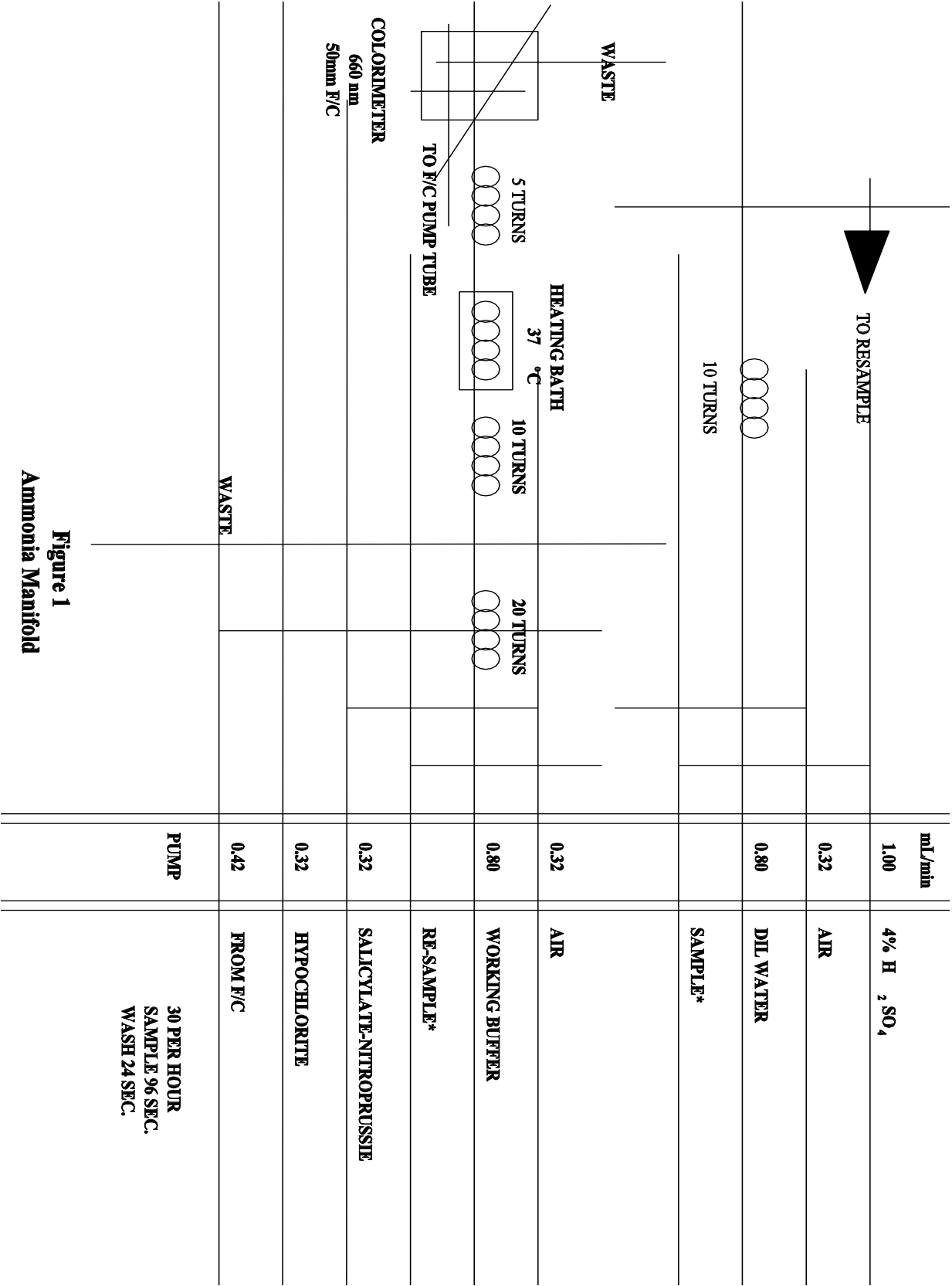


Figure 1
Ammonia Manifold

Technical Note 14

Total Dissolved Solids from conductivity

Glenn Carlson, Technical Support, In-Situ Inc.

May 26, 2005

Total Solids is the term applied to material residue left in a vessel after evaporation of a water sample and subsequent drying of the residue. Total Solids includes Total Suspended Solids (TSS), the portion of total solids in a sample that can be retained by a filter, and Total Dissolved Solids (TDS), the portion that passes through a filter.

The amount of dissolved material in a sample correlates to electrical conductivity. TDS values reported by Win-Situ software are derived from conductivity readings. This calculation, as with other calculations in Win-Situ, is per the 20th edition of *Standard Methods for the Examination of Water and Wastewater*. It should only be used as a rough field check of a sample, though. TDS derived from conductivity is not recommended for critical quantitative reporting purposes. The reason for this is that there is not a relationship between conductivity and TDS that is very repeatable across different locations and different dissolved material. The calculation used is:

$$\text{TDS} = \text{SC} * 0.65$$

where:

TDS = Total Dissolved Solids in mg/L

SC = Specific Conductance (temperature corrected) in uS/cm

The constant of 0.65 is only a VERY crude average for natural samples. The actual constant for any particular sample with a specific mix of dissolved materials and measurement temperature can vary widely. The actual multiplier necessary depends on the activity of each specific dissolved species present and the average activity of all species in a sample. These activities are influenced by sample temperature, the relative amounts of each species (they can influence each other) and the total concentration of dissolved

solids in the sample (can be a non-linear relationship).

While the default average value for this calculation can give good results for some samples, this calculation from conductivity only represents a very crude index for other samples and should not be used as the sole method to accurately quantify the actual amount of dissolved material in a sample. If measurements will always be made at the same location, then it would be far better practice to determine the actual constant that would be appropriate for those samples and then manually do the TDS calculation from Specific Conductance. Ideally, measuring TDS of preliminary samples gravimetrically and regressing those results against the measured Specific Conductance of the samples would determine the constant.

The composition of dissolved material in samples will certainly change from one site to another. Even for the same site, however, the type of dissolved material may also change over time. If the composition of dissolved solids changes appreciably, then it will be necessary to again determine a new constant for the site gravimetrically.

For more information contact In-Situ Inc.

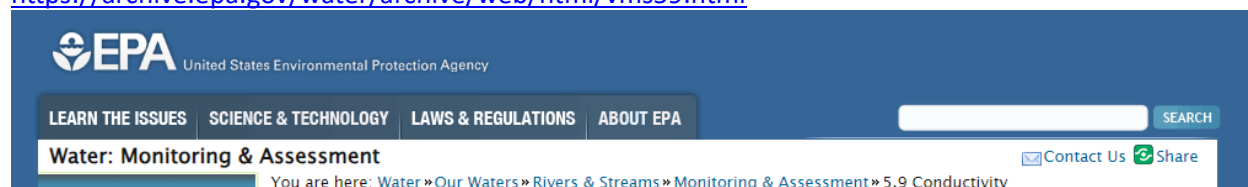
221 East Lincoln Avenue

Fort Collins, CO 80524

1-800-446-7488 (toll-free U.S. & Canada)

1-970-498-1500 (tel)

www.in-situ.com



5.9 Conductivity

What is conductivity and why is it important?

Conductivity is a measure of the ability of water to pass an electrical current. Conductivity in water is affected by the presence of inorganic dissolved solids such as chloride, nitrate, sulfate, and phosphate anions (ions that carry a negative charge) or sodium, magnesium, calcium, iron, and aluminum cations (ions that carry a positive charge). Organic compounds like oil, phenol, alcohol, and sugar do not conduct electrical current very well and therefore have a low conductivity when in water. Conductivity is also affected by temperature: the warmer the water, the higher the conductivity. For this reason, conductivity is reported as conductivity at 25 degrees Celsius (25 C).

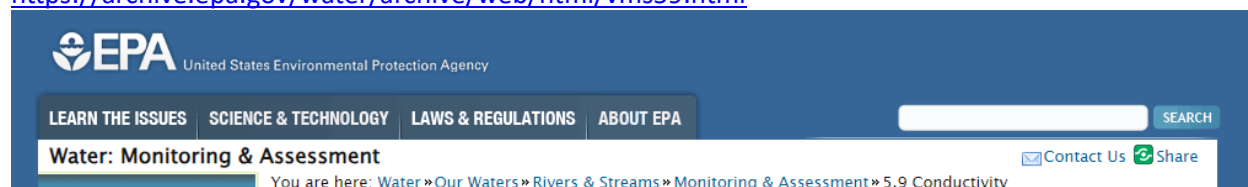
Conductivity in streams and rivers is affected primarily by the geology of the area through which the water flows. Streams that run through areas with granite bedrock tend to have lower conductivity because granite is composed of more inert materials that do not ionize (dissolve into ionic components) when washed into the water. On the other hand, streams that run through areas with clay soils tend to have higher conductivity because of the presence of materials that ionize when washed into the water. Ground water inflows can have the same effects depending on the bedrock they flow through.

Discharges to streams can change the conductivity depending on their make-up. A failing sewage system would raise the conductivity because of the presence of chloride, phosphate, and nitrate; an oil spill would lower the conductivity.

The basic unit of measurement of conductivity is the mho or siemens. Conductivity is measured in micromhos per centimeter ($\mu\text{mhos/cm}$) or microsiemens per centimeter ($\mu\text{s/cm}$). Distilled water has a conductivity in the range of 0.5 to 3 $\mu\text{mhos/cm}$. The conductivity of rivers in the United States generally ranges from 50 to 1500 $\mu\text{mhos/cm}$. Studies of inland fresh waters indicate that streams supporting good mixed fisheries have a range between 150 and 500 $\mu\text{hos/cm}$. Conductivity outside this range could indicate that the water is not suitable for certain species of fish or macroinvertebrates. Industrial waters can range as high as 10,000 $\mu\text{mhos/cm}$.

Sampling and equipment Considerations

Conductivity is useful as a general measure of stream water quality. Each stream tends to have a relatively constant range of conductivity that, once established, can be used as a baseline for



comparison with regular conductivity measurements. Significant changes in conductivity could then be an indicator that a discharge or some other source of pollution has entered a stream.

Conductivity is measured with a probe and a meter. Voltage is applied between two electrodes in a probe immersed in the sample water. The drop in voltage caused by the resistance of the water is used to calculate the conductivity per centimeter. The meter converts the probe measurement to micromhos per centimeter and displays the result for the user. NOTE: Some conductivity meters can also be used to test for total dissolved solids and salinity. The total dissolved solids concentration in milligrams per liter (mg/L) can also be calculated by multiplying the conductivity result by a factor between 0.55 and 0.9, which is empirically determined (see Standard Methods #2510, APHA 1992).

Suitable conductivity meters cost about \$350. Meters in this price range should also measure temperature and automatically compensate for temperature in the conductivity reading. Conductivity can be measured in the field or the lab. In most cases, it is probably better if the samples are collected in the field and taken to a lab for testing. In this way several teams of volunteers can collect samples simultaneously. If it is important to test in the field, meters designed for field use can be obtained for around the same cost mentioned above.

If samples will be collected in the field for later measurement, the sample bottle should be a glass or polyethylene bottle that has been washed in phosphate-free detergent and rinsed thoroughly with both tap and distilled water. Factory-prepared Whirl-pak® bags may be used.

How to sample

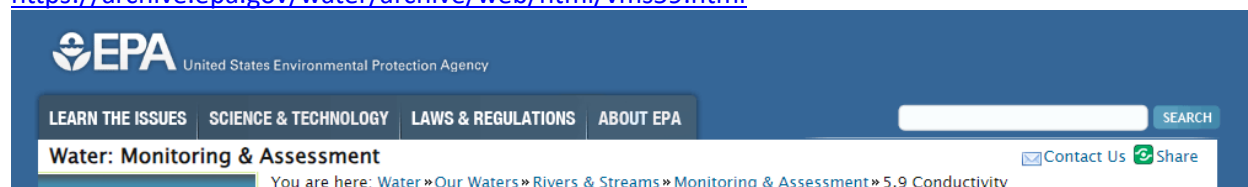
The procedures for collecting samples and analyzing conductivity consist of the following tasks:

TASK 1 Prepare the sample containers

If factory-sealed, disposable Whirl-pak® bags are used for sampling, no preparation is needed. Reused sample containers (and all glassware used in this procedure) must be cleaned before the first run and after each sampling run by following Method A as described in Method A in Table 1 in [Chapter 5 – Water Quality Conditions](#).

TASK 2 Prepare before leaving for the sampling site

Refer to [section 2.3 – Safety Considerations](#) for details on confirming sampling date and time, safety considerations, checking supplies, and checking weather and directions. In addition to the standard sampling equipment and apparel, when sampling for conductivity, include the following equipment:



- Conductivity meter and probe (if testing conductivity in the field)
- Conductivity standard appropriate for the range typical of the stream
- Data sheet for conductivity to record results

Be sure to let someone know where you are going and when you expect to return.

TASK 3 Collect the sample (if samples will be tested in the lab)

Refer to Task 2 in [Chapter 5 – Water Quality Conditions](#) for details on how to collect water samples using screw-cap bottles or Whirl-pak® bags.

TASK 4 Analyze the sample (field or lab)

The following procedure applies to field or lab use of the conductivity meter.

1. Prepare the conductivity meter for use according to the manufacturer's directions.
2. Use a conductivity standard solution (usually potassium chloride or sodium chloride) to calibrate the meter for the range that you will be measuring. The manufacturer's directions should describe the preparation procedures for the standard solution.
3. Rinse the probe with distilled or deionized water.
4. Select the appropriate range beginning with the highest range and working down. Read the conductivity of the water sample. If the reading is in the lower 10 percent of the range, switch to the next lower range. If the conductivity of the sample exceeds the range of the instrument, you may dilute the sample. Be sure to perform the dilution according to the manufacturer's directions because the dilution might not have a simple linear relationship to the conductivity.
5. Rinse the probe with distilled or deionized water and repeat step 4 until finished.

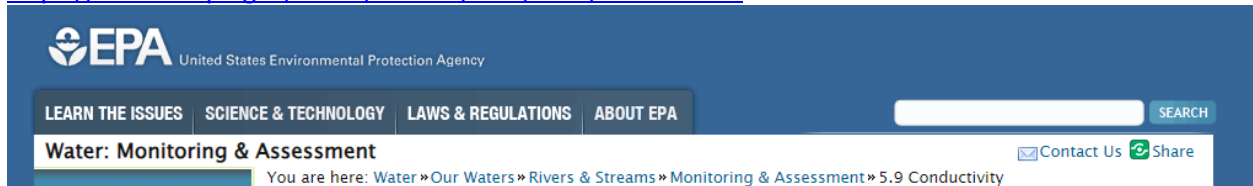
TASK 5 Return the samples and the field data sheets to the lab/drop-off point.

Samples that are sent to a lab for conductivity analysis must be tested within 28 days of collection. Keep the samples on ice or refrigerated.

References

APHA. 1992. *Standard methods for the examination of water and wastewater*. 18th ed. American Public Health Association, Washington, DC.

<https://archive.epa.gov/water/archive/web/html/vms59.html>



Hach Company. 1992. *Hach water analysis handbook*. 2nd ed. Loveland, CO.

Mississippi Headwaters River Watch. 1991. *Water quality procedures*. Mississippi Headwaters Board. March.

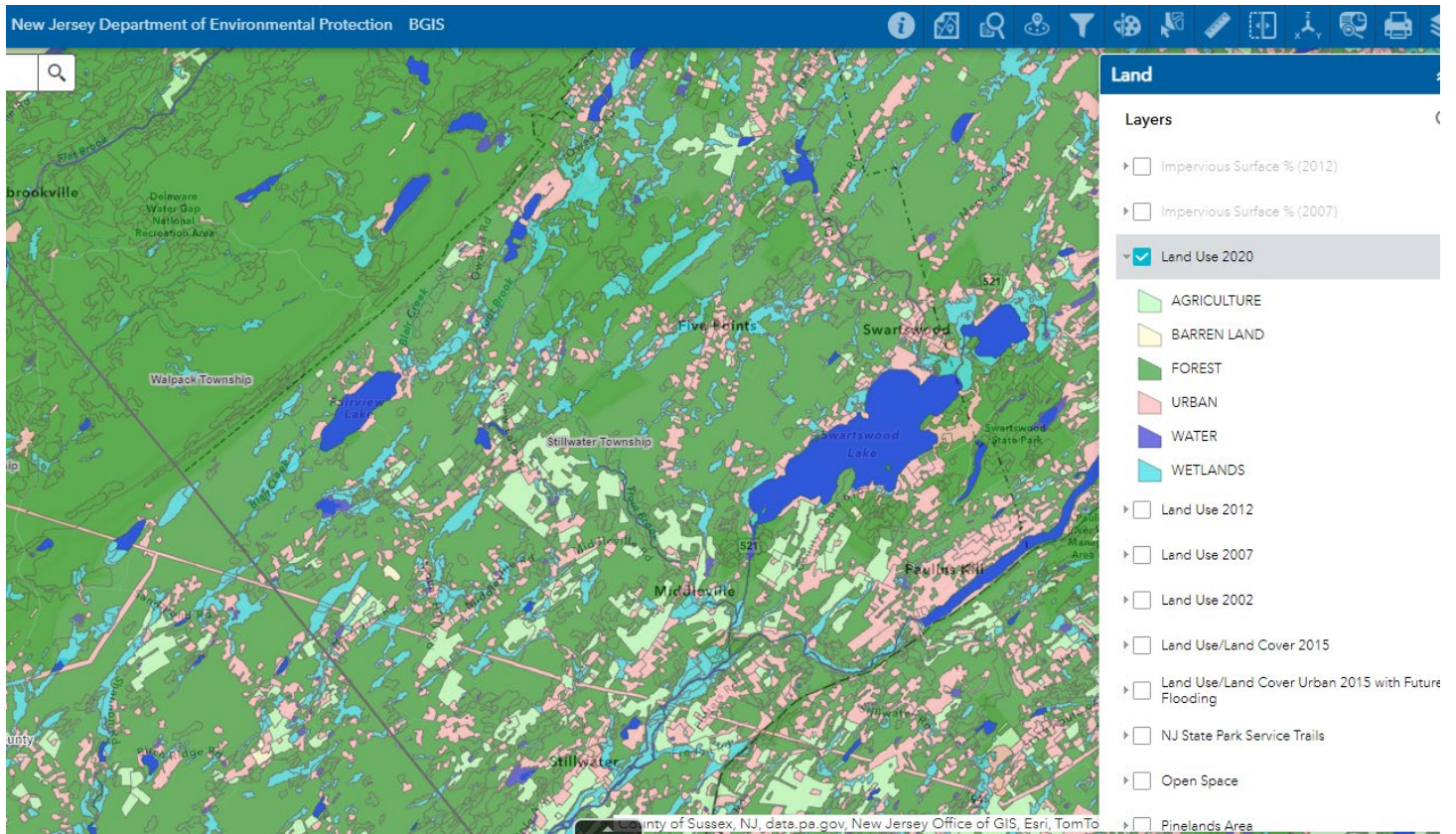
Source: <https://archive.epa.gov/water/archive/web/html/vms59.html> (accessed March 23, 2024)

Appendix C

NJDEP GeoWeb Map Information Excerpts

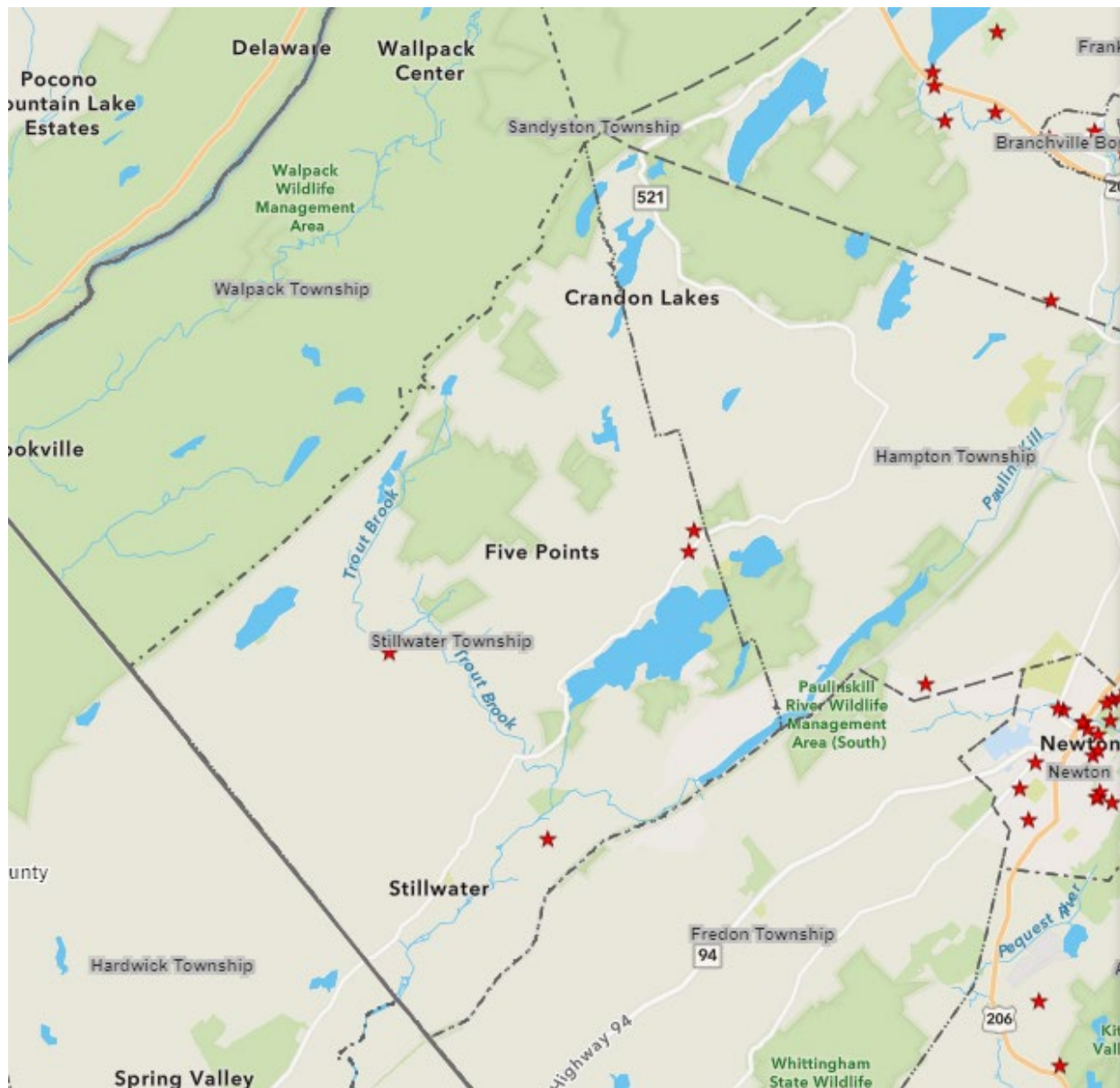
Appendix C
NJDEP GeoWeb Map Information Excerpts
Stillwater, NJ

Land Use



Appendix C
NJDEP GeoWeb Map Information Excerpts
Stillwater, NJ

Known Contaminated Sites

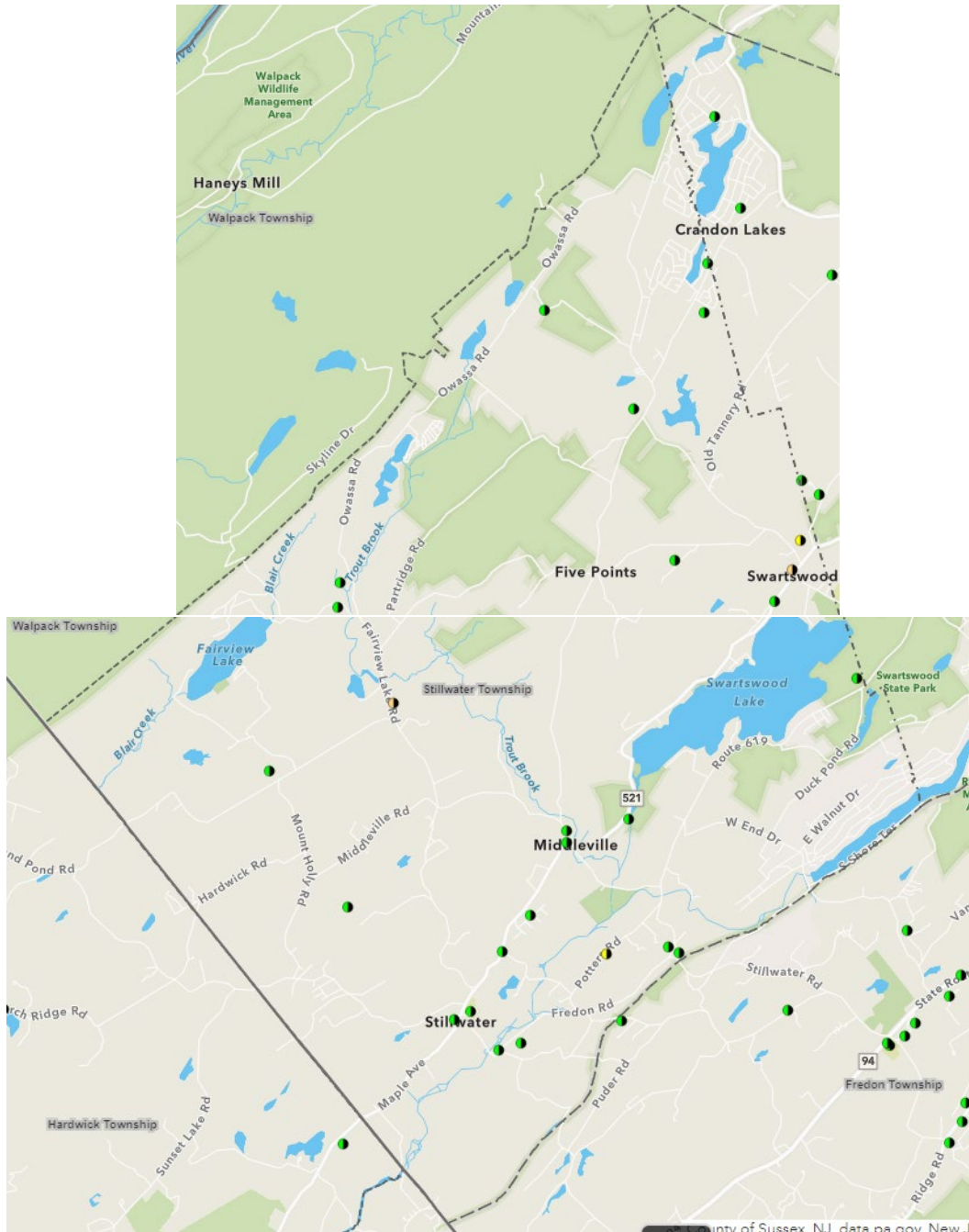


Appendix C
NJDEP GeoWeb Map Information Excerpts
Stillwater, NJ

Site Remediation Preferred ID Sites

Site Remediation Program Preferred ID Sites

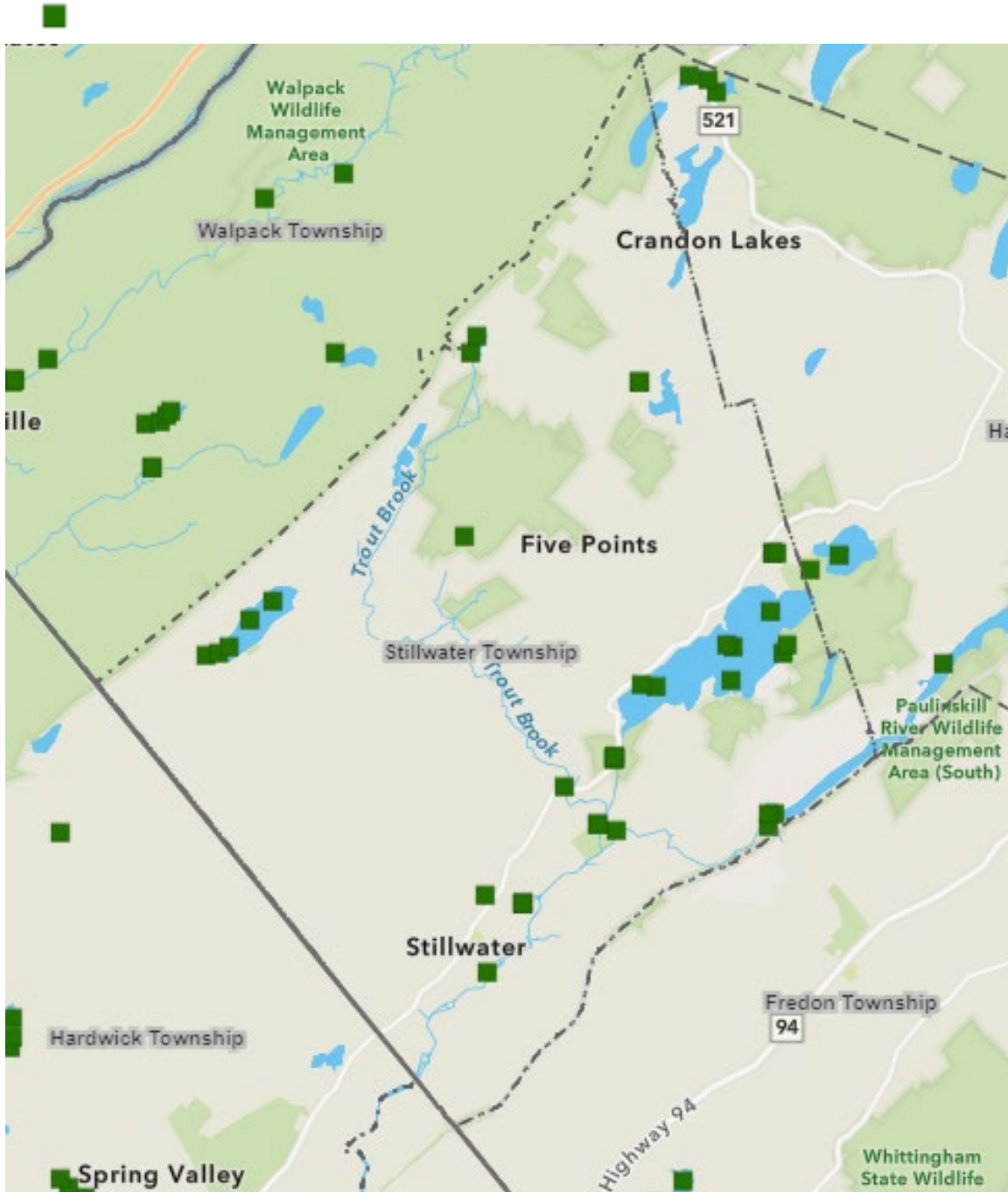
- Active
- Active - UHOT
- RAP\Post Remedial
- Closed
- Pending



Appendix C
NJDEP GeoWeb Map Information Excerpts
Stillwater, NJ

NJDEP WQDE Sample Stations

▼ ☒ Water Quality Data Exchange (WQDE)



Appendix D

Summary of 95UCL and Statistical Trend Analysis Results

Appendix D
Summary of SWMP 95UCL and Trend Analysis Results
Surface Water Monitoring Program (1984-2024) - Stillwater, NJ

Parameter	Station #	P-value	Signifcant Trend?	Trend Direction	95 UCL*	Units	Sample Size (n)
Alkalinity	1	0.254	No	No Trend	20.8	mg/L	26
Alkalinity	2	0.474	No	No Trend	14.8	mg/L	26
Alkalinity	3	0.056	No	No Trend	25.4	mg/L	26
Alkalinity	4	0.233	No	No Trend	22.4	mg/L	26
Alkalinity	5	0.005	Yes	Increasing	35.5	mg/L	25
Alkalinity	6	0.034	Yes	No Trend	31.9	mg/L	26
Alkalinity	7	0.362	No	No Trend	137.1	mg/L	26
Alkalinity	8	0.175	No	No Trend	77.3	mg/L	16
Alkalinity	9	0.242	No	No Trend	149.3	mg/L	10
Aluminum	1	0.184	No	No Trend	0.143	mg/L	18
Aluminum	2	0.048	Yes	Decreasing	0.139	mg/L	18
Aluminum	3	0.041	Yes	Decreasing	0.149	mg/L	18
Aluminum	4	0.048	Yes	Decreasing	0.184	mg/L	18
Aluminum	5	0.026	Yes	Decreasing	0.265	mg/L	16
Aluminum	6	0.054	No	No Trend	0.086	mg/L	17
Aluminum	7	0.038	Yes	Decreasing	0.161	mg/L	17
Aluminum	8	0.460	No	No Trend	N/A	mg/L	9
Aluminum	9	N/A		N/A	0.163	mg/L	3
Ammonia	1	0.003	Yes	Decreasing	0.174	mg/L	25
Ammonia	2	0.002	Yes	Decreasing	0.227	mg/L	25
Ammonia	3	0.005	Yes	Decreasing	0.134	mg/L	25
Ammonia	4	0.001	Yes	Decreasing	0.155	mg/L	25
Ammonia	5	0.003	Yes	Decreasing	0.118	mg/L	25
Ammonia	6	0.005	Yes	Decreasing	0.110	mg/L	25
Ammonia	7	0.002	Yes	Decreasing	0.114	mg/L	25
Ammonia	8	0.385	No	No Trend	0.073	mg/L	15
Ammonia	9	0.460	No	No Trend	0.151	mg/L	9
E. Coli	10	0.500	No	No Trend	370.1	col/100ml	7
Fecal Coliforms	1	0.121	No	No Trend	59.7	col/100ml	25
Fecal Coliforms	2	0.217	No	No Trend	56.8	col/100ml	25
Fecal Coliforms	3	0.226	No	No Trend	35.5	col/100ml	25
Fecal Coliforms	4	0.007	Yes	Decreasing	19.0	col/100ml	25
Fecal Coliforms	5	0.017	Yes	Decreasing	84.2	col/100ml	24
Fecal Coliforms	6	0.168	No	No Trend	31.1	col/100ml	25
Fecal Coliforms	7	0.023	Yes	Decreasing	180.8	col/100ml	25
Fecal Coliforms	8	0.225	No	No Trend	24.2	col/100ml	16
Fecal Coliforms	9	0.431	No	No Trend	158.4	col/100ml	10
Fecal Coliforms	10	0.281	No	No Trend	354.6	col/100ml	7
Lead	1	0.034	Yes	Decreasing	0.015	mg/L	19
Lead	2	0.093	No	No Trend	0.015	mg/L	19
Lead	3	0.105	No	No Trend	0.014	mg/L	19
Lead	4	0.105	No	No Trend	0.014	mg/L	19
Lead	5	0.010	Yes	Decreasing	0.015	mg/L	19
Lead	6	0.082	No	No Trend	0.015	mg/L	19
Lead	7	0.005	Yes	Decreasing	0.023	mg/L	19
Lead	8	0.130	No	No Trend	0.004	mg/L	9
Lead	9	N/A	N/A	N/A	N/A	mg/L	3
Nitrate	1	0.012	Yes	Decreasing	0.199	mg/L	26

Nitrate	2	0.012	Yes	Decreasing	0.232	mg/L	26
Nitrate	3	0.131	No	No Trend	0.167	mg/L	26
Nitrate	4	0.295	No	No Trend	0.217	mg/L	26
Nitrate	5	0.121	No	No Trend	0.231	mg/L	26
Nitrate	6	0.066	No	No Trend	0.199	mg/L	26
Nitrate	7	0.430	No	No Trend	0.636	mg/L	26
Nitrate	8	0.199	No	No Trend	0.201	mg/L	16
Nitrate	9	0.364	No	No Trend	0.508	mg/L	10
Nitrite	1	0.093	No	No Trend	0.037	mg/L	25
Nitrite	2	0.259	No	No Trend	0.035	mg/L	25
Nitrite	3	0.267	No	No Trend	0.035	mg/L	25
Nitrite	4	0.195	No	No Trend	0.047	mg/L	25
Nitrite	5	0.275	No	No Trend	0.035	mg/L	25
Nitrite	6	0.202	No	No Trend	0.036	mg/L	25
Nitrite	7	0.060	No	No Trend	0.039	mg/L	24
Nitrite	8	0.423	No	No Trend	0.047	mg/L	15
Nitrite	9	0.000	Yes	No Trend	0.096	mg/L	9
Orthophosphate	1	0.041	Yes	Decreasing	0.038	mg/L	26
Orthophosphate	2	0.033	Yes	Decreasing	0.036	mg/L	26
Orthophosphate	3	0.094	No	No Trend	0.033	mg/L	26
Orthophosphate	4	0.030	Yes	Decreasing	0.037	mg/L	26
Orthophosphate	5	0.029	Yes	No Trend	0.034	mg/L	25
Orthophosphate	6	0.049	Yes	Decreasing	0.033	mg/L	26
Orthophosphate	7	0.023	Yes	Decreasing	0.038	mg/L	25
Orthophosphate	8	0.345	No	No Trend	0.038	mg/L	16
Orthophosphate	9	0.242	No	No Trend	0.054	mg/L	10
pH	1	0.330	No	No Trend	6.90	su	26
pH	2	0.166	No	No Trend	6.77	su	26
pH	3	0.421	No	No Trend	7.20	su	26
pH	4	0.370	No	No Trend	7.08	su	26
pH	5	0.249	No	No Trend	7.23	su	25
pH	6	0.195	No	No Trend	7.26	su	26
pH	7	0.338	No	No Trend	8.02	su	26
pH	8	0.253	No	No Trend	7.76	su	16
pH	9	0.190	No	No Trend	8.04	su	10
Phosphorus	1	0.086	No	No Trend	0.065	mg/L	25
Phosphorus	2	0.234	No	No Trend	0.104	mg/L	25
Phosphorus	3	0.044	Yes	Decreasing	0.070	mg/L	25
Phosphorus	4	0.035	Yes	Decreasing	0.061	mg/L	25
Phosphorus	5	0.178	No	No Trend	0.062	mg/L	24
Phosphorus	6	0.241	No	No Trend	0.060	mg/L	25
Phosphorus	7	0.009	Yes	Decreasing	0.069	mg/L	25
Phosphorus	8	0.349	No	No Trend	0.091	mg/L	15
Phosphorus	9	0.460	No	No Trend	0.134	mg/L	9
Specific conductivity	1	0.261	No	No Trend	118.2	umohs/cm	26
Specific conductivity	2	0.183	No	No Trend	130.5	umohs/cm	26
Specific conductivity	3	0.330	No	No Trend	134.0	umohs/cm	26
Specific conductivity	4	0.076	No	No Trend	131.7	umohs/cm	26
Specific conductivity	5	0.000	Yes	Increasing	201.1	umohs/cm	25
Specific conductivity	6	0.003	Yes	Increasing	167.8	umohs/cm	26
Specific conductivity	7	0.100	No	No Trend	455.6	umohs/cm	26
Specific conductivity	8	0.199	No	No Trend	245.3	umohs/cm	16
Specific conductivity	9	0.078	No	No Trend	553.5	umohs/cm	10
TKN	1	0.395	No	No Trend	0.856	mg/L	23

TKN	2	0.110	No	No Trend	2.832	mg/L	24
TKN	3	0.263	No	No Trend	0.803	mg/L	24
TKN	4	0.231	No	No Trend	0.520	mg/L	24
TKN	5	0.162	No	No Trend	0.782	mg/L	24
TKN	6	0.264	No	No Trend	0.723	mg/L	24
TKN	7	0.226	No	No Trend	0.853	mg/L	24
TKN	8	0.225	No	No Trend	1.033	mg/L	14
TKN	9	0.238	No	No Trend	0.565	mg/L	9
TSS	1	0.424	No	No Trend	6.58	mg/L	25
TSS	2	0.032	Yes	Decreasing	4.01	mg/L	25
TSS	3	0.015	Yes	Decreasing	2.82	mg/L	25
TSS	4	0.005	Yes	Decreasing	4.26	mg/L	25
TSS	5	0.109	No	Decreasing	9.44	mg/L	25
TSS	6	0.006	Yes	Decreasing	3.36	mg/L	25
TSS	7	0.453	No	No Trend	6.61	mg/L	25
TSS	8	0.218	No	No Trend	16.87	mg/L	15
TSS	9	0.540	No	No Trend	15.92	mg/L	9

Notes:

* 95UCL qualified due to low sample size ($n < 10$)

N/A = not applicable; 95UCL not calculated due to small sample size (n).

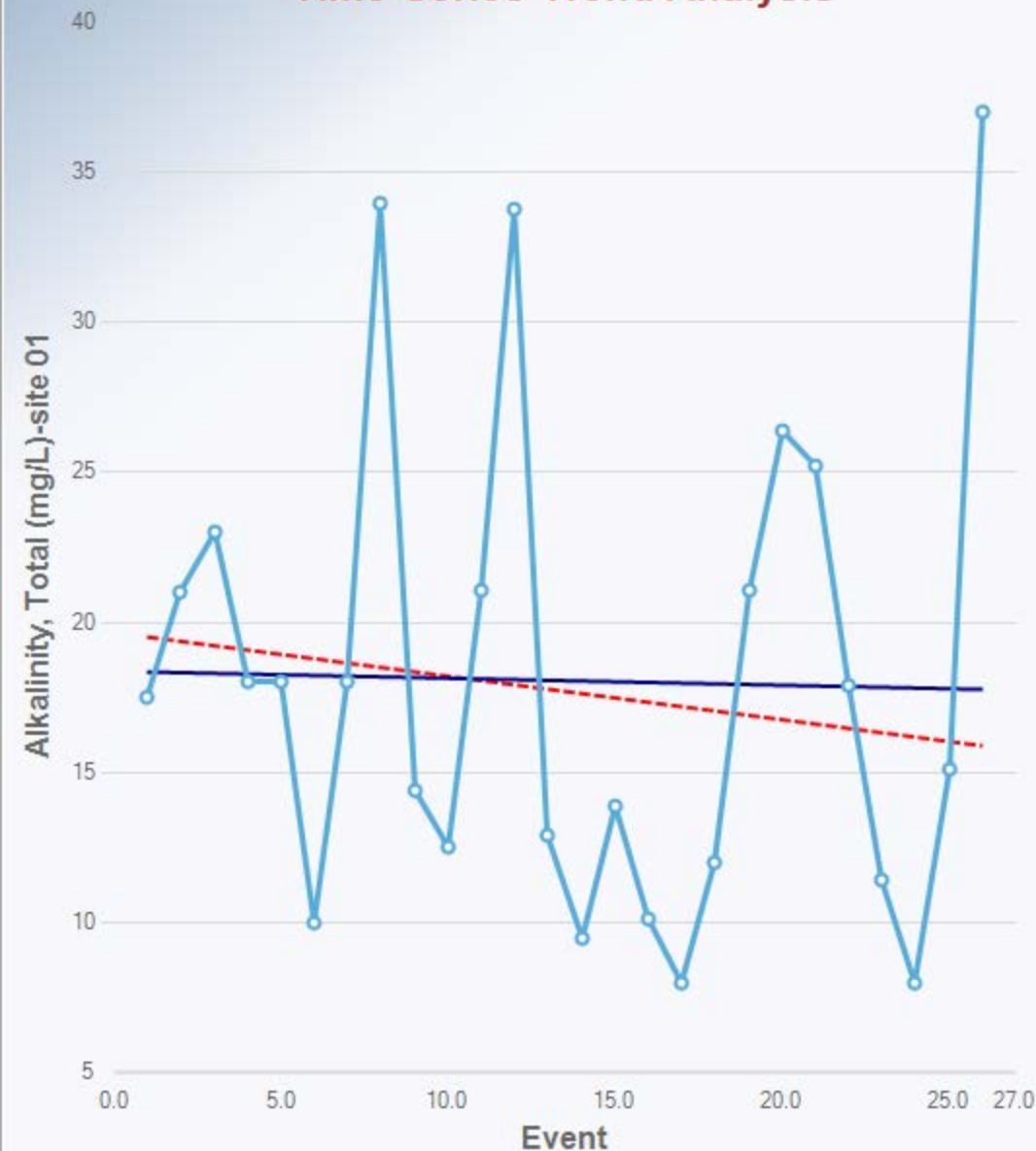
ND = Not Detected or not detected above SWCS; 95UCL not calculated due to low detection frequency.

Significant trend identified if $P > 0.05$.

95UCL based on 95% Student's-t UCL.

Alkalinity Trend Graphs

Time-Series Trend Analysis



Time-Series Trend Analysis

Events/Time Periods 26

OLS Regression Line (Blue)

OLS Regression Slope -0.0227

OLS Regression Intercept 18.3746

Theil-Sen Trend Line (Red)

Theil-Sen Slope -0.1450

Theil-Sen Intercept 19.6575

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 118.0898

M2 206.9102

LCL of Slope -0.5663

UCL of Slope 0.2675

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 45.3174

M-K Standardized Val (S) -0.6620

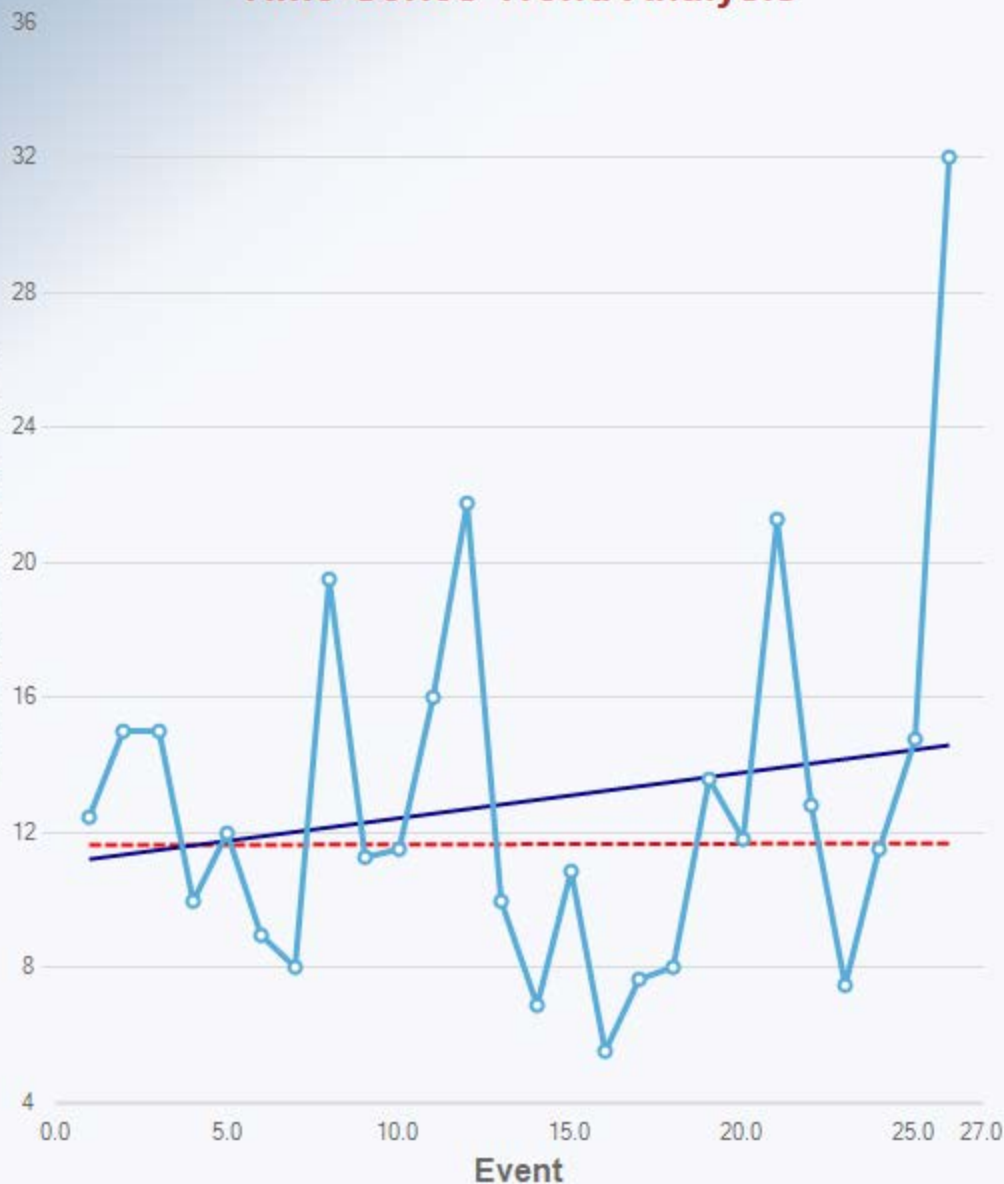
Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.2540

Insufficient evidence of a significant trend

Time-Series Trend Analysis

Alkalinity, Total (mg/L)-site 02



Time-Series Trend Analysis

Events/Time Periods 26

OLS Regression Line (Blue)

OLS Regression Slope 0.1367

OLS Regression Intercept 11.0735

Theil-Sen Trend Line (Red)

Theil-Sen Slope 0.0027

Theil-Sen Intercept 11.6132

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 118.0717

M2 206.9283

LCL of Slope -0.2500

UCL of Slope 0.2916

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 45.3358

M-K Standardized Val (S) 0.0662

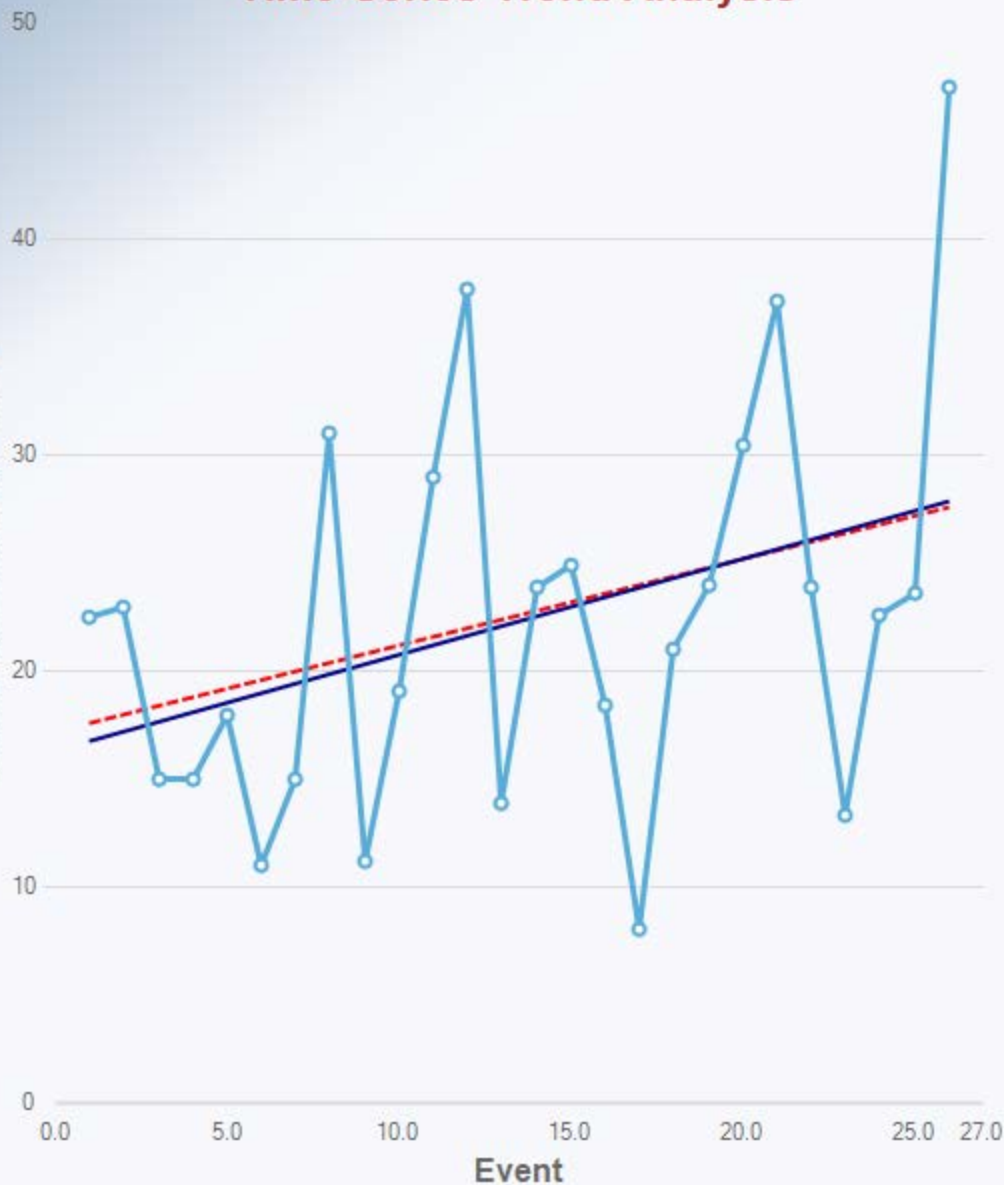
Appx. Critical Value (0.05) 1.6449

Approximate p-value (S) 0.4736

Insufficient evidence of a significant trend

Time-Series Trend Analysis

Alkalinity, Total (mg/L)-site 03



Time-Series Trend Analysis

Events/Time Periods 26

OLS Regression Line (Blue)

OLS Regression Slope 0.4442

OLS Regression Intercept 16.2972

Theil-Sen Trend Line (Red)

Theil-Sen Slope 0.4000

Theil-Sen Intercept 17.1500

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 118.0898

M2 206.9102

LCL of Slope -0.0667

UCL of Slope 0.8333

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 45.3174

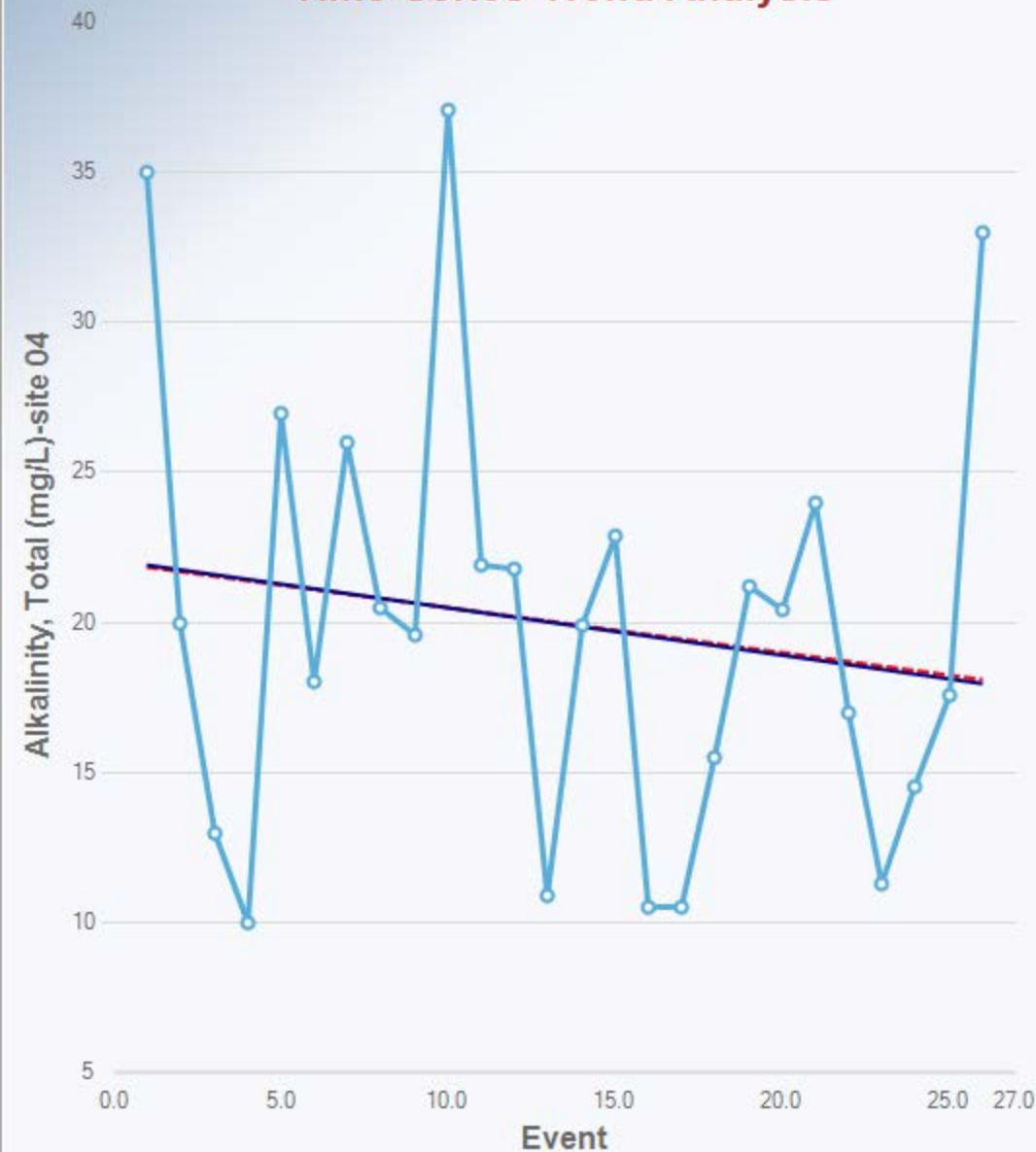
M-K Standardized Val (S) 1.5888

Appx. Critical Value (0.05) 1.6449

Approximate p-value (S) 0.0561

Insufficient evidence of a significant trend

Time-Series Trend Analysis



Time-Series Trend Analysis

Events/Time Periods 26

OLS Regression Line (Blue)

OLS Regression Slope -0.1579

OLS Regression Intercept 22.0972

Theil-Sen Trend Line (Red)

Theil-Sen Slope -0.1500

Theil-Sen Intercept 21.9750

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 118.0501

M2 206.9499

LCL of Slope -0.5873

UCL of Slope 0.2225

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 45.3578

M-K Standardized Val (S) -0.7275

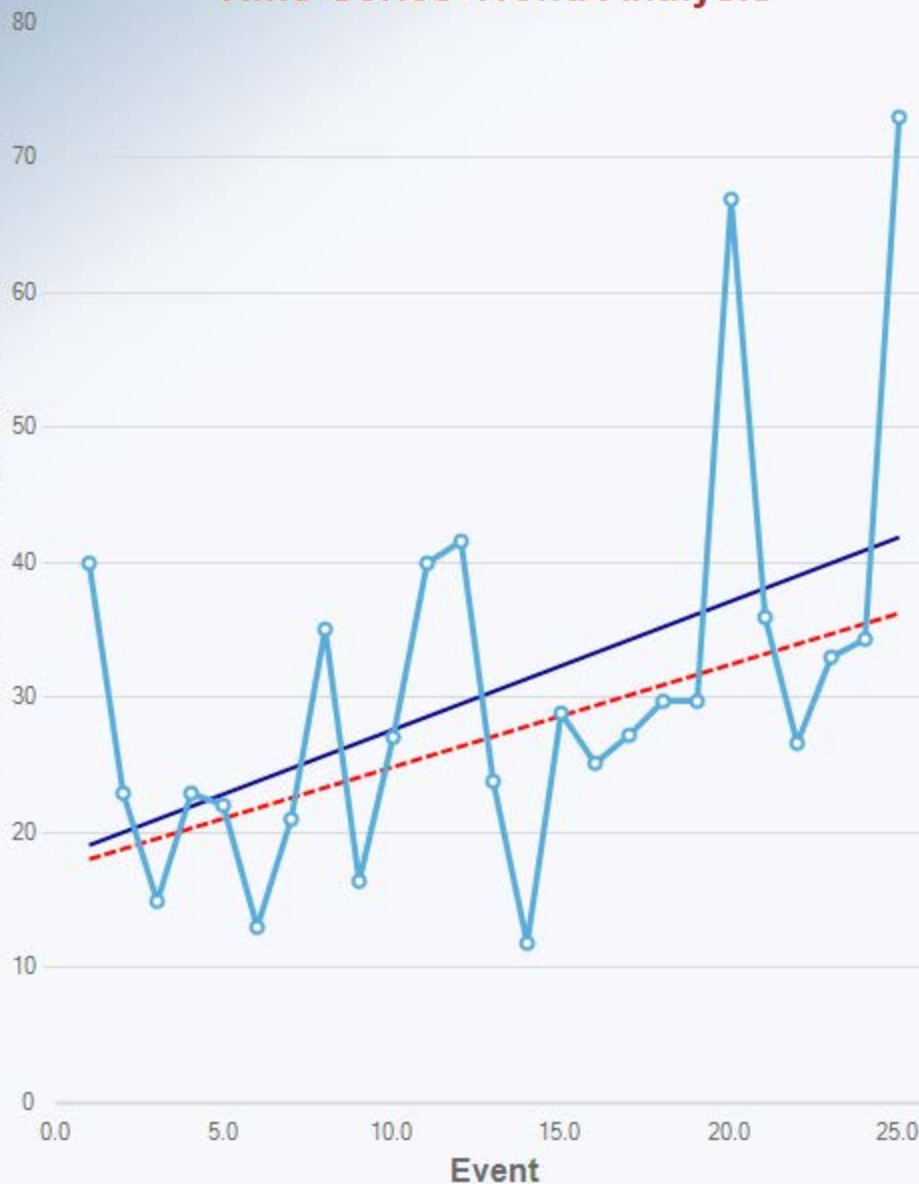
Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.2334

Insufficient evidence of a significant trend

Time-Series Trend Analysis

Alkalinity, Total (mg/L)-site 05



Time-Series Trend Analysis

Events/Time Periods 25

OLS Regression Line (Blue)

OLS Regression Slope 0.9511

OLS Regression Intercept 18.2015

Theil-Sen Trend Line (Red)

Theil-Sen Slope 0.7605

Theil-Sen Intercept 17.3138

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 108.0740

M2 191.9260

LCL of Slope 0.2384

UCL of Slope 1.2922

Statistically significant evidence of an increasing trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 42.7824

M-K Standardized Val (S) 2.5712

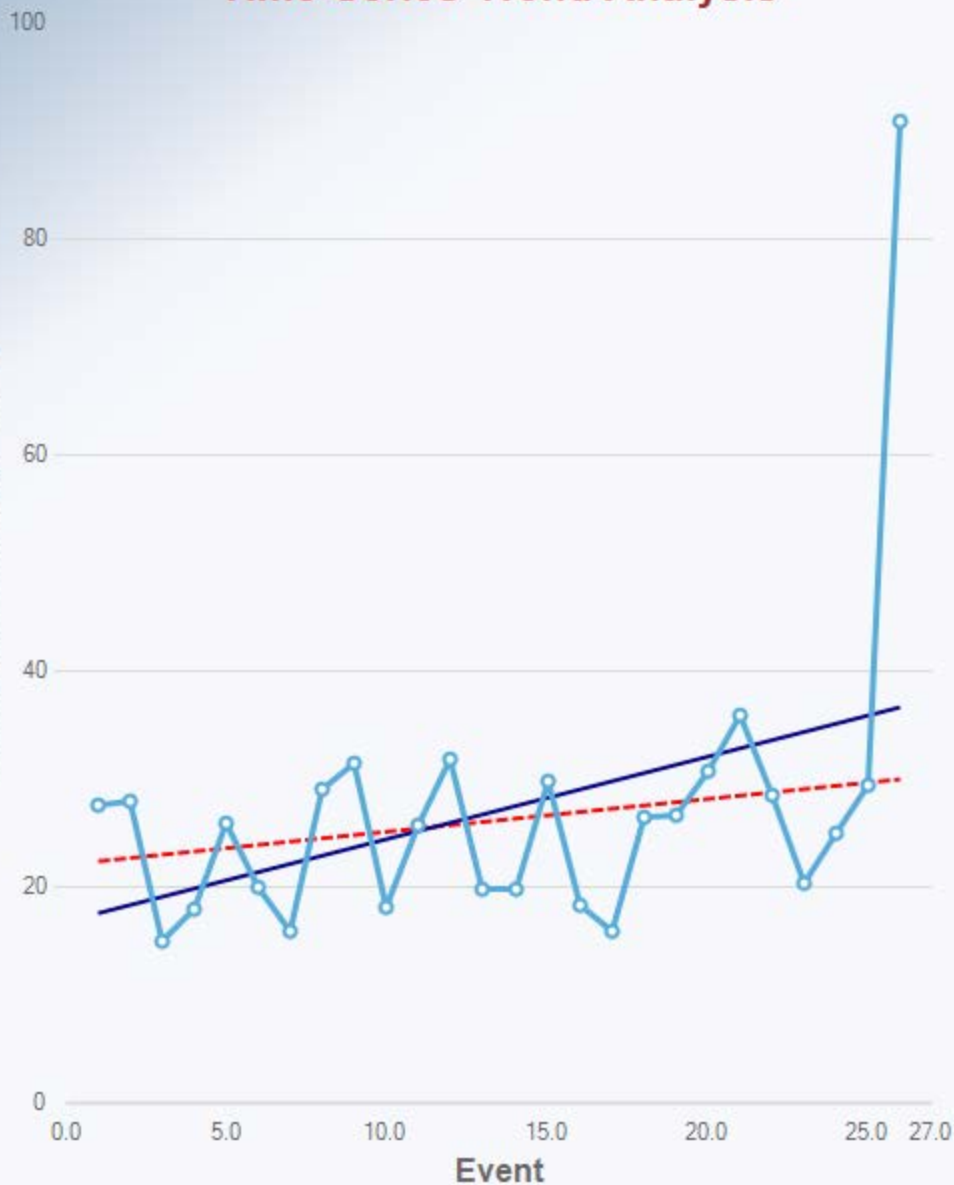
Appx. Critical Value (0.05) 1.6449

Approximate p-value (S) 0.0051

Significant evidence of an increasing trend

Time-Series Trend Analysis

Alkalinity, Total (mg/L)-site 06



Time-Series Trend Analysis

# Events/Time Periods	26
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OLS Regression Line (Blue)

OLS Regression Slope	0.7600
OLS Regression Intercept	16.8443

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.3000
Theil-Sen Intercept	22.1500

Theil-Sen Trend Analysis

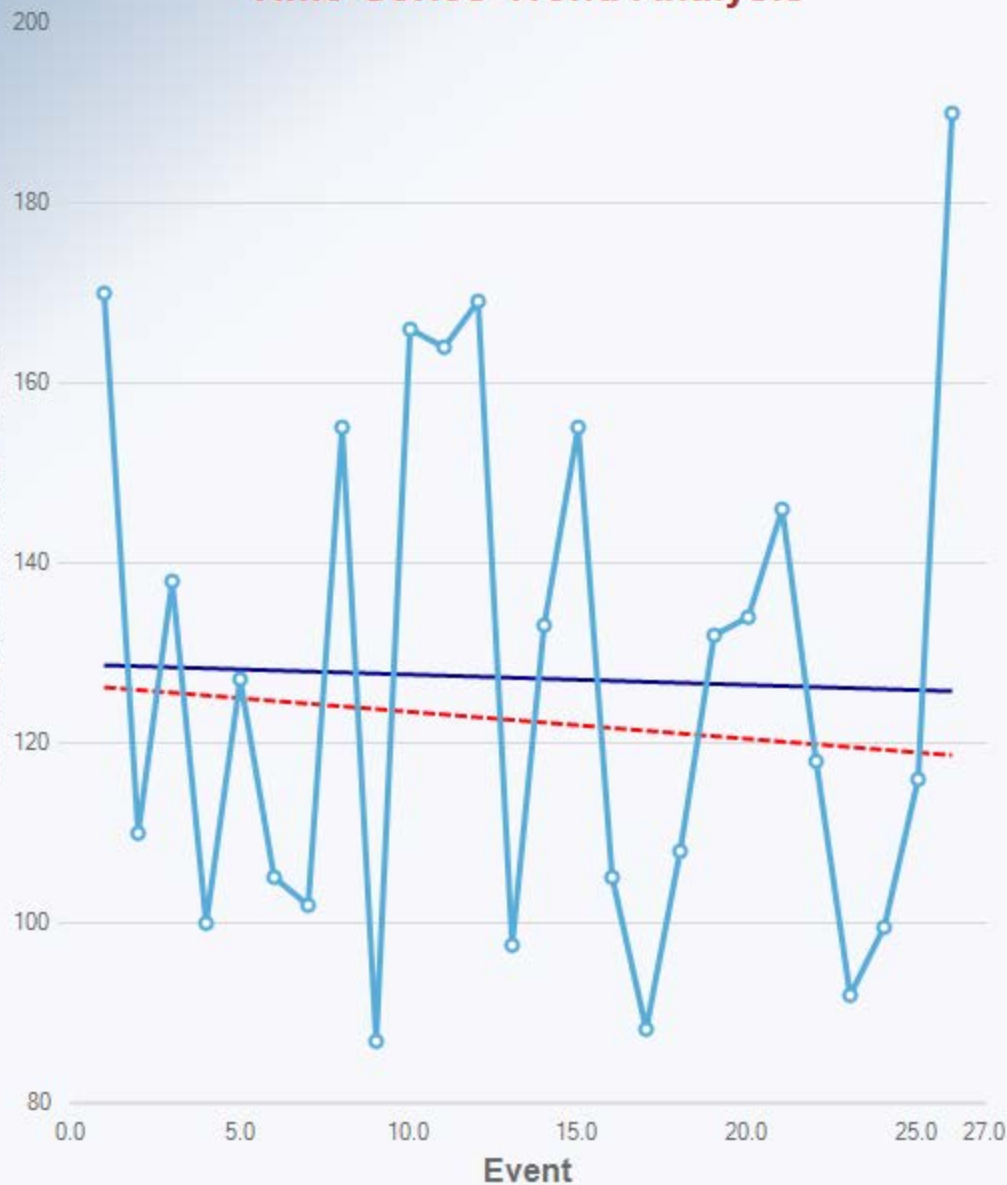
Level of Significance	0.0500
M1	118.0501
M2	206.9499
LCL of Slope	-0.0142
UCL of Slope	0.7150
Statistically significant evidence of an increasing trend at the specified level of significance.	

Mann-Kendall Trend Analysis

Standard Deviation of S	45.3578
M-K Standardized Val (S)	1.8299
Appx. Critical Value (0.05)	1.6449
Approximate p-value (S)	0.0336
Significant evidence of an increasing trend	

Time-Series Trend Analysis

Alkalinity, Total (mg/L)-site 07



Time-Series Trend Analysis

Events/Time Periods 26

OLS Regression Line (Blue)

OLS Regression Slope -0.1197

OLS Regression Intercept 128.8154

Theil-Sen Trend Line (Red)

Theil-Sen Slope -0.3000

Theil-Sen Intercept 126.5500

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 118.0609

M2 206.9391

LCL of Slope -2.0000

UCL of Slope 1.5000

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 45.3468

M-K Standardized Val (S) -0.3528

Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.3621

Insufficient evidence of a significant trend

Time-Series Trend Analysis

Alkalinity, Total (mg/L)-site 08



Time-Series Trend Analysis

Events/Time Periods 16

OLS Regression Line (Blue)

OLS Regression Slope 0.6618

OLS Regression Intercept 67.9000

Theil-Sen Trend Line (Red)

Theil-Sen Slope 0.4308

Theil-Sen Intercept 69.0379

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 38.2335

M2 81.7665

LCL of Slope -0.4204

UCL of Slope 1.2945

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 22.2111

M-K Test Value (S) 22

Tabulated p-value 0.1750

Insufficient evidence of a significant trend

Time-Series Trend Analysis

Alkalinity, Total (mg/L)-site 09



Time-Series Trend Analysis

Events/Time Periods 10

OLS Regression Line (Blue)

OLS Regression Slope 3.9903
OLS Regression Intercept 109.6933

Theil-Sen Trend Line (Red)

Theil-Sen Slope 3.2857
Theil-Sen Intercept 112.9286

Theil-Sen Trend Analysis

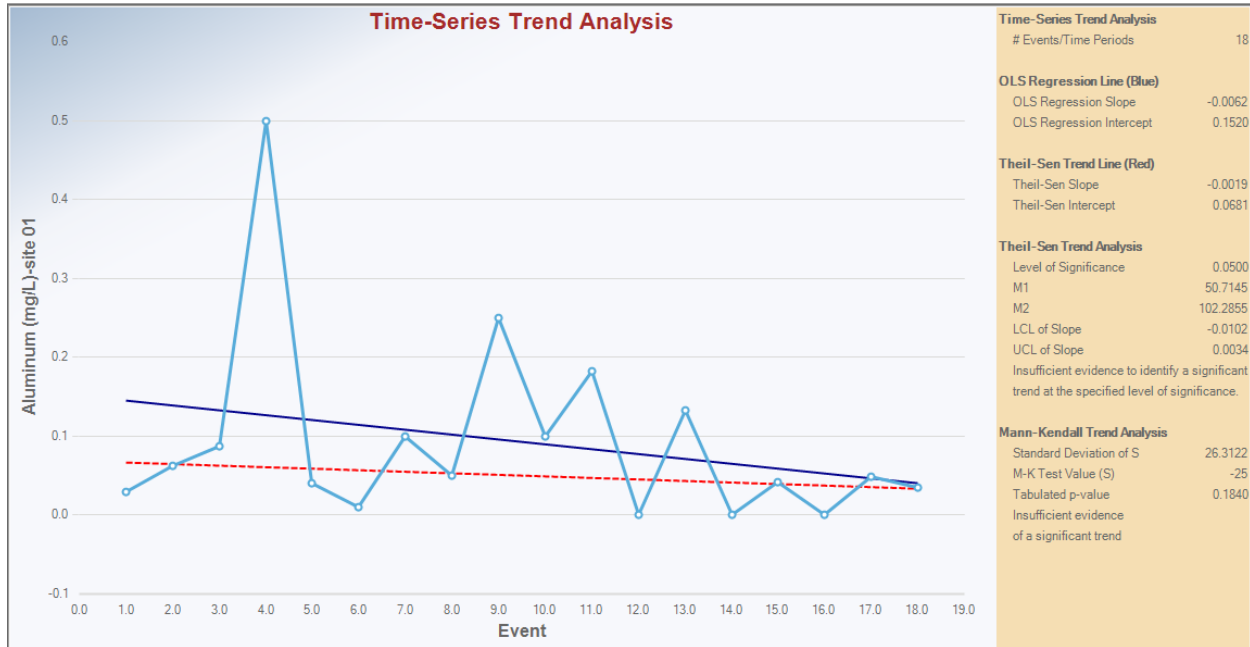
Level of Significance 0.0500
M1 11.5435
M2 33.4565
LCL of Slope -8.4565
UCL of Slope 11.8499
Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

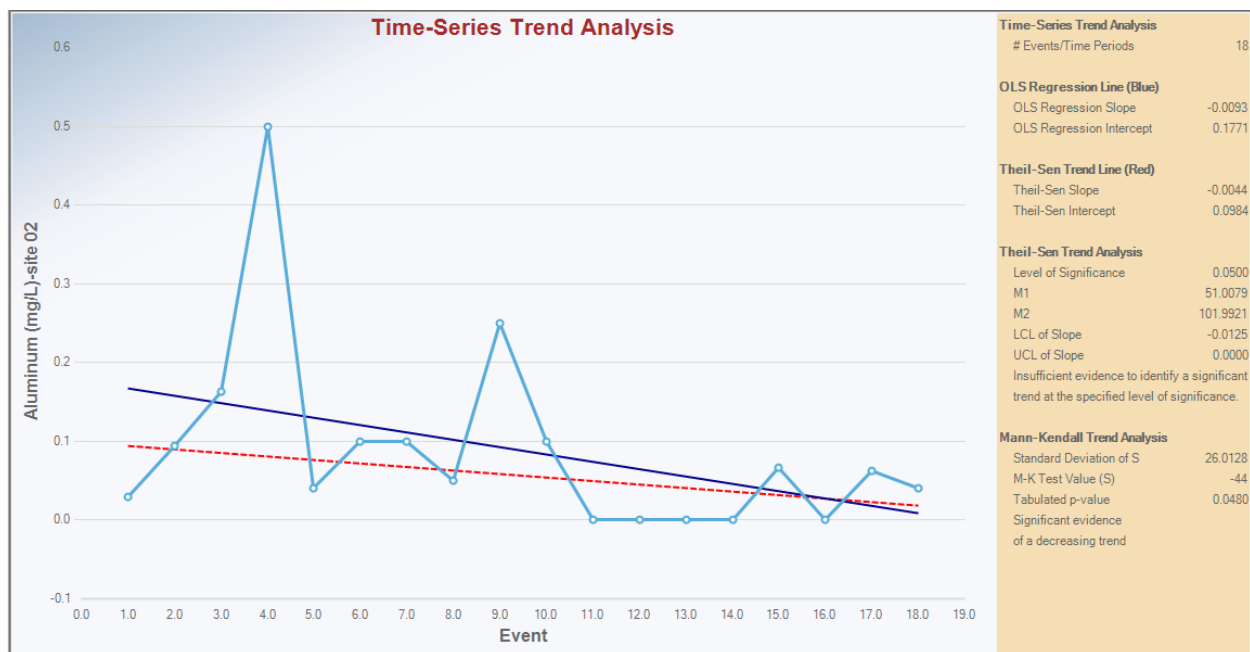
Standard Deviation of S 11.1803
M-K Test Value (S) 9
Tabulated p-value 0.2420
Insufficient evidence of a significant trend

Aluminum graphs

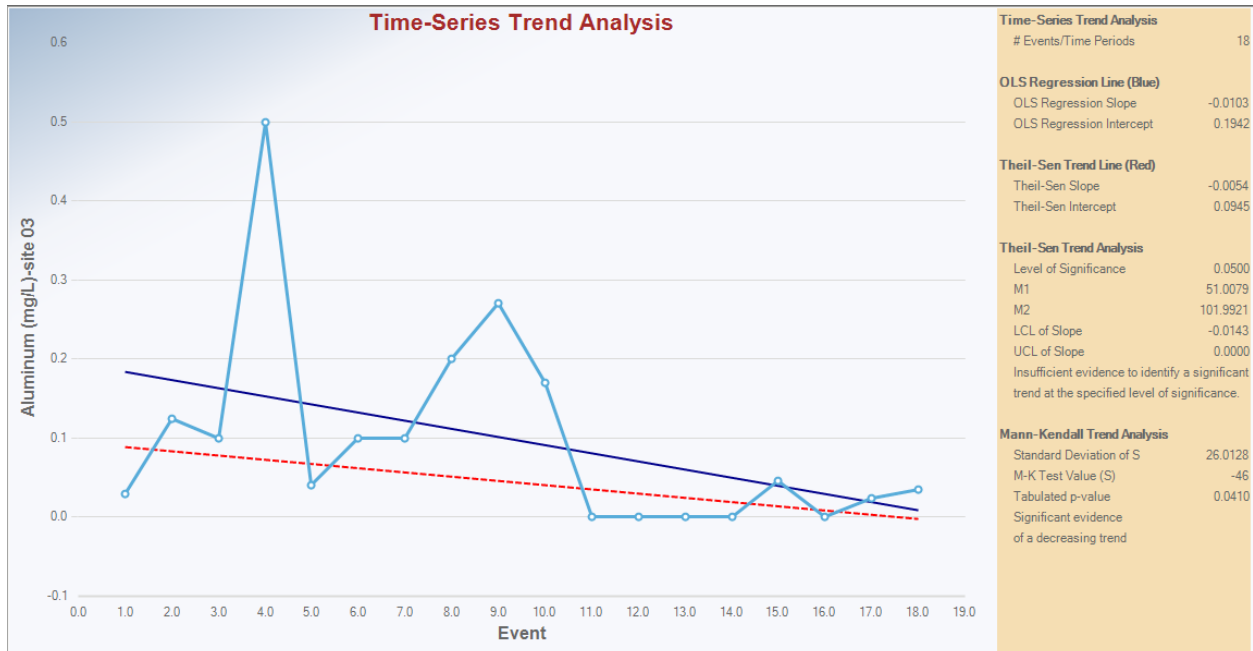
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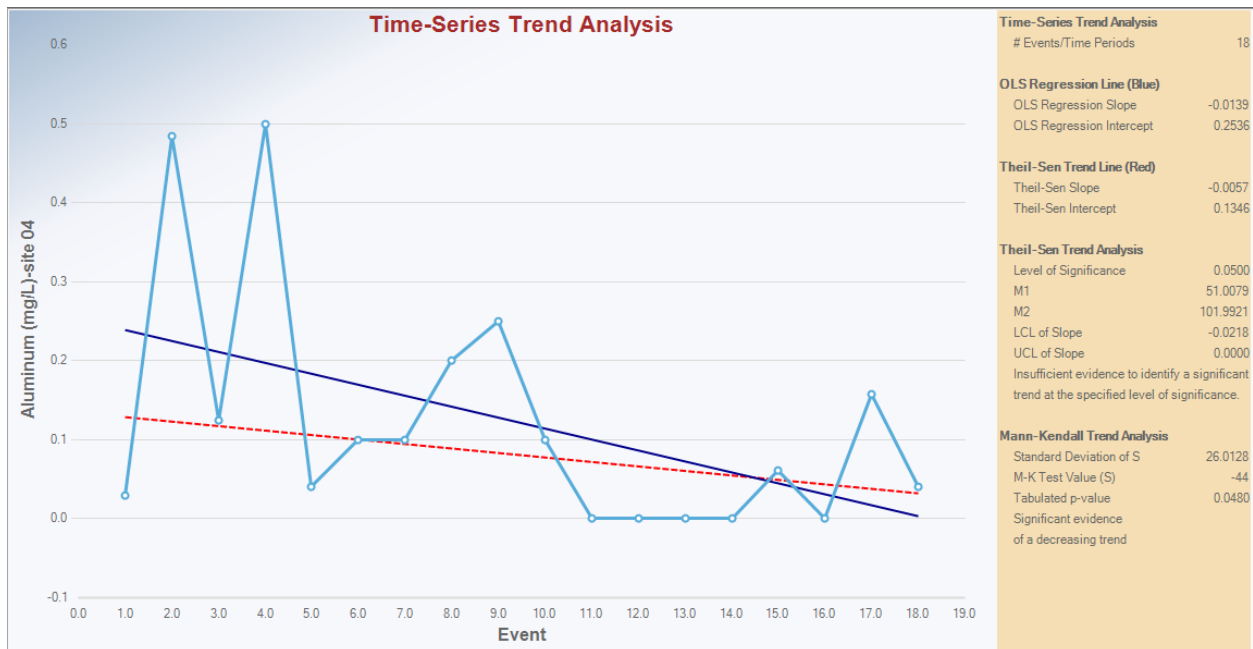
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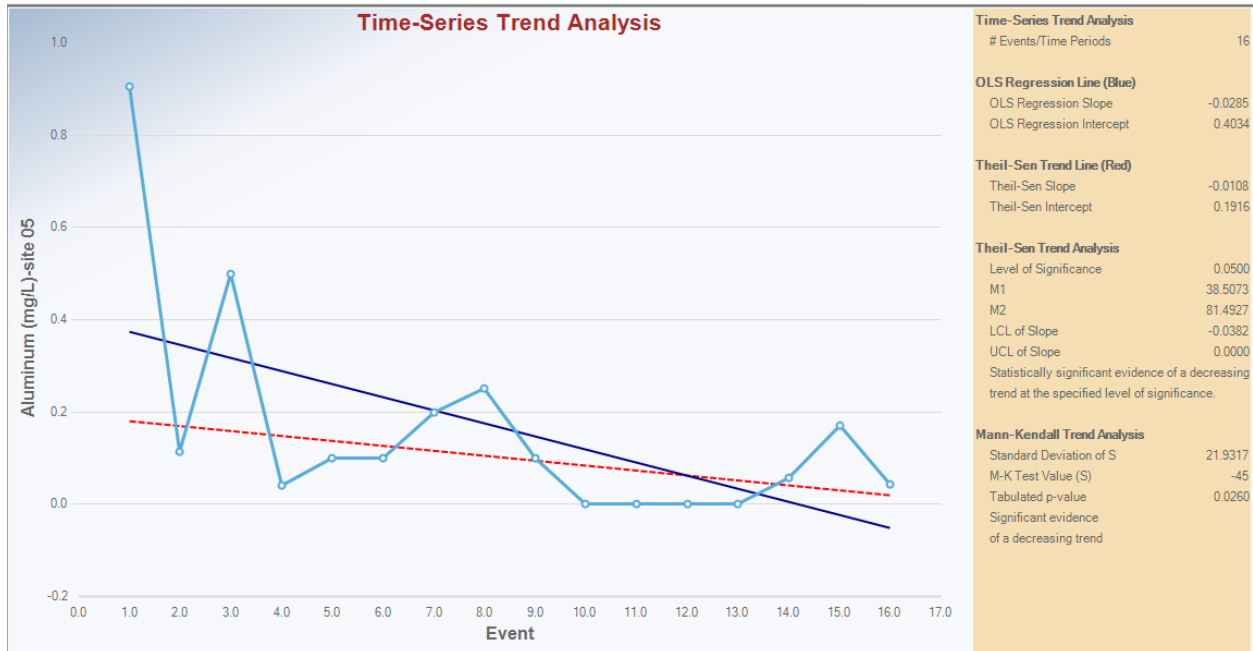
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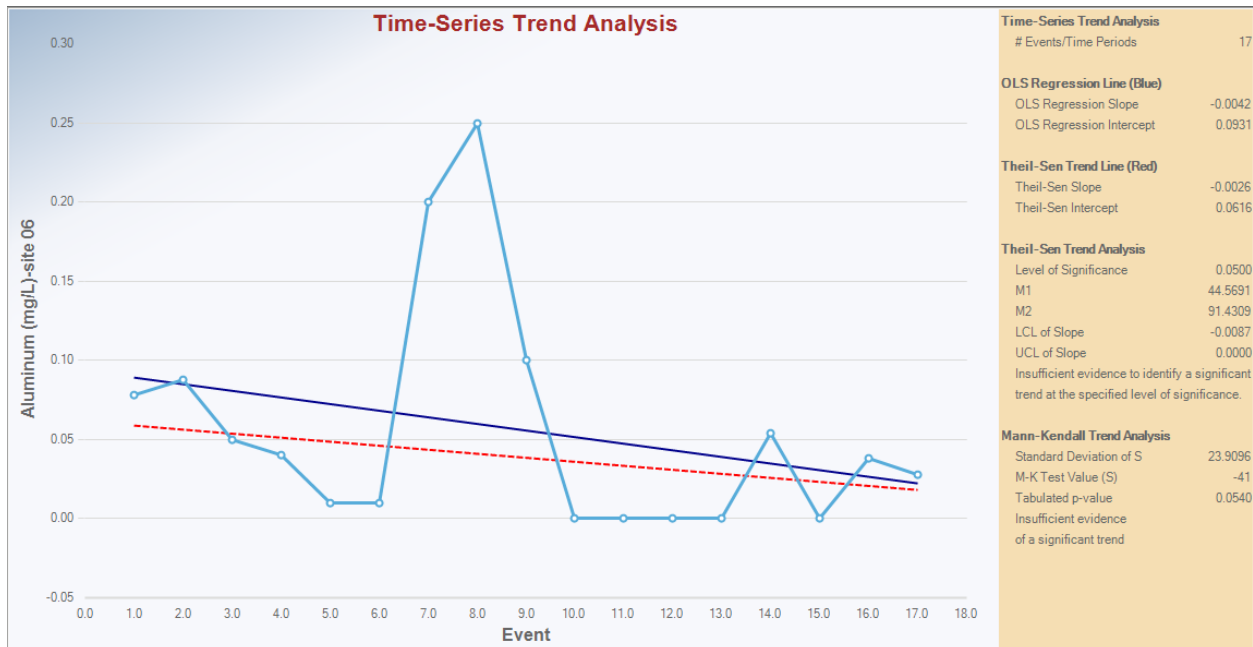
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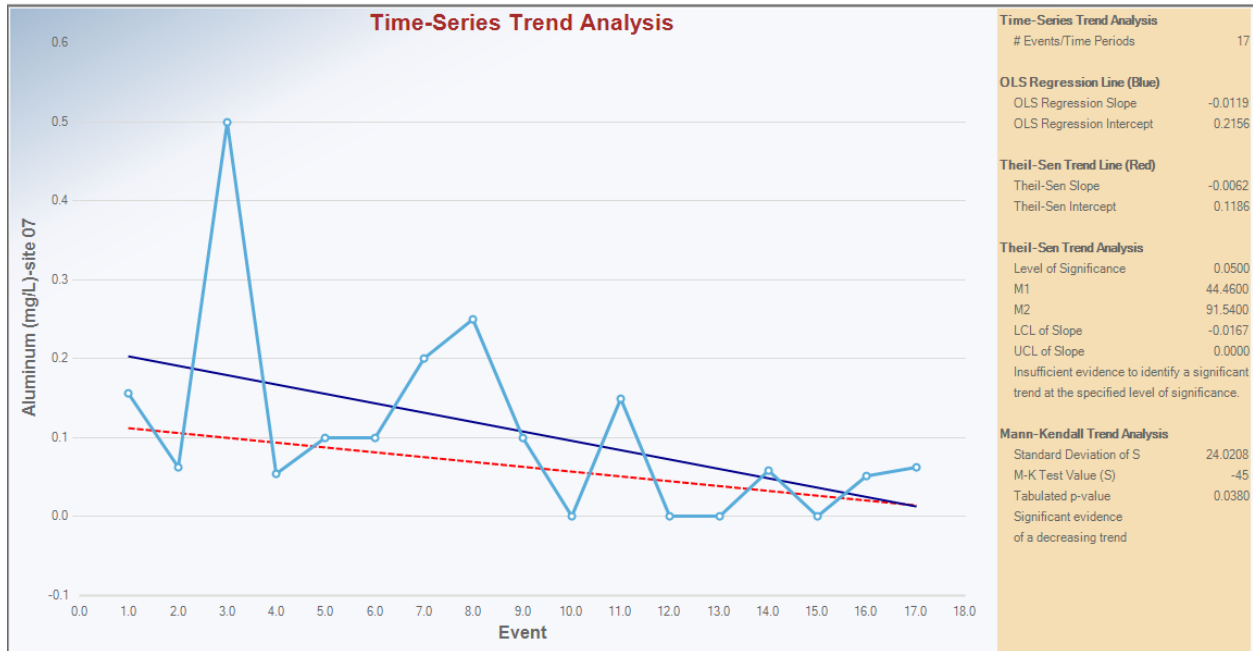
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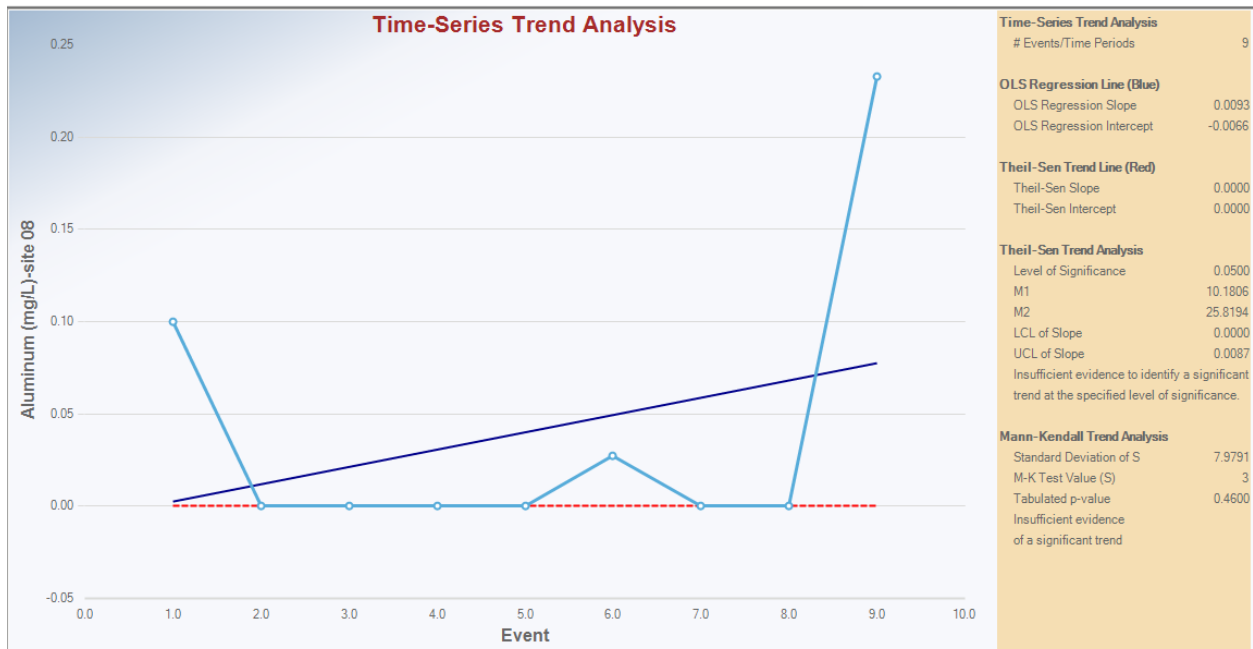
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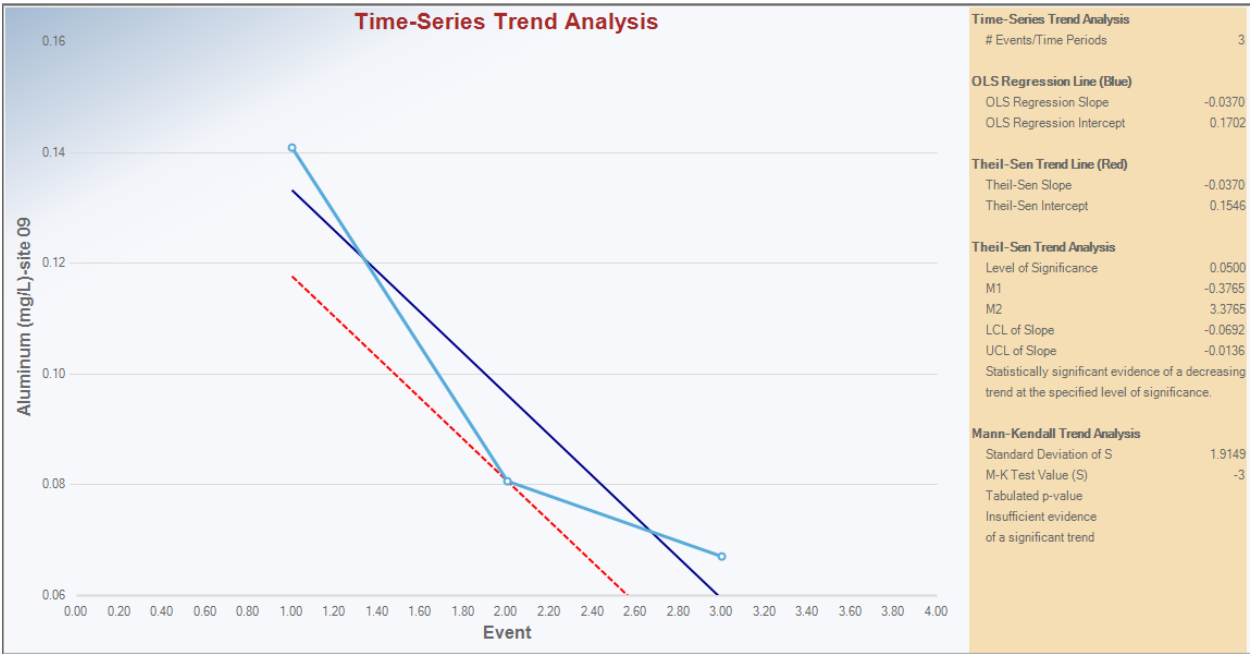
Site 7:



Site 8:



Site 9:



Ammonia Trend Graphs

Time-Series Trend Analysis

Ammonia N (mg/L)-site 01



Time-Series Trend Analysis

Events/Time Periods 25

OLS Regression Line (Blue)

OLS Regression Slope -0.0111

OLS Regression Intercept 0.2619

Theil-Sen Trend Line (Red)

Theil-Sen Slope -0.0071

Theil-Sen Intercept 0.1929

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 108.8369

M2 191.1631

LCL of Slope -0.0117

UCL of Slope 0.0000

Statistically significant evidence of a decreasing trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 42.0040

M-K Standardized Val (S) -2.7140

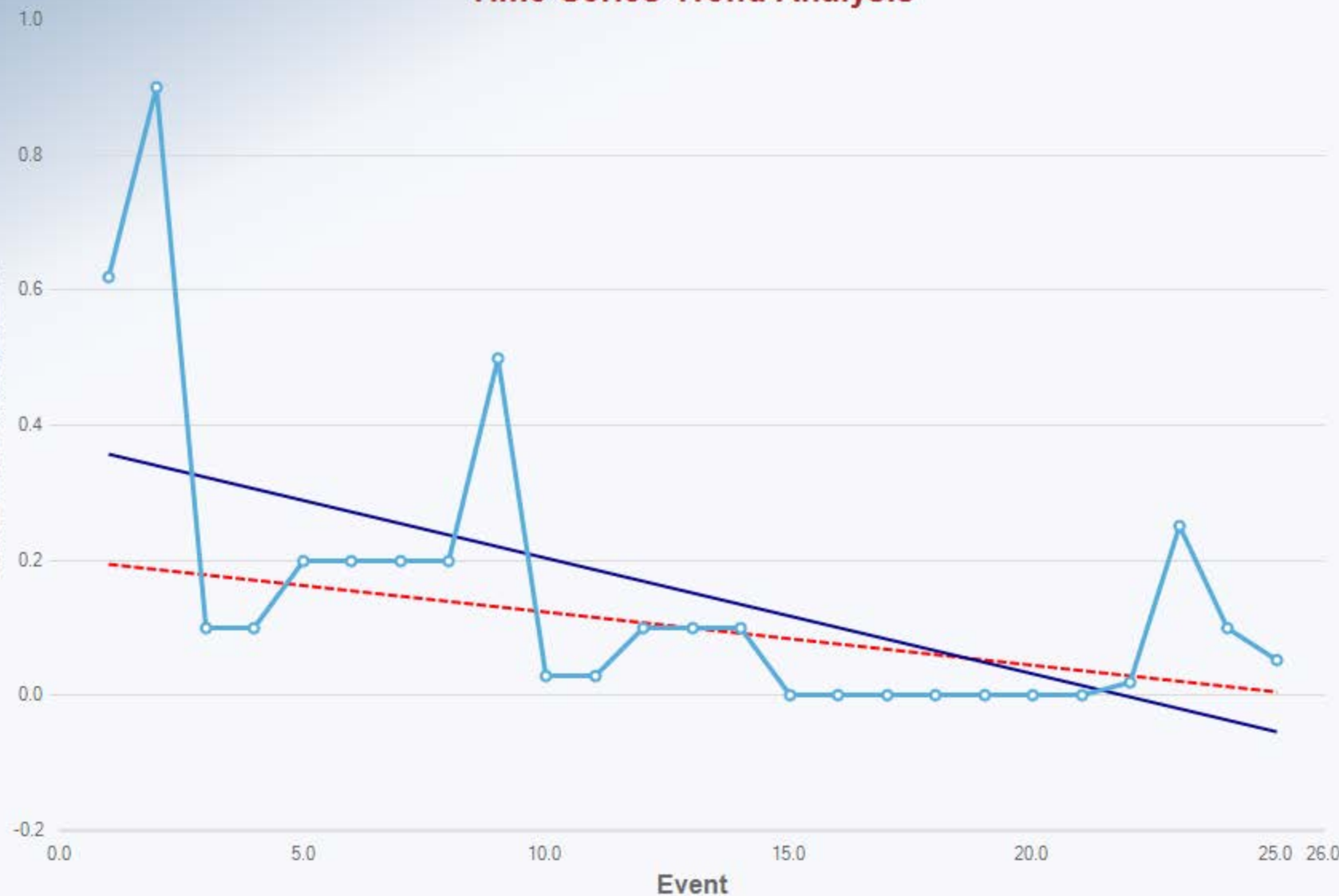
Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.0033

Significant evidence of a decreasing trend

Time-Series Trend Analysis

Ammonia N (mg/L)-site 02



Time-Series Trend Analysis

Events/Time Periods 25

OLS Regression Line (Blue)

OLS Regression Slope -0.0171

OLS Regression Intercept 0.3739

Theil-Sen Trend Line (Red)

Theil-Sen Slope -0.0079

Theil-Sen Intercept 0.2023

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 108.9927

M2 191.0073

LCL of Slope -0.0167

UCL of Slope 0.0000

Statistically significant evidence of a decreasing trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 41.8450

M-K Standardized Val (S) -2.9155

Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.0018

Significant evidence of a decreasing trend

Time-Series Trend Analysis

Ammonia N (mg/L)-site 03



Time-Series Trend Analysis

Events/Time Periods 25

OLS Regression Line (Blue)

OLS Regression Slope -0.0072

OLS Regression Intercept 0.1894

Theil-Sen Trend Line (Red)

Theil-Sen Slope -0.0050

Theil-Sen Intercept 0.1150

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 109.0357

M2 190.9643

LCL of Slope -0.0100

UCL of Slope 0.0000

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 41.8011

M-K Standardized Val (S) -2.5597

Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.0052

Significant evidence of a decreasing trend

Time-Series Trend Analysis

Ammonia N (mg/L)-site 04



Time-Series Trend Analysis

Events/Time Periods 25

OLS Regression Line (Blue)

OLS Regression Slope -0.0103

OLS Regression Intercept 0.2446

Theil-Sen Trend Line (Red)

Theil-Sen Slope -0.0074

Theil-Sen Intercept 0.1962

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 108.9927

M2 191.0073

LCL of Slope -0.0143

UCL of Slope -0.0012

Statistically significant evidence of a decreasing trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 41.8450

M-K Standardized Val (S) -3.0589

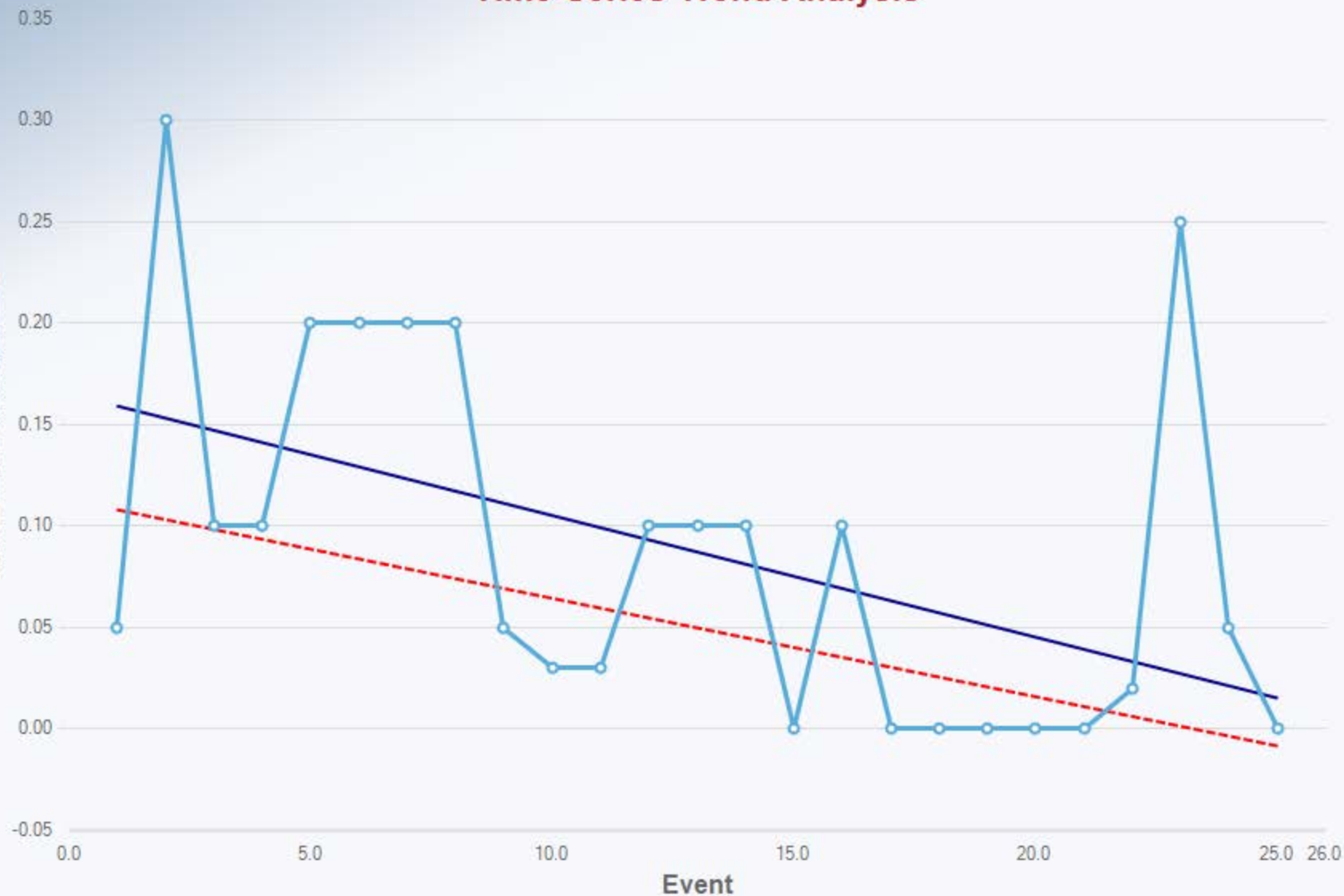
Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.0011

Significant evidence of a decreasing trend

Time-Series Trend Analysis

Ammonia N (mg/L)-site 05



Time-Series Trend Analysis

Events/Time Periods 25

OLS Regression Line (Blue)

OLS Regression Slope -0.0060

OLS Regression Intercept 0.1654

Theil-Sen Trend Line (Red)

Theil-Sen Slope -0.0049

Theil-Sen Intercept 0.1135

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 109.0357

M2 190.9643

LCL of Slope -0.0105

UCL of Slope 0.0000

Statistically significant evidence of a decreasing trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 41.8011

M-K Standardized Val (S) -2.7990

Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.0026

Significant evidence of a decreasing trend

Time-Series Trend Analysis



Time-Series Trend Analysis

Events/Time Periods 25

OLS Regression Line (Blue)

OLS Regression Slope -0.0050

OLS Regression Intercept 0.1459

Theil-Sen Trend Line (Red)

Theil-Sen Slope -0.0043

Theil-Sen Intercept 0.1057

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 109.3455

M2 190.6545

LCL of Slope -0.0088

UCL of Slope 0.0000

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 41.4849

M-K Standardized Val (S) -2.6034

Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.0046

Significant evidence of a decreasing trend

Time-Series Trend Analysis

Ammonia N (mg/L)-site 07



Time-Series Trend Analysis

Events/Time Periods 25

OLS Regression Line (Blue)

OLS Regression Slope -0.0062

OLS Regression Intercept 0.1643

Theil-Sen Trend Line (Red)

Theil-Sen Slope -0.0047

Theil-Sen Intercept 0.1115

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 109.1139

M2 190.8861

LCL of Slope -0.0100

UCL of Slope 0.0000

Statistically significant evidence of a decreasing trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 41.7213

M-K Standardized Val (S) -2.8523

Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.0022

Significant evidence
of a decreasing trend

Time-Series Trend Analysis

Ammonia N (mg/L)-site 08



Time-Series Trend Analysis

Events/Time Periods 15

OLS Regression Line (Blue)

OLS Regression Slope 0.0018

OLS Regression Intercept 0.0327

Theil-Sen Trend Line (Red)

Theil-Sen Slope 0.0000

Theil-Sen Intercept 0.0200

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 33.8975

M2 71.1025

LCL of Slope -0.0030

UCL of Slope 0.0051

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 18.9824

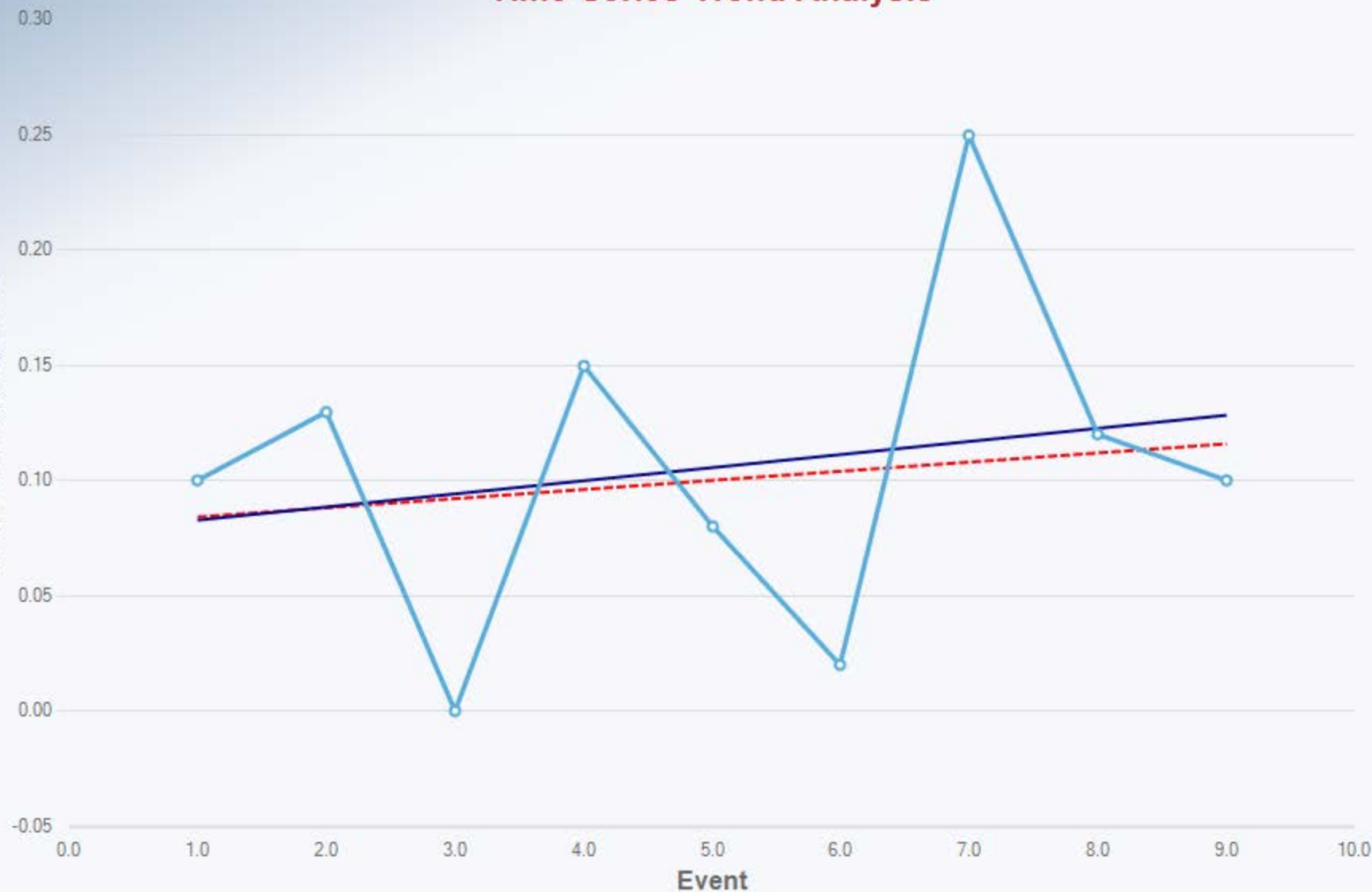
M-K Test Value (S) 7

Tabulated p-value 0.3850

Insufficient evidence of a significant trend

Time-Series Trend Analysis

Ammonia N (mg/L)-site 09



Time-Series Trend Analysis

Events/Time Periods 9

OLS Regression Line (Blue)

OLS Regression Slope 0.0057

OLS Regression Intercept 0.0772

Theil-Sen Trend Line (Red)

Theil-Sen Slope 0.0039

Theil-Sen Intercept 0.0804

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 8.6516

M2 27.3484

LCL of Slope -0.0226

UCL of Slope 0.0256

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

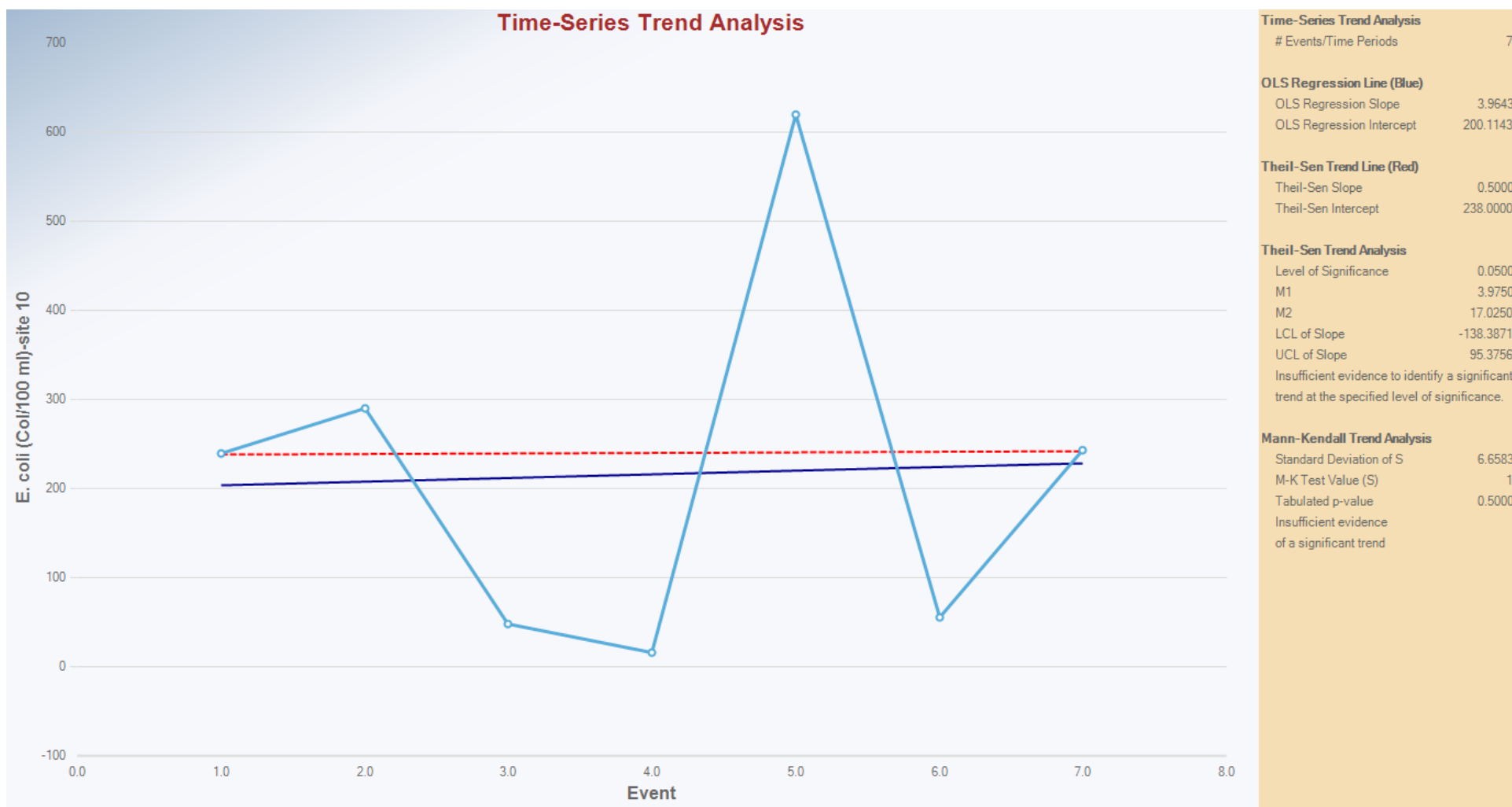
Standard Deviation of S 9.5394

M-K Test Value (S) 3

Tabulated p-value 0.4600

Insufficient evidence of a significant trend

Trend Graph – E. coli in Surface Water (2015-2024)
Station 10



Fecal Coliforms Trend Graphs

Time-Series Trend Analysis

Fecal Coliforms (Col/100ml)-site 01



Time-Series Trend Analysis

Events/Time Periods 25

OLS Regression Line (Blue)

OLS Regression Slope -1.0885

OLS Regression Intercept 59.4700

Theil-Sen Trend Line (Red)

Theil-Sen Slope -1.4286

Theil-Sen Intercept 54.5714

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 108.2040

M2 191.7960

LCL of Slope -3.1429

UCL of Slope 0.5995

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 42.6497

M-K Standardized Val (S) -1.1723

Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.1205

Insufficient evidence of a significant trend

Time-Series Trend Analysis



Time-Series Trend Analysis

Events/Time Periods 25

OLS Regression Line (Blue)

OLS Regression Slope -0.9708

OLS Regression Intercept 52.9800

Theil-Sen Trend Line (Red)

Theil-Sen Slope -0.1678

Theil-Sen Intercept 26.1818

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 108.6158

M2 191.3842

LCL of Slope -2.5982

UCL of Slope 0.7242

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 42.2295

M-K Standardized Val (S) -0.7814

Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.2173

Insufficient evidence of a significant trend

Time-Series Trend Analysis

Fecal Coliforms (Col/100ml)-site 03



Time-Series Trend Analysis

Events/Time Periods 25

OLS Regression Line (Blue)

OLS Regression Slope -1.0208

OLS Regression Intercept 39.5900

Theil-Sen Trend Line (Red)

Theil-Sen Slope -0.3485

Theil-Sen Intercept 22.5303

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 108.2884

M2 191.7116

LCL of Slope -2.0000

UCL of Slope 0.5639

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 42.5637

M-K Standardized Val (S) -0.7518

Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.2261

Insufficient evidence of a significant trend

Time-Series Trend Analysis

Fecal Coliforms (Col/100ml)-site 04



Time-Series Trend Analysis

Events/Time Periods 25

OLS Regression Line (Blue)

OLS Regression Slope -0.9869

OLS Regression Intercept 26.5500

Theil-Sen Trend Line (Red)

Theil-Sen Slope -0.6250

Theil-Sen Intercept 18.1250

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 108.5694

M2 191.4306

LCL of Slope -1.3750

UCL of Slope 0.0000

Statistically significant evidence of a decreasing trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 42.2769

M-K Standardized Val (S) -2.4836

Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.0065

Significant evidence of a decreasing trend

Time-Series Trend Analysis

Fecal Coliforms (Col/100ml)-site 05



Time-Series Trend Analysis

Events/Time Periods 24

OLS Regression Line (Blue)

OLS Regression Slope -4.7861

OLS Regression Intercept 117.4094

Theil-Sen Trend Line (Red)

Theil-Sen Slope -2.5132

Theil-Sen Intercept 62.4145

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 98.8825

M2 177.1175

LCL of Slope -6.0000

UCL of Slope 0.0000

Statistically significant evidence of a decreasing trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 39.9166

M-K Standardized Val (S) -2.1294

Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.0166

Significant evidence of a decreasing trend

Time-Series Trend Analysis

Fecal Coliforms (Col/100ml)-site 06



Time-Series Trend Analysis

Events/Time Periods 25

OLS Regression Line (Blue)

OLS Regression Slope -0.7000

OLS Regression Intercept 32.9000

Theil-Sen Trend Line (Red)

Theil-Sen Slope -0.4008

Theil-Sen Intercept 23.2103

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 108.3076

M2 191.6924

LCL of Slope -1.8126

UCL of Slope 0.5182

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 42.5441

M-K Standardized Val (S) -0.9637

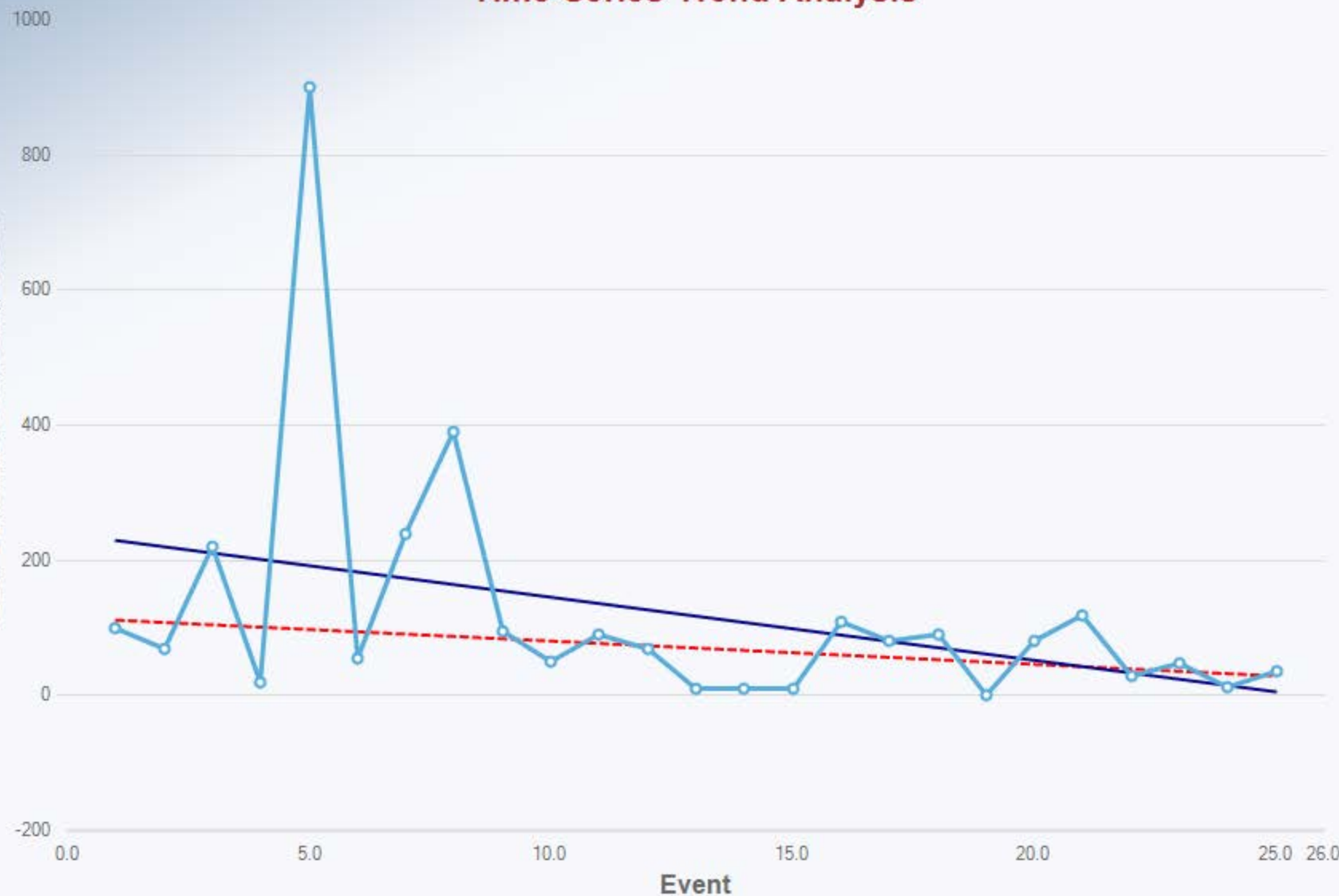
Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.1676

Insufficient evidence of a significant trend

Time-Series Trend Analysis

Fecal Coliforms (Col/100ml)-site 07



Time-Series Trend Analysis

Events/Time Periods 25

OLS Regression Line (Blue)

OLS Regression Slope -9.3431

OLS Regression Intercept 239.0600

Theil-Sen Trend Line (Red)

Theil-Sen Slope -3.4643

Theil-Sen Intercept 115.0357

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 108.1160

M2 191.8840

LCL of Slope -8.6667

UCL of Slope 0.0000

Statistically significant evidence of a decreasing trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 42.7395

M-K Standardized Val (S) -1.9888

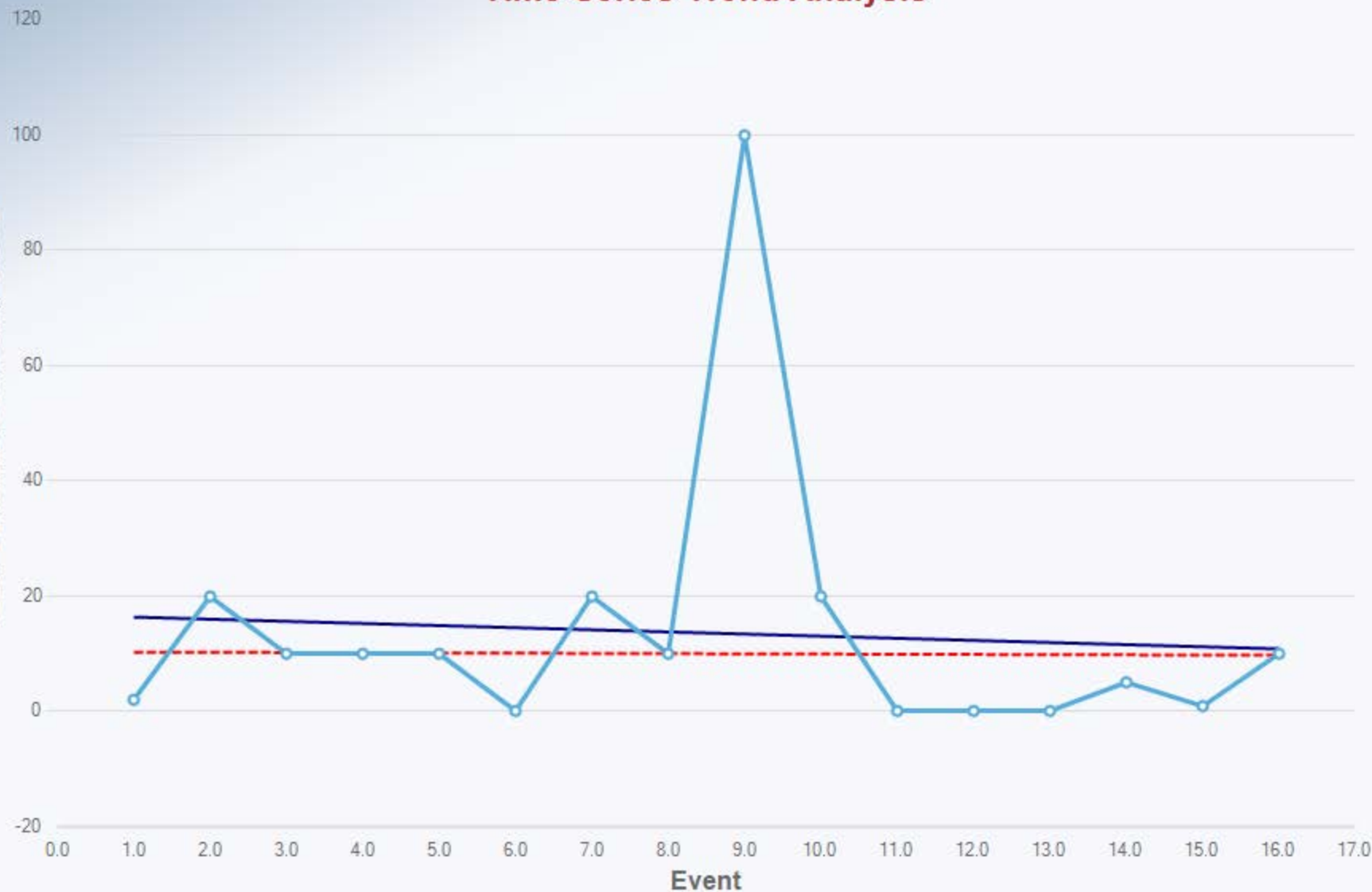
Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.0234

Significant evidence of a decreasing trend

Time-Series Trend Analysis

Fecal Coliforms (Col/100ml)-site 08



Time-Series Trend Analysis

Events/Time Periods 16

OLS Regression Line (Blue)

OLS Regression Slope -0.3706
OLS Regression Intercept 16.7750

Theil-Sen Trend Line (Red)

Theil-Sen Slope -0.0357
Theil-Sen Intercept 10.3036

Theil-Sen Trend Analysis

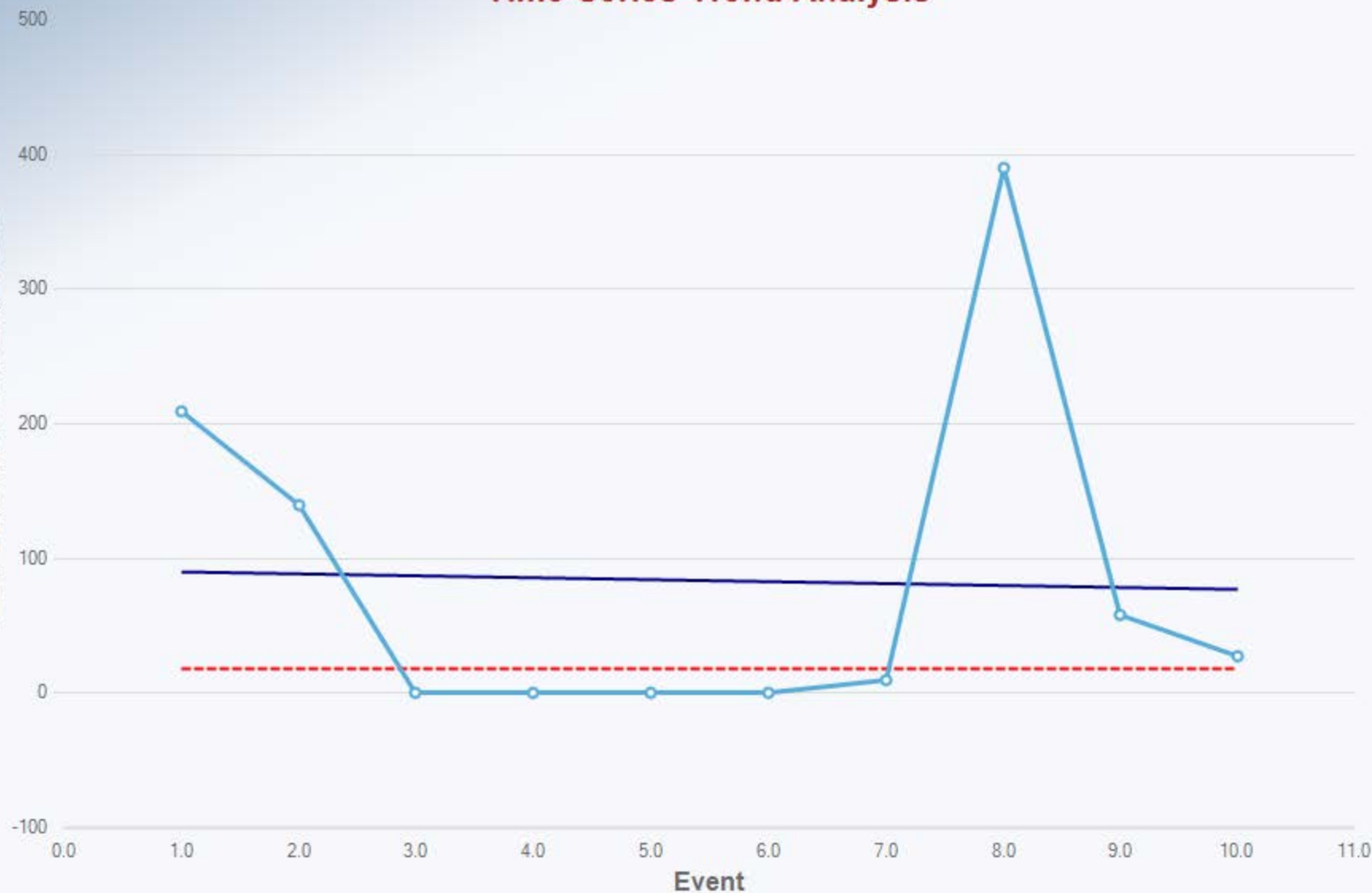
Level of Significance 0.0500
M1 38.8830
M2 81.1170
LCL of Slope -1.3024
UCL of Slope 0.2330
Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 21.5484
M-K Test Value (S) -19
Tabulated p-value 0.2250
Insufficient evidence of a significant trend

Time-Series Trend Analysis

Fecal Coliforms (Col/100ml)-site 09



Time-Series Trend Analysis

Events/Time Periods 10

OLS Regression Line (Blue)

OLS Regression Slope -1.4606

OLS Regression Intercept 91.5333

Theil-Sen Trend Line (Red)

Theil-Sen Slope 0.0000

Theil-Sen Intercept 18.5000

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 11.9301

M2 33.0699

LCL of Slope -33.4498

UCL of Slope 9.6900

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 10.7858

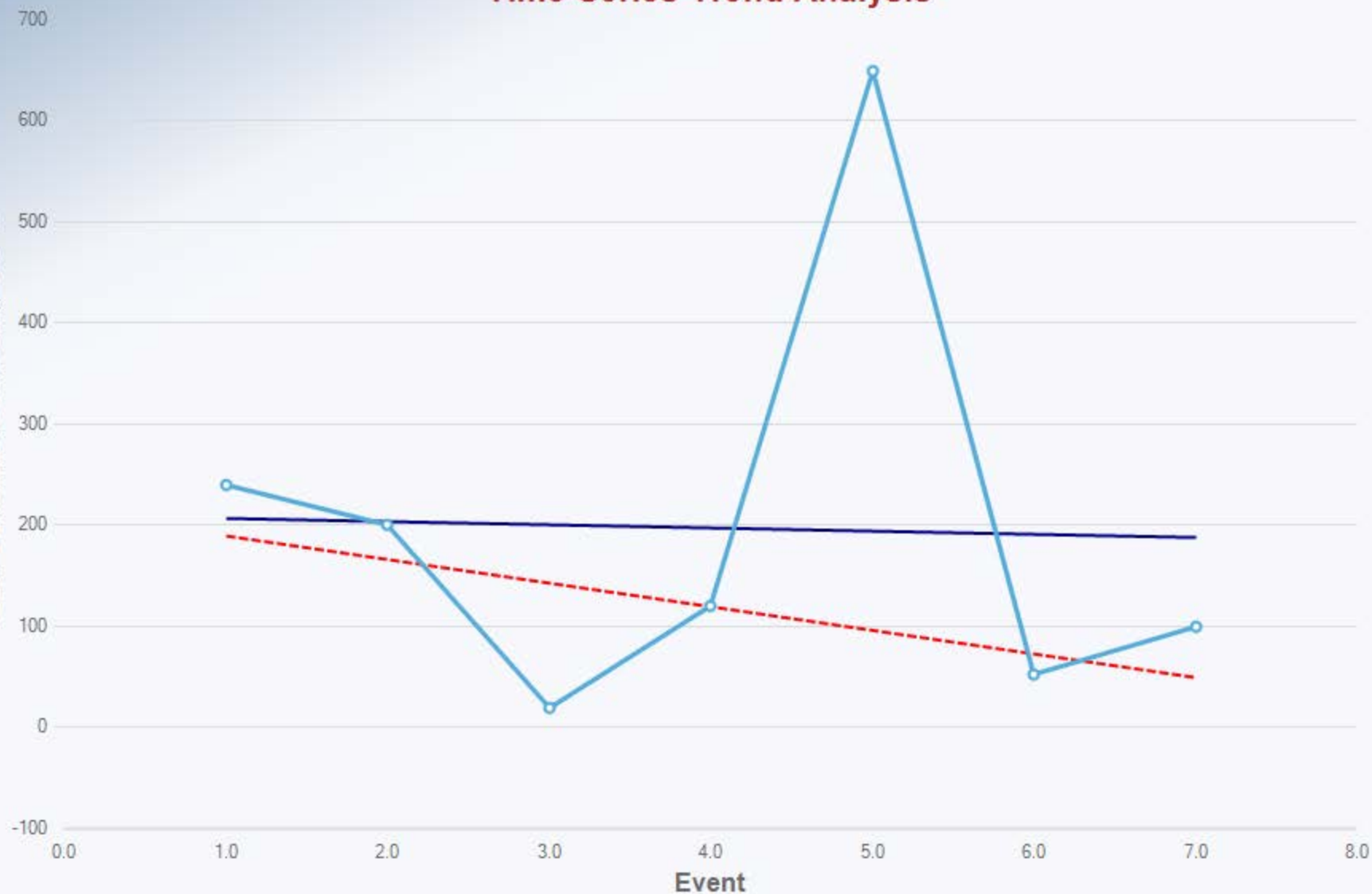
M-K Test Value (S) 3

Tabulated p-value 0.4310

Insufficient evidence of a significant trend

Time-Series Trend Analysis

Fecal Coliforms (Col/100ml)-site 10



Time-Series Trend Analysis

Events/Time Periods 7

OLS Regression Line (Blue)

OLS Regression Slope -3.0714

OLS Regression Intercept 209.7143

Theil-Sen Trend Line (Red)

Theil-Sen Slope -23.3333

Theil-Sen Intercept 213.3333

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 3.9750

M2 17.0250

LCL of Slope -111.7529

UCL of Slope 100.0626

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 6.6583

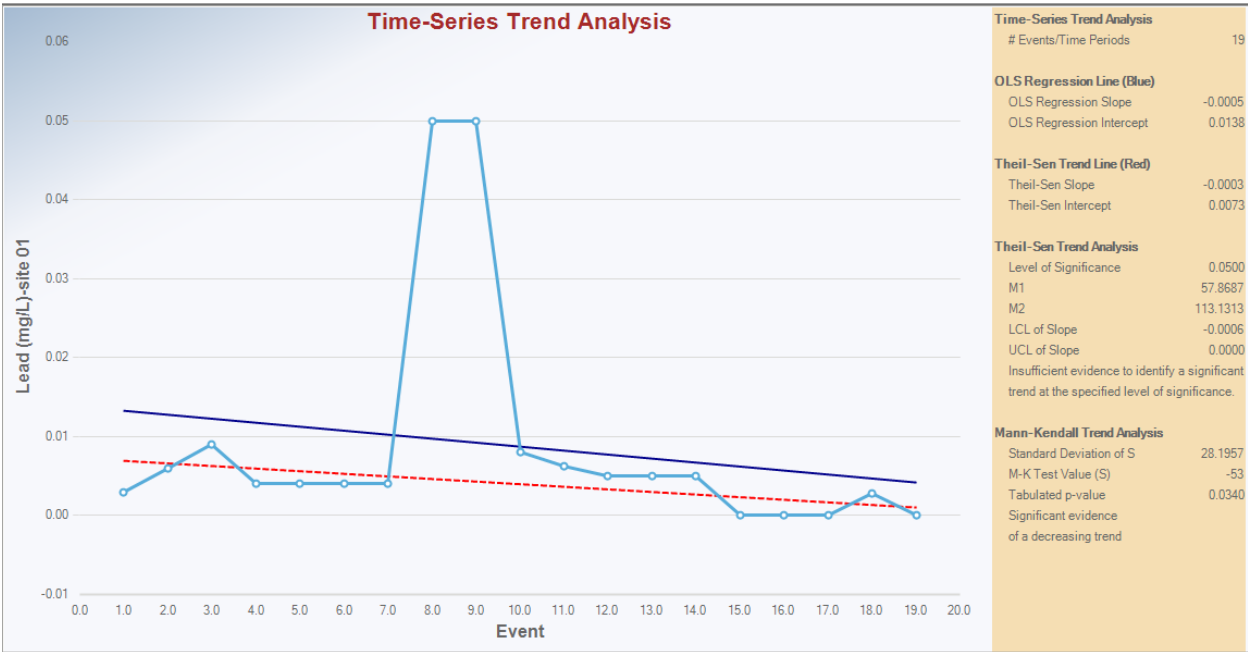
M-K Test Value (S) -5

Tabulated p-value 0.2810

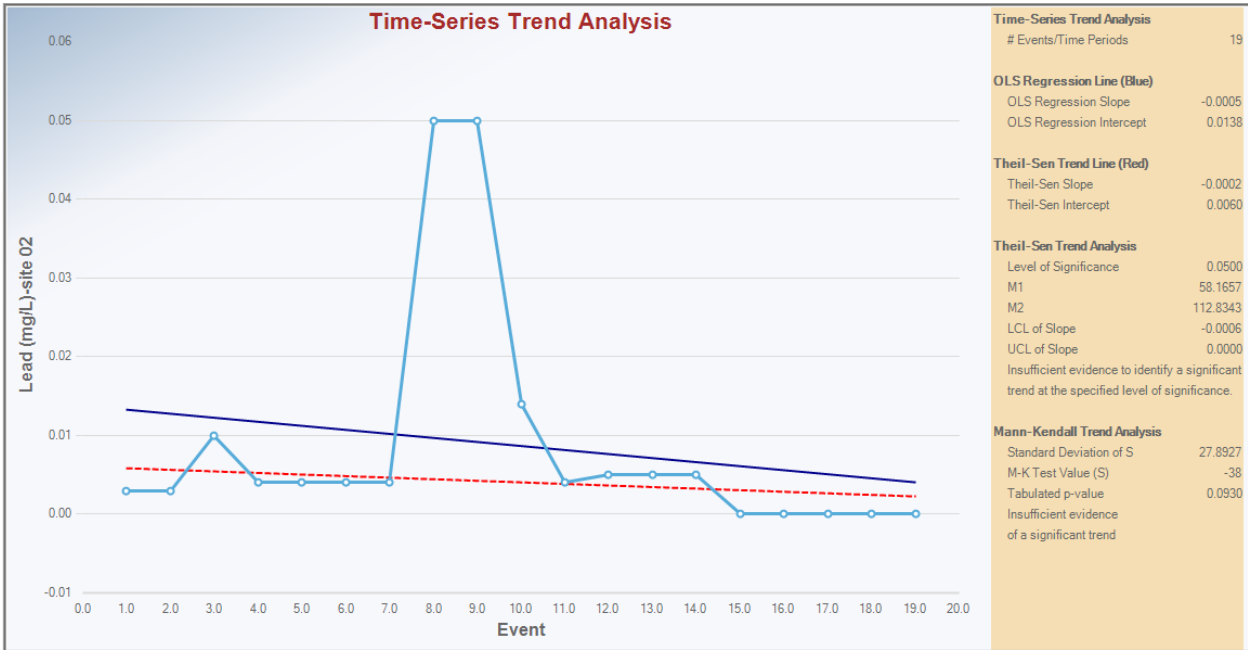
Insufficient evidence of a significant trend

Lead graphs

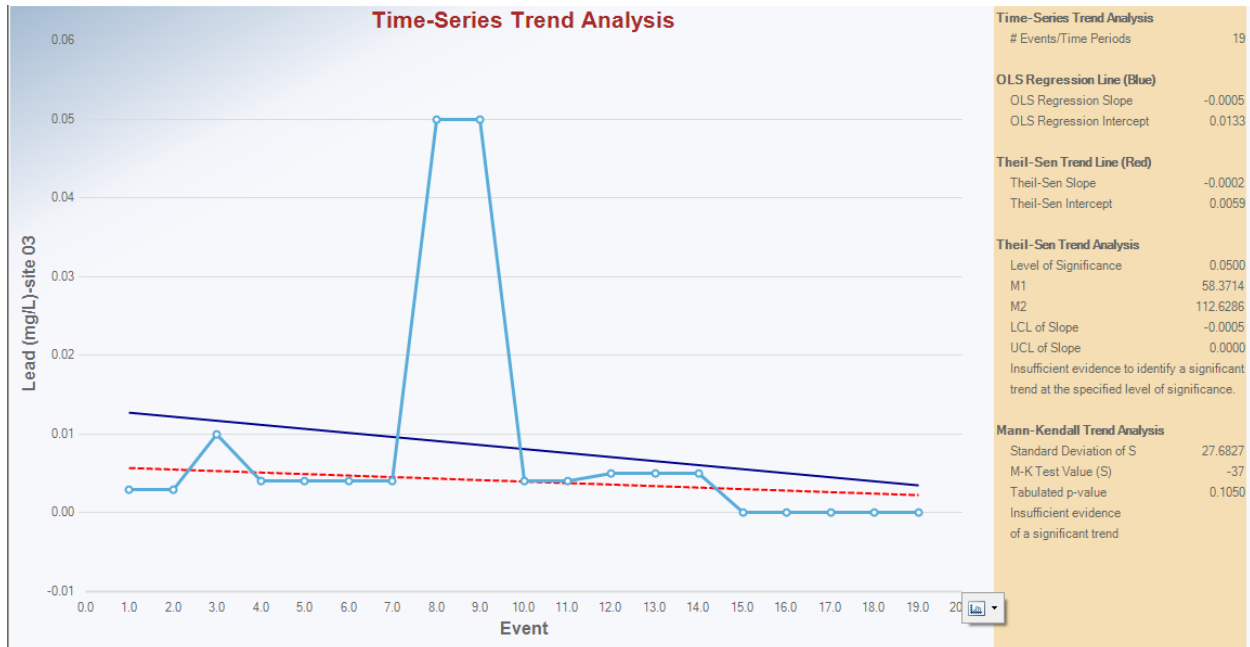
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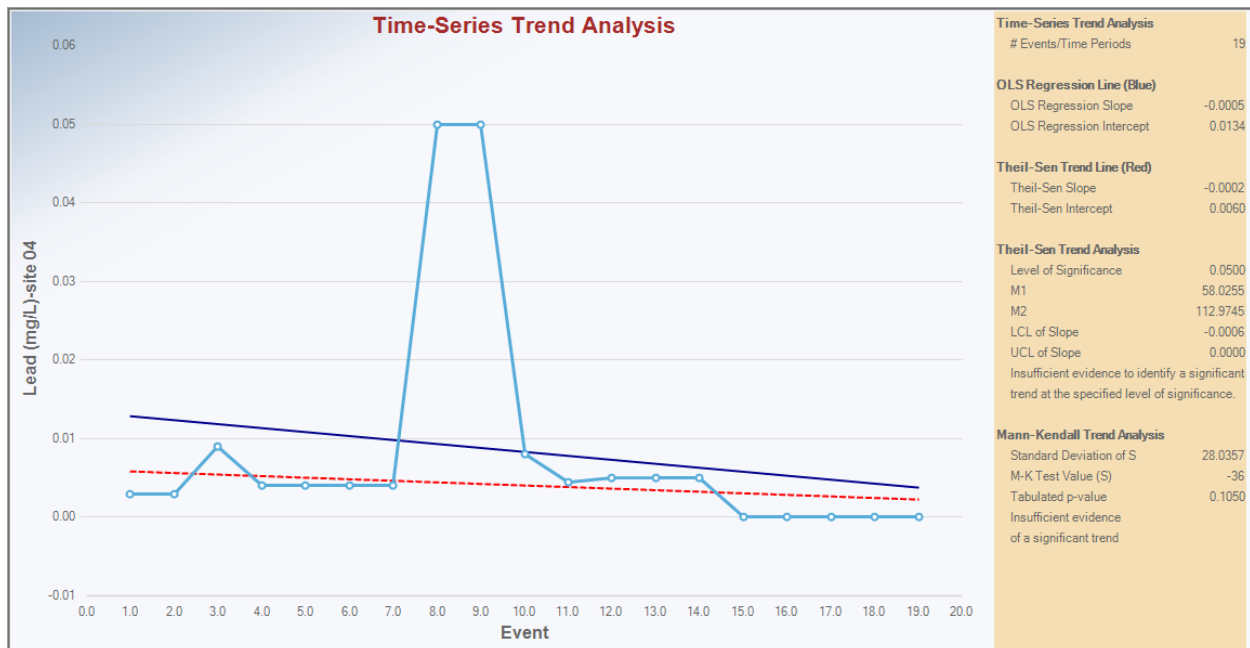
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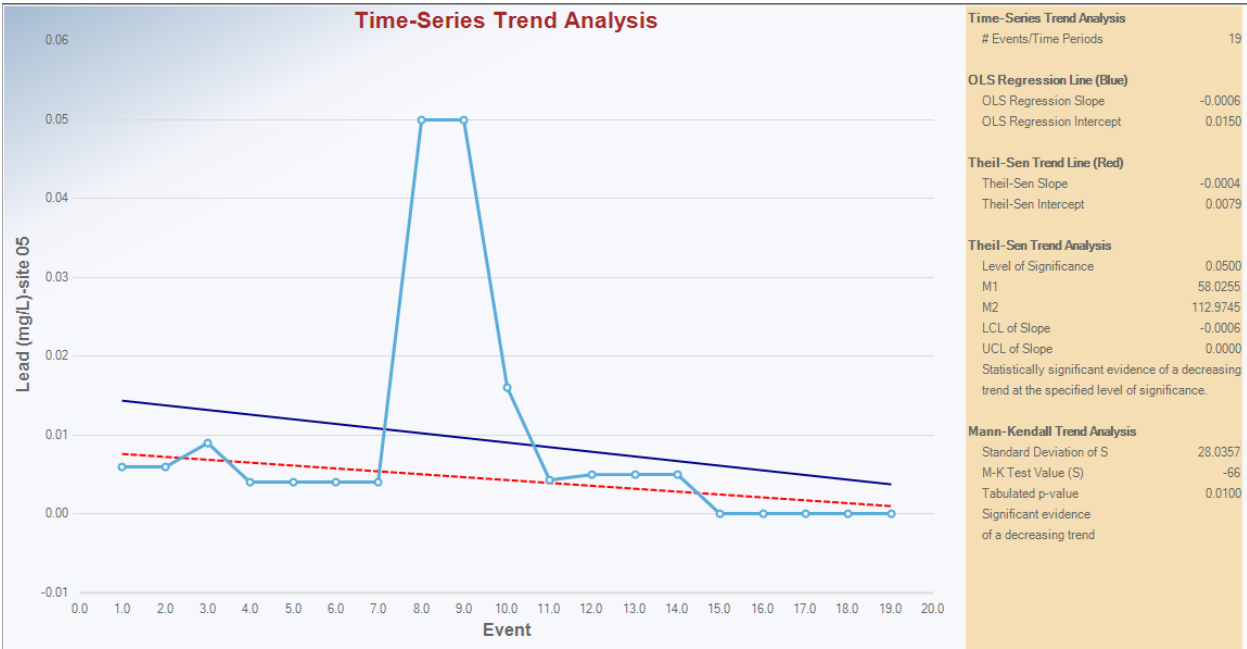
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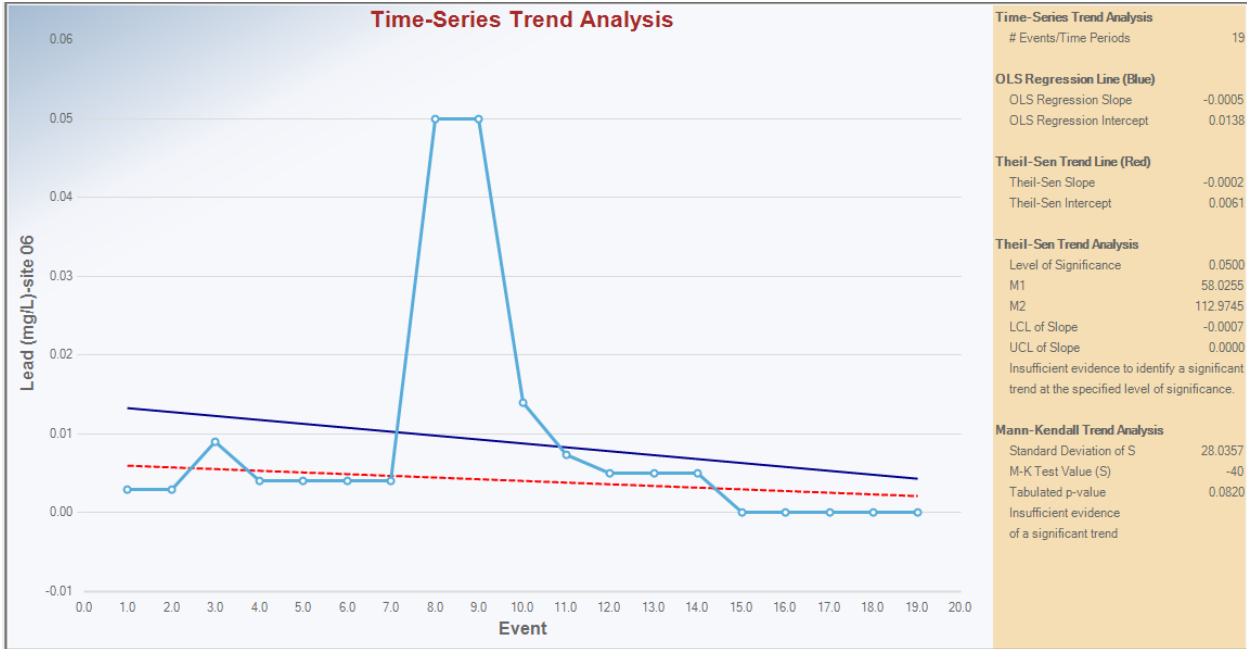
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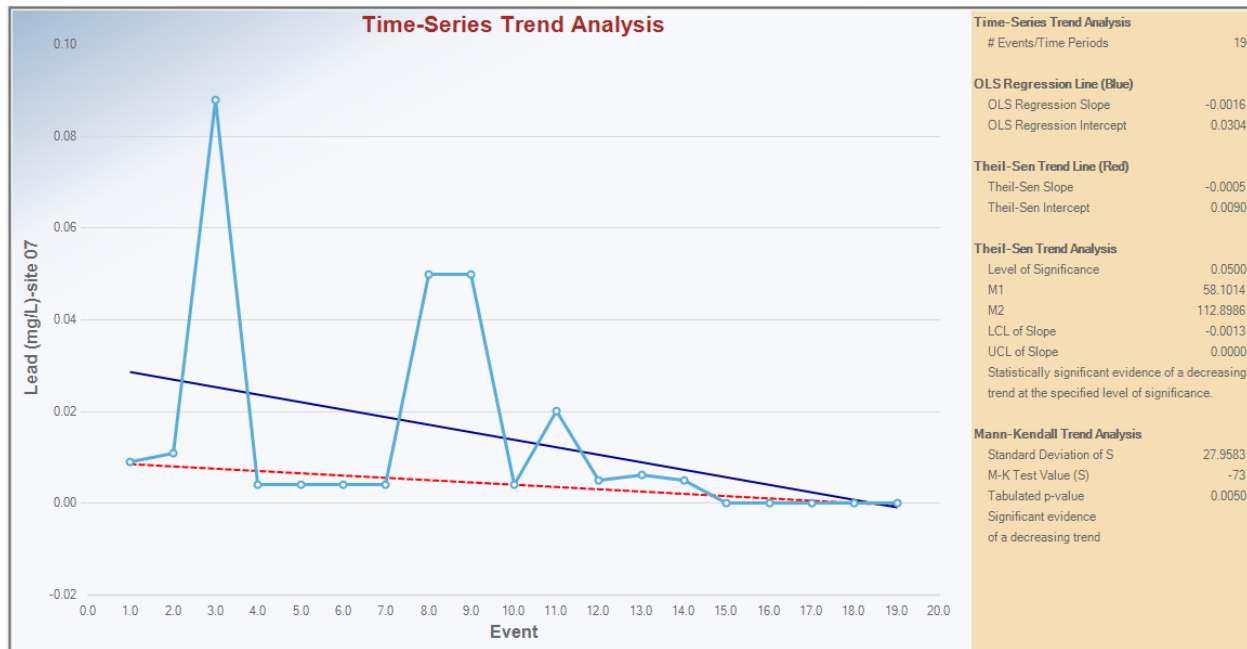
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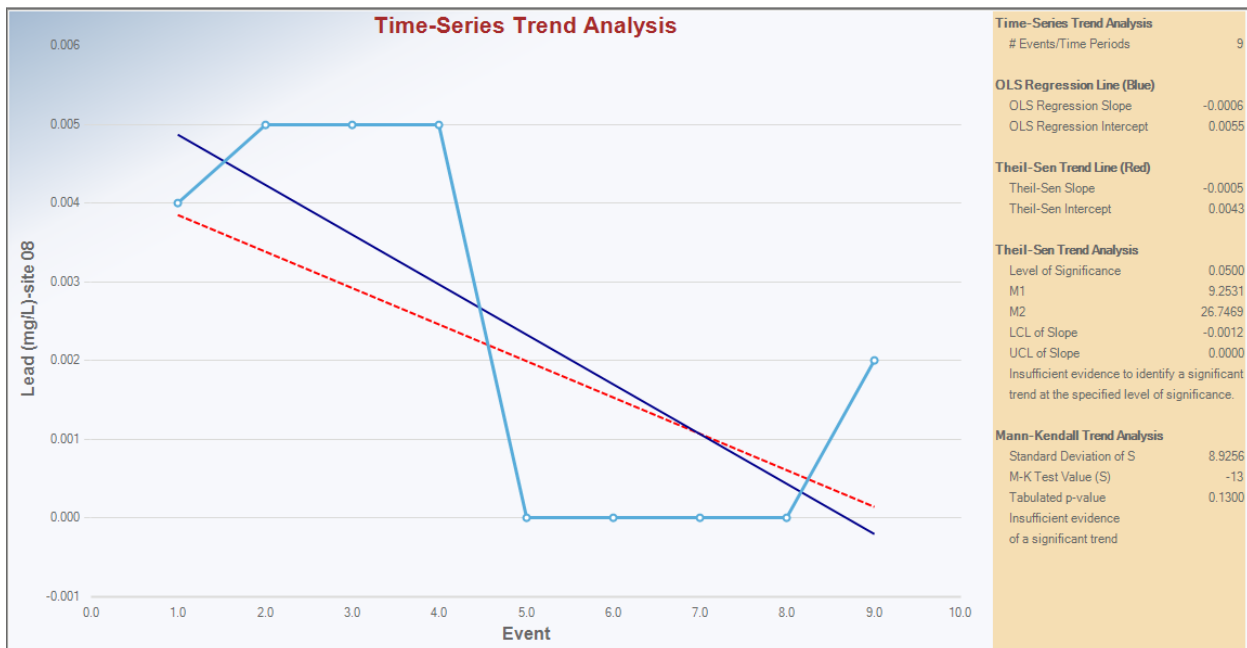
Site 6:



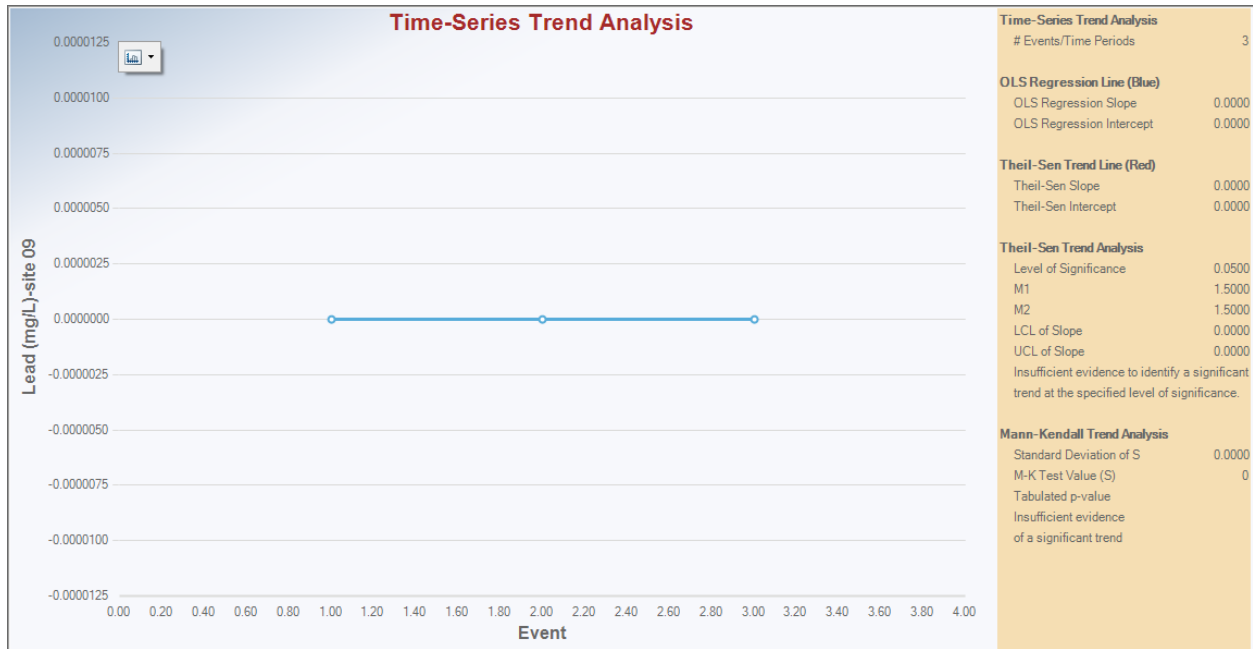
Site 7:



Site 8:



Site 9:



Nitrate - Nitrogen Trend Graphs

Time-Series Trend Analysis

Nitrate N (mg/L)-site 01



Time-Series Trend Analysis

Events/Time Periods 26

OLS Regression Line (Blue)

OLS Regression Slope -0.0084

OLS Regression Intercept 0.2482

Theil-Sen Trend Line (Red)

Theil-Sen Slope -0.0034

Theil-Sen Intercept 0.0895

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 119.2511

M2 205.7489

LCL of Slope -0.0077

UCL of Slope 0.0000

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 44.1324

M-K Standardized Val (S) -2.2659

Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.0117

Significant evidence of a decreasing trend

Time-Series Trend Analysis

Nitrate N (mg/L)-site 02



Time-Series Trend Analysis

Events/Time Periods 26

OLS Regression Line (Blue)

OLS Regression Slope -0.0120

OLS Regression Intercept 0.3196

Theil-Sen Trend Line (Red)

Theil-Sen Slope -0.0038

Theil-Sen Intercept 0.1015

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 119.2918

M2 205.7082

LCL of Slope -0.0094

UCL of Slope 0.0000

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 44.0908

M-K Standardized Val (S) -2.2454

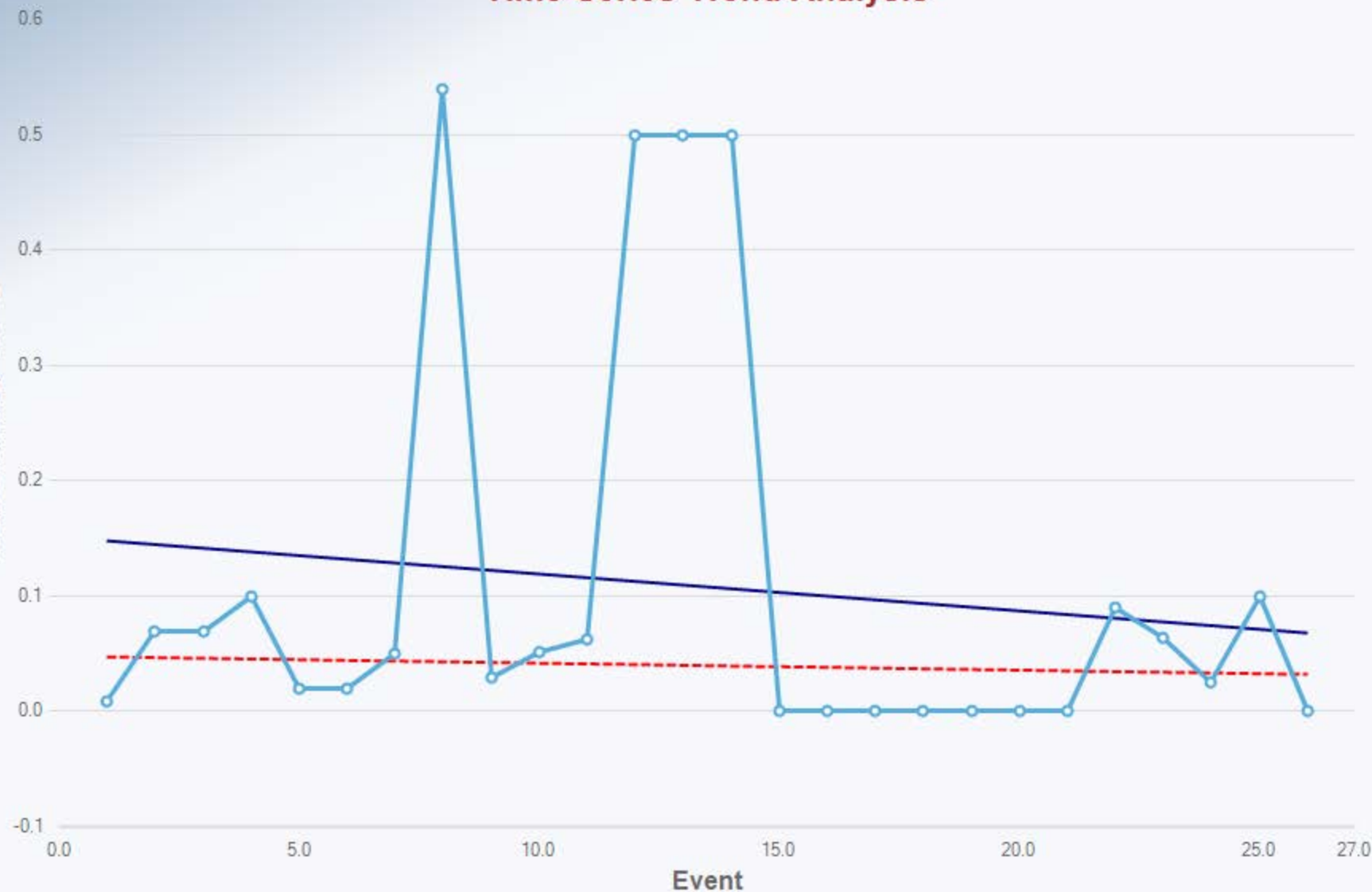
Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.0124

Significant evidence of a decreasing trend

Time-Series Trend Analysis

Nitrate N (mg/L)-site 03



Time-Series Trend Analysis

Events/Time Periods 26

OLS Regression Line (Blue)

OLS Regression Slope -0.0032

OLS Regression Intercept 0.1507

Theil-Sen Trend Line (Red)

Theil-Sen Slope -0.0006

Theil-Sen Intercept 0.0476

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 118.8239

M2 206.1761

LCL of Slope -0.0039

UCL of Slope 0.0001

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 44.5683

M-K Standardized Val (S) -1.1219

Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.1310

Insufficient evidence of a significant trend

Time-Series Trend Analysis

Nitrate N (mg/L)-site 04



Time-Series Trend Analysis

Events/Time Periods 26

OLS Regression Line (Blue)

OLS Regression Slope -0.0034

OLS Regression Intercept 0.1992

Theil-Sen Trend Line (Red)

Theil-Sen Slope 0.0000

Theil-Sen Intercept 0.0800

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 118.7653

M2 206.2347

LCL of Slope -0.0050

UCL of Slope 0.0036

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 44.6281

M-K Standardized Val (S) -0.5378

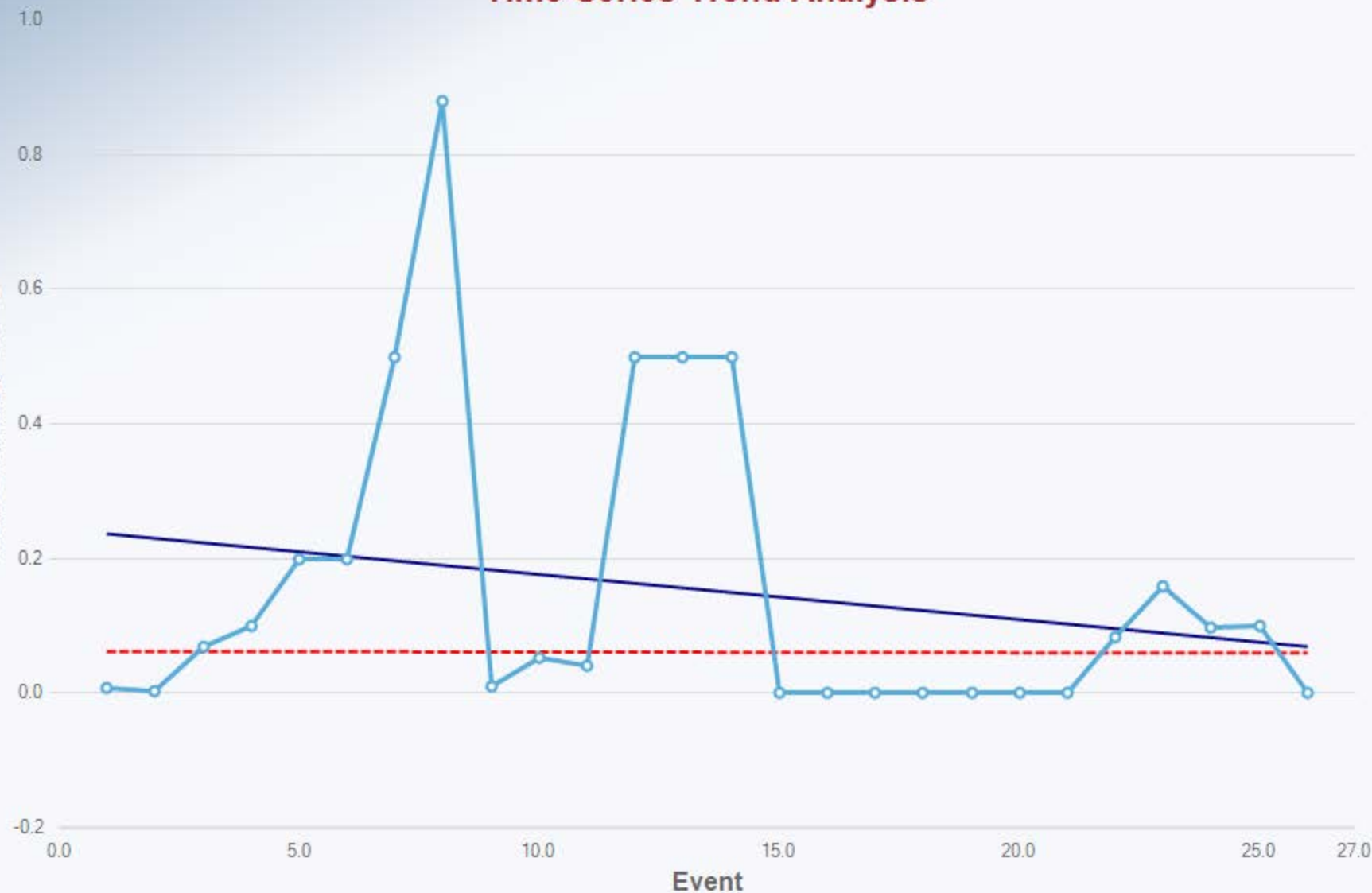
Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.2954

Insufficient evidence of a significant trend

Time-Series Trend Analysis

Nitrate N (mg/L)-site 05



Time-Series Trend Analysis

Events/Time Periods 26

OLS Regression Line (Blue)

OLS Regression Slope -0.0067

OLS Regression Intercept 0.2444

Theil-Sen Trend Line (Red)

Theil-Sen Slope -0.0002

Theil-Sen Intercept 0.0631

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 118.8679

M2 206.1321

LCL of Slope -0.0060

UCL of Slope 0.0000

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 44.5234

M-K Standardized Val (S) -1.1679

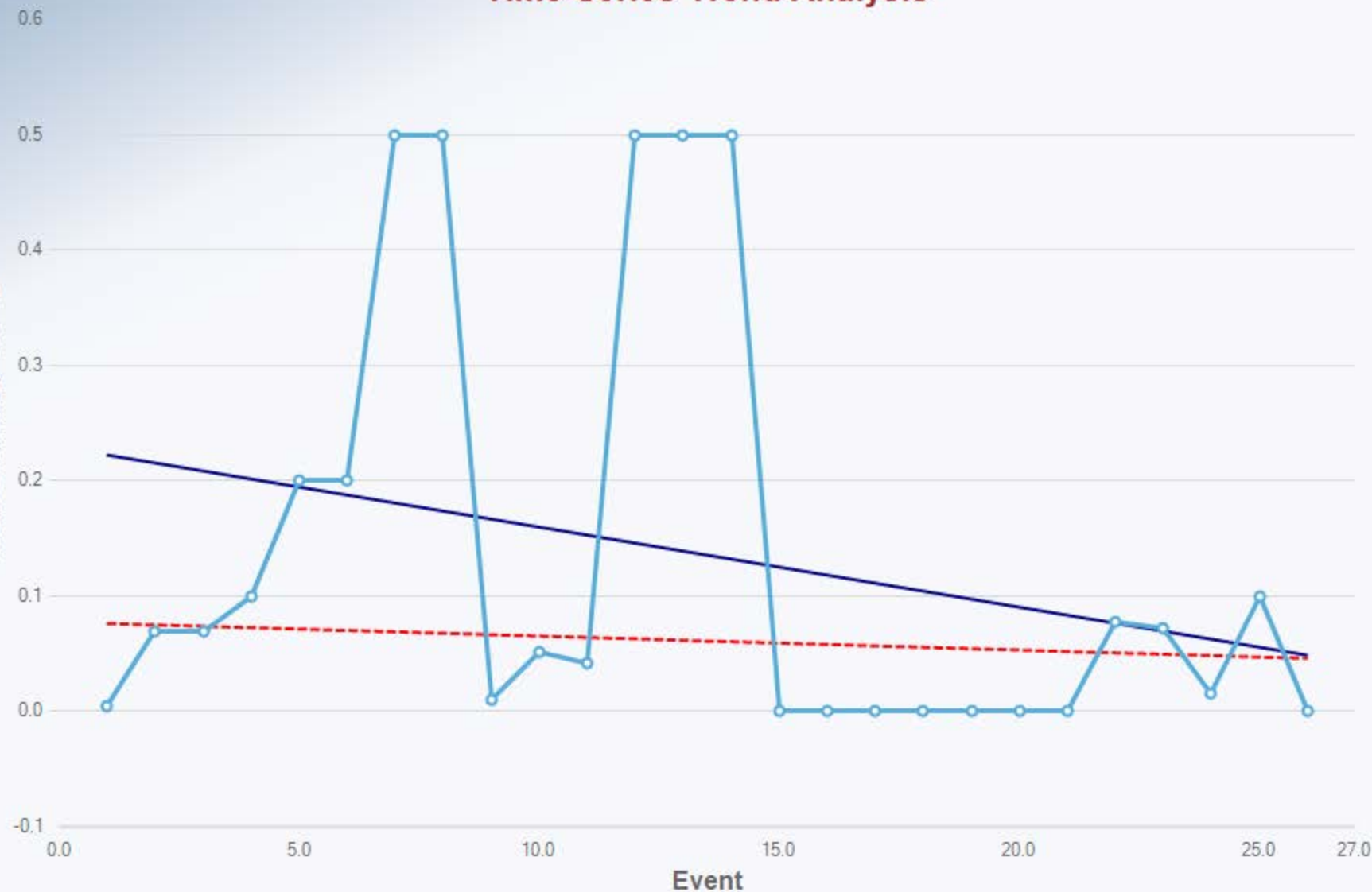
Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.1214

Insufficient evidence of a significant trend

Time-Series Trend Analysis

Nitrate N (mg/L)-site 06



Time-Series Trend Analysis

Events/Time Periods 26

OLS Regression Line (Blue)

OLS Regression Slope -0.0070

OLS Regression Intercept 0.2291

Theil-Sen Trend Line (Red)

Theil-Sen Slope -0.0013

Theil-Sen Intercept 0.0779

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 118.9670

M2 206.0330

LCL of Slope -0.0063

UCL of Slope 0.0000

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 44.4222

M-K Standardized Val (S) -1.5083

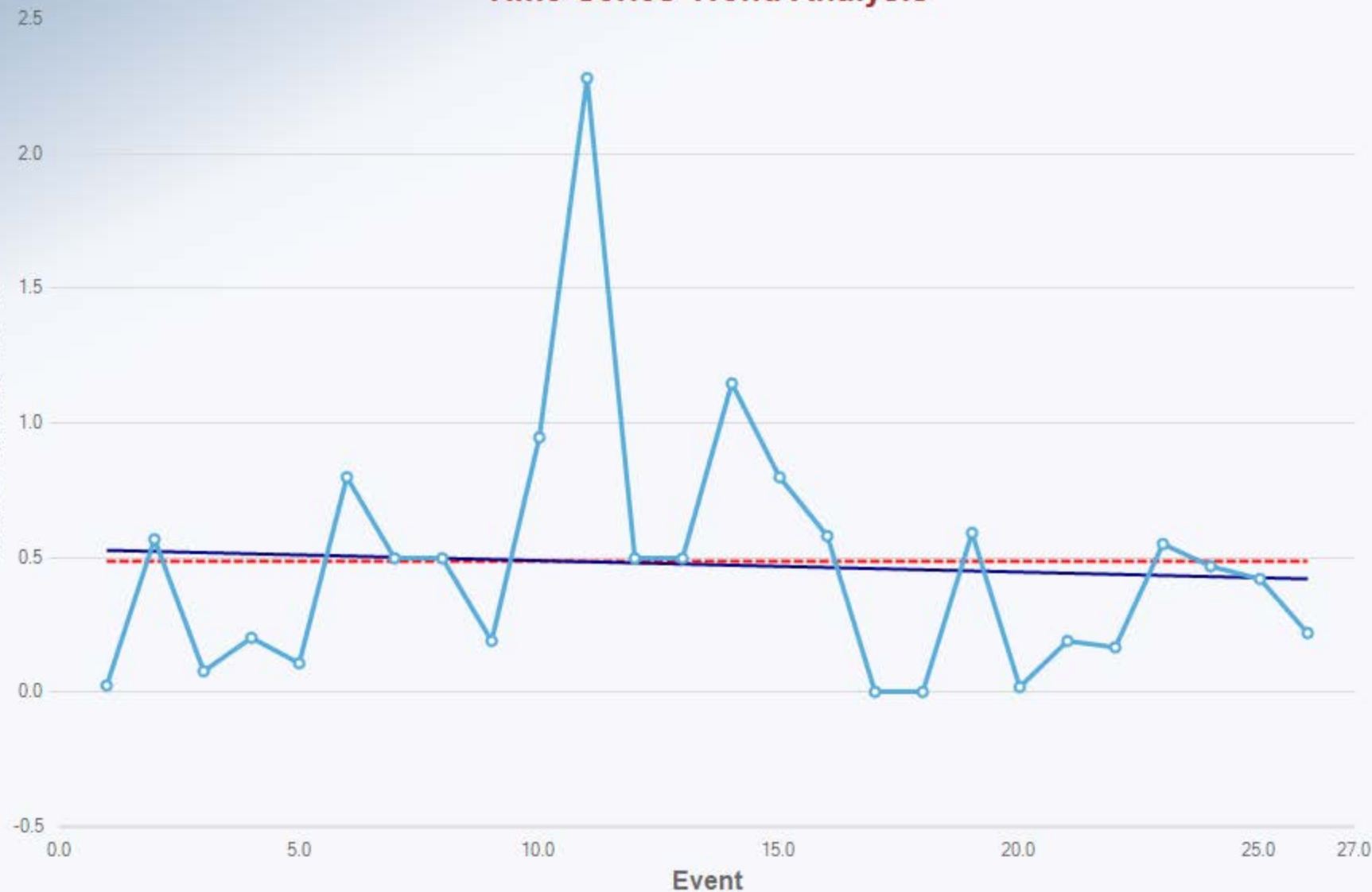
Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.0657

Insufficient evidence of a significant trend

Time-Series Trend Analysis

Nitrate N (mg/L)-site 07



Time-Series Trend Analysis

Events/Time Periods 26

OLS Regression Line (Blue)

OLS Regression Slope -0.0043

OLS Regression Intercept 0.5334

Theil-Sen Trend Line (Red)

Theil-Sen Slope -0.0001

Theil-Sen Intercept 0.4861

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 118.1547

M2 206.8453

LCL of Slope -0.0200

UCL of Slope 0.0175

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 45.2512

M-K Standardized Val (S) -0.1768

Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.4298

Insufficient evidence of a significant trend

Time-Series Trend Analysis

Nitrate N (mg/L)-site 08



Time-Series Trend Analysis

Events/Time Periods 16

OLS Regression Line (Blue)

OLS Regression Slope -0.0218

OLS Regression Intercept 0.3007

Theil-Sen Trend Line (Red)

Theil-Sen Slope 0.0000

Theil-Sen Intercept 0.0000

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 40.4576

M2 79.5424

LCL of Slope -0.0193

UCL of Slope 0.0000

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 19.9416

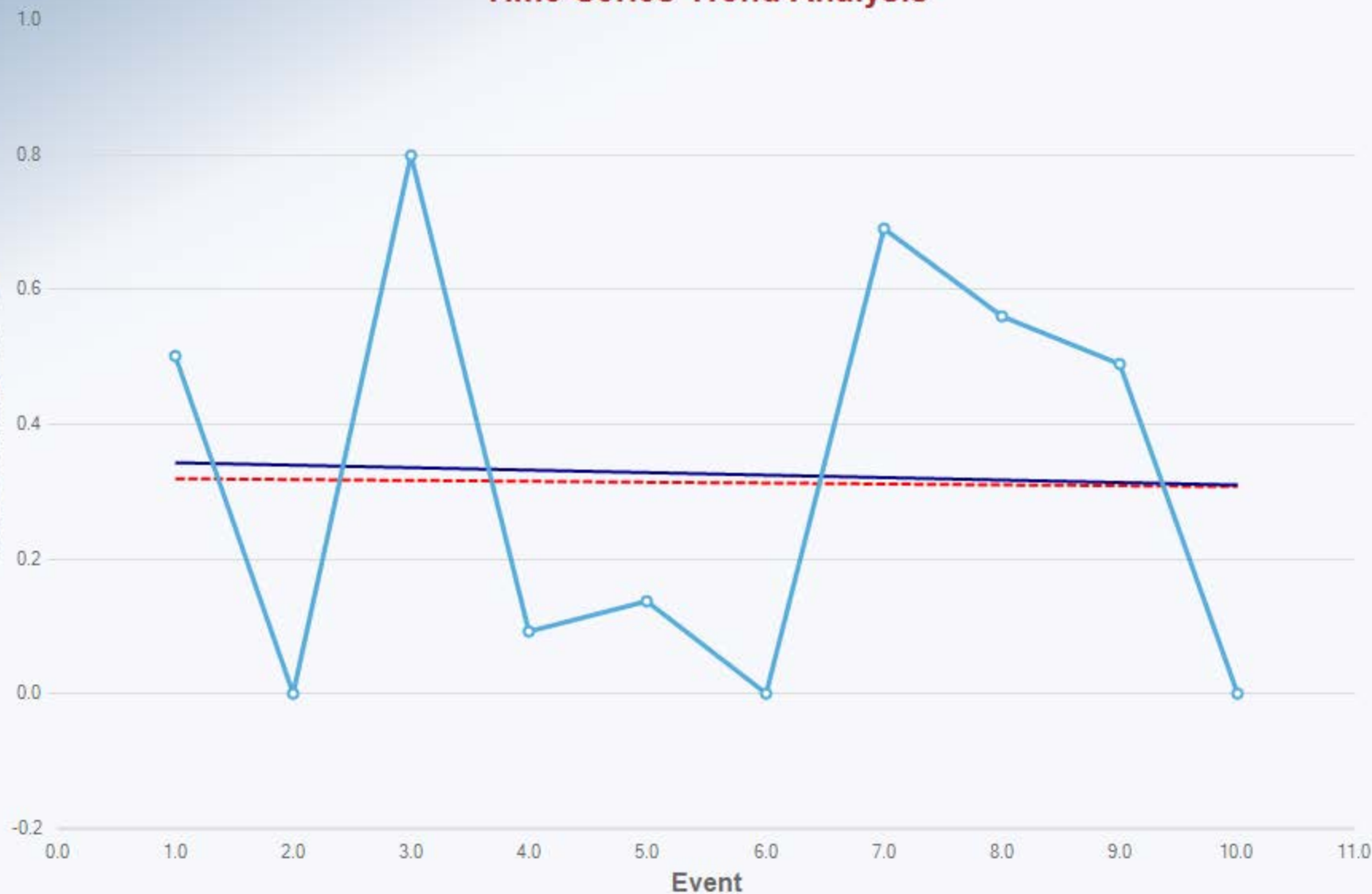
M-K Test Value (S) -21

Tabulated p-value 0.1990

Insufficient evidence of a significant trend

Time-Series Trend Analysis

Nitrate N (mg/L)-site 09



Time-Series Trend Analysis

Events/Time Periods 10

OLS Regression Line (Blue)

OLS Regression Slope -0.0037

OLS Regression Intercept 0.3476

Theil-Sen Trend Line (Red)

Theil-Sen Slope -0.0014

Theil-Sen Intercept 0.3216

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 11.7054

M2 33.2946

LCL of Slope -0.1043

UCL of Slope 0.0821

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 11.0151

M-K Test Value (S) -4

Tabulated p-value 0.3640

Insufficient evidence of a significant trend

Nitrite - Nitrogen Trend Graphs

Time-Series Trend Analysis

Nitrite N (mg/L)-site 01



Time-Series Trend Analysis

Events/Time Periods 25

OLS Regression Line (Blue)

OLS Regression Slope -0.0004

OLS Regression Intercept 0.0277

Theil-Sen Trend Line (Red)

Theil-Sen Slope -0.0003

Theil-Sen Intercept 0.0137

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 109.1923

M2 190.8077

LCL of Slope -0.0011

UCL of Slope 0.0000

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 41.6413

M-K Standardized Val (S) -1.3208

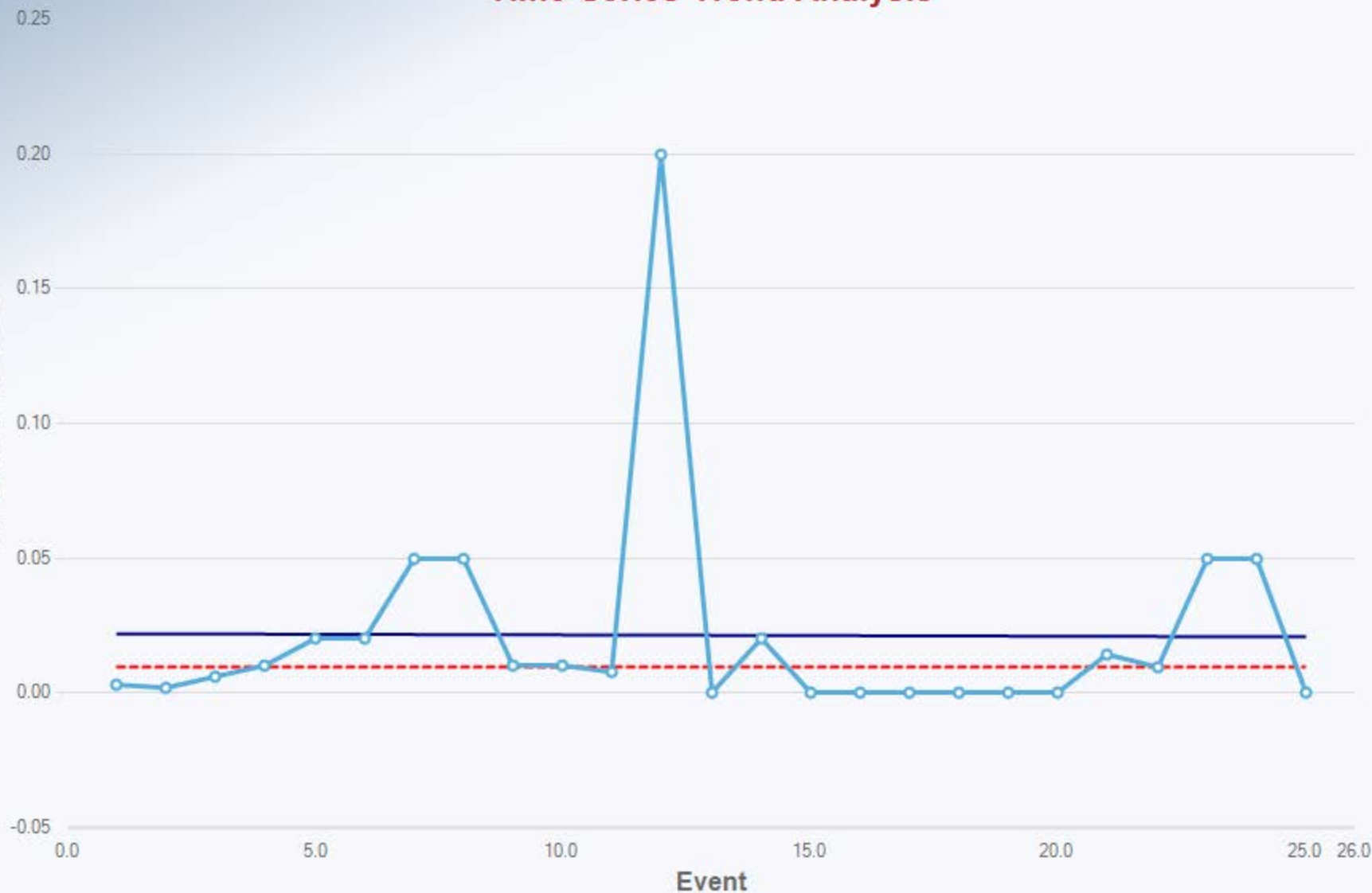
Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.0933

Insufficient evidence of a significant trend

Time-Series Trend Analysis

Nitrite N (mg/L)-site 02



Time-Series Trend Analysis

Events/Time Periods 25

OLS Regression Line (Blue)

OLS Regression Slope -0.0001

OLS Regression Intercept 0.0220

Theil-Sen Trend Line (Red)

Theil-Sen Slope 0.0000

Theil-Sen Intercept 0.0099

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 108.9810

M2 191.0190

LCL of Slope -0.0006

UCL of Slope 0.0004

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 41.8569

M-K Standardized Val (S) -0.6451

Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.2594

Insufficient evidence of a significant trend

Time-Series Trend Analysis

Nitrite N (mg/L)-site 03



Time-Series Trend Analysis

Events/Time Periods 25

OLS Regression Line (Blue)

OLS Regression Slope 0.0000

OLS Regression Intercept 0.0212

Theil-Sen Trend Line (Red)

Theil-Sen Slope 0.0000

Theil-Sen Intercept 0.0093

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 108.9927

M2 191.0073

LCL of Slope -0.0006

UCL of Slope 0.0004

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 41.8450

M-K Standardized Val (S) -0.6213

Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.2672

Insufficient evidence of a significant trend

Time-Series Trend Analysis

Nitrite N (mg/L)-site 04



Time-Series Trend Analysis

Events/Time Periods 25

OLS Regression Line (Blue)

OLS Regression Slope -0.0011

OLS Regression Intercept 0.0416

Theil-Sen Trend Line (Red)

Theil-Sen Slope 0.0000

Theil-Sen Intercept 0.0080

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 108.9537

M2 191.0463

LCL of Slope -0.0008

UCL of Slope 0.0003

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 41.8848

M-K Standardized Val (S) -0.8595

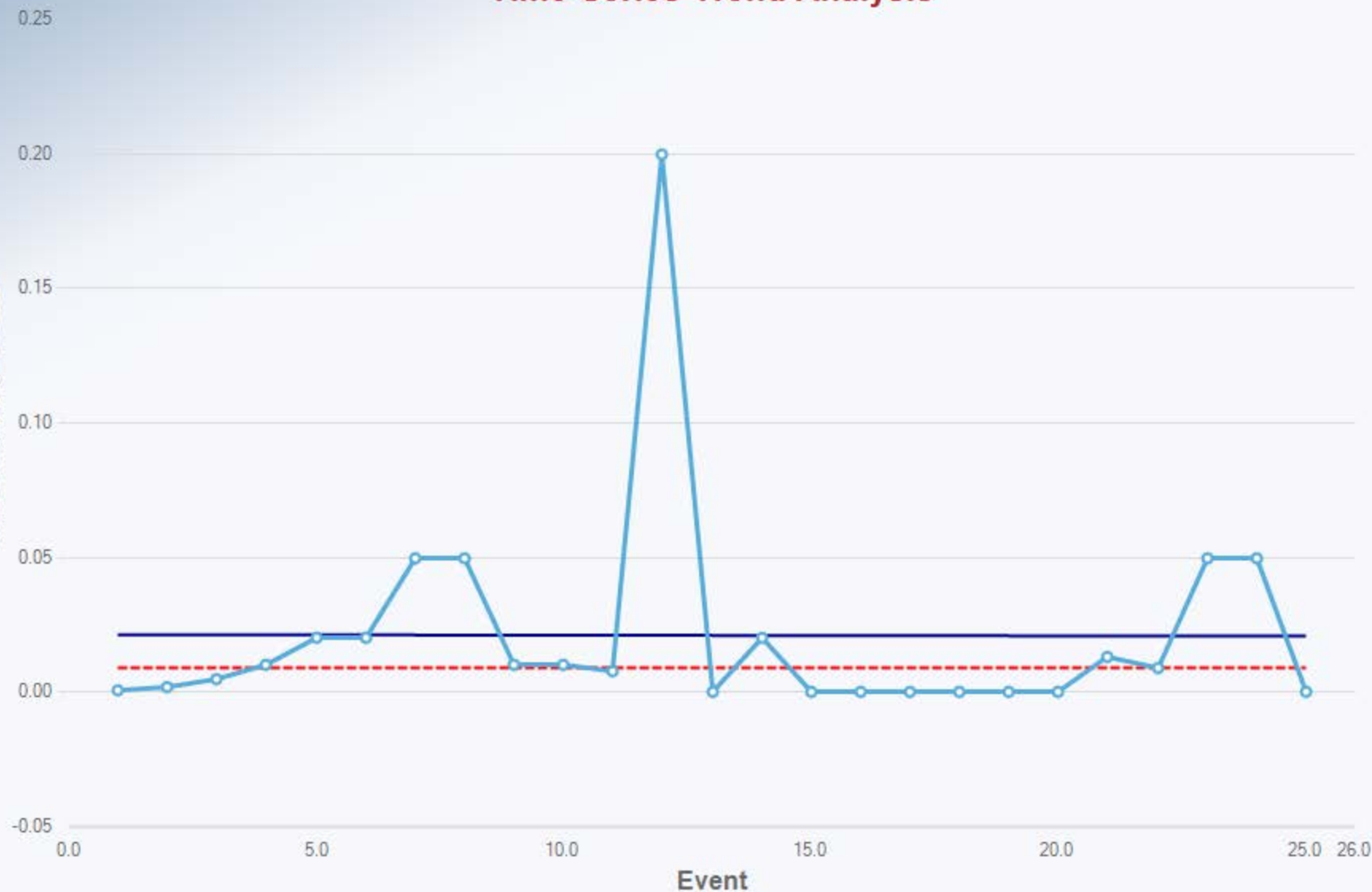
Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.1950

Insufficient evidence of a significant trend

Time-Series Trend Analysis

Nitrite N (mg/L)-site 05



Time-Series Trend Analysis

Events/Time Periods 25

OLS Regression Line (Blue)

OLS Regression Slope 0.0000

OLS Regression Intercept 0.0217

Theil-Sen Trend Line (Red)

Theil-Sen Slope 0.0000

Theil-Sen Intercept 0.0091

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 108.9810

M2 191.0190

LCL of Slope -0.0006

UCL of Slope 0.0004

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 41.8569

M-K Standardized Val (S) -0.5973

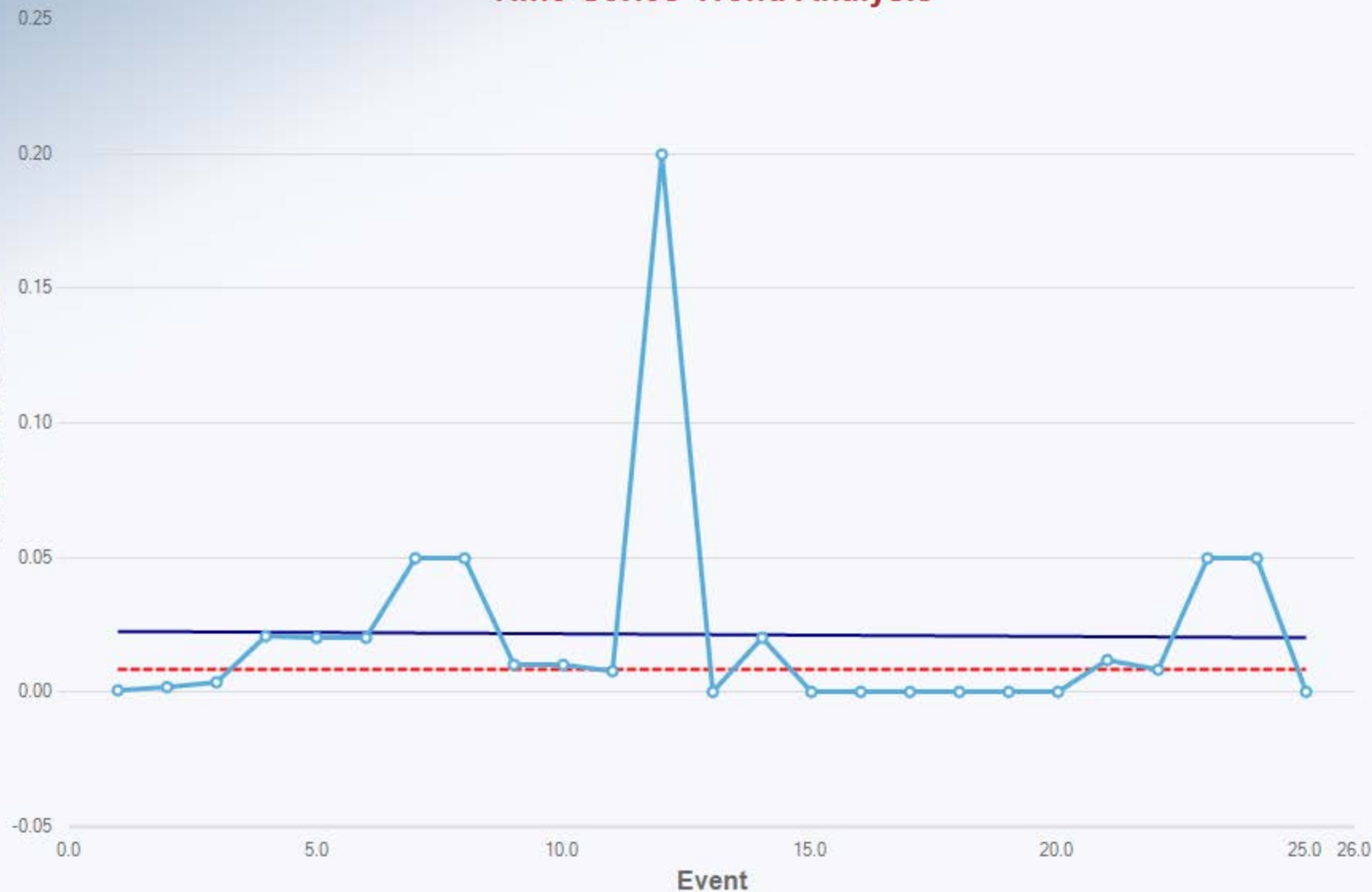
Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.2752

Insufficient evidence of a significant trend

Time-Series Trend Analysis

Nitrite N (mg/L)-site 06



Time-Series Trend Analysis

Events/Time Periods 25

OLS Regression Line (Blue)

OLS Regression Slope -0.0001

OLS Regression Intercept 0.0230

Theil-Sen Trend Line (Red)

Theil-Sen Slope 0.0000

Theil-Sen Intercept 0.0082

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 108.9498

M2 191.0502

LCL of Slope -0.0010

UCL of Slope 0.0002

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 41.8887

M-K Standardized Val (S) -0.8355

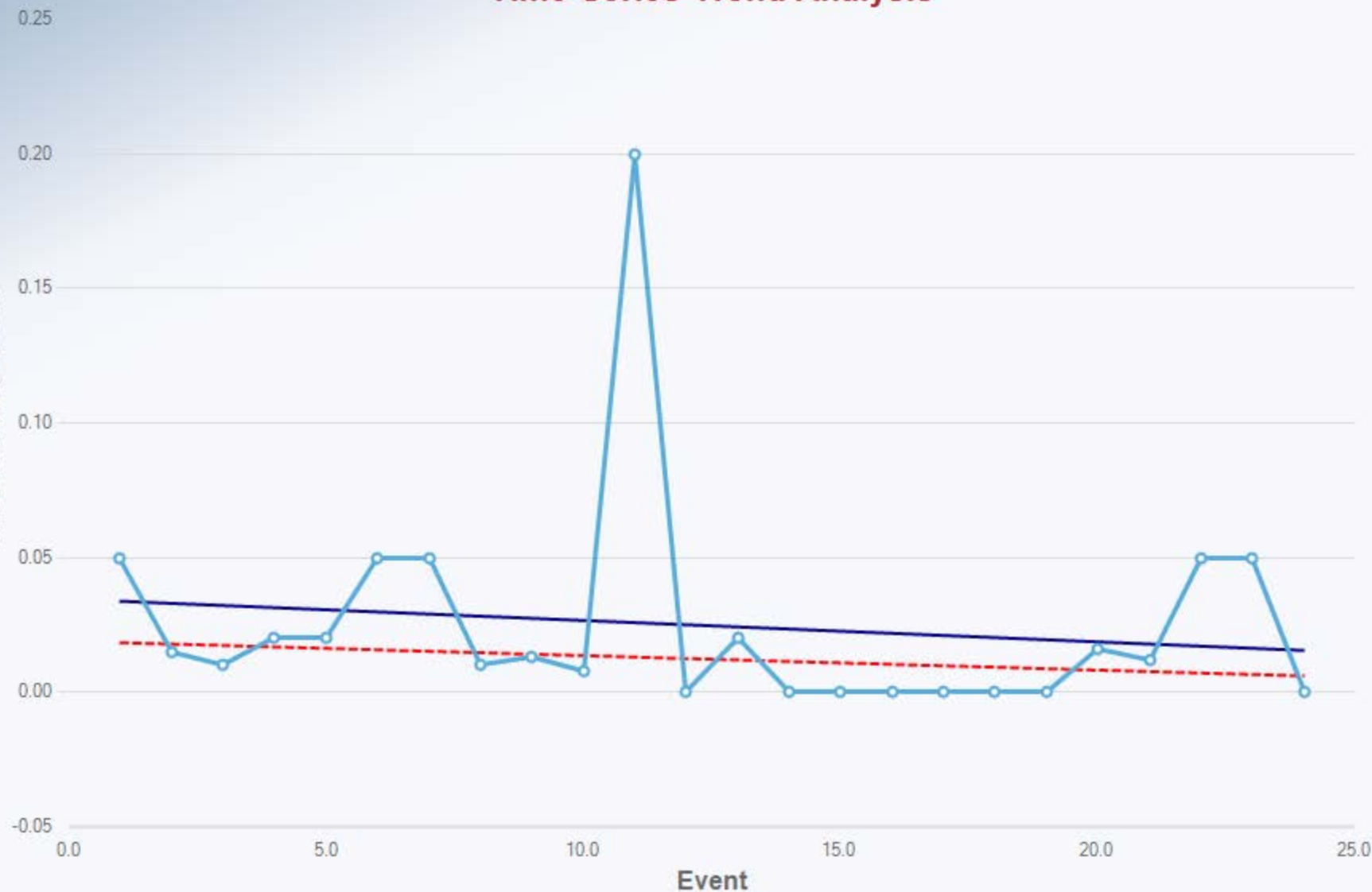
Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.2017

Insufficient evidence of a significant trend

Time-Series Trend Analysis

Nitrite N (mg/L)-site 07



Time-Series Trend Analysis

Events/Time Periods 24

OLS Regression Line (Blue)

OLS Regression Slope -0.0008

OLS Regression Intercept 0.0348

Theil-Sen Trend Line (Red)

Theil-Sen Slope -0.0005

Theil-Sen Intercept 0.0193

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 99.5594

M2 176.4406

LCL of Slope -0.0015

UCL of Slope 0.0000

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 39.2258

M-K Standardized Val (S) -1.5551

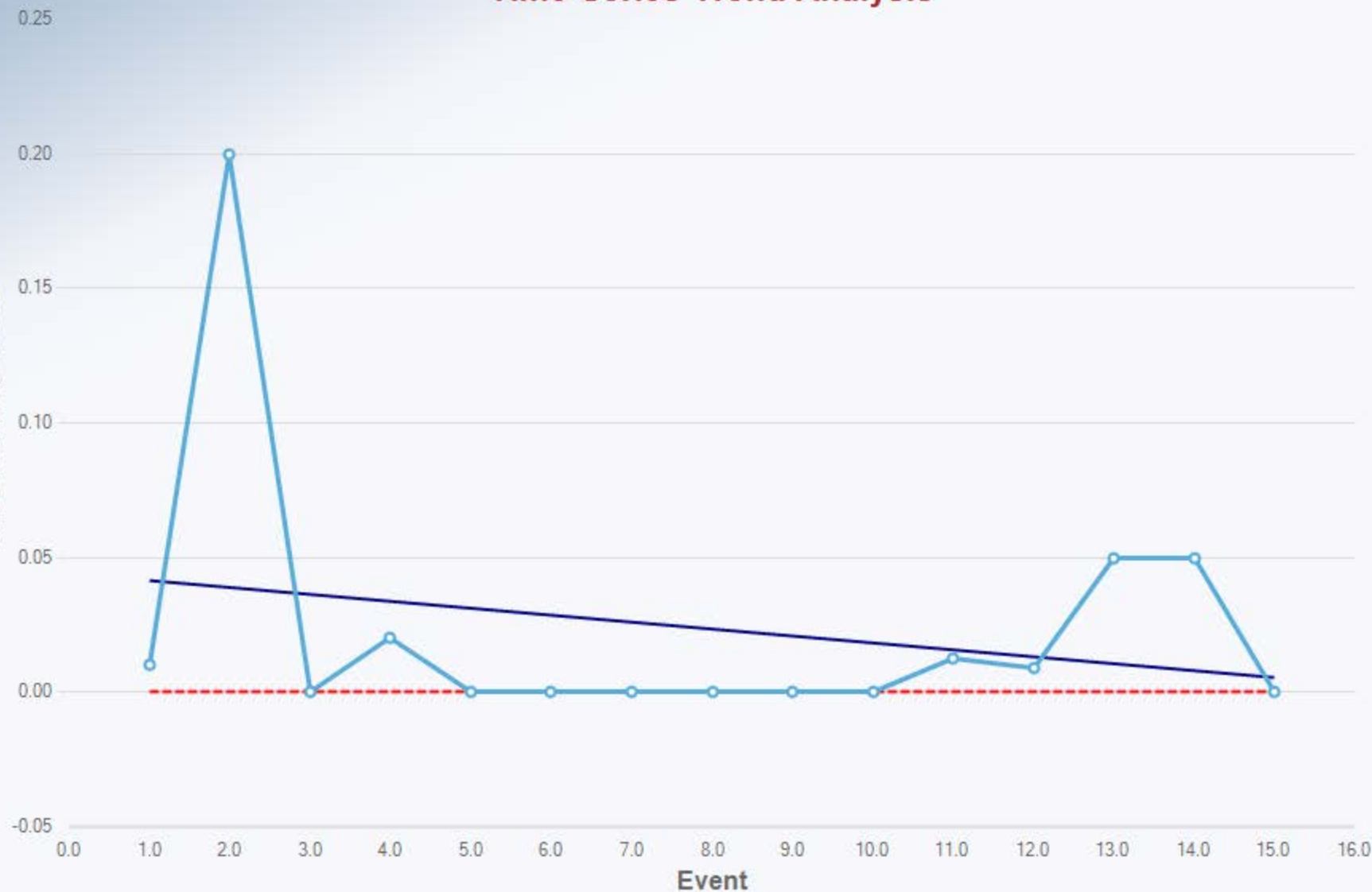
Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.0600

Insufficient evidence of a significant trend

Time-Series Trend Analysis

Nitrite N (mg/L)-site 08



Time-Series Trend Analysis

Nitrite N (mg/L)-site 09



Time-Series Trend Analysis

Events/Time Periods 9

OLS Regression Line (Blue)

OLS Regression Slope 0.0216

OLS Regression Intercept -0.0637

Theil-Sen Trend Line (Red)

Theil-Sen Slope 0.0095

Theil-Sen Intercept -0.0356

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 8.8418

M2 27.1582

LCL of Slope 0.0029

UCL of Slope 0.0211

Statistically significant evidence of an increasing trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 9.3452

M-K Test Value (S) 30

Tabulated p-value 0.0000

Significant evidence of an increasing trend

Total Kjeldahl Nitrogen (TKN) Trend Graphs

Time-Series Trend Analysis

TKN (mg/L)-site 01



Time-Series Trend Analysis

Events/Time Periods 24

OLS Regression Line (Blue)

OLS Regression Slope -0.0095

OLS Regression Intercept 0.7603

Theil-Sen Trend Line (Red)

Theil-Sen Slope 0.0000

Theil-Sen Intercept 0.5050

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 98.9234

M2 177.0766

LCL of Slope -0.0283

UCL of Slope 0.0258

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 39.8748

M-K Standardized Val (S) -0.3762

Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.3534

Insufficient evidence of a significant trend

Time-Series Trend Analysis

TKN (mg/L)-site 02



Time-Series Trend Analysis

Events/Time Periods 25

OLS Regression Line (Blue)

OLS Regression Slope 0.1915
OLS Regression Intercept -1.1417

Theil-Sen Trend Line (Red)

Theil-Sen Slope 0.0088
Theil-Sen Intercept 0.3859

Theil-Sen Trend Analysis

Level of Significance 0.0500
M1 108.4537
M2 191.5463
LCL of Slope -0.0071
UCL of Slope 0.0400
Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 42.3950
M-K Standardized Val (S) 1.2030
Appx. Critical Value (0.05) 1.6449
Approximate p-value (S) 0.1145
Insufficient evidence of a significant trend

Time-Series Trend Analysis

TKN (mg/L)-site 03



Time-Series Trend Analysis

Events/Time Periods 25

OLS Regression Line (Blue)

OLS Regression Slope -0.0060

OLS Regression Intercept 0.6362

Theil-Sen Trend Line (Red)

Theil-Sen Slope 0.0000

Theil-Sen Intercept 0.5000

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 108.8874

M2 191.1126

LCL of Slope -0.0250

UCL of Slope 0.0193

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 41.9524

M-K Standardized Val (S) -0.5959

Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.2756

Insufficient evidence of a significant trend

Time-Series Trend Analysis

TKN (mg/L)-site 04



Time-Series Trend Analysis

Events/Time Periods 25

OLS Regression Line (Blue)

OLS Regression Slope -0.0050

OLS Regression Intercept 0.4738

Theil-Sen Trend Line (Red)

Theil-Sen Slope 0.0000

Theil-Sen Intercept 0.4000

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 108.9498

M2 191.0502

LCL of Slope -0.0201

UCL of Slope 0.0067

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 41.8887

M-K Standardized Val (S) -0.6923

Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.2444

Insufficient evidence of a significant trend

Time-Series Trend Analysis

TKN (mg/L)-site 05



Time-Series Trend Analysis

Events/Time Periods 25

OLS Regression Line (Blue)

OLS Regression Slope -0.0142

OLS Regression Intercept 0.7137

Theil-Sen Trend Line (Red)

Theil-Sen Slope -0.0039

Theil-Sen Intercept 0.3504

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 108.7514

M2 191.2486

LCL of Slope -0.0296

UCL of Slope 0.0036

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 42.0912

M-K Standardized Val (S) -0.9978

Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.1592

Insufficient evidence of a significant trend

Time-Series Trend Analysis

TKN (mg/L)-site 06



Time-Series Trend Analysis

Events/Time Periods 25

OLS Regression Line (Blue)

OLS Regression Slope -0.0062

OLS Regression Intercept 0.6089

Theil-Sen Trend Line (Red)

Theil-Sen Slope 0.0000

Theil-Sen Intercept 0.5000

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 108.7631

M2 191.2369

LCL of Slope -0.0264

UCL of Slope 0.0085

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 42.0793

M-K Standardized Val (S) -0.5941

Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.2762

Insufficient evidence of a significant trend

Time-Series Trend Analysis

TKN (mg/L)-site 07



Time-Series Trend Analysis

Events/Time Periods 25

OLS Regression Line (Blue)

OLS Regression Slope -0.0175

OLS Regression Intercept 0.8356

Theil-Sen Trend Line (Red)

Theil-Sen Slope -0.0050

Theil-Sen Intercept 0.5750

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 108.4190

M2 191.5810

LCL of Slope -0.0347

UCL of Slope 0.0100

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 42.4303

M-K Standardized Val (S) -0.7542

Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.2254

Insufficient evidence of a significant trend

Time-Series Trend Analysis

TKN (mg/L)-site 08



Time-Series Trend Analysis

Events/Time Periods 15

OLS Regression Line (Blue)

OLS Regression Slope -0.0786

OLS Regression Intercept 1.2952

Theil-Sen Trend Line (Red)

Theil-Sen Slope -0.0291

Theil-Sen Intercept 0.9027

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 33.6157

M2 71.3843

LCL of Slope -0.1659

UCL of Slope 0.0000

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 19.2700

M-K Test Value (S) -24

Tabulated p-value 0.1200

Insufficient evidence of a significant trend

Time-Series Trend Analysis

TKN (mg/L)-site 09



Time-Series Trend Analysis

Events/Time Periods 9

OLS Regression Line (Blue)

OLS Regression Slope 0.0418

OLS Regression Intercept 0.1164

Theil-Sen Trend Line (Red)

Theil-Sen Slope 0.0473

Theil-Sen Intercept -0.0263

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 9.0540

M2 26.9460

LCL of Slope -0.0842

UCL of Slope 0.1323

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 9.1287

M-K Test Value (S) 8

Tabulated p-value 0.2380

Insufficient evidence of a significant trend

Ortho Phosphate Trend Graphs

Time-Series Trend Analysis

Ortho Phosphate (mg/L)-site 01



Time-Series Trend Analysis

Events/Time Periods 26

OLS Regression Line (Blue)

OLS Regression Slope -0.0007

OLS Regression Intercept 0.0388

Theil-Sen Trend Line (Red)

Theil-Sen Slope -0.0009

Theil-Sen Intercept 0.0408

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 118.6775

M2 206.3225

LCL of Slope -0.0020

UCL of Slope 0.0000

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 44.7176

M-K Standardized Val (S) -1.7443

Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.0406

Significant evidence of a decreasing trend

Time-Series Trend Analysis

Ortho Phosphate (mg/L)-site 02



Time-Series Trend Analysis

Events/Time Periods 26

OLS Regression Line (Blue)

OLS Regression Slope -0.0009

OLS Regression Intercept 0.0397

Theil-Sen Trend Line (Red)

Theil-Sen Slope -0.0010

Theil-Sen Intercept 0.0335

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 118.7946

M2 206.2054

LCL of Slope -0.0021

UCL of Slope 0.0000

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 44.5982

M-K Standardized Val (S) -1.8386

Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.0330

Significant evidence of a decreasing trend

Time-Series Trend Analysis

Ortho Phosphate (mg/L)-site 03



Time-Series Trend Analysis

Events/Time Periods 26

OLS Regression Line (Blue)

OLS Regression Slope -0.0003

OLS Regression Intercept 0.0292

Theil-Sen Trend Line (Red)

Theil-Sen Slope -0.0005

Theil-Sen Intercept 0.0271

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 118.6228

M2 206.3772

LCL of Slope -0.0019

UCL of Slope 0.0000

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 44.7735

M-K Standardized Val (S) -1.3177

Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.0938

Insufficient evidence of a significant trend

Time-Series Trend Analysis

Ortho Phosphate (mg/L)-site 04



Time-Series Trend Analysis

Events/Time Periods 26

OLS Regression Line (Blue)

OLS Regression Slope -0.0009

OLS Regression Intercept 0.0401

Theil-Sen Trend Line (Red)

Theil-Sen Slope -0.0008

Theil-Sen Intercept 0.0371

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 118.7433

M2 206.2567

LCL of Slope -0.0021

UCL of Slope 0.0000

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 44.6505

M-K Standardized Val (S) -1.8813

Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.0300

Significant evidence of a decreasing trend

Time-Series Trend Analysis



Time-Series Trend Analysis

Events/Time Periods 25

OLS Regression Line (Blue)

OLS Regression Slope -0.0007

OLS Regression Intercept 0.0337

Theil-Sen Trend Line (Red)

Theil-Sen Slope -0.0008

Theil-Sen Intercept 0.0346

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 108.7514

M2 191.2486

LCL of Slope -0.0022

UCL of Slope 0.0000

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 42.0912

M-K Standardized Val (S) -1.9006

Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.0287

Significant evidence of a decreasing trend

Time-Series Trend Analysis



Time-Series Trend Analysis

Events/Time Periods 26

OLS Regression Line (Blue)

OLS Regression Slope -0.0007

OLS Regression Intercept 0.0334

Theil-Sen Trend Line (Red)

Theil-Sen Slope -0.0009

Theil-Sen Intercept 0.0273

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 118.7946

M2 206.2054

LCL of Slope -0.0020

UCL of Slope 0.0000

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 44.5982

M-K Standardized Val (S) -1.6593

Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.0485

Significant evidence of a decreasing trend

Time-Series Trend Analysis



Time-Series Trend Analysis	
# Events/Time Periods	25
OLS Regression Line (Blue)	
OLS Regression Slope	-0.0009
OLS Regression Intercept	0.0415
Theil-Sen Trend Line (Red)	
Theil-Sen Slope	-0.0012
Theil-Sen Intercept	0.0434
Theil-Sen Trend Analysis	
Level of Significance	0.0500
M1	108.2922
M2	191.7078
LCL of Slope	-0.0024
UCL of Slope	0.0000
Statistically significant evidence of a decreasing trend at the specified level of significance.	
Mann-Kendall Trend Analysis	
Standard Deviation of S	42.5598
M-K Standardized Val (S)	-1.9972
Appx. Critical Value (0.05)	-1.6449
Approximate p-value (S)	0.0229
Significant evidence of a decreasing trend	

Time-Series Trend Analysis



Time-Series Trend Analysis

Events/Time Periods 16

OLS Regression Line (Blue)

OLS Regression Slope 0.0013

OLS Regression Intercept 0.0146

Theil-Sen Trend Line (Red)

Theil-Sen Slope 0.0000

Theil-Sen Intercept 0.0200

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 38.7319

M2 81.2681

LCL of Slope -0.0017

UCL of Slope 0.0033

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 21.7025

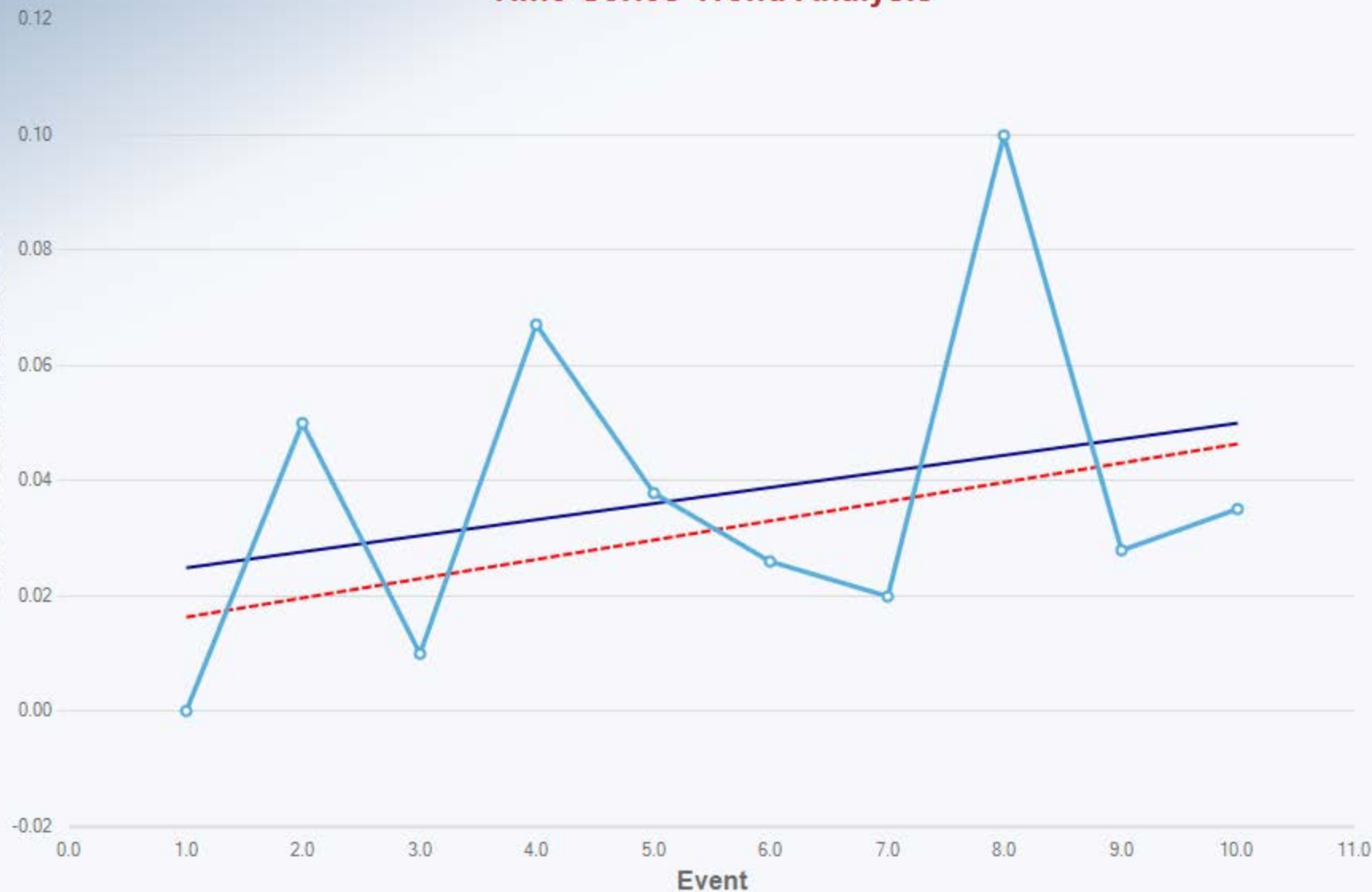
M-K Test Value (S) 11

Tabulated p-value 0.3450

Insufficient evidence of a significant trend

Time-Series Trend Analysis

Ortho Phosphate (mg/L)-site 09



Time-Series Trend Analysis

Events/Time Periods 10

OLS Regression Line (Blue)

OLS Regression Slope 0.0028

OLS Regression Intercept 0.0221

Theil-Sen Trend Line (Red)

Theil-Sen Slope 0.0033

Theil-Sen Intercept 0.0132

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 11.5435

M2 33.4565

LCL of Slope -0.0060

UCL of Slope 0.0083

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 11.1803

M-K Test Value (S) 9

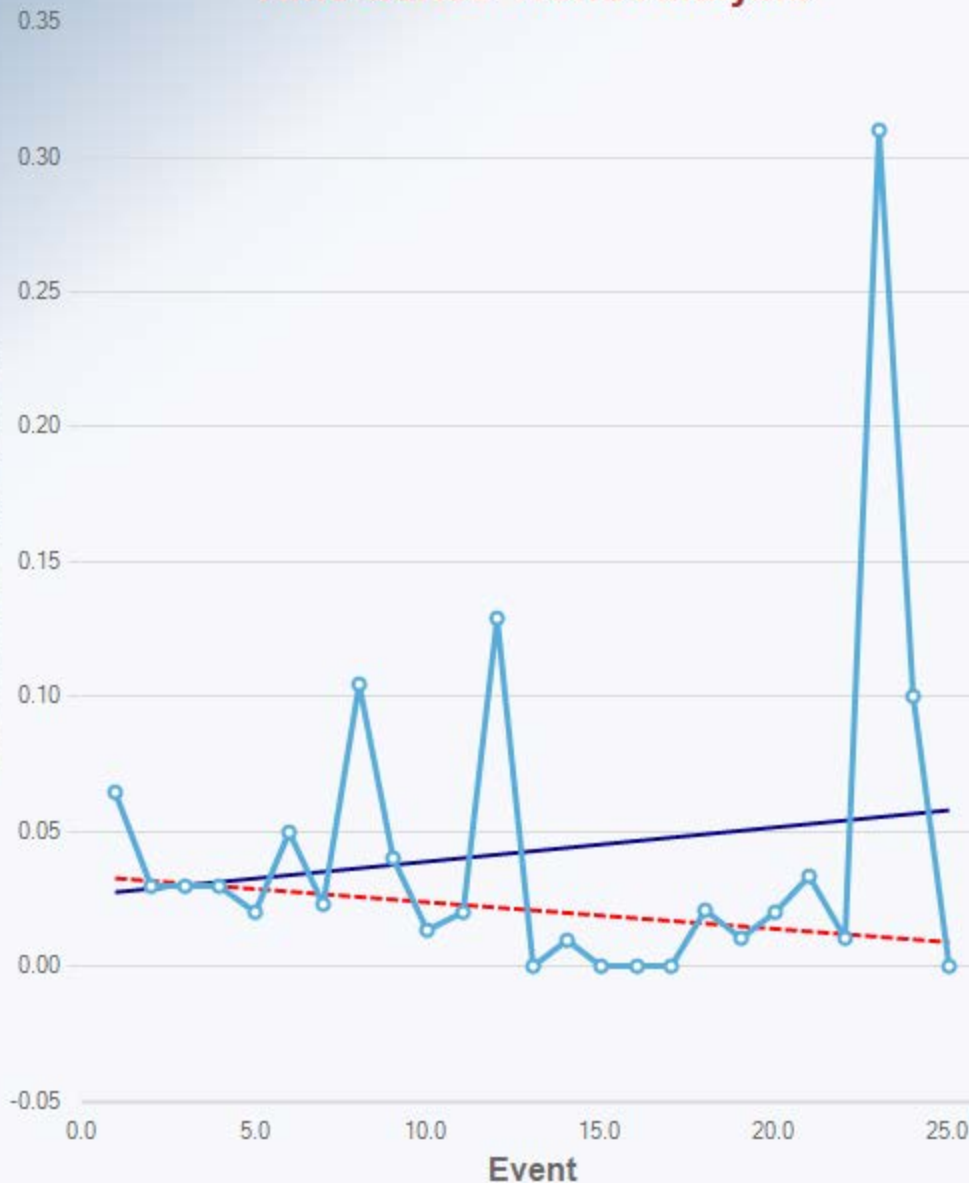
Tabulated p-value 0.2420

Insufficient evidence of a significant trend

Phosphorous Trend Graphs

Time-Series Trend Analysis

Phosphorous (mg/L)-site 01



Time-Series Trend Analysis

Events/Time Periods 25

OLS Regression Line (Blue)

OLS Regression Slope 0.0013

OLS Regression Intercept 0.0262

Theil-Sen Trend Line (Red)

Theil-Sen Slope -0.0010

Theil-Sen Intercept 0.0337

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 108.3268

M2 191.6732

LCL of Slope -0.0023

UCL of Slope 0.0002

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 42.5245

M-K Standardized Val (S) -1.3639

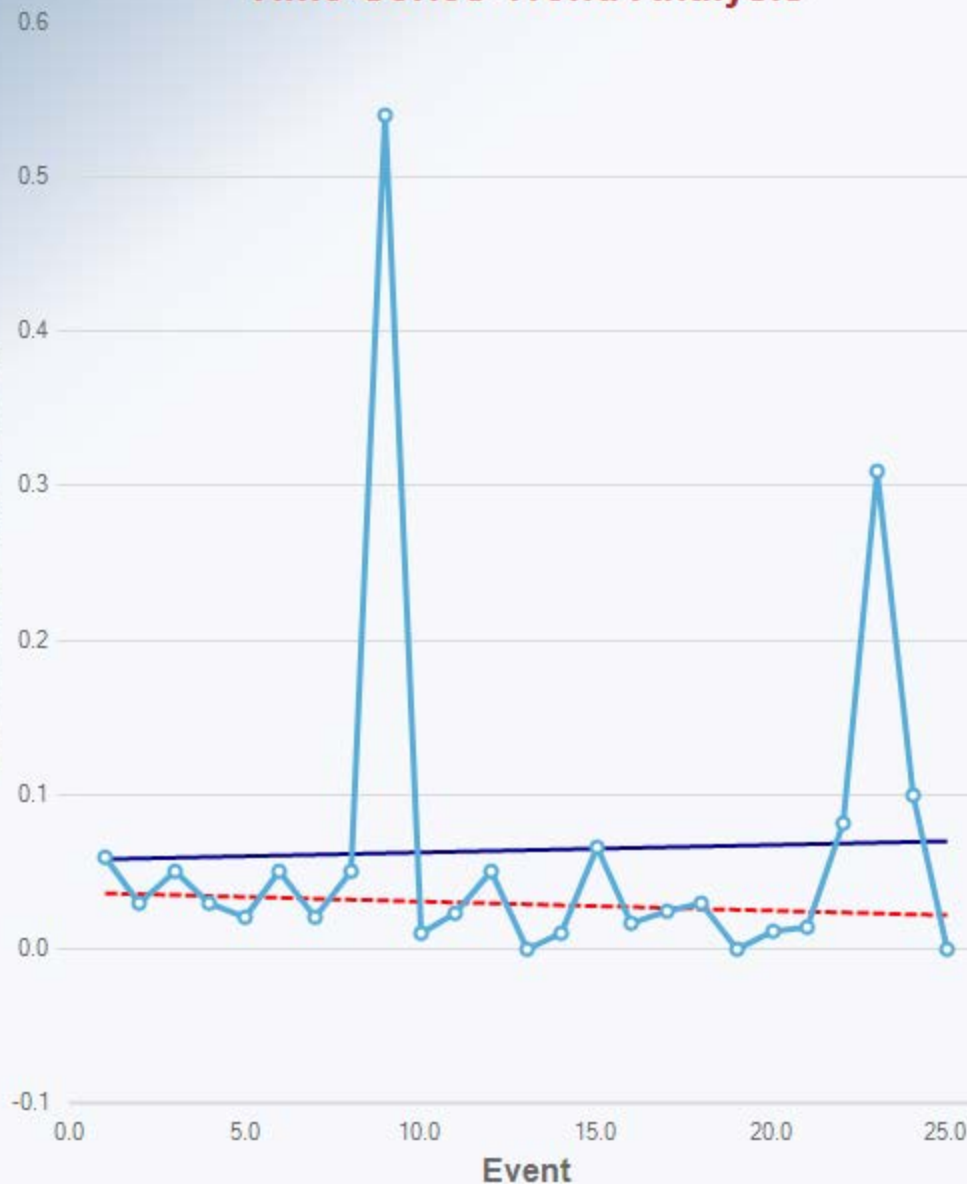
Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.0863

Insufficient evidence of a significant trend

Time-Series Trend Analysis

Phosphorous (mg/L)-site 02



Time-Series Trend Analysis

Events/Time Periods 25

OLS Regression Line (Blue)

OLS Regression Slope 0.0004
OLS Regression Intercept 0.0581

Theil-Sen Trend Line (Red)

Theil-Sen Slope -0.0006
Theil-Sen Intercept 0.0369

Theil-Sen Trend Analysis

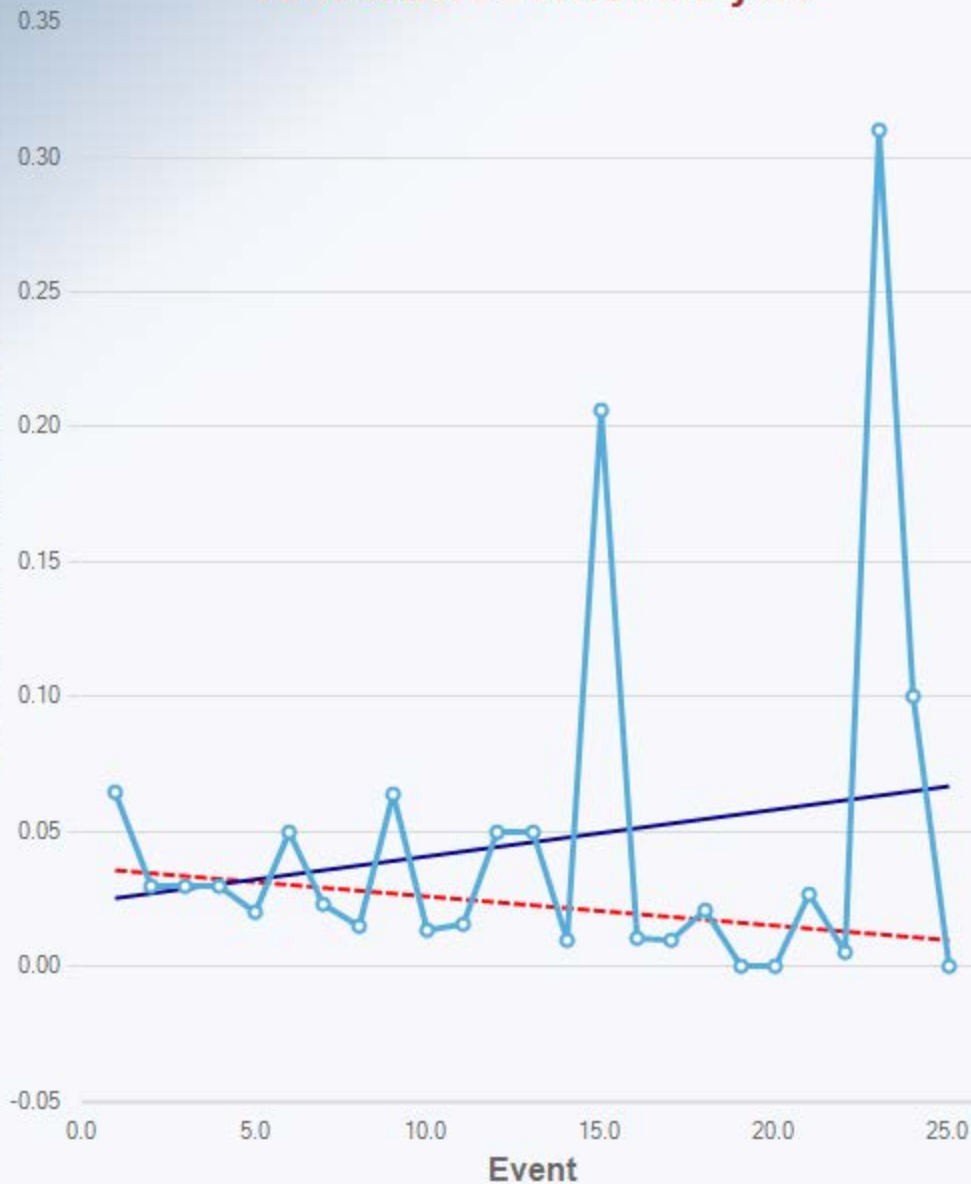
Level of Significance 0.0500
M1 108.2155
M2 191.7845
LCL of Slope -0.0022
UCL of Slope 0.0017
Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 42.6380
M-K Standardized Val (S) -0.7271
Appx. Critical Value (0.05) -1.6449
Approximate p-value (S) 0.2336
Insufficient evidence of a significant trend

Time-Series Trend Analysis

Phosphorous (mg/L)-site 03



Time-Series Trend Analysis

Events/Time Periods 25

OLS Regression Line (Blue)

OLS Regression Slope 0.0018

OLS Regression Intercept 0.0235

Theil-Sen Trend Line (Red)

Theil-Sen Slope -0.0011

Theil-Sen Intercept 0.0367

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 108.1772

M2 191.8228

LCL of Slope -0.0018

UCL of Slope 0.0000

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 42.6771

M-K Standardized Val (S) -1.7105

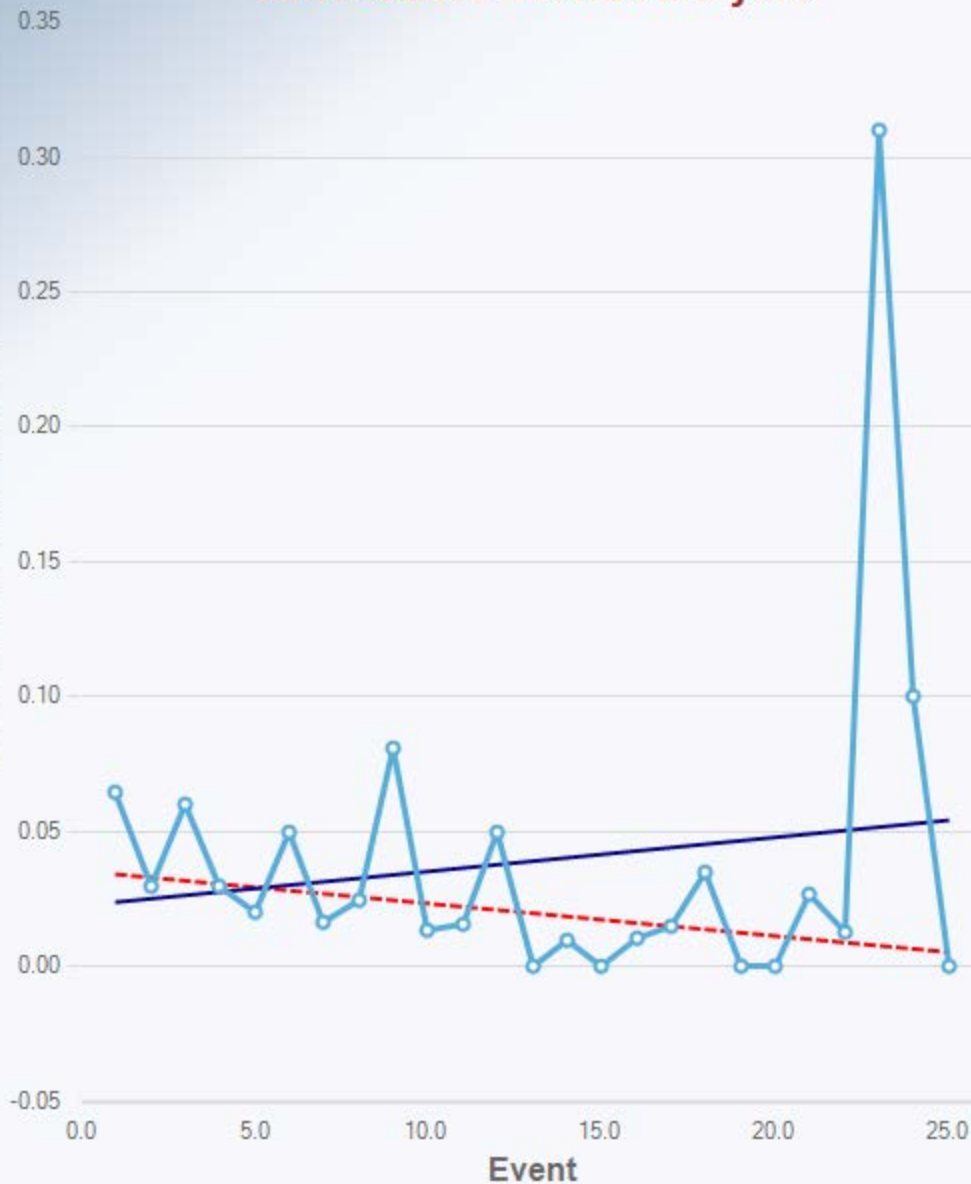
Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.0436

Significant evidence of a decreasing trend

Time-Series Trend Analysis

Phosphorous (mg/L)-site 04



Time-Series Trend Analysis

Events/Time Periods 25

OLS Regression Line (Blue)

OLS Regression Slope 0.0013
OLS Regression Intercept 0.0227

Theil-Sen Trend Line (Red)

Theil-Sen Slope -0.0012
Theil-Sen Intercept 0.0353

Theil-Sen Trend Analysis

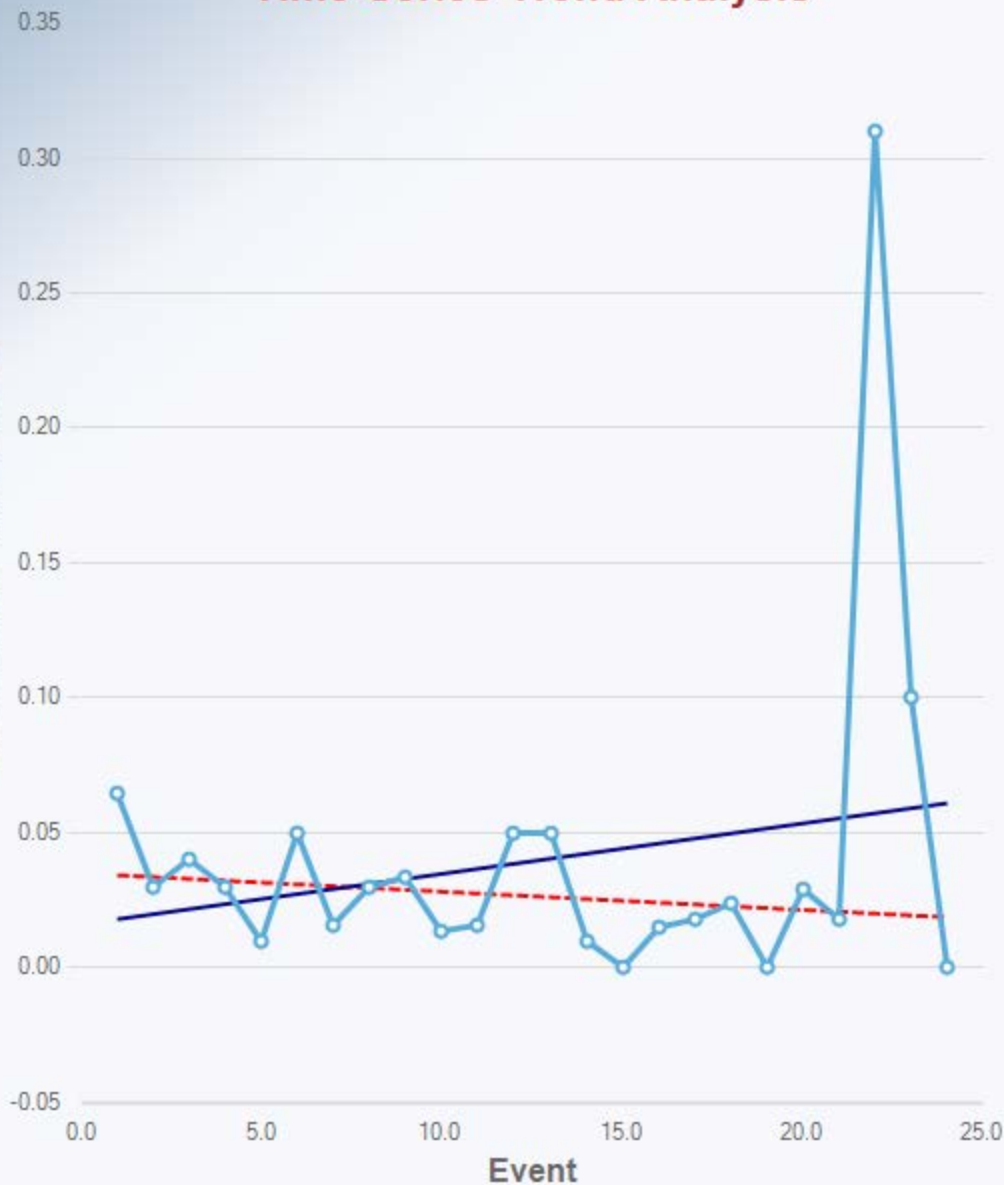
Level of Significance 0.0500
M1 108.2538
M2 191.7462
LCL of Slope -0.0023
UCL of Slope 0.0000
Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 42.5989
M-K Standardized Val (S) -1.8076
Appx. Critical Value (0.05) -1.6449
Approximate p-value (S) 0.0353
Significant evidence of a decreasing trend

Time-Series Trend Analysis

Phosphorous (mg/L)-site 05



Time-Series Trend Analysis

Events/Time Periods 24

OLS Regression Line (Blue)

OLS Regression Slope 0.0019
OLS Regression Intercept 0.0166

Theil-Sen Trend Line (Red)

Theil-Sen Slope -0.0007
Theil-Sen Intercept 0.0351

Theil-Sen Trend Analysis

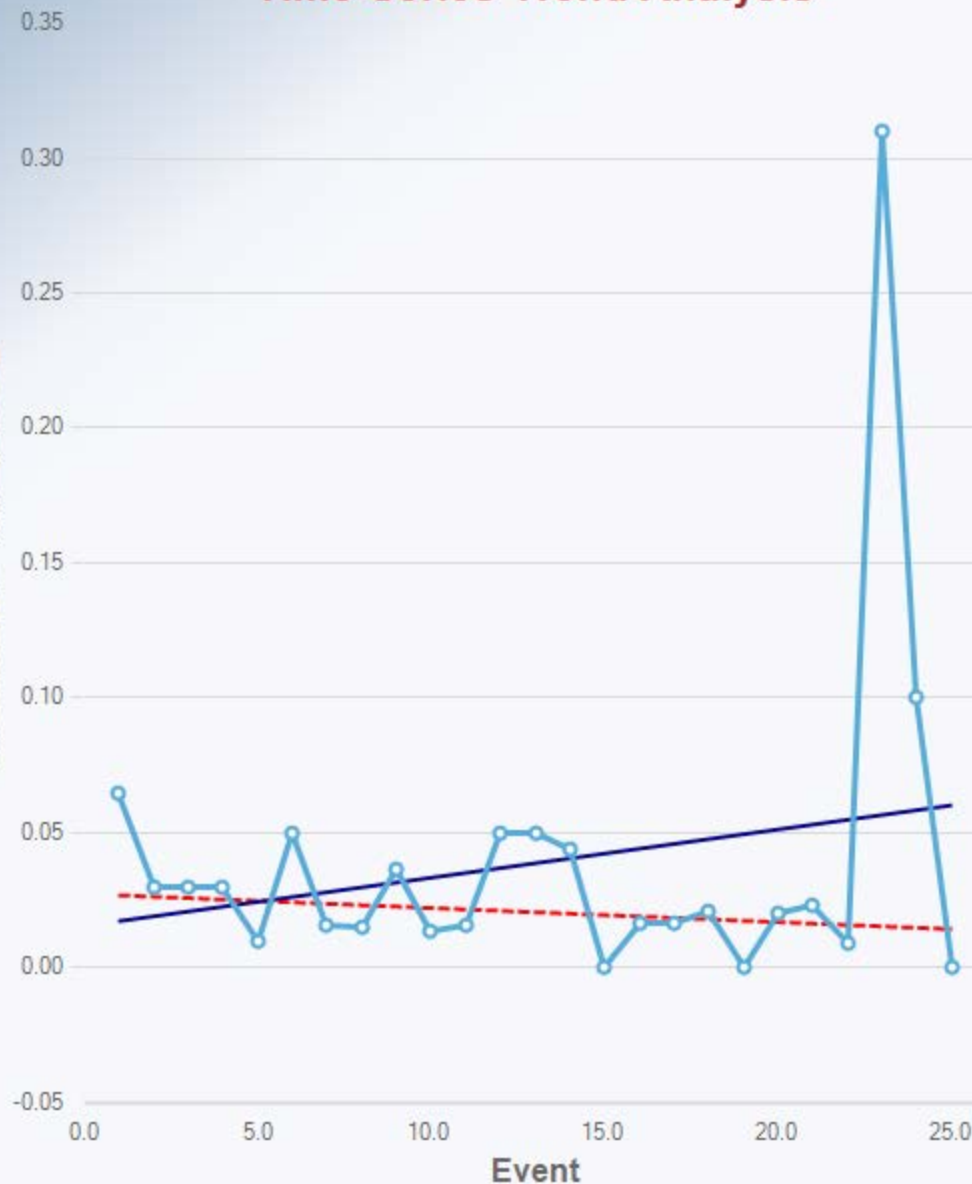
Level of Significance 0.0500
M1 98.6621
M2 177.3379
LCL of Slope -0.0020
UCL of Slope 0.0008
Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 40.1414
M-K Standardized Val (S) -0.9217
Appx. Critical Value (0.05) -1.6449
Approximate p-value (S) 0.1783
Insufficient evidence of a significant trend

Time-Series Trend Analysis

Phosphorous (mg/L)-site 06



Time-Series Trend Analysis

Events/Time Periods 25

OLS Regression Line (Blue)

OLS Regression Slope 0.0018

OLS Regression Intercept 0.0158

Theil-Sen Trend Line (Red)

Theil-Sen Slope -0.0005

Theil-Sen Intercept 0.0279

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 108.1887

M2 191.8113

LCL of Slope -0.0018

UCL of Slope 0.0007

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 42.6654

M-K Standardized Val (S) -0.7031

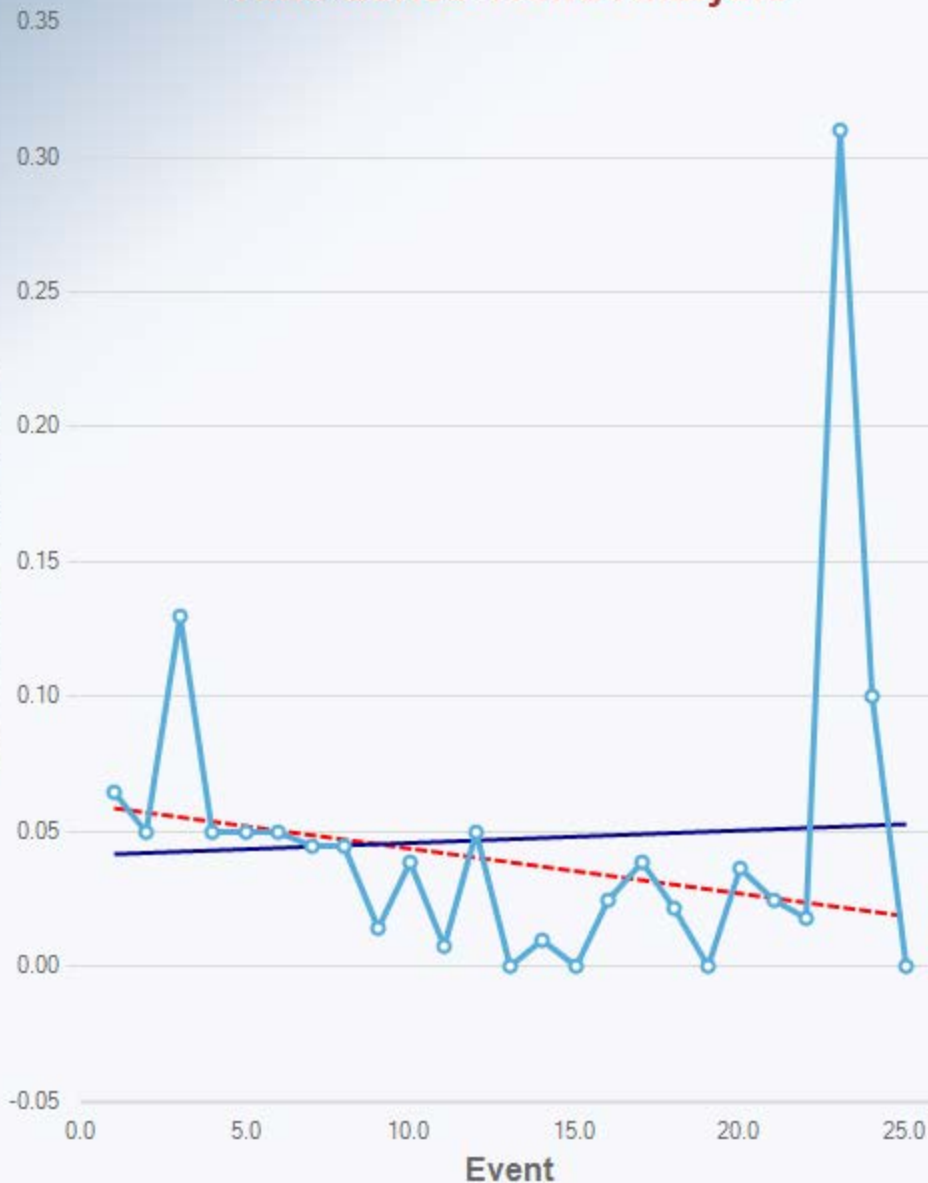
Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.2410

Insufficient evidence of a significant trend

Time-Series Trend Analysis

Phosphorous (mg/L)-site 07



Time-Series Trend Analysis

Events/Time Periods 25

OLS Regression Line (Blue)

OLS Regression Slope 0.0005

OLS Regression Intercept 0.0413

Theil-Sen Trend Line (Red)

Theil-Sen Slope -0.0017

Theil-Sen Intercept 0.0607

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 108.3652

M2 191.6348

LCL of Slope -0.0027

UCL of Slope -0.0001

Statistically significant evidence of a decreasing trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 42.4853

M-K Standardized Val (S) -2.3538

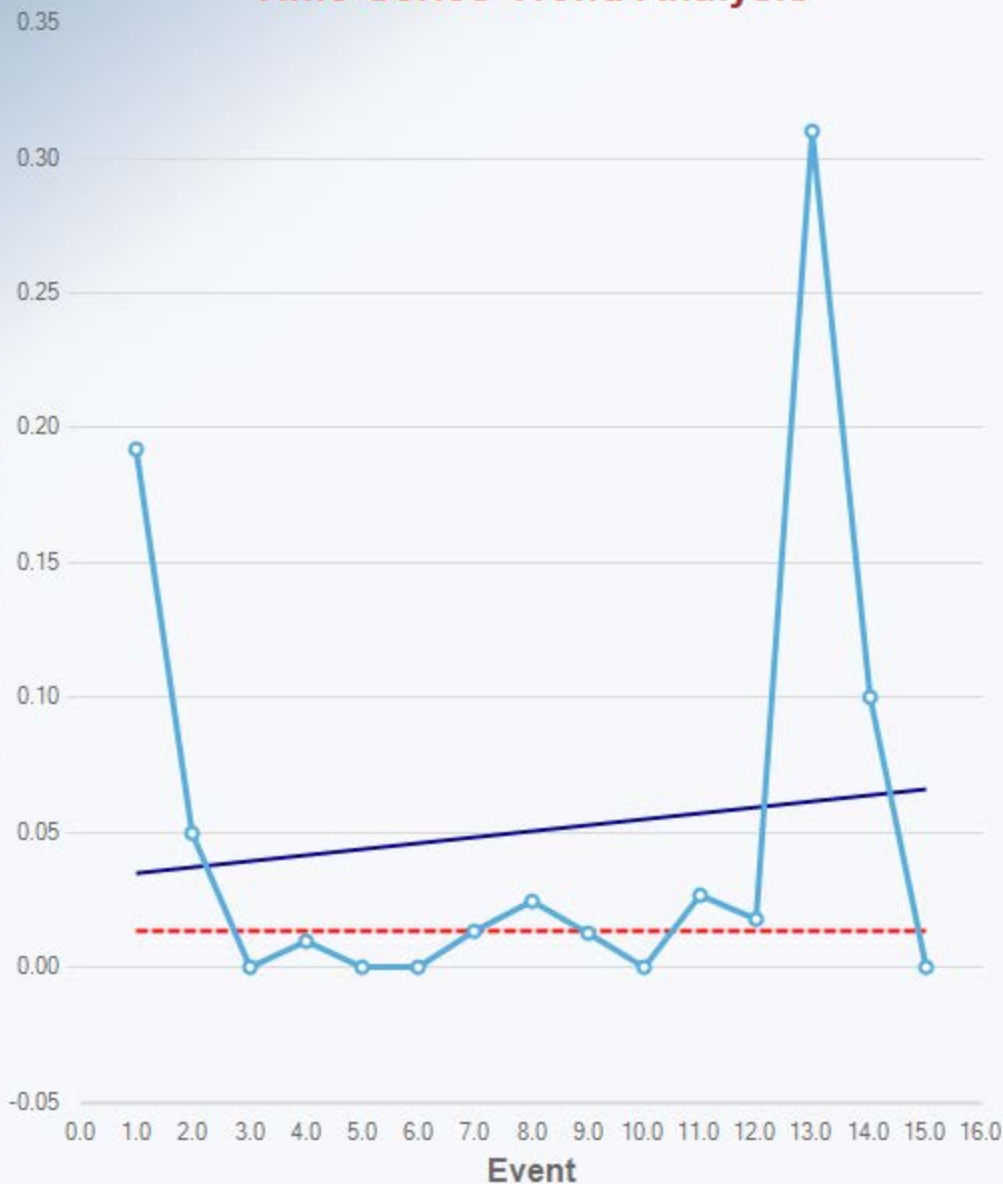
Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.0093

Significant evidence of a decreasing trend

Time-Series Trend Analysis

Phosphorous (mg/L)-site 08



Time-Series Trend Analysis

Events/Time Periods 15

OLS Regression Line (Blue)

OLS Regression Slope 0.0022
OLS Regression Intercept 0.0329

Theil-Sen Trend Line (Red)

Theil-Sen Slope 0.0000
Theil-Sen Intercept 0.0140

Theil-Sen Trend Analysis

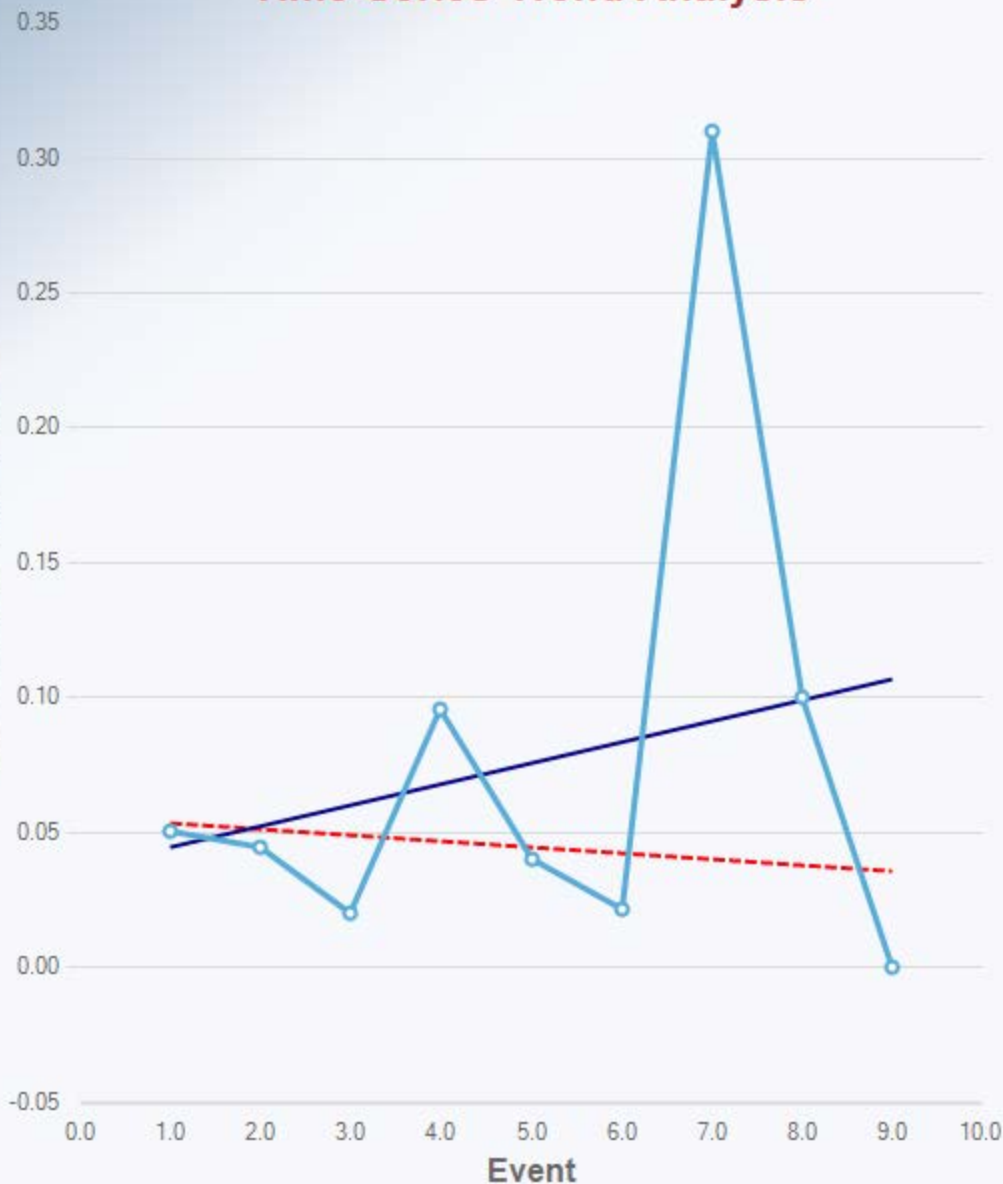
Level of Significance 0.0500
M1 33.1056
M2 71.8944
LCL of Slope -0.0041
UCL of Slope 0.0045
Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 19.7906
M-K Test Value (S) 9
Tabulated p-value 0.3490
Insufficient evidence of a significant trend

Time-Series Trend Analysis

Phosphorous (mg/L)-site 09



Time-Series Trend Analysis

Events/Time Periods 9

OLS Regression Line (Blue)

OLS Regression Slope 0.0078
OLS Regression Intercept 0.0371

Theil-Sen Trend Line (Red)

Theil-Sen Slope -0.0022
Theil-Sen Intercept 0.0560

Theil-Sen Trend Analysis

Level of Significance 0.0500
M1 8.6003
M2 27.3997
LCL of Slope -0.0165
UCL of Slope 0.0222
Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 9.5917
M-K Test Value (S) -2
Tabulated p-value 0.4600
Insufficient evidence of a significant trend

pH Trend Graphs

Time-Series Trend Analysis

pH (s.u.)-site 01



Time-Series Trend Analysis

Events/Time Periods 26

OLS Regression Line (Blue)

OLS Regression Slope 0.0061

OLS Regression Intercept 6.7000

Theil-Sen Trend Line (Red)

Theil-Sen Slope 0.0058

Theil-Sen Intercept 6.7368

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 118.0609

M2 206.9391

LCL of Slope -0.0161

UCL of Slope 0.0240

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 45.3468

M-K Standardized Val (S) 0.4410

Appx. Critical Value (0.05) 1.6449

Approximate p-value (S) 0.3296

Insufficient evidence of a significant trend

Time-Series Trend Analysis



Time-Series Trend Analysis

Events/Time Periods 26

OLS Regression Line (Blue)

OLS Regression Slope 0.0108

OLS Regression Intercept 6.5119

Theil-Sen Trend Line (Red)

Theil-Sen Slope 0.0100

Theil-Sen Intercept 6.5150

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 118.0609

M2 206.9391

LCL of Slope -0.0100

UCL of Slope 0.0283

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 45.3468

M-K Standardized Val (S) 0.9703

Appx. Critical Value (0.05) 1.6449

Approximate p-value (S) 0.1659

Insufficient evidence of a significant trend

Time-Series Trend Analysis

pH (s.u.)-site 03



Time-Series Trend Analysis

Events/Time Periods 26

OLS Regression Line (Blue)

OLS Regression Slope 0.0016

OLS Regression Intercept 7.0220

Theil-Sen Trend Line (Red)

Theil-Sen Slope 0.0019

Theil-Sen Intercept 7.0247

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 118.0717

M2 206.9283

LCL of Slope -0.0270

UCL of Slope 0.0282

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 45.3358

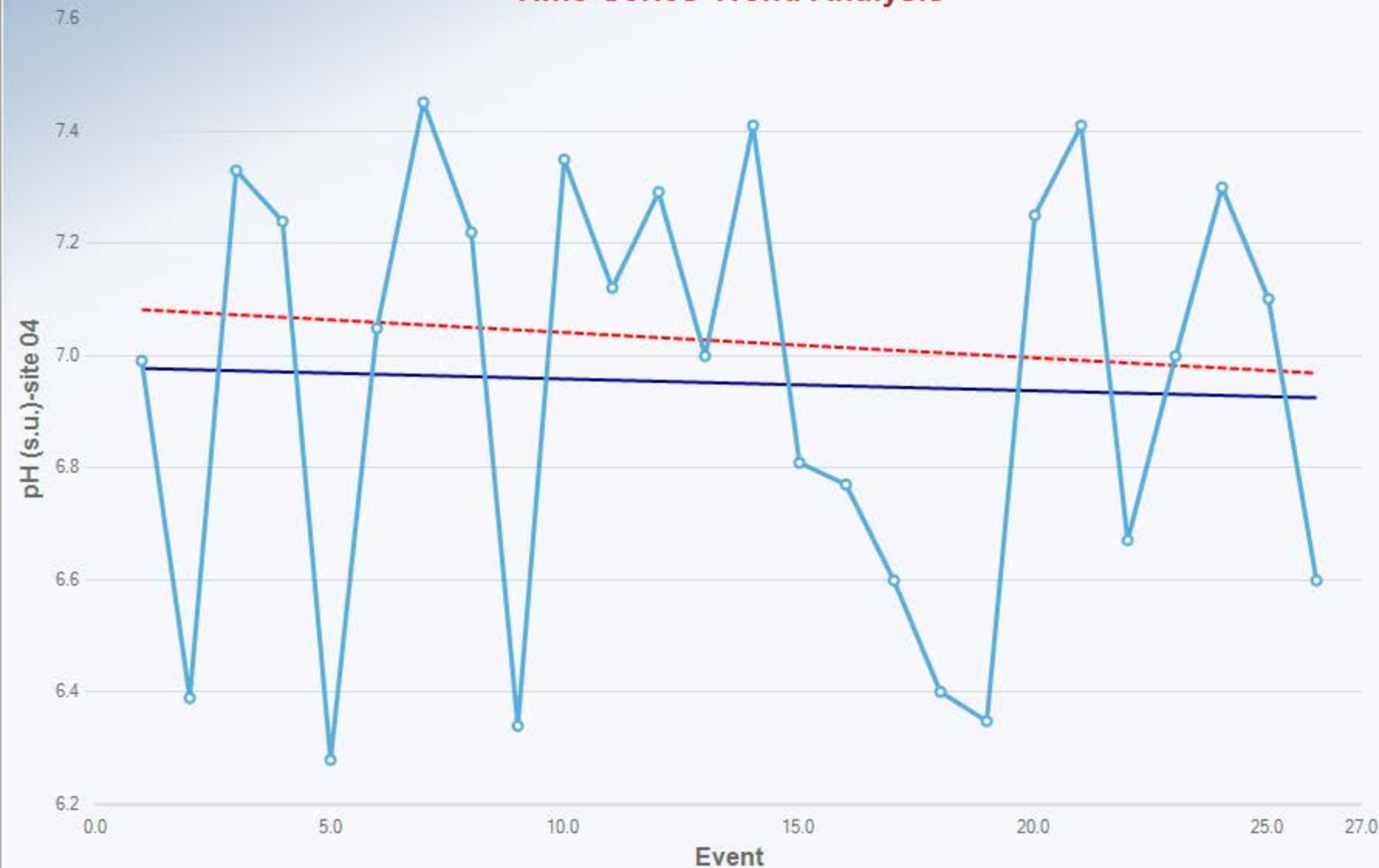
M-K Standardized Val (S) 0.1985

Appx. Critical Value (0.05) 1.6449

Approximate p-value (S) 0.4213

Insufficient evidence of a significant trend

Time-Series Trend Analysis



Time-Series Trend Analysis

Events/Time Periods 26

OLS Regression Line (Blue)

OLS Regression Slope -0.0021

OLS Regression Intercept 6.9796

Theil-Sen Trend Line (Red)

Theil-Sen Slope -0.0044

Theil-Sen Intercept 7.0850

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 118.0717

M2 206.9283

LCL of Slope -0.0299

UCL of Slope 0.0143

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 45.3358

M-K Standardized Val (S) -0.3309

Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.3704

Insufficient evidence of a significant trend

Time-Series Trend Analysis



Time-Series Trend Analysis

Events/Time Periods 25

OLS Regression Line (Blue)

OLS Regression Slope 0.0102

OLS Regression Intercept 6.9776

Theil-Sen Trend Line (Red)

Theil-Sen Slope 0.0063

Theil-Sen Intercept 7.0977

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 108.0626

M2 191.9374

LCL of Slope -0.0164

UCL of Slope 0.0271

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 42.7941

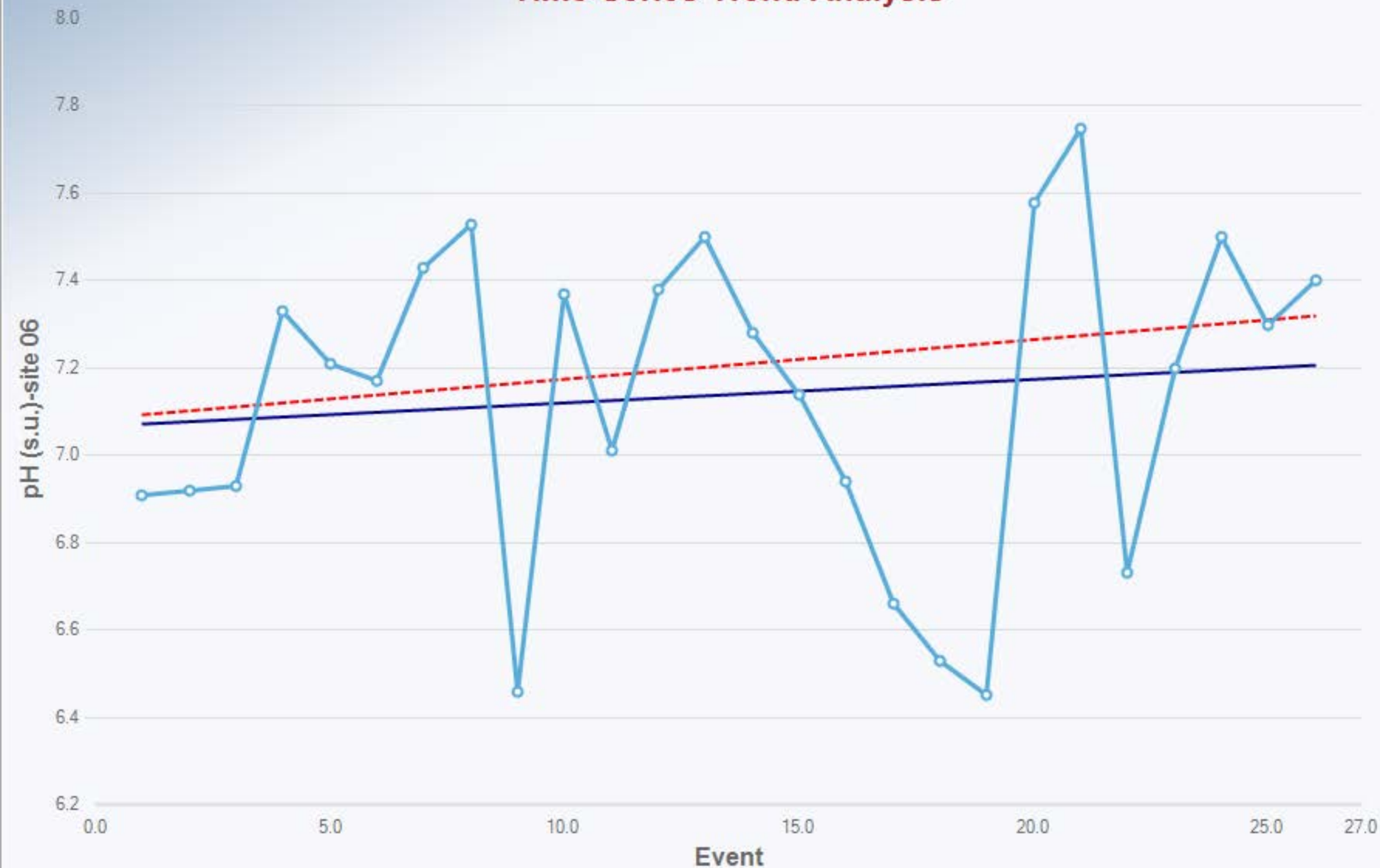
M-K Standardized Val (S) 0.6777

Appx. Critical Value (0.05) 1.6449

Approximate p-value (S) 0.2490

Insufficient evidence of a significant trend

Time-Series Trend Analysis



Time-Series Trend Analysis

Events/Time Periods 26

OLS Regression Line (Blue)

OLS Regression Slope 0.0053

OLS Regression Intercept 7.0674

Theil-Sen Trend Line (Red)

Theil-Sen Slope 0.0090

Theil-Sen Intercept 7.0829

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 118.0501

M2 206.9499

LCL of Slope -0.0156

UCL of Slope 0.0250

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 45.3578

M-K Standardized Val (S) 0.8598

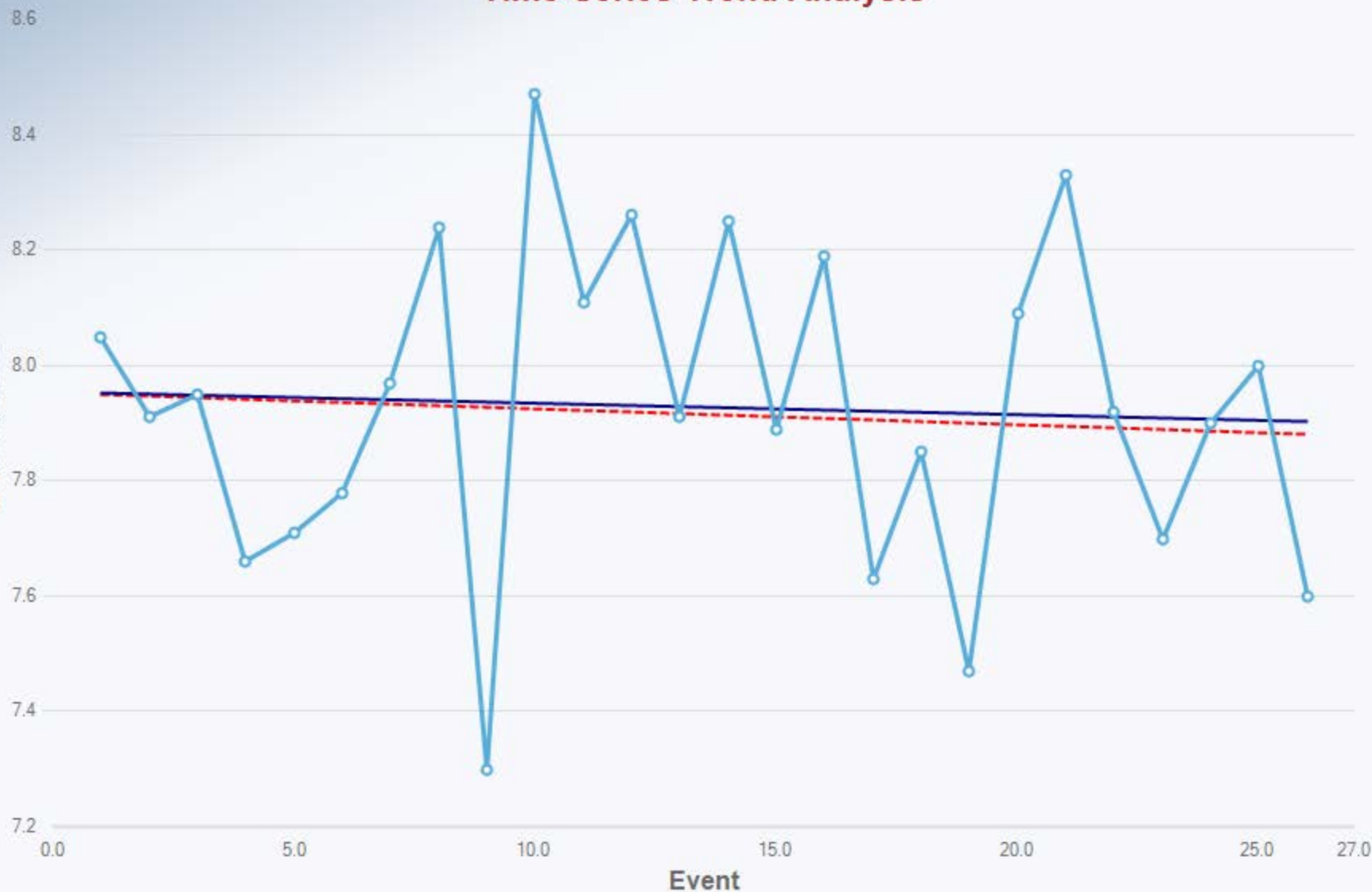
Appx. Critical Value (0.05) 1.6449

Approximate p-value (S) 0.1949

Insufficient evidence of a significant trend

Time-Series Trend Analysis

pH (s.u.)-site 07



Time-Series Trend Analysis

Events/Time Periods 26

OLS Regression Line (Blue)

OLS Regression Slope -0.0020

OLS Regression Intercept 7.9555

Theil-Sen Trend Line (Red)

Theil-Sen Slope -0.0027

Theil-Sen Intercept 7.9518

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 118.0501

M2 206.9499

LCL of Slope -0.0186

UCL of Slope 0.0123

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 45.3578

M-K Standardized Val (S) -0.4189

Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.3376

Insufficient evidence of a significant trend

Time-Series Trend Analysis



Time-Series Trend Analysis

Events/Time Periods 16

OLS Regression Line (Blue)

OLS Regression Slope -0.0125

OLS Regression Intercept 7.7278

Theil-Sen Trend Line (Red)

Theil-Sen Slope -0.0133

Theil-Sen Intercept 7.8133

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 38.3367

M2 81.6633

LCL of Slope -0.0493

UCL of Slope 0.0220

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 22.1058

M-K Test Value (S) -16

Tabulated p-value 0.2530

Insufficient evidence of a significant trend

Time-Series Trend Analysis

pH (s.u.)-site 09



Time-Series Trend Analysis

Events/Time Periods 10

OLS Regression Line (Blue)

OLS Regression Slope 0.0367

OLS Regression Intercept 7.6673

Theil-Sen Trend Line (Red)

Theil-Sen Slope 0.0333

Theil-Sen Intercept 7.6667

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 11.5435

M2 33.4565

LCL of Slope -0.0630

UCL of Slope 0.1391

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 11.1803

M-K Test Value (S) 11

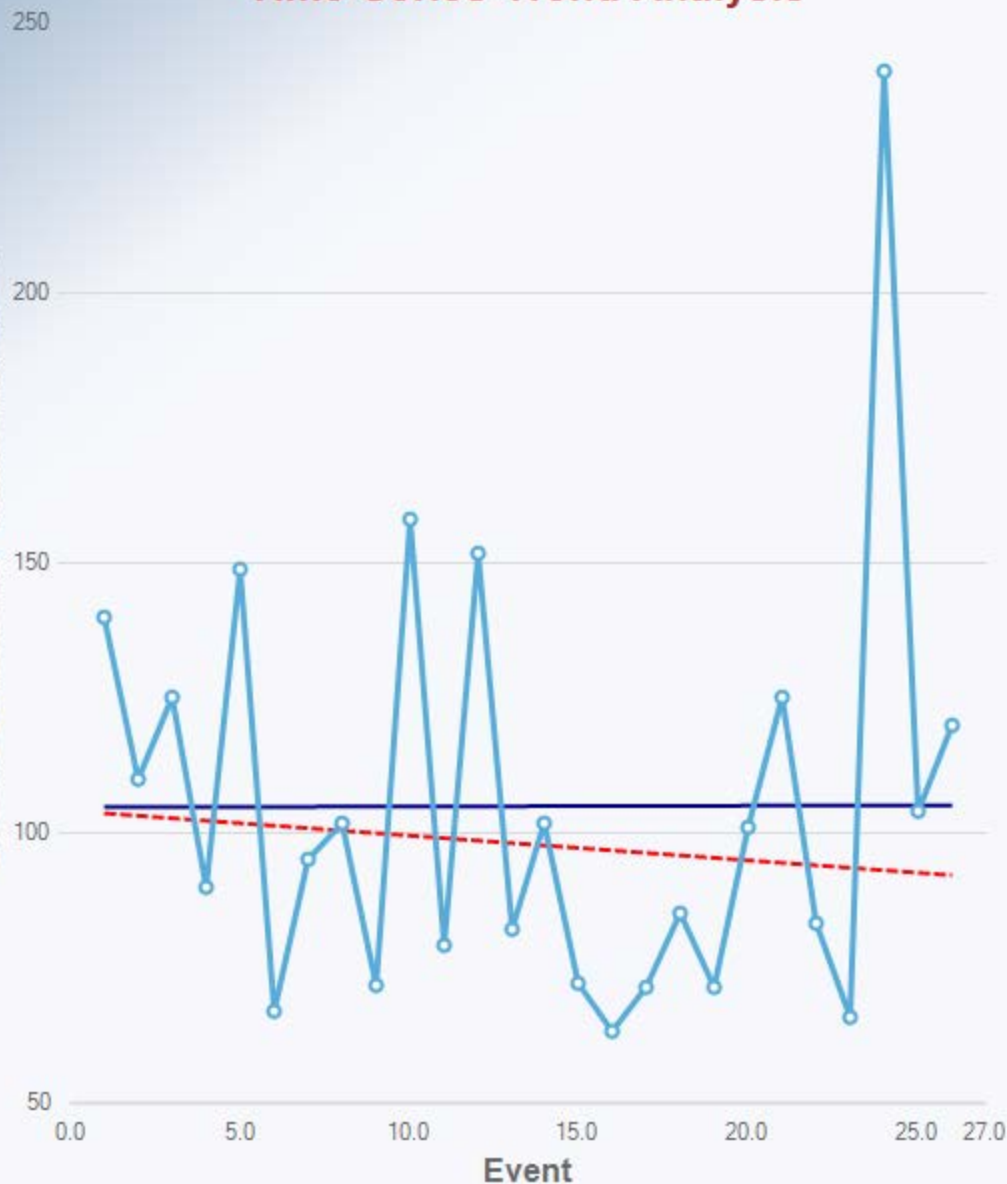
Tabulated p-value 0.1900

Insufficient evidence of a significant trend

Specific Conductivity Trend Graphs

Time-Series Trend Analysis

Specific Conductivity (umhos/cm)-site 01



Time-Series Trend Analysis

Events/Time Periods 26

OLS Regression Line (Blue)

OLS Regression Slope 0.0182

OLS Regression Intercept 104.6665

Theil-Sen Trend Line (Red)

Theil-Sen Slope -0.4500

Theil-Sen Intercept 104.0750

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 118.0717

M2 206.9283

LCL of Slope -2.3106

UCL of Slope 1.4490

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 45.3358

M-K Standardized Val (S) -0.6397

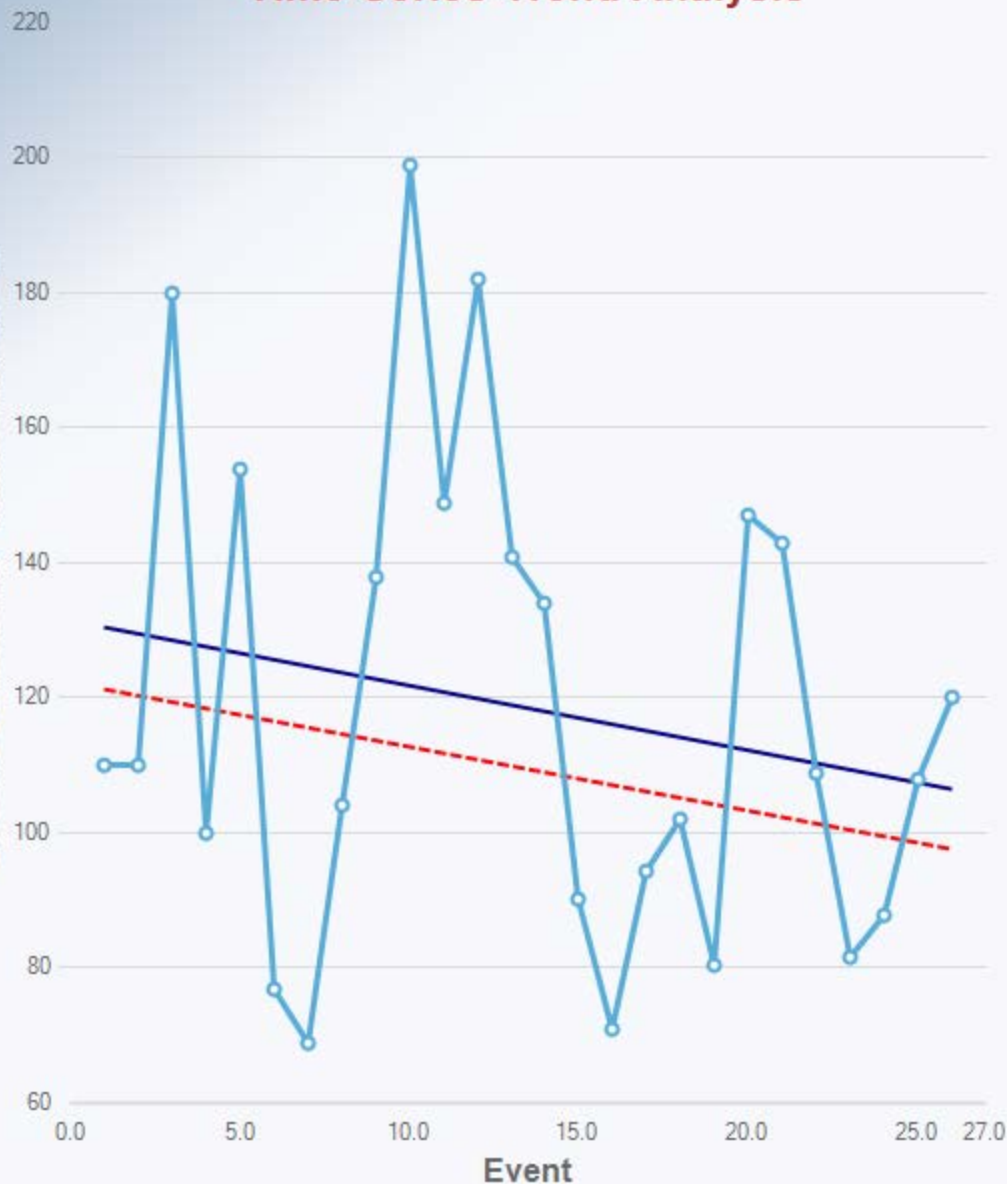
Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.2612

Insufficient evidence of a significant trend

Time-Series Trend Analysis

Specific Conductivity (umhos/cm)-site 02



Time-Series Trend Analysis

Events/Time Periods 26

OLS Regression Line (Blue)

OLS Regression Slope -0.9668

OLS Regression Intercept 131.5788

Theil-Sen Trend Line (Red)

Theil-Sen Slope -0.9571

Theil-Sen Intercept 122.4214

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 118.0501

M2 206.9499

LCL of Slope -3.3303

UCL of Slope 0.9479

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 45.3578

M-K Standardized Val (S) -0.9039

Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.1830

Insufficient evidence of a significant trend

Time-Series Trend Analysis

Specific Conductivity (umhos/cm)-site 03



Time-Series Trend Analysis

Events/Time Periods 26

OLS Regression Line (Blue)

OLS Regression Slope 0.2985

OLS Regression Intercept 120.3631

Theil-Sen Trend Line (Red)

Theil-Sen Slope 0.4286

Theil-Sen Intercept 115.7143

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 118.0898

M2 206.9102

LCL of Slope -1.3740

UCL of Slope 1.8892

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 45.3174

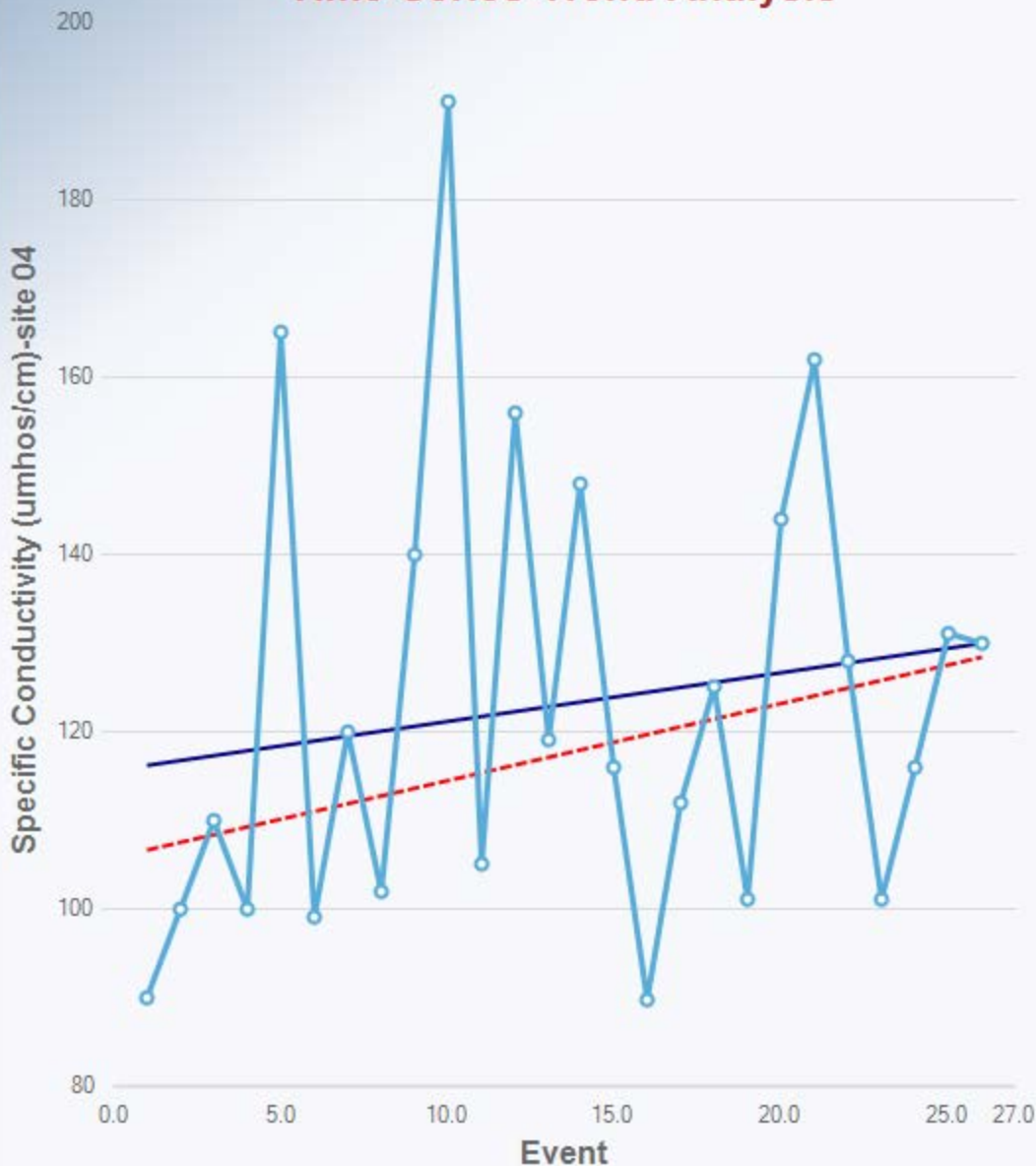
M-K Standardized Val (S) 0.4413

Appx. Critical Value (0.05) 1.6449

Approximate p-value (S) 0.3295

Insufficient evidence of a significant trend

Time-Series Trend Analysis



Time-Series Trend Analysis

Events/Time Periods 26

OLS Regression Line (Blue)

OLS Regression Slope 0.5538

OLS Regression Intercept 115.6308

Theil-Sen Trend Line (Red)

Theil-Sen Slope 0.8696

Theil-Sen Intercept 105.7609

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 118.0717

M2 206.9283

LCL of Slope -0.4964

UCL of Slope 1.7815

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 45.3358

M-K Standardized Val (S) 1.4337

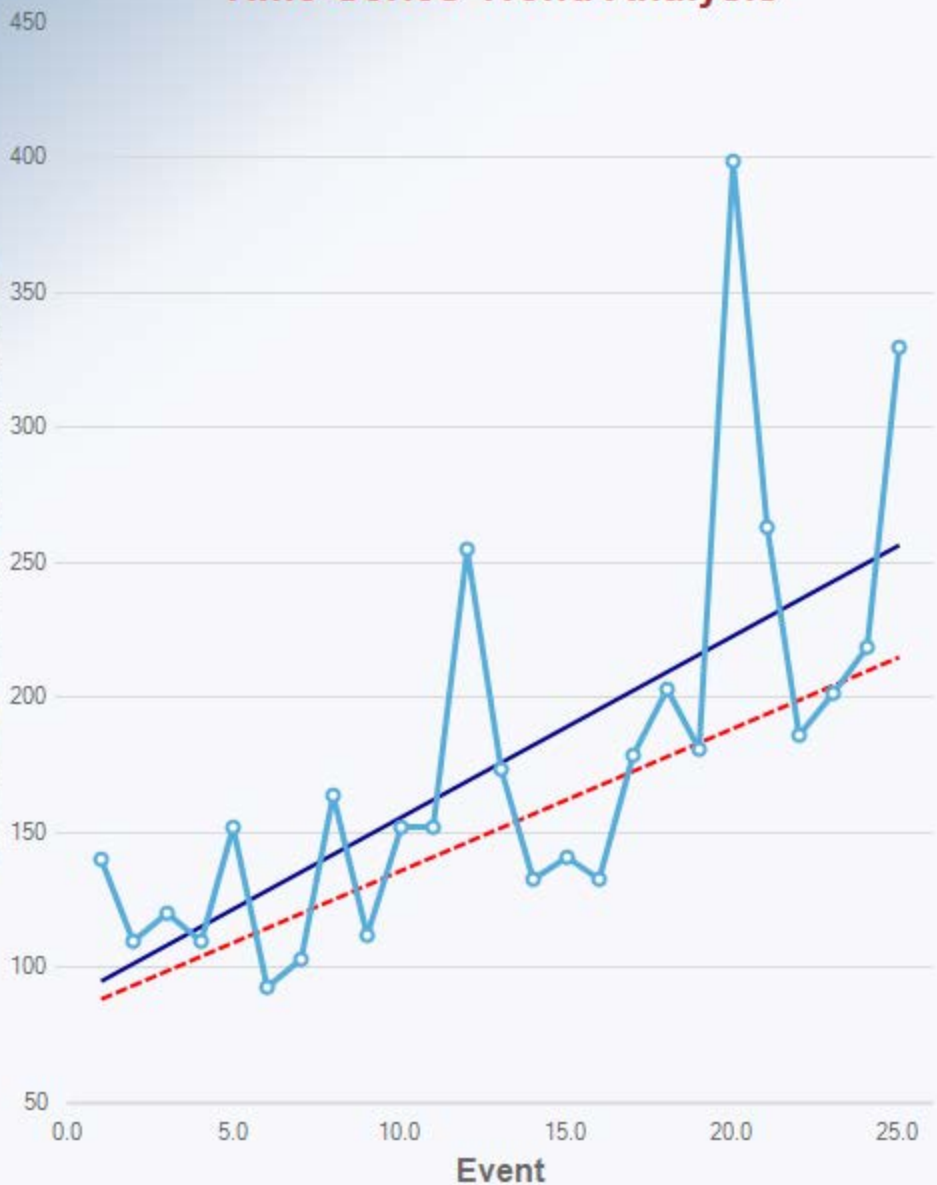
Appx. Critical Value (0.05) 1.6449

Approximate p-value (S) 0.0758

Insufficient evidence of a significant trend

Time-Series Trend Analysis

Specific Conductivity (umhos/cm)-site 05



Time-Series Trend Analysis

Events/Time Periods 25

OLS Regression Line (Blue)

OLS Regression Slope 6.7254
OLS Regression Intercept 88.8100

Theil-Sen Trend Line (Red)

Theil-Sen Slope 5.2788
Theil-Sen Intercept 83.3750

Theil-Sen Trend Analysis

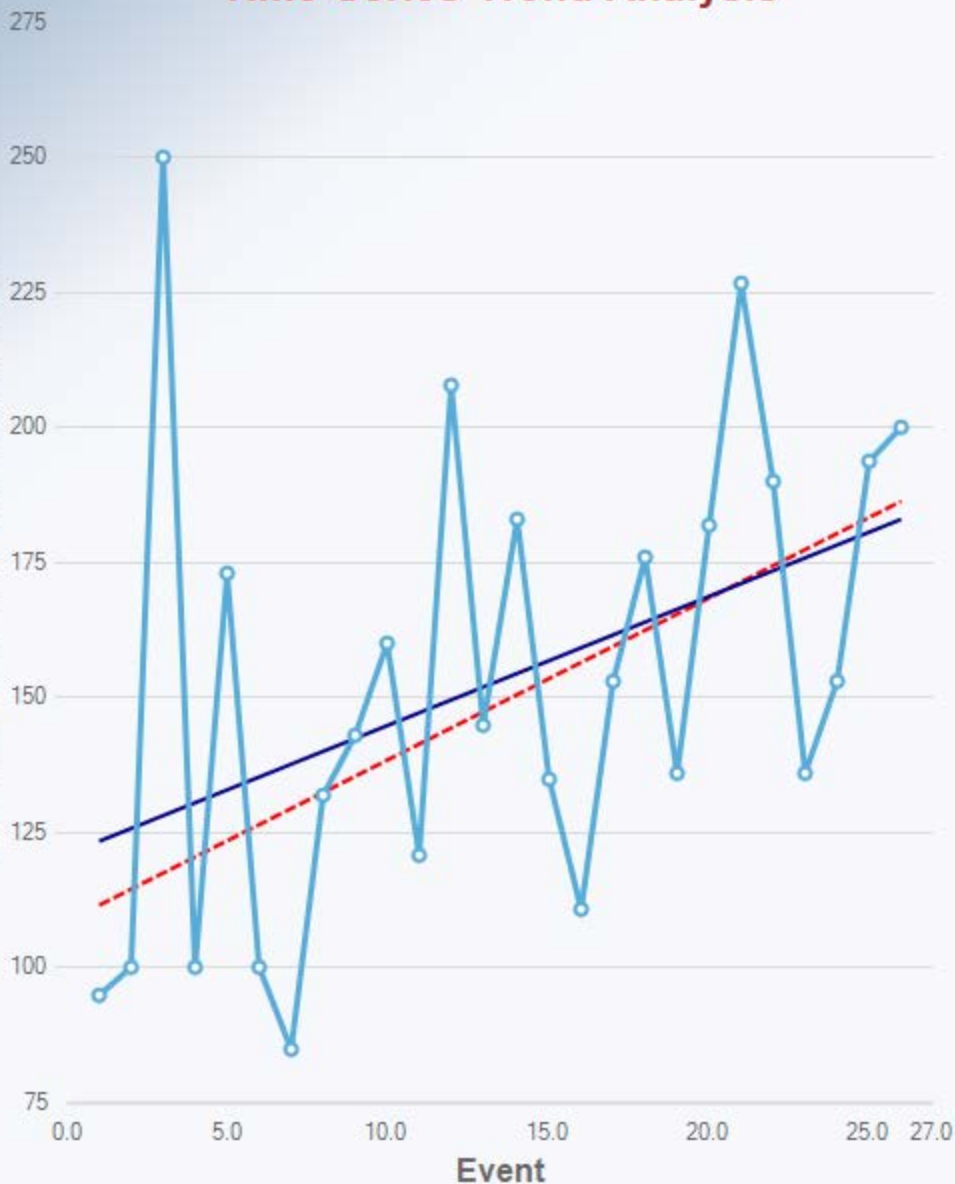
Level of Significance 0.0500
M1 108.1046
M2 191.8954
LCL of Slope 3.3433
UCL of Slope 7.9415
Statistically significant evidence of an increasing trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 42.7512
M-K Standardized Val (S) 4.1168
Appx. Critical Value (0.05) 1.6449
Approximate p-value (S) 0.0000
Significant evidence of an increasing trend

Time-Series Trend Analysis

Specific Conductivity (umhos/cm)-site 06



Time-Series Trend Analysis

Events/Time Periods 26

OLS Regression Line (Blue)

OLS Regression Slope 2.3761

OLS Regression Intercept 121.3077

Theil-Sen Trend Line (Red)

Theil-Sen Slope 3.0000

Theil-Sen Intercept 108.5000

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 118.1006

M2 206.8994

LCL of Slope 1.0517

UCL of Slope 4.9344

Statistically significant evidence of an increasing trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 45.3064

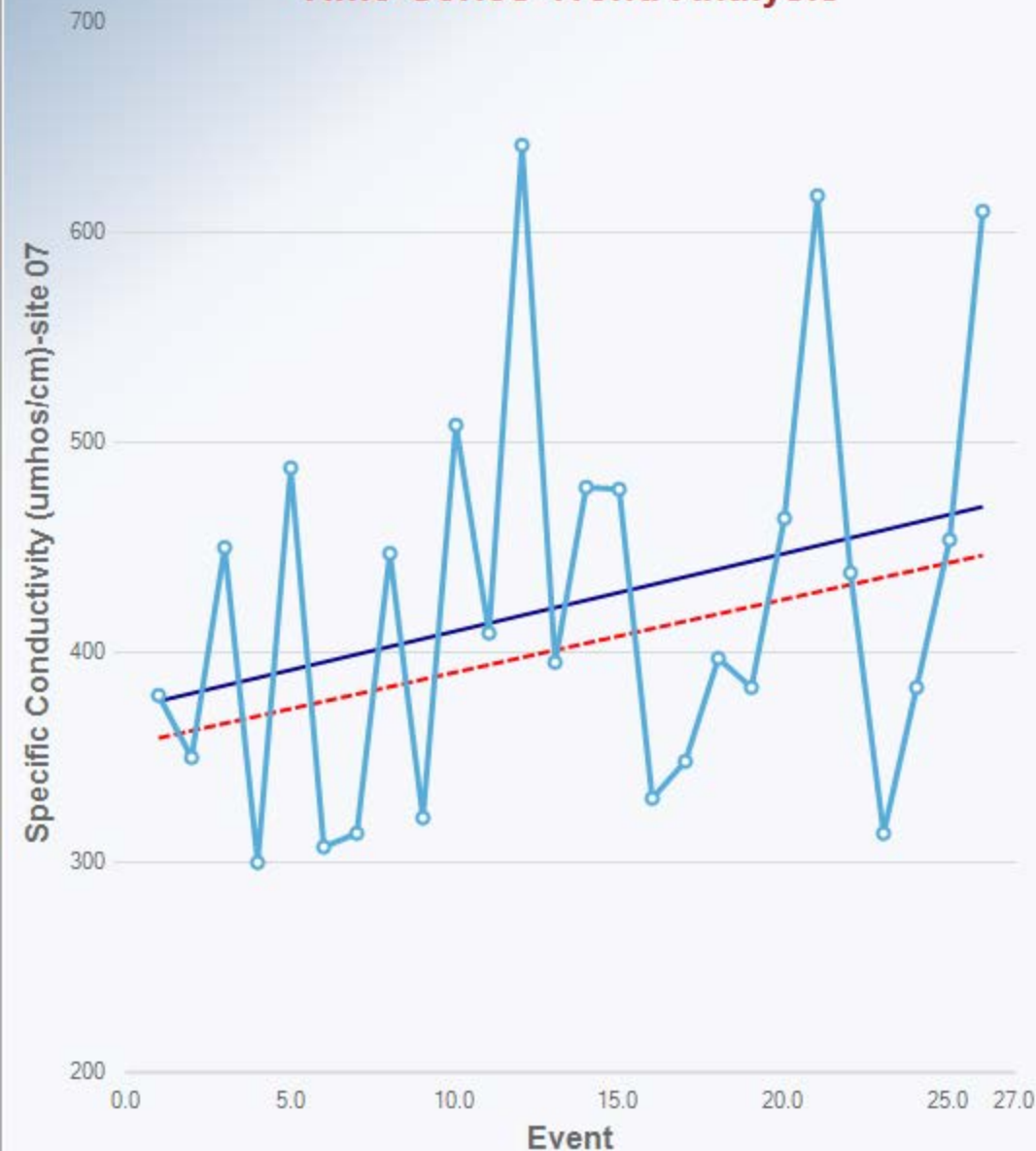
M-K Standardized Val (S) 2.8031

Appx. Critical Value (0.05) 1.6449

Approximate p-value (S) 0.0025

Significant evidence of an increasing trend

Time-Series Trend Analysis



Time-Series Trend Analysis

Events/Time Periods 26

OLS Regression Line (Blue)

OLS Regression Slope 3.7019

OLS Regression Intercept 373.4092

Theil-Sen Trend Line (Red)

Theil-Sen Slope 3.5000

Theil-Sen Intercept 355.7500

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 118.0609

M2 206.9391

LCL of Slope -1.7143

UCL of Slope 8.1848

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 45.3468

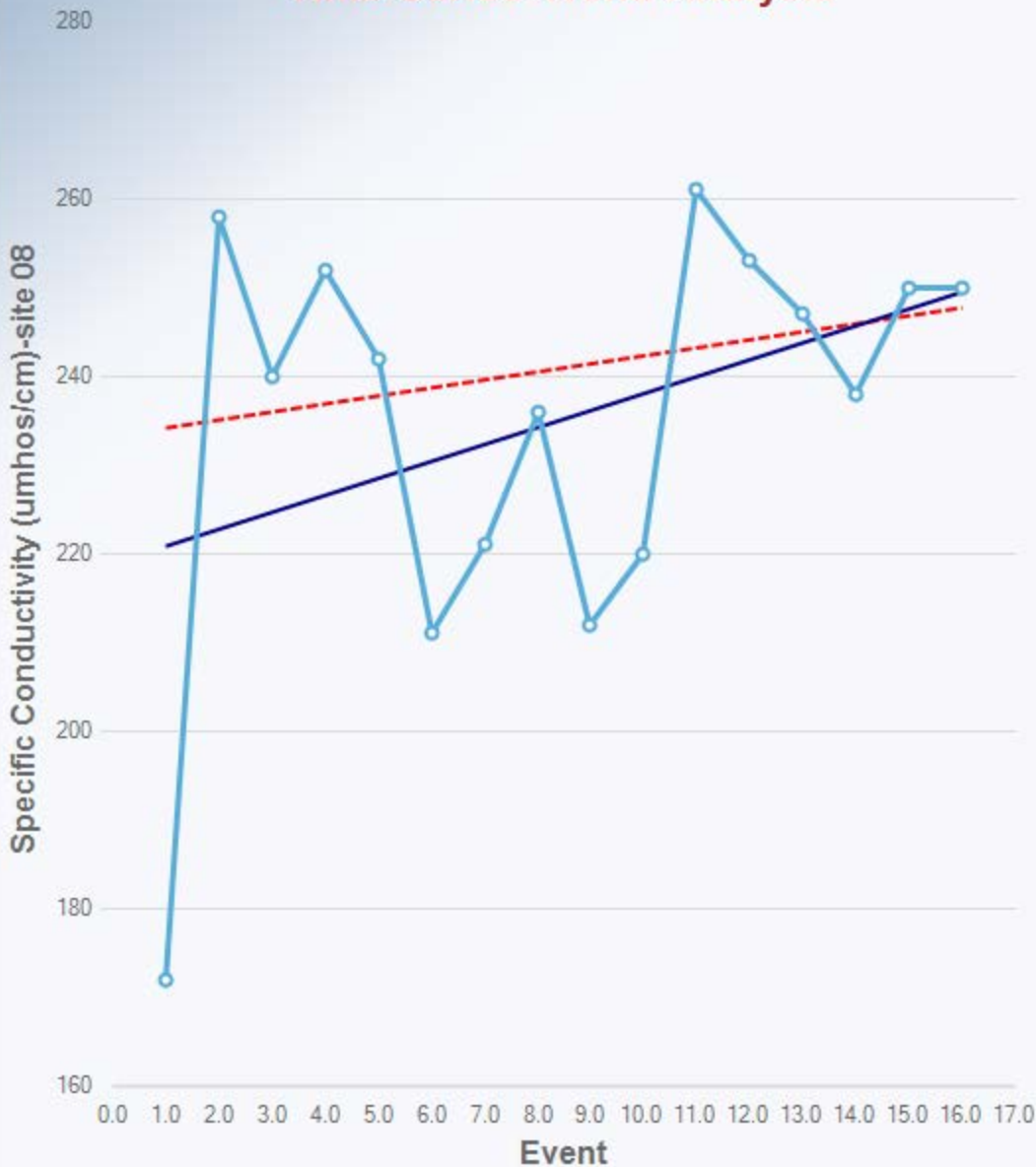
M-K Standardized Val (S) 1.2790

Appx. Critical Value (0.05) 1.6449

Approximate p-value (S) 0.1004

Insufficient evidence of a significant trend

Time-Series Trend Analysis



Time-Series Trend Analysis

Events/Time Periods 16

OLS Regression Line (Blue)

OLS Regression Slope 1.9103

OLS Regression Intercept 218.9500

Theil-Sen Trend Line (Red)

Theil-Sen Slope 0.9167

Theil-Sen Intercept 233.2083

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 38.2556

M2 81.7444

LCL of Slope -0.9489

UCL of Slope 4.8722

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 22.1886

M-K Test Value (S) 21

Tabulated p-value 0.1990

Insufficient evidence of a significant trend

Time-Series Trend Analysis

Specific Conductivity (umhos/cm)-site 09



Time-Series Trend Analysis

Events/Time Periods 10

OLS Regression Line (Blue)

OLS Regression Slope 13.5394

OLS Regression Intercept 423.5333

Theil-Sen Trend Line (Red)

Theil-Sen Slope 19.6667

Theil-Sen Intercept 373.8333

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 11.5435

M2 33.4565

LCL of Slope -9.5490

UCL of Slope 54.3968

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 11.1803

M-K Test Value (S) 17

Tabulated p-value 0.0780

Insufficient evidence of a significant trend

Total Suspended Solids (TSS) Trend Graphs

Time-Series Trend Analysis

TSS (mg/L)-site 01



Time-Series Trend Analysis

Events/Time Periods 25

OLS Regression Line (Blue)

OLS Regression Slope -0.1621

OLS Regression Intercept 5.6990

Theil-Sen Trend Line (Red)

Theil-Sen Slope 0.0000

Theil-Sen Intercept 2.0000

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 109.0787

M2 190.9213

LCL of Slope -0.0633

UCL of Slope 0.0818

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 41.7572

M-K Standardized Val (S) 0.1916

Appx. Critical Value (0.05) 1.6449

Approximate p-value (S) 0.4240

Insufficient evidence of a significant trend

Time-Series Trend Analysis

TSS (mg/L)-site 02



Time-Series Trend Analysis

Events/Time Periods 25

OLS Regression Line (Blue)

OLS Regression Slope -0.1185

OLS Regression Intercept 4.4440

Theil-Sen Trend Line (Red)

Theil-Sen Slope -0.1239

Theil-Sen Intercept 3.6102

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 108.8913

M2 191.1087

LCL of Slope -0.2500

UCL of Slope 0.0000

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 41.9484

M-K Standardized Val (S) -1.8594

Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.0315

Significant evidence of a decreasing trend

Time-Series Trend Analysis

TSS (mg/L)-site 03



Time-Series Trend Analysis

Events/Time Periods 25

OLS Regression Line (Blue)

OLS Regression Slope -0.1225

OLS Regression Intercept 3.5840

Theil-Sen Trend Line (Red)

Theil-Sen Slope -0.0785

Theil-Sen Intercept 3.0200

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 109.7372

M2 190.2628

LCL of Slope -0.1895

UCL of Slope 0.0000

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 41.0853

M-K Standardized Val (S) -2.1662

Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.0151

Significant evidence of a decreasing trend

Time-Series Trend Analysis

TSS (mg/L)-site 04



Time-Series Trend Analysis

Events/Time Periods 25

OLS Regression Line (Blue)

OLS Regression Slope -0.1920

OLS Regression Intercept 5.3800

Theil-Sen Trend Line (Red)

Theil-Sen Slope -0.1292

Theil-Sen Intercept 3.6792

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 109.0122

M2 190.9878

LCL of Slope -0.2222

UCL of Slope 0.0000

Statistically significant evidence of a decreasing trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 41.8250

M-K Standardized Val (S) -2.5583

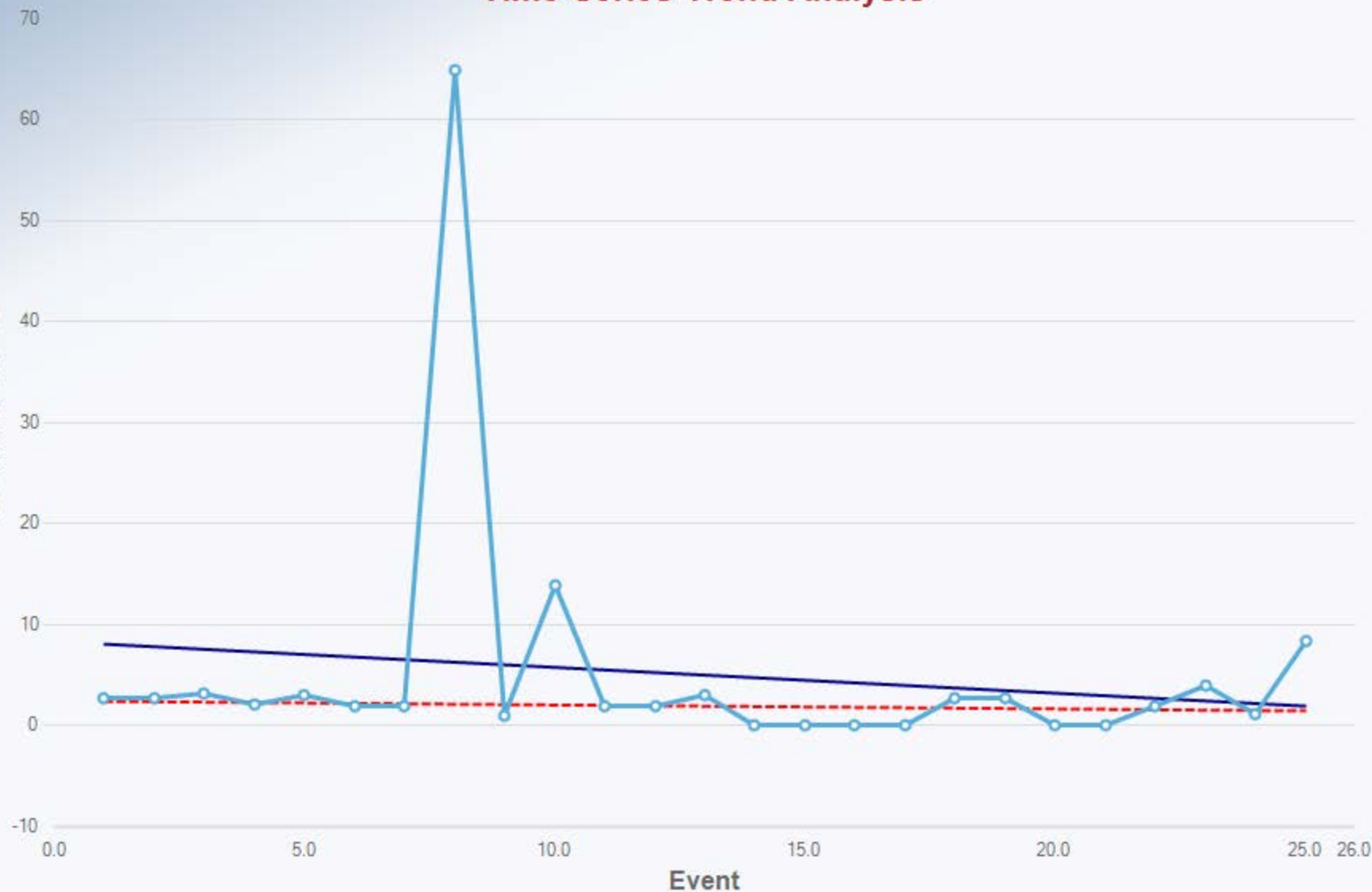
Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.0053

Significant evidence
of a decreasing trend

Time-Series Trend Analysis

TSS (mg/L)-site 05



Time-Series Trend Analysis

Events/Time Periods 25

OLS Regression Line (Blue)

OLS Regression Slope -0.2617

OLS Regression Intercept 8.4500

Theil-Sen Trend Line (Red)

Theil-Sen Slope -0.0422

Theil-Sen Intercept 2.5489

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 108.6120

M2 191.3880

LCL of Slope -0.1667

UCL of Slope 0.0022

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 42.2335

M-K Standardized Val (S) -1.2313

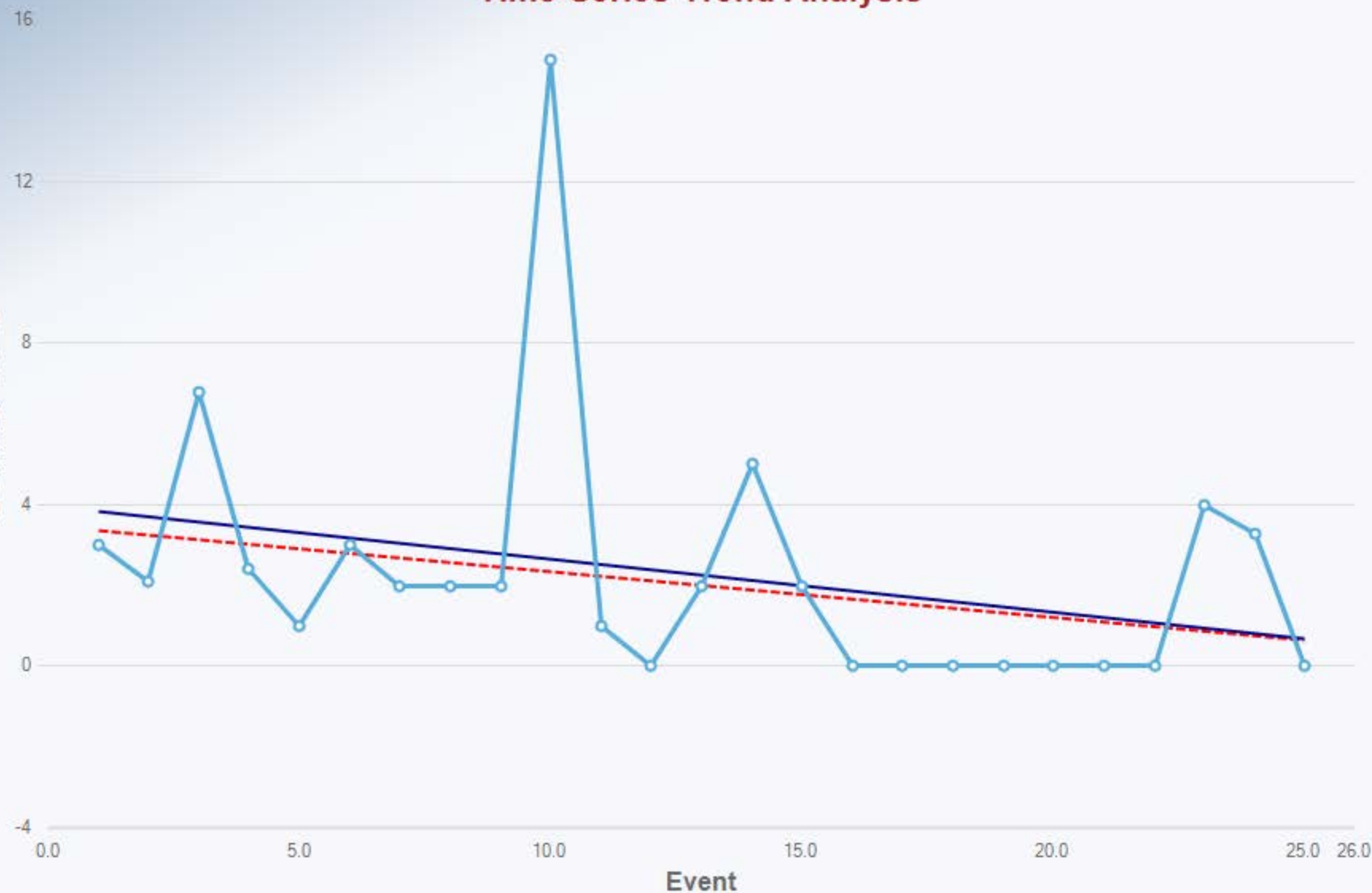
Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.1091

Insufficient evidence of a significant trend

Time-Series Trend Analysis

TSS (mg/L)-site 06



Time-Series Trend Analysis

Events/Time Periods 25

OLS Regression Line (Blue)

OLS Regression Slope -0.1303

OLS Regression Intercept 3.9580

Theil-Sen Trend Line (Red)

Theil-Sen Slope -0.1127

Theil-Sen Intercept 3.4651

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 109.3258

M2 190.6742

LCL of Slope -0.1689

UCL of Slope 0.0000

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 41.5050

M-K Standardized Val (S) -2.5298

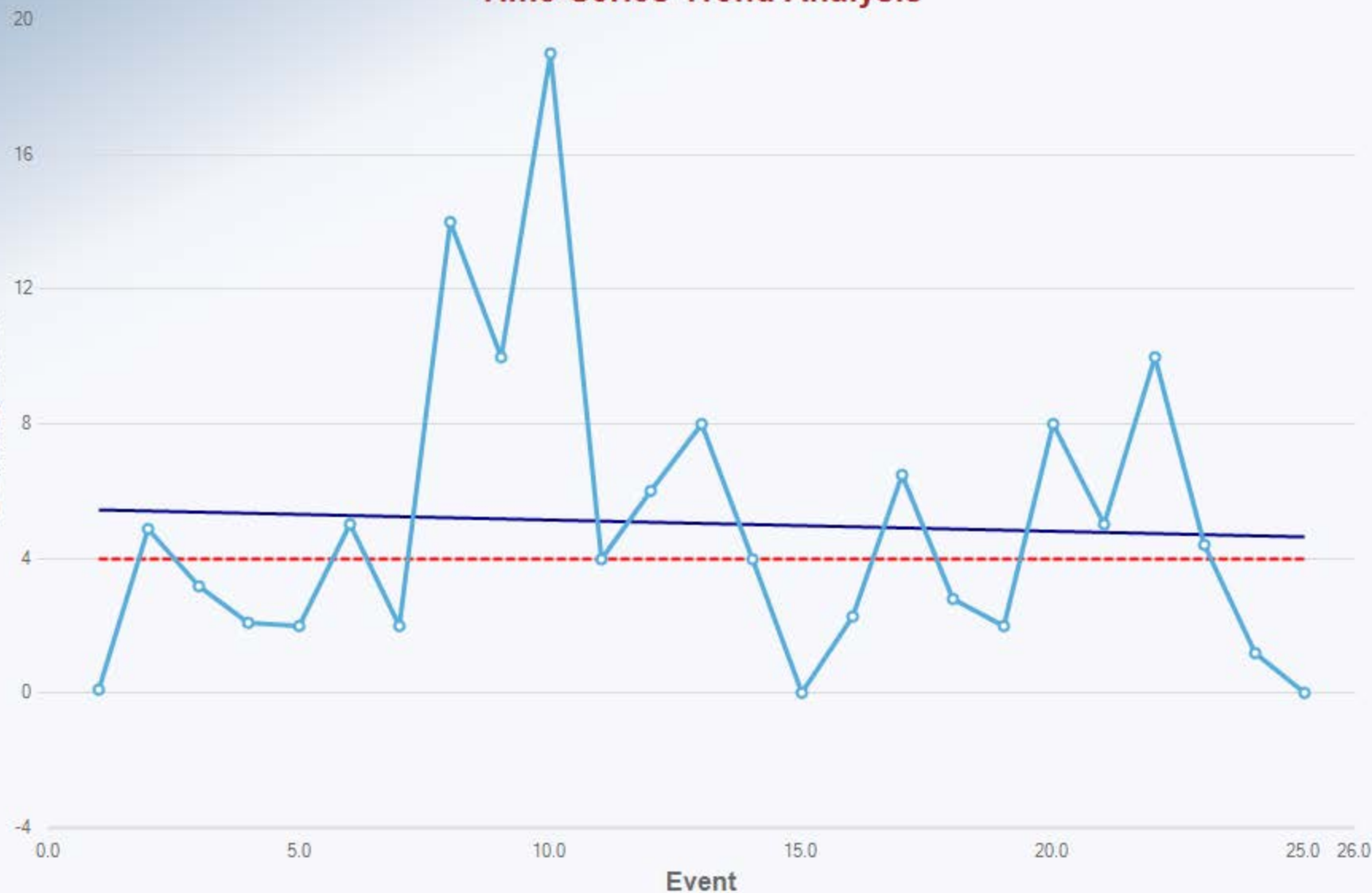
Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.0057

Significant evidence of a decreasing trend

Time-Series Trend Analysis

TSS (mg/L)-site 07



Time-Series Trend Analysis

Events/Time Periods 25

OLS Regression Line (Blue)

OLS Regression Slope -0.0338

OLS Regression Intercept 5.4990

Theil-Sen Trend Line (Red)

Theil-Sen Slope 0.0000

Theil-Sen Intercept 4.0000

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 108.1390

M2 191.8610

LCL of Slope -0.2500

UCL of Slope 0.2117

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 42.7161

M-K Standardized Val (S) -0.1171

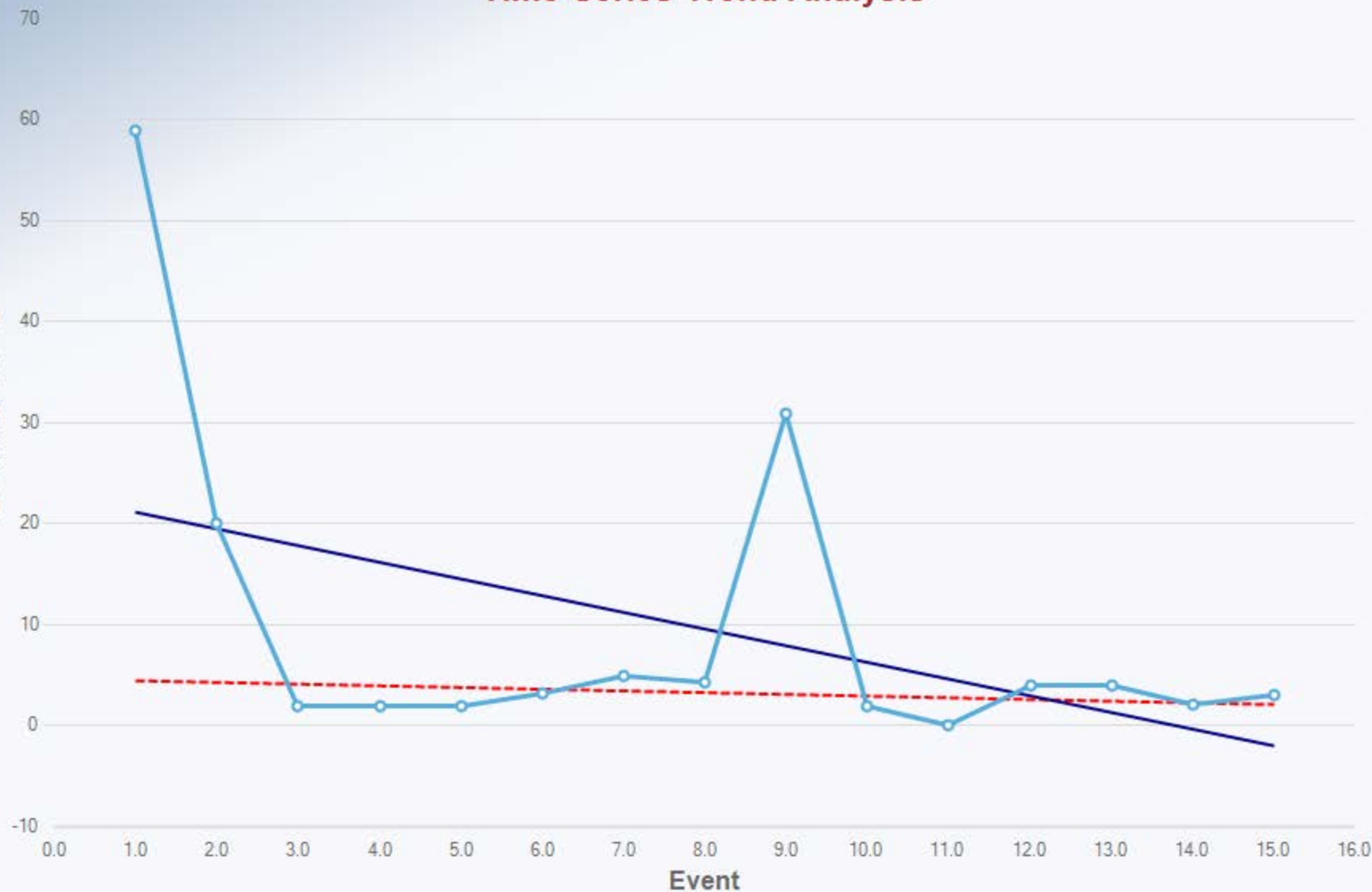
Appx. Critical Value (0.05) -1.6449

Approximate p-value (S) 0.4534

Insufficient evidence of a significant trend

Time-Series Trend Analysis

TSS (mg/L)-site 08



Time-Series Trend Analysis

Events/Time Periods 15

OLS Regression Line (Blue)

OLS Regression Slope -1.6525

OLS Regression Intercept 22.8200

Theil-Sen Trend Line (Red)

Theil-Sen Slope -0.1667

Theil-Sen Intercept 4.6333

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 32.9331

M2 72.0669

LCL of Slope -1.4678

UCL of Slope 0.1104

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 19.9666

M-K Test Value (S) -16

Tabulated p-value 0.2180

Insufficient evidence of a significant trend

Time-Series Trend Analysis

TSS (mg/L)-site 09



Time-Series Trend Analysis

Events/Time Periods 9

OLS Regression Line (Blue)

OLS Regression Slope 0.9683

OLS Regression Intercept 5.9917

Theil-Sen Trend Line (Red)

Theil-Sen Slope 0.2000

Theil-Sen Intercept 6.0000

Theil-Sen Trend Analysis

Level of Significance 0.0500

M1 8.6516

M2 27.3484

LCL of Slope -2.7394

UCL of Slope 2.9348

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

Standard Deviation of S 9.5394

M-K Test Value (S) 1

Tabulated p-value 0.5400

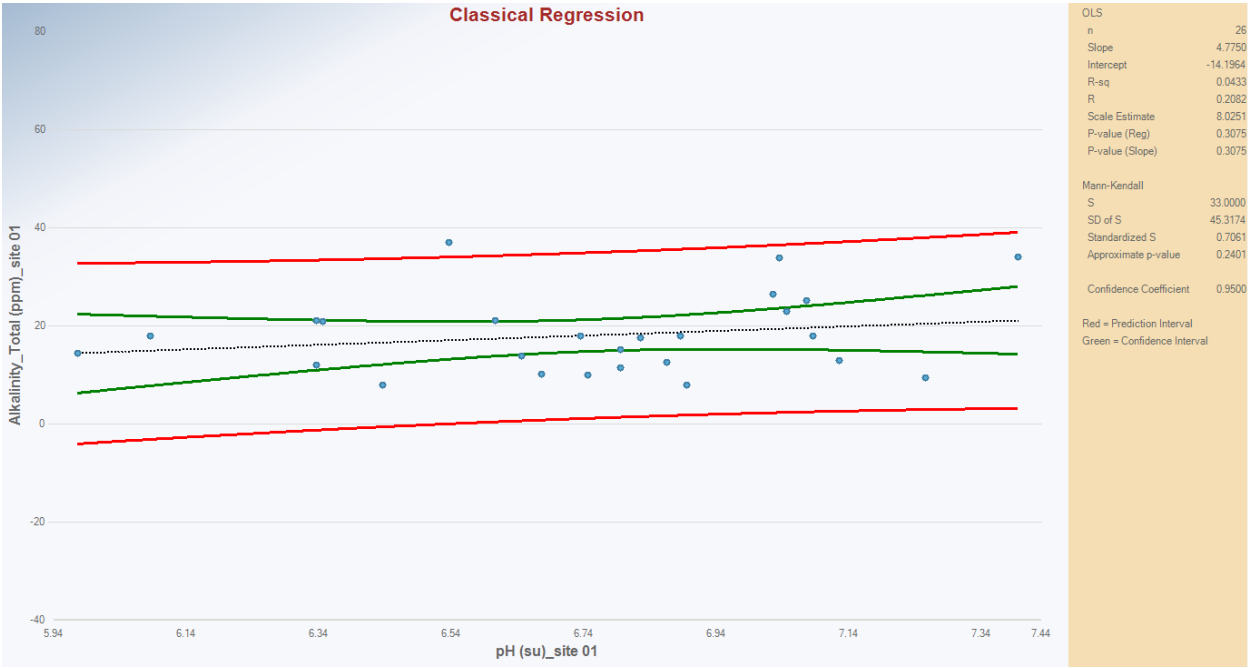
Insufficient evidence of a significant trend

Appendix E

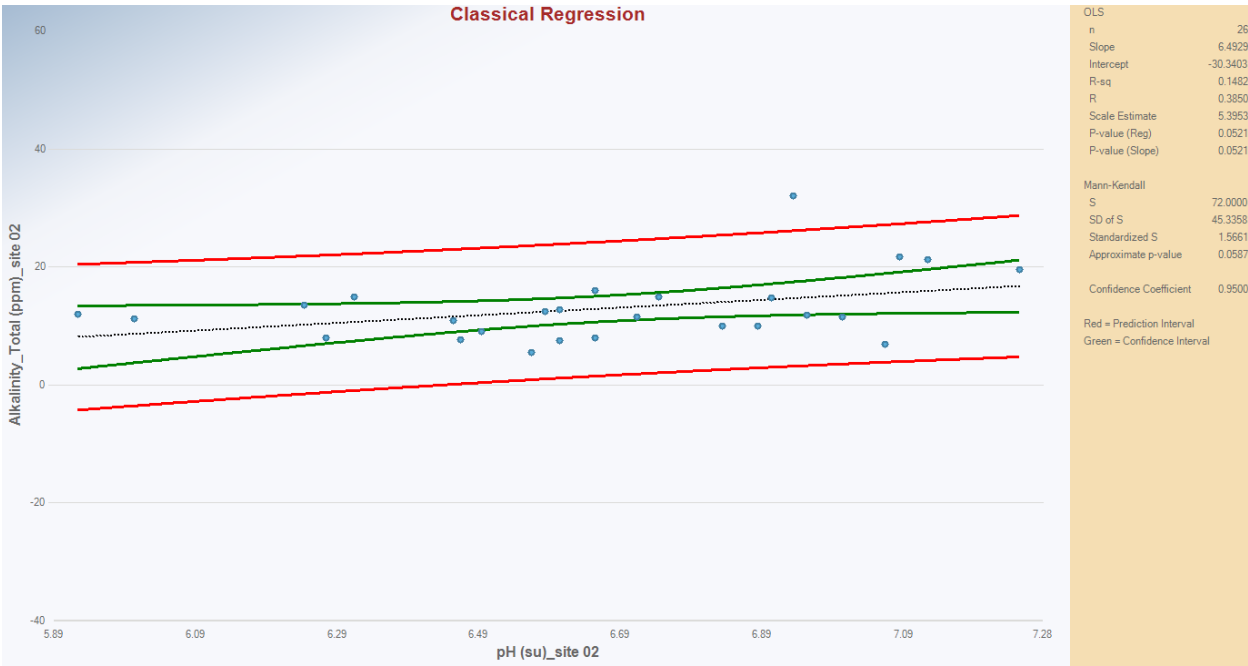
Miscellaneous Statistical Analysis Graphs and Calculations

Alkalinity vs. pH OLS Trend Analysis (Correlation) Graphs

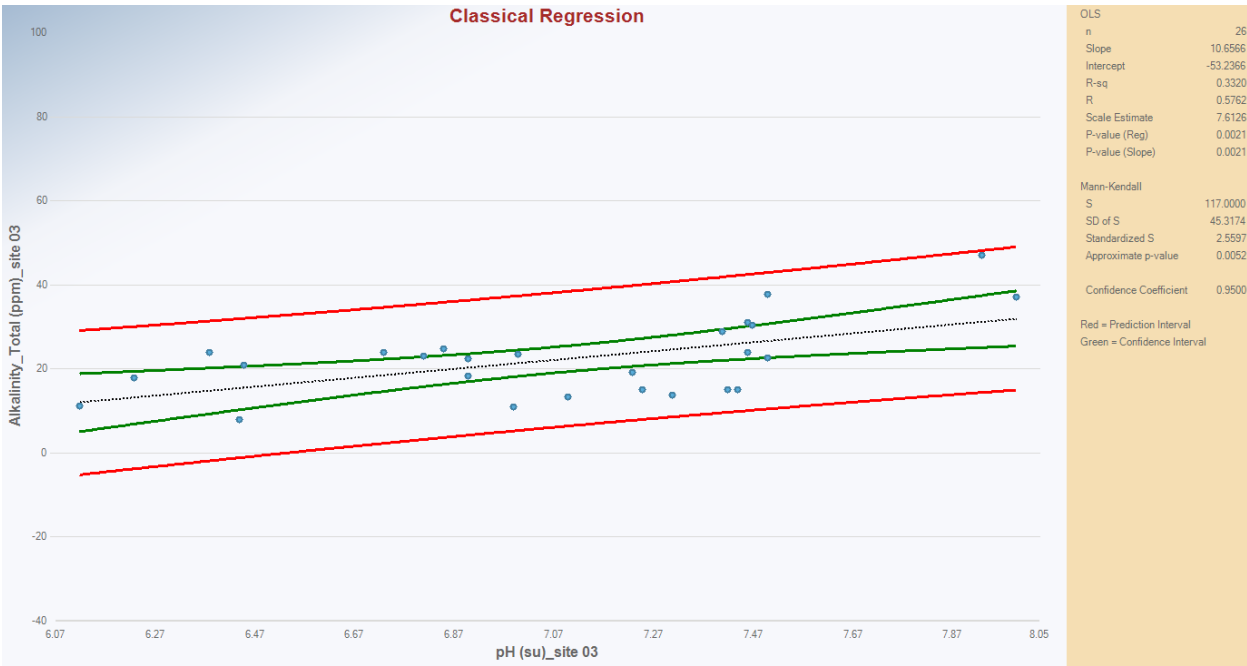
Site 1:



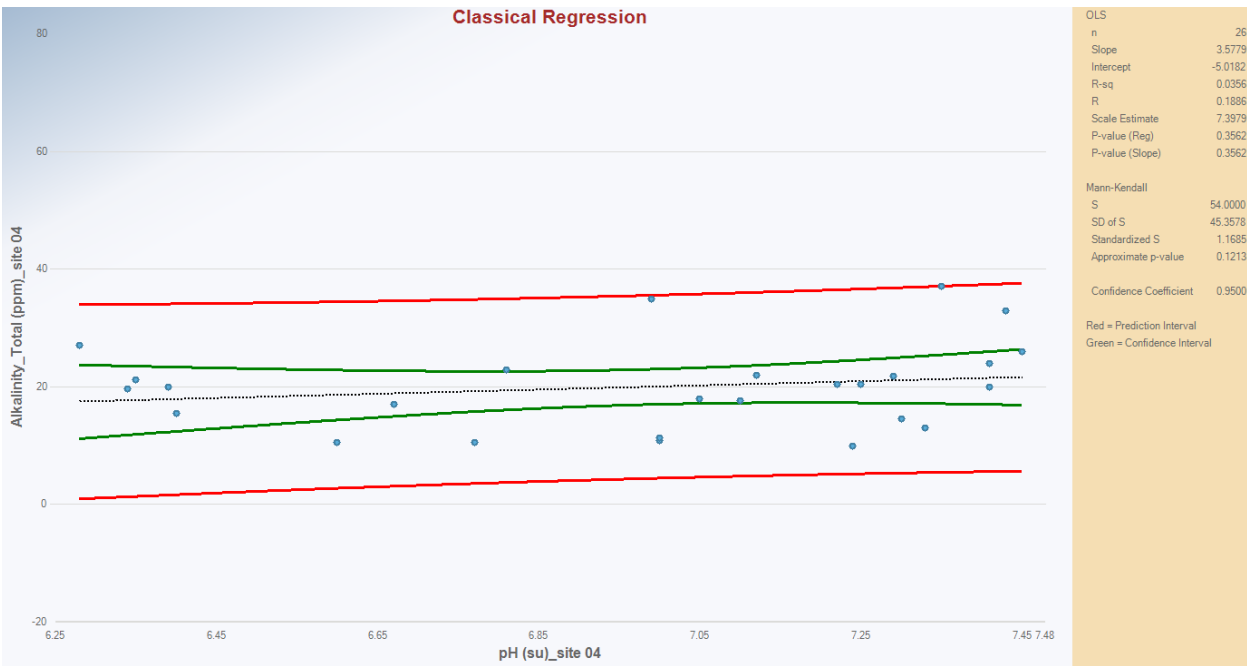
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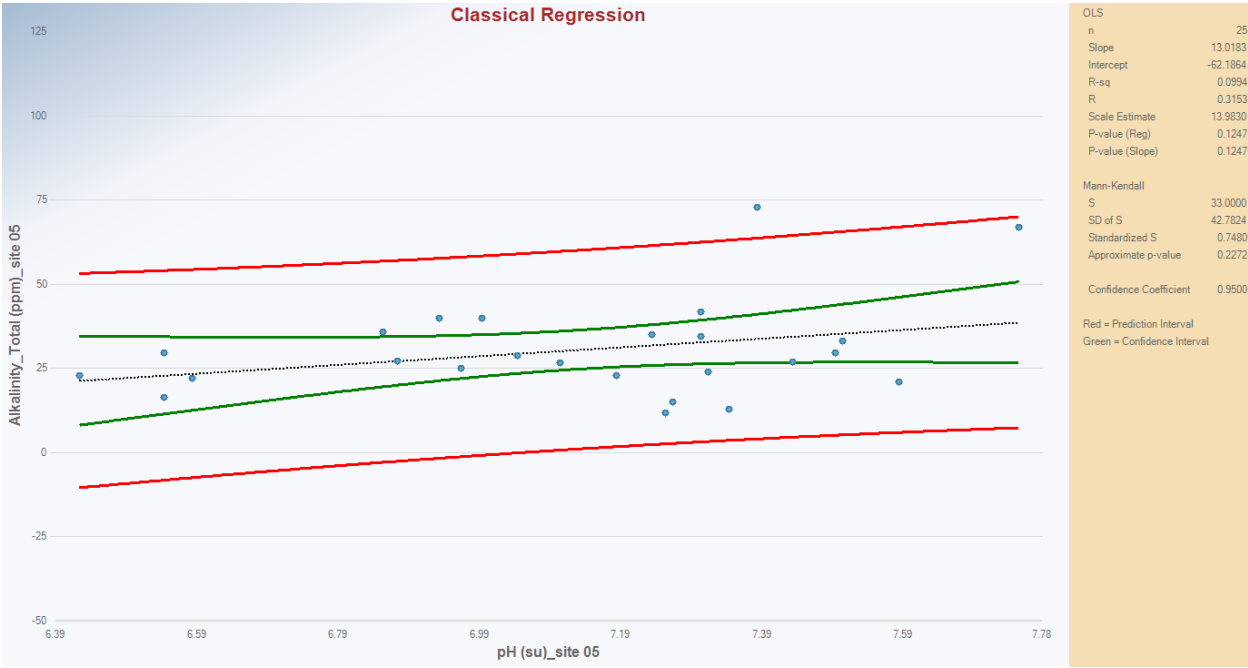
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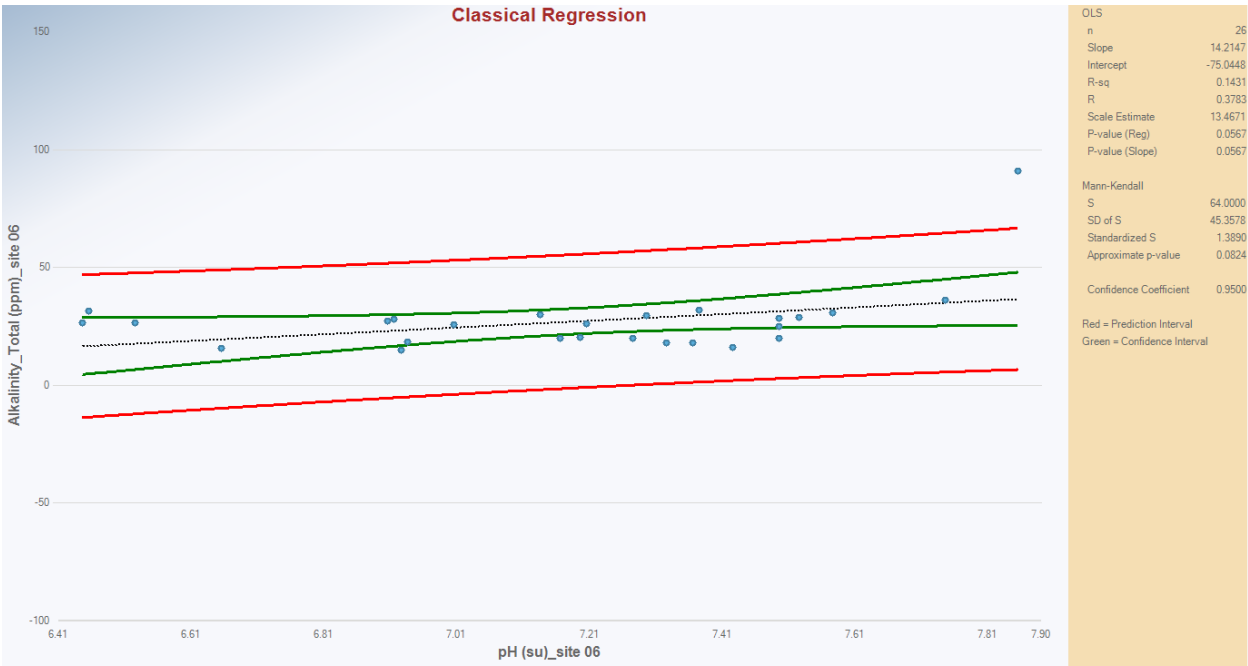
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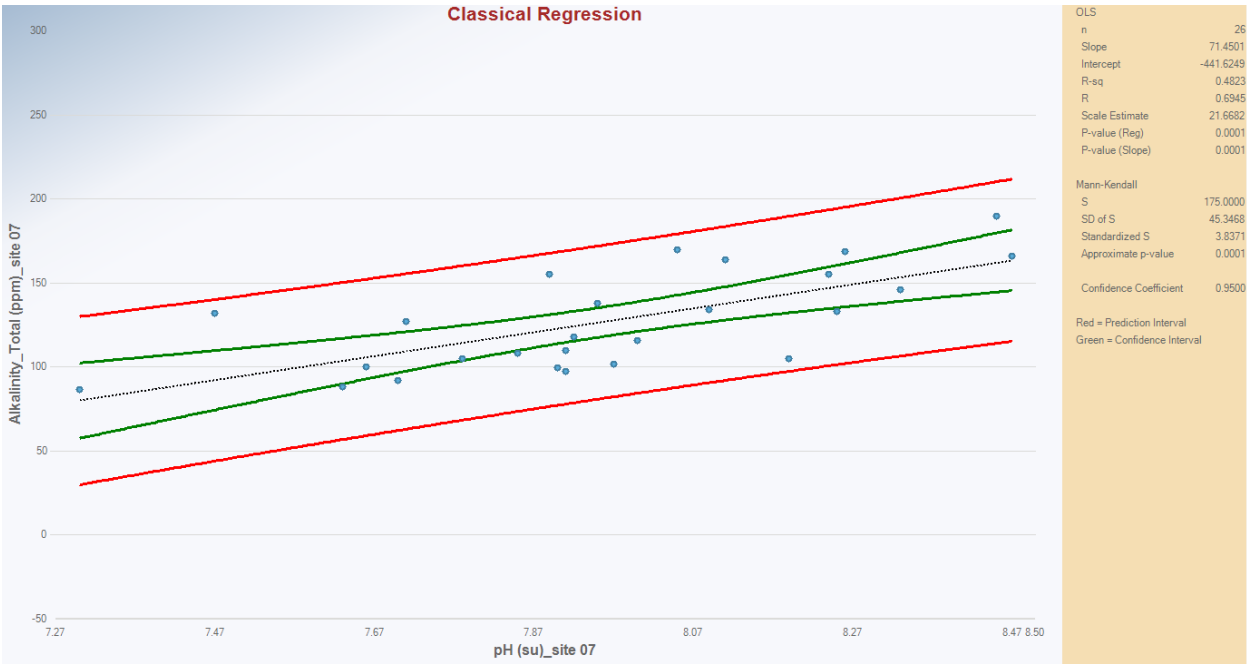
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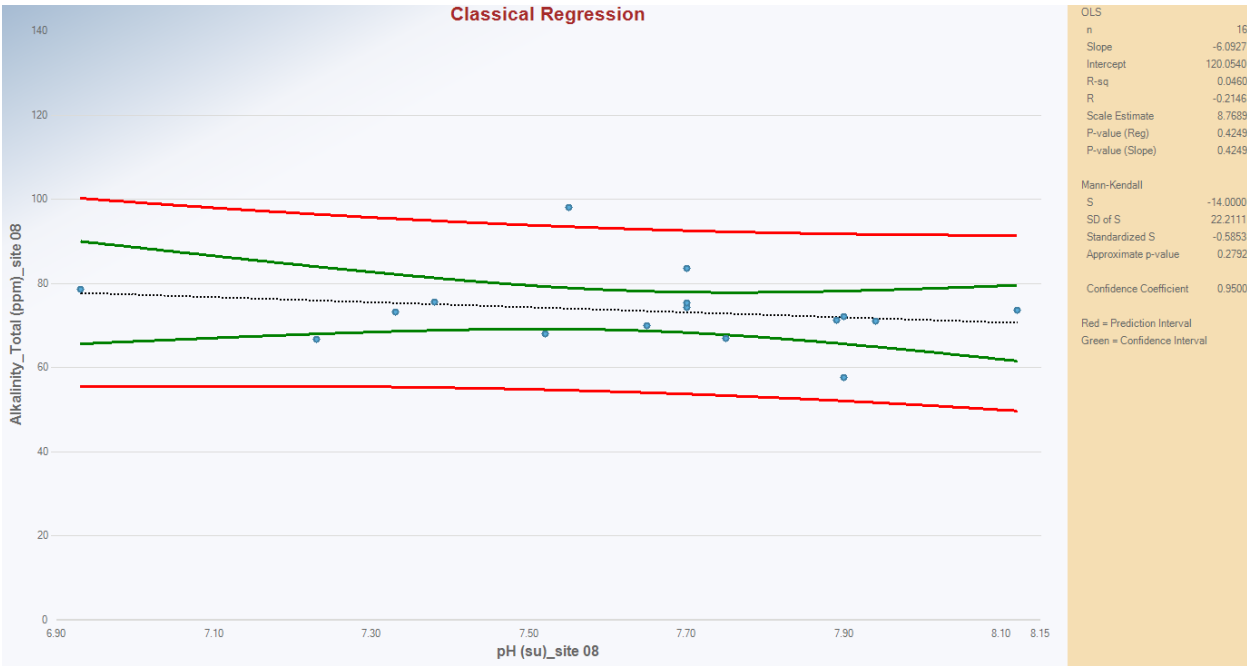
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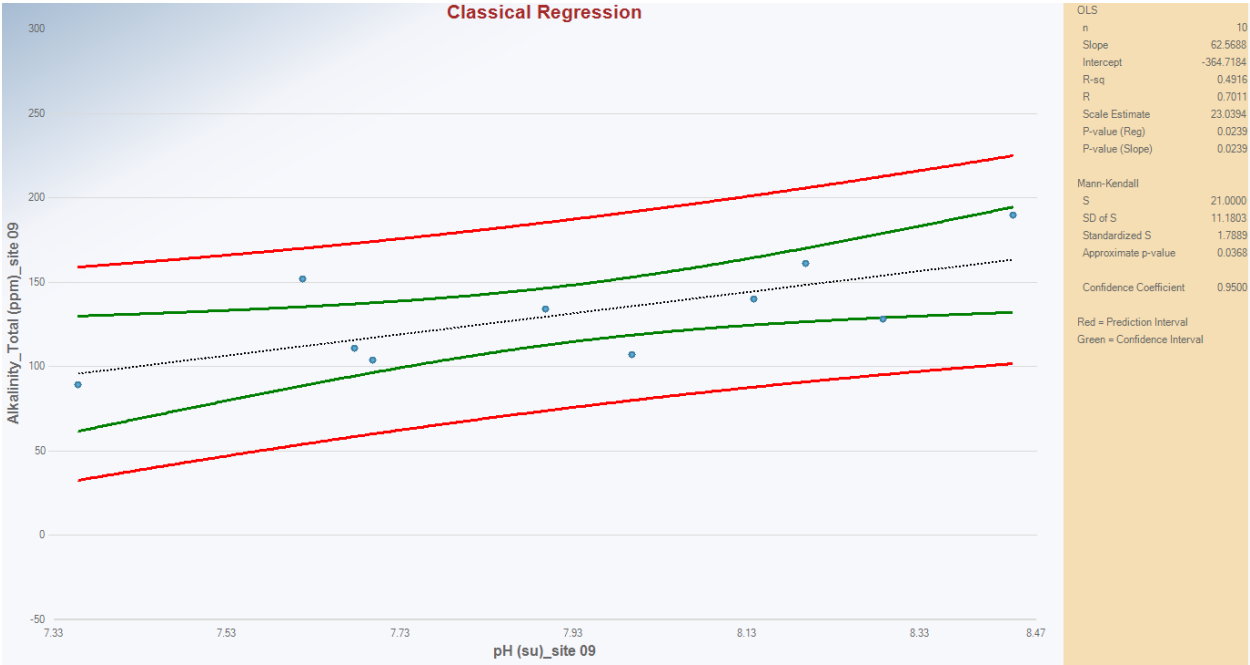
Site 7:



Site 8:



Site 9:



Alkalinity in Paulins Kill vs. Tributaries

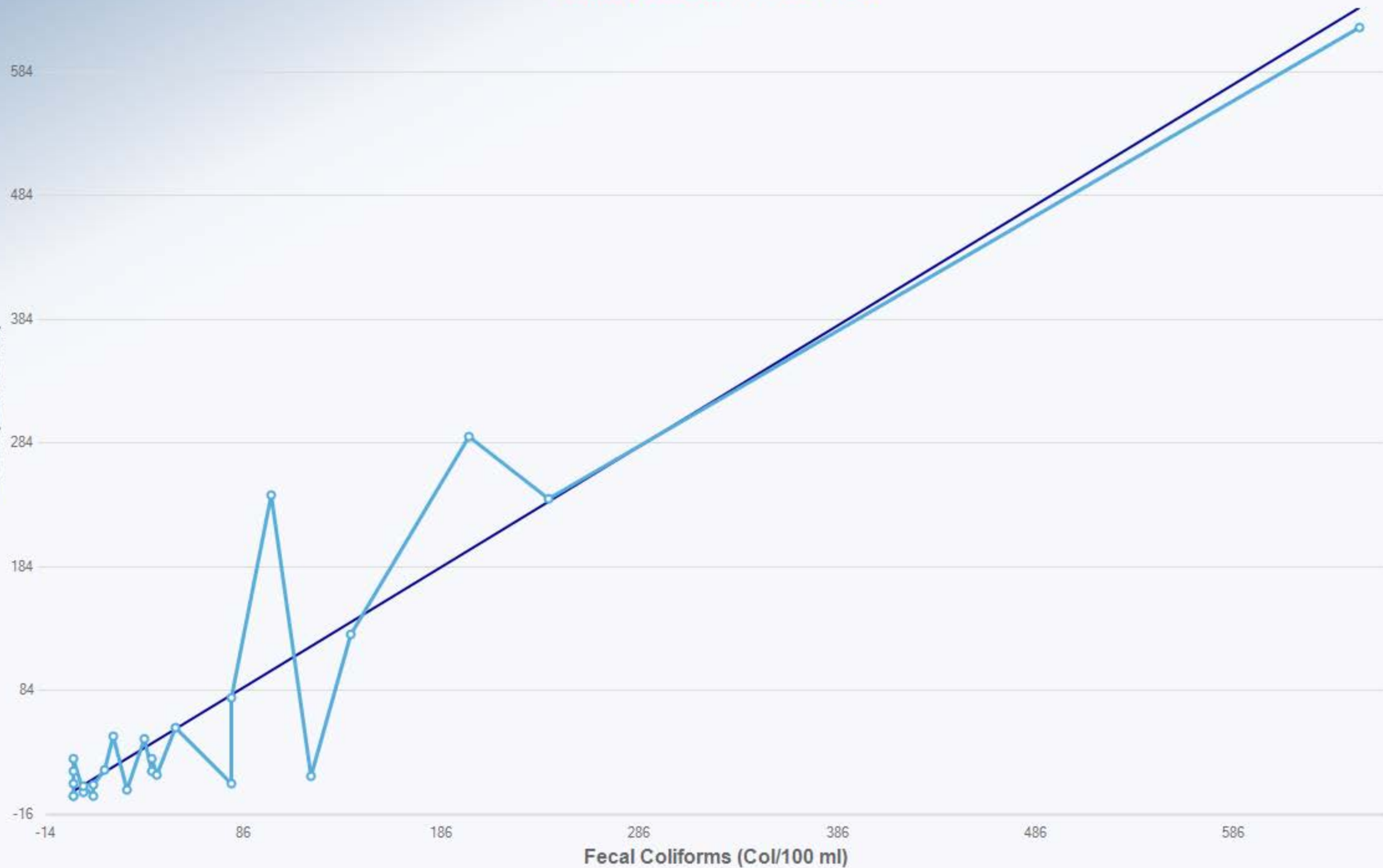
	A	B	C	D	E	F	G	H	I	J	K	L	M
1													
2		t-Test Sample 1 vs Sample 2 Comparison for Uncensored Full Data Sets without NDs											
3													
4		User Selected Options											
5		Date/Time of Computation			ProUCL 5.2 12/13/2024 5:54:07 PM								
6		From File			All Data_ProUCL_11.12.2024_a.xls								
7		Full Precision			OFF								
8		Confidence Coefficient			95%								
9		Substantial Difference (S)			0.000								
10		Selected Null Hypothesis			Sample 1 Mean = Sample 2 Mean (Two Sided Alternative)								
11		Alternative Hypothesis			Sample 1 Mean <> Sample 2 Mean								
12													
13													
14		Sample 1 Data: Alkalinity, Total (mg/L)(paulins kill)											
15		Sample 2 Data: Alkalinity, Total (mg/L)(tributaries)											
16													
17													
18		Raw Statistics											
19						Sample 1	Sample 2						
20		Number of Valid Observations				36	171						
21		Number of Distinct Observations				32	123						
22		Minimum				86.8	5.52						
23		Maximum				190	98						
24		Mean				128.4	26.61						
25		Median				127.5	21.1						
26		SD				29.4	18.96						
27		SE of Mean				4.901	1.45						
28													
29		Sample 1 vs Sample 2 Two-Sample t-Test											
30													
31		H0: Mean of Sample 1 = Mean of Sample 2											
32						t-Test	Lower C.Val	Upper C.Val					
33		Method			DF	Value	t (0.025)	t (0.975)	P-Value				
34		Pooled (Equal Variance)			205	26.305	-1.972	1.972	0.000				
35		Welch-Satterthwaite (Unequal Variance)			41.3	19.925	-2.020	2.020	0.000				
36		Pooled SD: 21.110											
37		Conclusion with Alpha = 0.050											
38		Student t (Pooled): Reject H0, Conclude Sample 1 <> Sample 2											
39		Welch-Satterthwaite: Reject H0, Conclude Sample 1 <> Sample 2											
40													
41		Test of Equality of Variances											
42													
43		Variance of Sample 1				864.6							
44		Variance of Sample 2				359.4							
45													
46		Numerator DF		Denominator DF		F-Test Value		P-Value					
47		35		170		2.406		0.000					
48		Conclusion with Alpha = 0.05											
49		Two variances are not equal											
50													

	A	B	C	D	E	F	G	H	I	J	K	L	M
1													
2		Wilcoxon-Mann-Whitney Sample 1 vs Sample 2 Comparison Test for Uncensor Full Data Sets without NDs											
3													
4		User Selected Options											
5		Date/Time of Computation			ProUCL 5.2 12/13/2024 5:57:50 PM								
6		From File			All Data_ProUCL_11.12.2024_a.xls								
7		Full Precision			OFF								
8		Confidence Coefficient			95%								
9		Substantial Difference			0.000								
10		Selected Null Hypothesis			Sample 1 Mean/Median = Sample 2 Mean/Median (Two Sided Alternative)								
11		Alternative Hypothesis			Sample 1 Mean/Median <> Sample 2 Mean/Median								
12													
13													
14		Sample 1 Data: Alkalinity, Total (mg/L)(paulins kill)											
15		Sample 2 Data: Alkalinity, Total (mg/L)(tributaries)											
16													
17		Raw Statistics											
18						Sample 1	Sample 2						
19		Number of Valid Observations				36	171						
20		Number of Distinct Observations				32	123						
21		Minimum				86.8	5.52						
22		Maximum				190	98						
23		Mean				128.4	26.61						
24		Median				127.5	21.1						
25		SD				29.4	18.96						
26		SE of Mean				4.901	1.45						
27													
28		Wilcoxon-Mann-Whitney (WMW) Test											
29													
30		H0: Mean/Median of Sample 1 = Mean/Median of Sample 2											
31													
32		Sample 1 Rank Sum W-Stat				6814							
33		WMW U-Stat				6148							
34		Standardized WMW U-Stat				9.399							
35		Mean (U)				3078							
36		SD(U) - Adj ties				326.6							
37		Lower Approximate U-Stat Critical Value (0.025)				-1.96							
38		Upper Approximate U-Stat Critical Value (0.975)				1.96							
39		P-Value (Adjusted for Ties)				5.521E-21							
40													
41		Conclusion with Alpha = 0.05											
42		Reject H0, Conclude Sample 1 <> Sample 2											
43													
44		P-Value < alpha (0.05)											
45													

Fecal Coliforms and E. coli

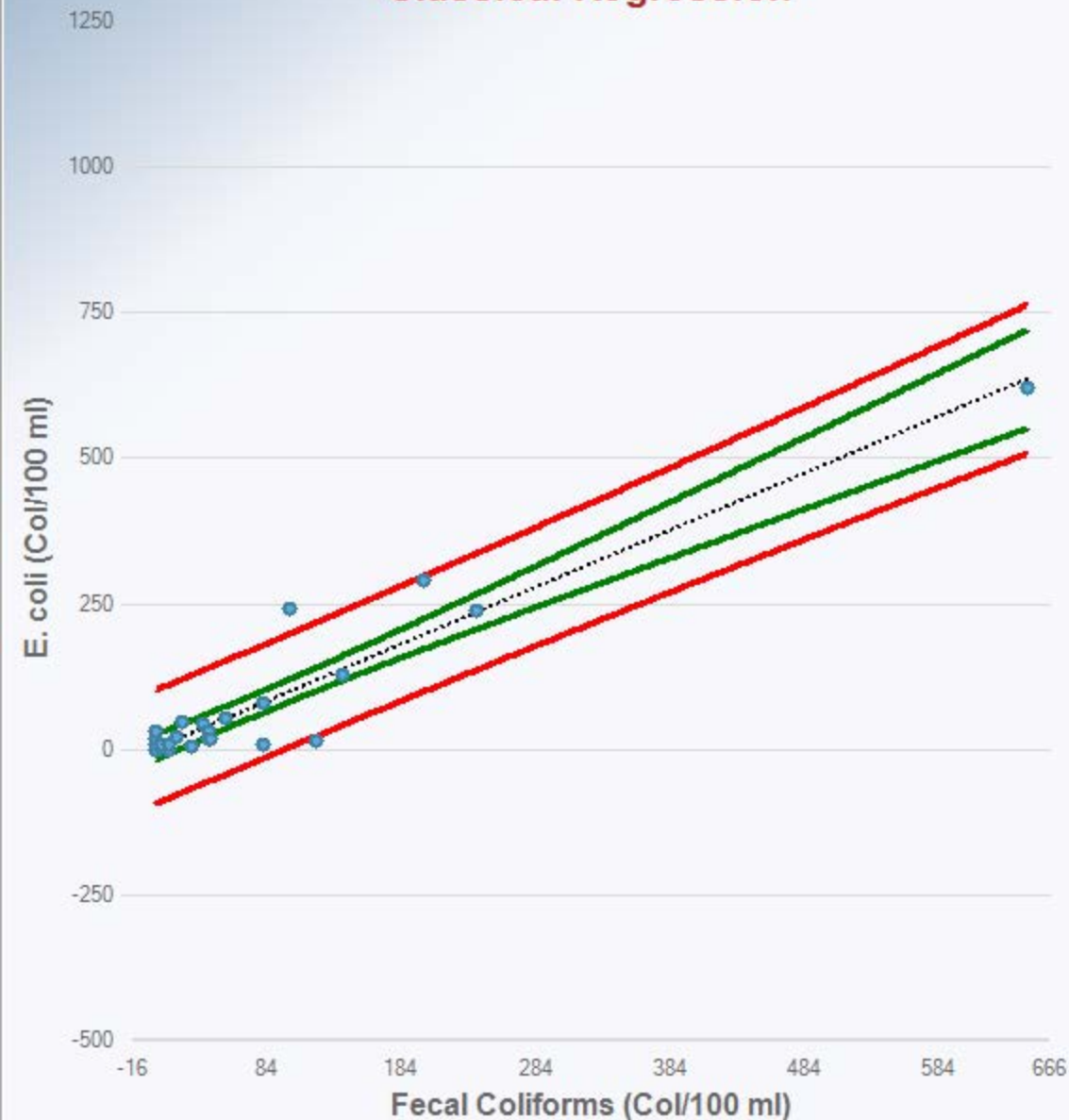
Mann-Kendall Trend Test

E. coli (Col/100 ml)



Mann-Kendall Trend Analysis	
n	25
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	42.7395
Standardized Value of S	4.0946
M-K Test Value (S)	176
Appx. Critical Value (0.05)	1.6449
Approximate p-value	0.0000
OLS Regression Line (Blue)	
OLS Regression Slope	0.9742
OLS Regression Intercept	3.4483
Statistically significant evidence of an increasing trend at the specified level of significance.	

Classical Regression



OLS	
n	25
Slope	0.9742
Intercept	3.4483
R-sq	0.8952
R	0.9462
Scale Estimate	46.1567
P-value (Reg)	0.0000
P-value (Slope)	0.0000

Mann-Kendall	
S	176.0000
SD of S	42.7395
Standardized S	4.0946
Approximate p-value	0.0000

Confidence Coefficient	0.9500
------------------------	--------

Red = Prediction Interval
Green = Confidence Interval

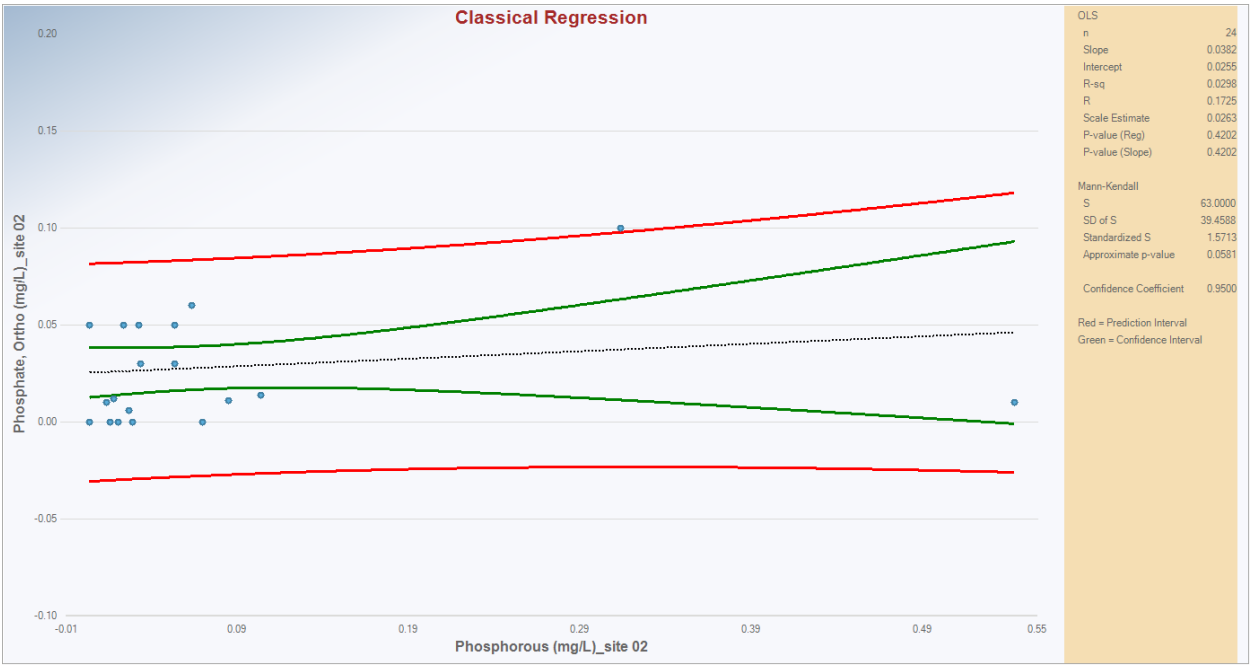
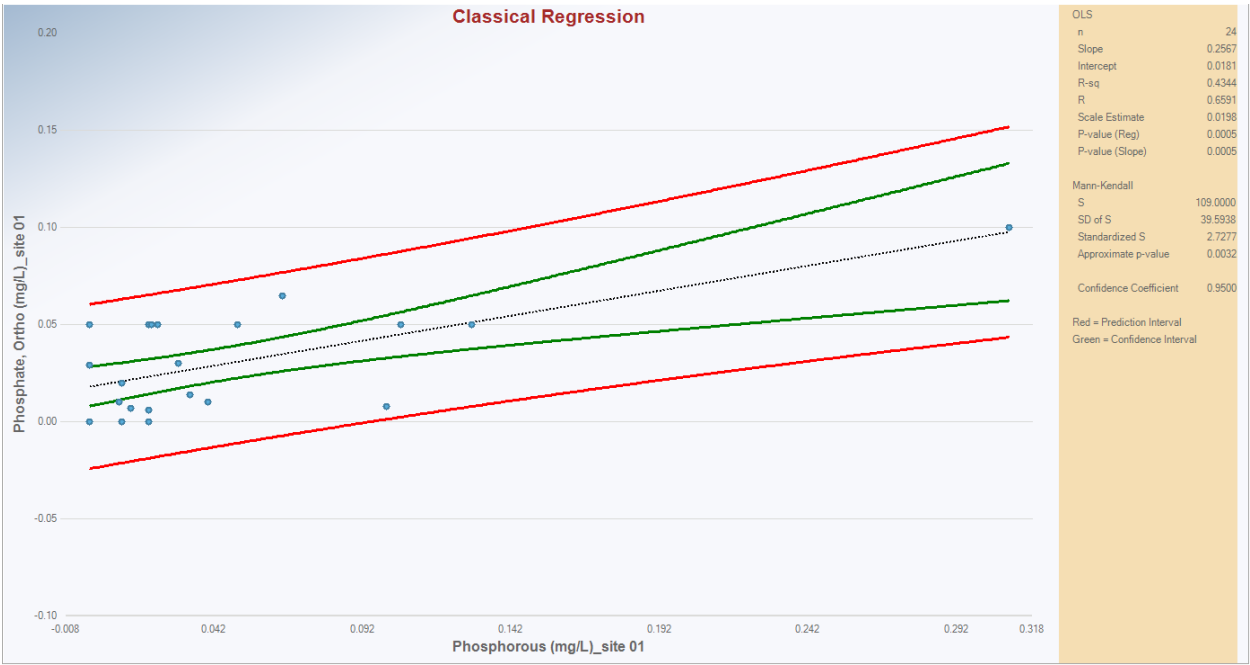
	A	B	C	D	E	F	G	H	I	J	K	L	M
2		t-Test Sample 1 vs Sample 2 Comparison for Uncensored Full Data Sets without NDs											
3													
4		User Selected Options											
5		Date/Time of Computation			ProUCL 5.2 1/1/2025 11:47:50 PM								
6		From File			ProUCL Input_E.coli_FC Data_a.xls								
7		Full Precision			OFF								
8		Confidence Coefficient			95%								
9		Substantial Difference (S)			0								
10		Selected Null Hypothesis			Sample 1 Mean = Sample 2 Mean (Two Sided Alternative)								
11		Alternative Hypothesis			Sample 1 Mean <> Sample 2 Mean								
12													
13													
14		Sample 1 Data: E. coli (Col/100 ml)											
15		Sample 2 Data: Fecal Coliforms (Col/100 ml)											
16													
17													
18		Raw Statistics											
19					Sample 1	Sample 2							
20		Number of Valid Observations			25	25							
21		Number of Distinct Observations			20	17							
22		Minimum			0	0							
23		Maximum			620	650							
24		Mean			77.99	76.52							
25		Median			20	36							
26		SD			139.6	135.6							
27		SE of Mean			27.92	27.11							
28													
29		Sample 1 vs Sample 2 Two-Sample t-Test											
30													
31		H0: Mean of Sample 1 = Mean of Sample 2											
32						t-Test	Lower C.Val	Upper C.Val					
33		Method			DF	Value	t (0.025)	t (0.975)	P-Value				
34		Pooled (Equal Variance)			48	0.038	-2.011	2.011	0.97				
35		Welch-Satterthwaite (Unequal Variance)			48	0.038	-2.011	2.011	0.97				
36		Pooled SD: 137.594											
37		Conclusion with Alpha = 0.050											
38		Student t (Pooled): Do Not Reject H0, Conclude Sample 1 = Sample 2											
39		Welch-Satterthwaite: Do Not Reject H0, Conclude Sample 1 = Sample 2											
40													
41		Test of Equality of Variances											
42													
43		Variance of Sample 1			19484								
44		Variance of Sample 2			18380								
45													
46		Numerator DF		Denominator DF		F-Test Value		P-Value					
47		24		24		1.06		0.888					
48		Conclusion with Alpha = 0.05											
49		Two variances appear to be equal											
50													

	B	C	D	E	F	G	H	I	J	K	L	M
2	Wilcoxon-Mann-Whitney Sample 1 vs Sample 2 Comparison Test for Uncensor Full Data Sets without NDs											
3												
4	User Selected Options											
5	Date/Time of Computation			ProUCL 5.2 12/19/2024 4:52:50 PM								
6	From File			ProUCL Input_E.coli_FC Data.xls								
7	Full Precision			OFF								
8	Confidence Coefficient			95%								
9	Substantial Difference			0.000								
10	Selected Null Hypothesis			Sample 1 Mean/Median = Sample 2 Mean/Median (Two Sided Alternative)								
11	Alternative Hypothesis			Sample 1 Mean/Median <> Sample 2 Mean/Median								
12												
13												
14	Sample 1 Data: Bacterial quality (Col/100 ml)(fecal coliforms)											
15	Sample 2 Data: Bacterial quality (Col/100 ml)(e. coli)											
16												
17	Raw Statistics											
18					Sample 1	Sample 2						
19	Number of Valid Observations				25	25						
20	Number of Distinct Observations				17	20						
21	Minimum				0	0						
22	Maximum				650	620						
23	Mean				76.52	77.99						
24	Median				36	20						
25	SD				135.6	139.6						
26	SE of Mean				27.11	27.92						
27												
28	Wilcoxon-Mann-Whitney (WMW) Test											
29												
30	H0: Mean/Median of Sample 1 = Mean/Median of Sample 2											
31												
32	Sample 1 Rank Sum W-Stat				644							
33	WMW U-Stat				319							
34	Standardized WMW U-Stat				0.126							
35	Mean (U)				312.5							
36	SD(U) - Adj ties				51.51							
37	Lower Approximate U-Stat Critical Value (0.025)				-1.96							
38	Upper Approximate U-Stat Critical Value (0.975)				1.96							
39	P-Value (Adjusted for Ties)				0.899							
40												
41	Conclusion with Alpha = 0.05											
42	Do Not Reject H0, Conclude Sample 1 = Sample 2											
43												
44	P-Value >= alpha (0.05)											
45												

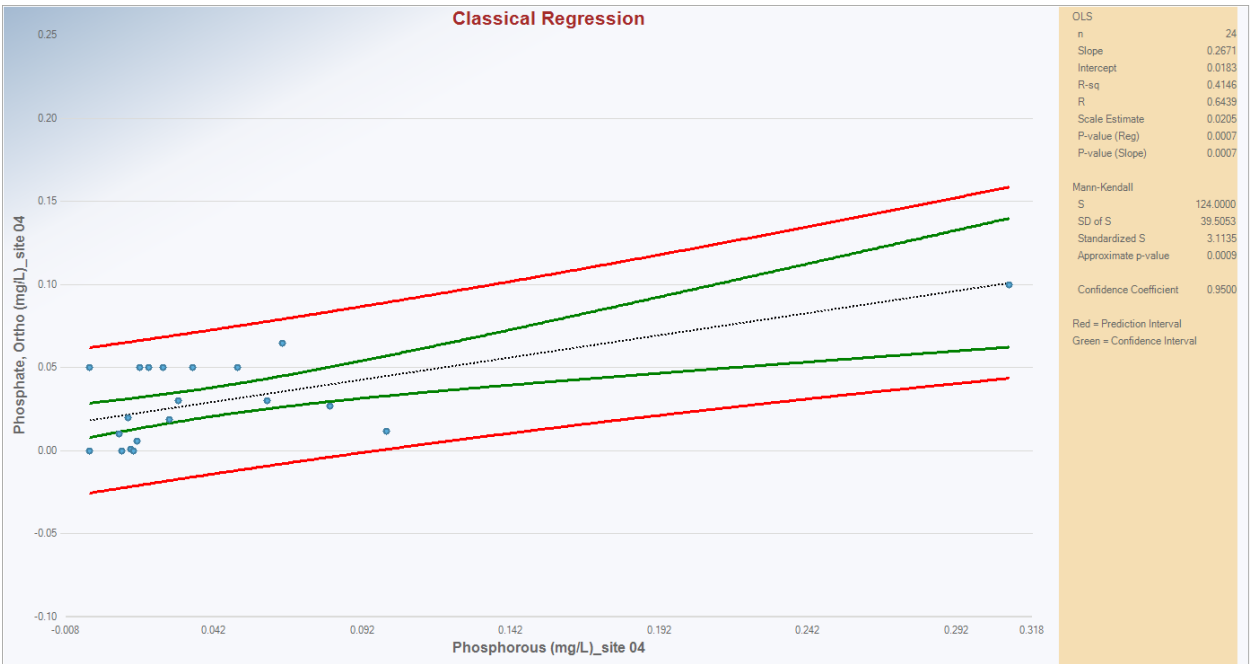
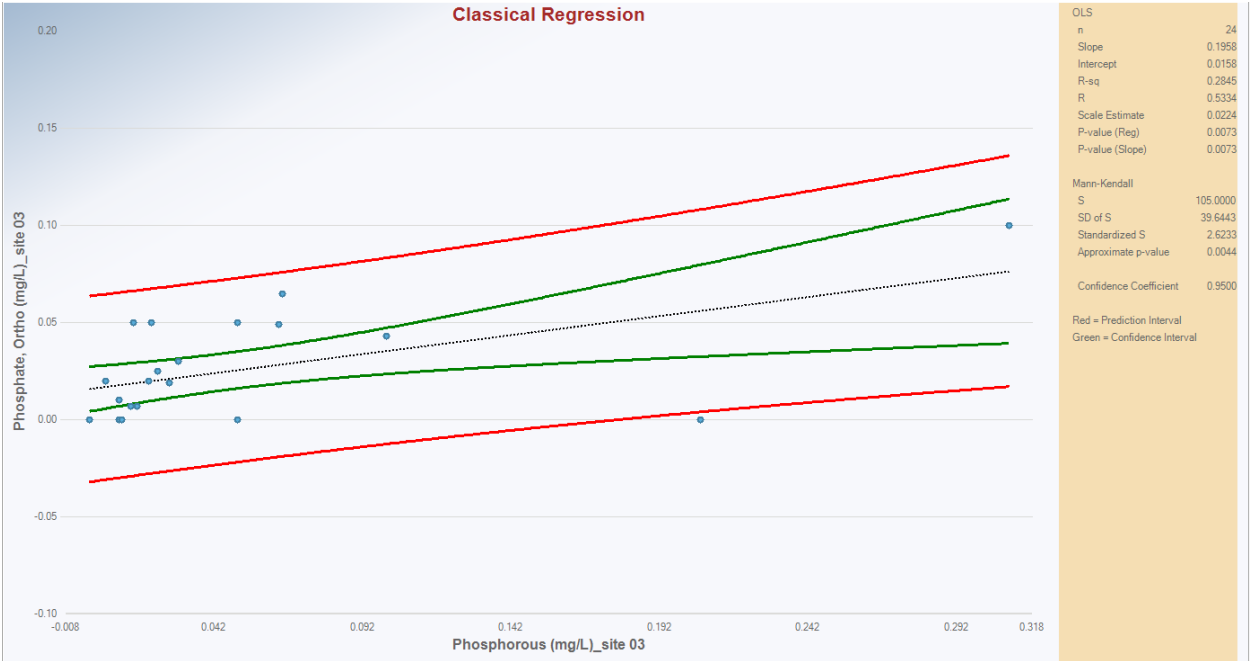
Phosphorus and Orthophosphate

	A	B	C	D	E	F	G	H	I	J	K	L
1	Wilcoxon-Mann-Whitney Sample 1 vs Sample 2 Comparison Test for Uncensor Full Data Sets without NDs											
2												
3	User Selected Options											
4	Date/Time of Computation			ProUCL 5.2 12/22/2024 12:50:16 PM								
5	From File			2024.12_P Data_a.xls								
6	Full Precision			OFF								
7	Confidence Coefficient			95%								
8	Substantial Difference			0.000								
9	Selected Null Hypothesis			Sample 1 Mean/Median = Sample 2 Mean/Median (Two Sided Alternative)								
10	Alternative Hypothesis			Sample 1 Mean/Median <> Sample 2 Mean/Median								
11												
12												
13	Sample 1 Data: Phosphate, Ortho (mg/L)											
14	Sample 2 Data: Phosphorous (mg/L)											
15												
16	Raw Statistics											
17				Sample 1	Sample 2							
18	Number of Valid Observations			199	199							
19	Number of Distinct Observations			37	45							
20	Minimum			0	0							
21	Maximum			0.1	0.54							
22	Mean			0.0275	0.048							
23	Median			0.021	0.025							
24	SD			0.0263	0.077							
25	SE of Mean			0.00186	0.00546							
26												
27	Wilcoxon-Mann-Whitney (WMW) Test											
28												
29	H0: Mean/Median of Sample 1 = Mean/Median of Sample 2											
30												
31	Sample 1 Rank Sum W-Stat			37508								
32	WMW U-Stat			17608								
33	Standardized WMW U-Stat			-1.923								
34	Mean (U)			19801								
35	SD(U) - Adj ties			1145								
36	Lower Approximate U-Stat Critical Value (0.025)			-1.96								
37	Upper Approximate U-Stat Critical Value (0.975)			1.96								
38	P-Value (Adjusted for Ties)			0.0544								
39												
40	Conclusion with Alpha = 0.05											
41	Do Not Reject H0, Conclude Sample 1 = Sample 2											
42												
43	P-Value >= alpha (0.05)											
44												

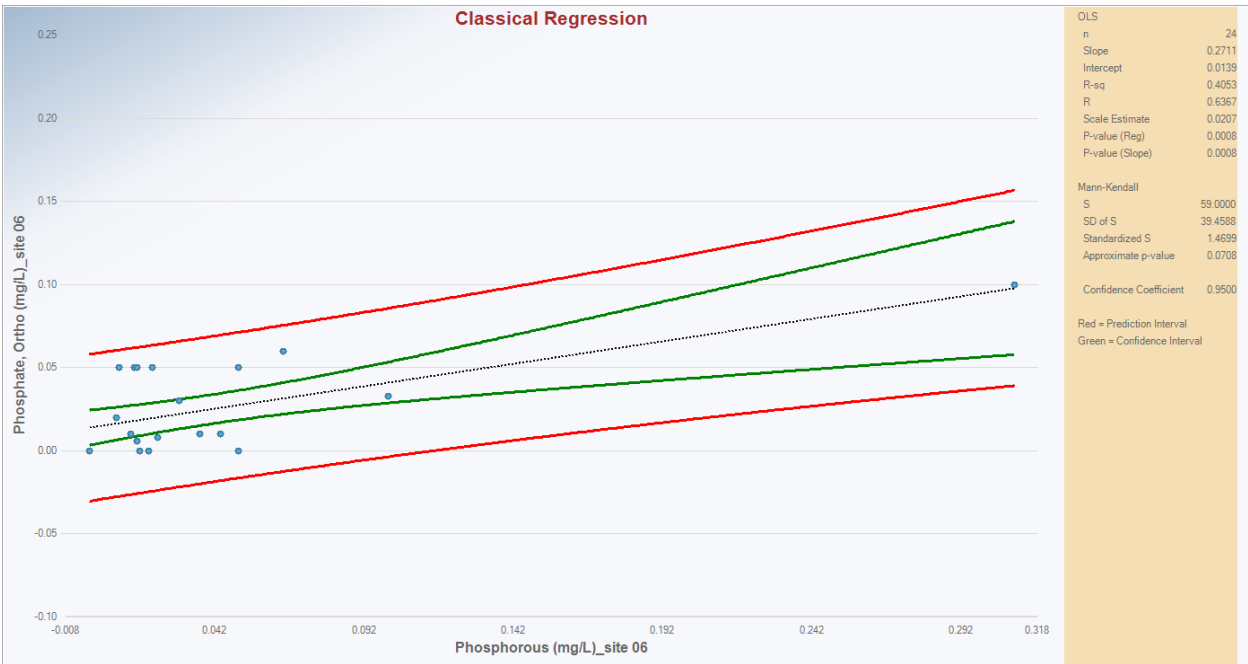
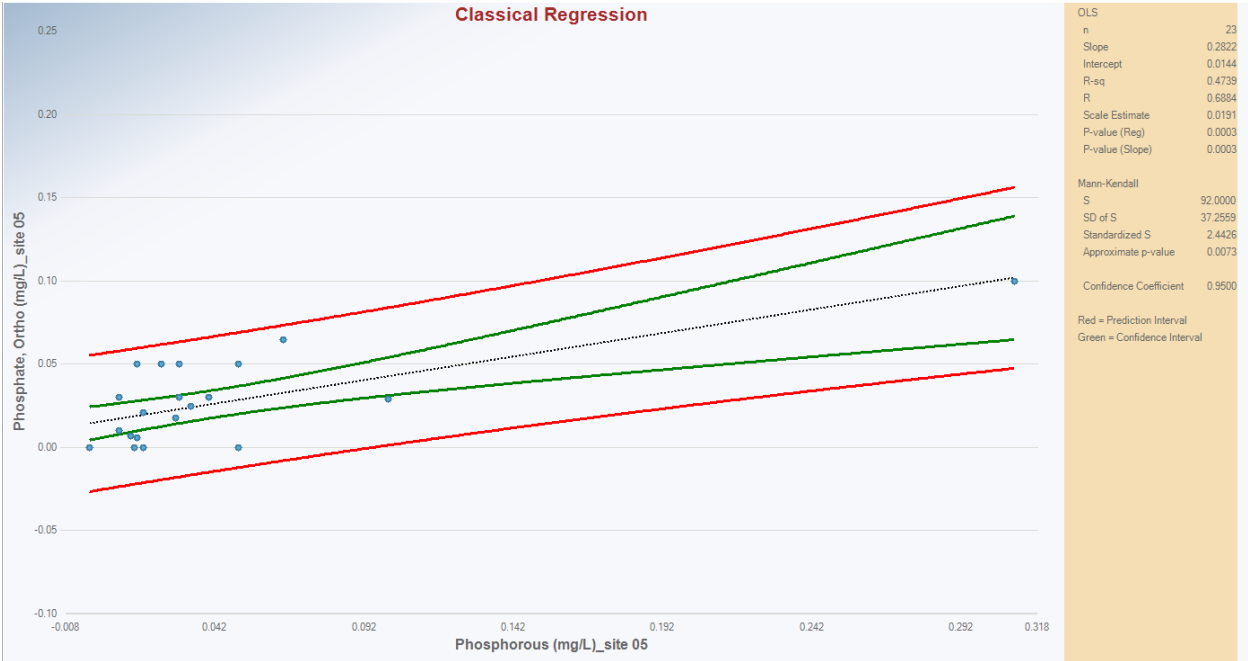
OLS Regression
Phosphorus_Orthophosphate



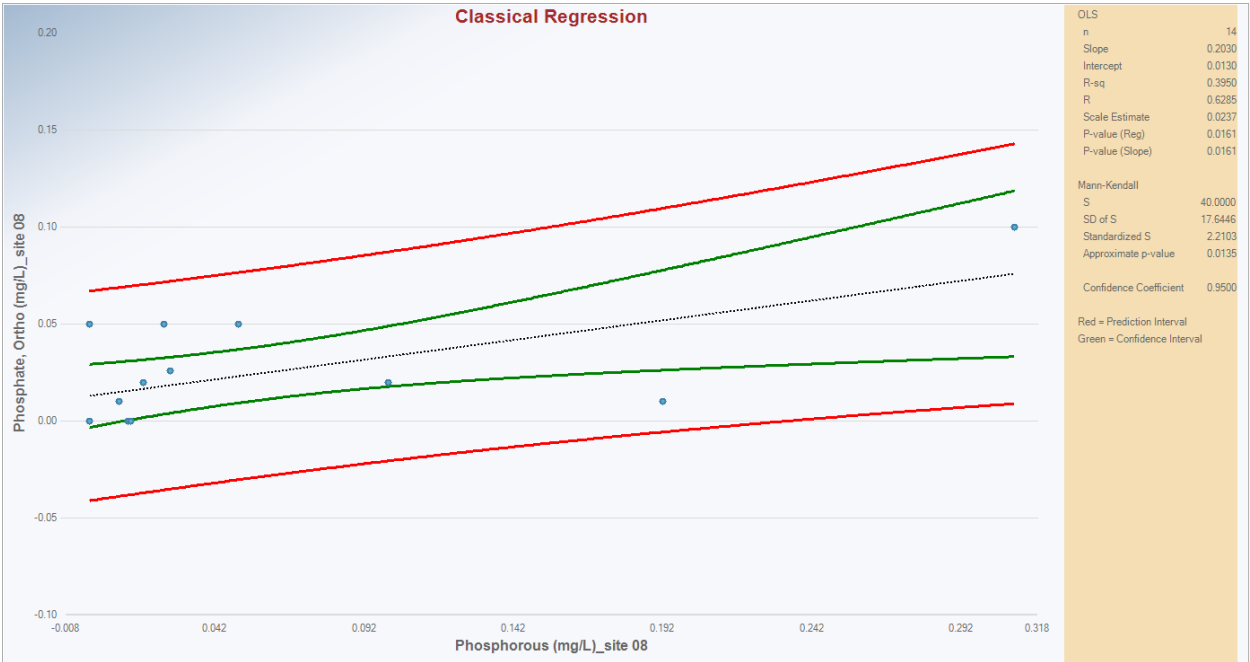
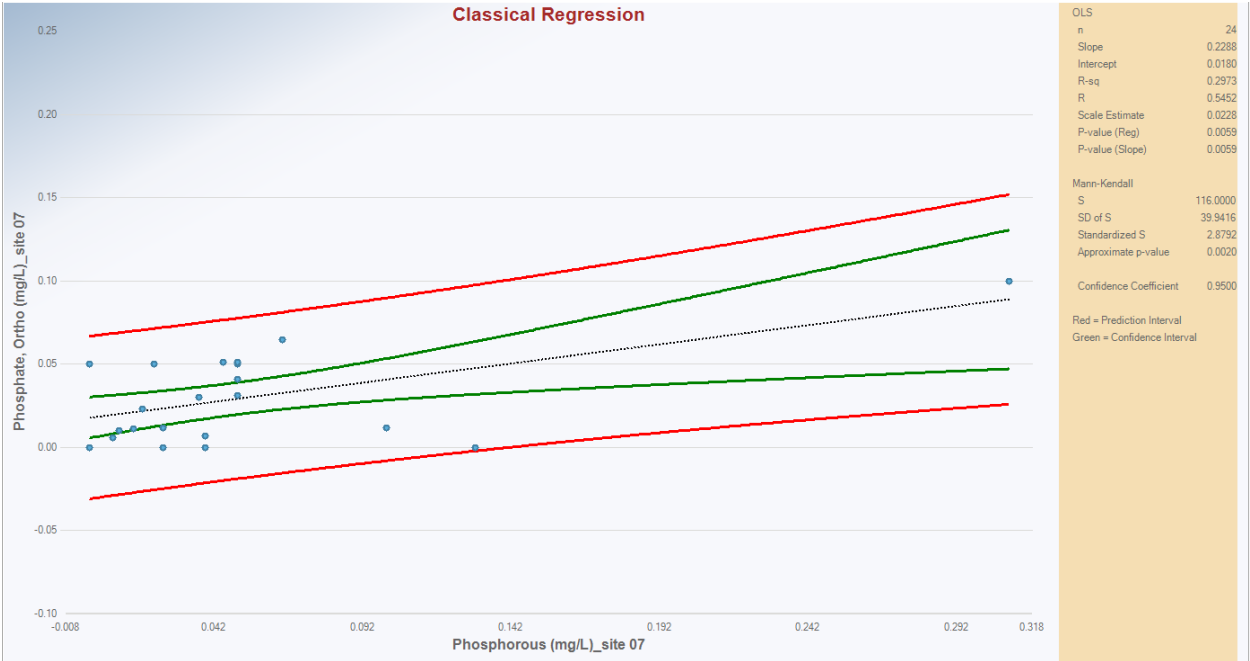
OLS Regression
Phosphorus_Orthophosphate



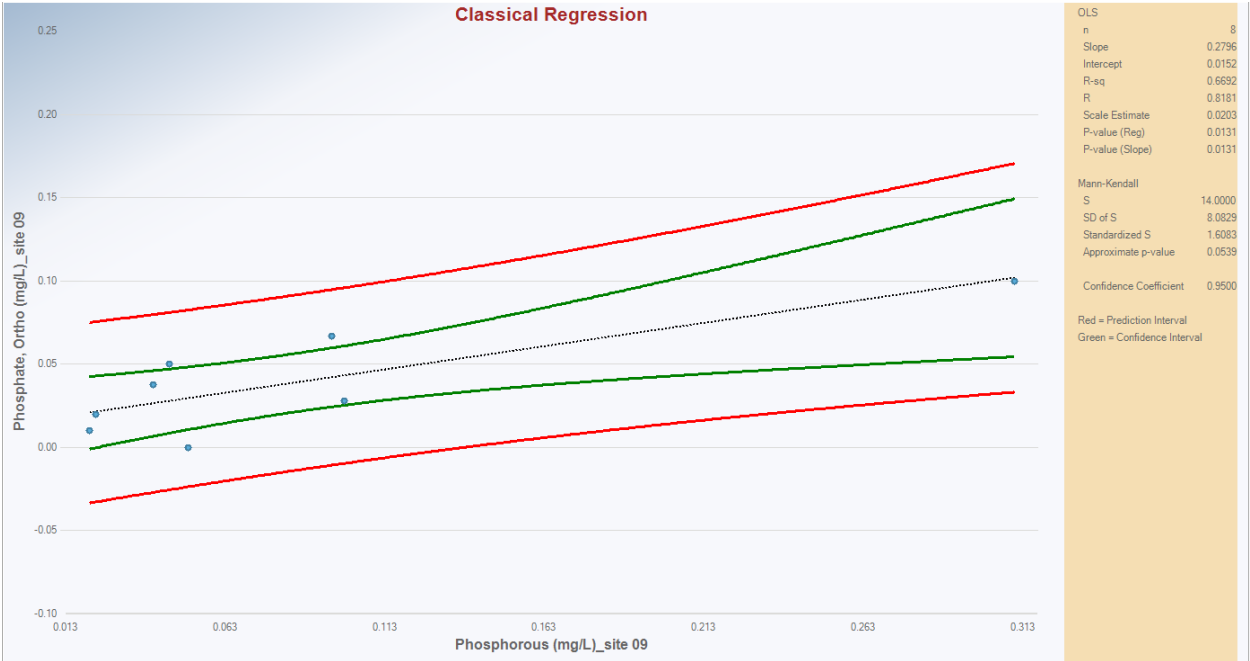
OLS Regression
Phosphorus_Orthophosphate



OLS Regression
Phosphorus_Orthophosphate



OLS Regression
Phosphorus_Orthophosphate



Specific Conductivity in Paulins Kill vs. Tributaries

t-Test Sample 1 vs Sample 2 Comparison for Uncensored Full Data Sets without NDs

User Selected Options

Date/Time of Computation	ProUCL 5.2 9/1/2024 6:26:29 PM
From File	All Data_ProUCL_04182024_n.xls
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0.000
Selected Null Hypothesis	Sample 1 Mean = Sample 2 Mean (Two Sided Alternative)
Alternative Hypothesis	Sample 1 Mean <> Sample 2 Mean

Sample 1 Data: Specific Conductivity (umhos/cm)(paulins kill)
Sample 2 Data: Specific Conductivity (umhos/cm)(tributaries)

Raw Statistics		
	Sample 1	Sample 2
Number of Valid Observations	34	165
Number of Distinct Observations	31	115
Minimum	300	63.4
Maximum	642	399
Mean	433.5	141.4
Median	437.5	132
SD	92.88	54.3
SE of Mean	15.93	4.227

Sample 1 vs Sample 2 Two-Sample t-Test

H0: Mean of Sample 1 = Mean of Sample 2

Method	DF	t-Test	Lower C.ValUpper C.Val		P-Value
		Value	t (0.025)	t (0.975)	
Pooled (Equal Variance)	197	24.835	-1.972	1.972	0.000
Welch-Satterthwaite (Unequal Variance)	37.8	17.724	-2.024	2.024	0.000

Pooled SD: 62.450

Conclusion with Alpha = 0.050

Student t (Pooled): Reject H0, Conclude Sample 1 <> Sample 2
Welch-Satterthwaite: Reject H0, Conclude Sample 1 <> Sample 2

Test of Equality of Variances

Variance of Sample 1	8627
Variance of Sample 2	2949

Numerator DF	Denominator DF	F-Test Value	P-Value
33	164	2.926	0.000

Conclusion with Alpha = 0.05
Two variances are not equal

Specific Conductivity and TDS Regression Analysis

Classical Regression



OLS	
n	19
Slope	1.8743
Intercept	4.6283
R-sq	0.9654
R	0.9825
Scale Estimate	33.6632
P-value (Reg)	0.0000
P-value (Slope)	0.0000

Mann-Kendall	
S	147.0000
SD of S	28.5015
Standardized S	5.1225
Approximate p-value	0.0000

Confidence Coefficient	0.9500
------------------------	--------

Red = Prediction Interval
Green = Confidence Interval

TDS from Specific Conductivity and TDS Analysis

	A	B	C	D	E	F	G	H	I	J	K	L	M
1													
2		t-Test Sample 1 vs Sample 2 Comparison for Uncensored Full Data Sets without NDs											
3													
4		User Selected Options											
5		Date/Time of Computation			ProUCL 5.2 12/22/2024 2:14:27 PM								
6		From File			2024_ProUCL_Input_Spec.Cond_TDS_a.xls								
7		Full Precision			OFF								
8		Confidence Coefficient			95%								
9		Substantial Difference (S)			0.000								
10		Selected Null Hypothesis			Sample 1 Mean = Sample 2 Mean (Two Sided Alternative)								
11		Alternative Hypothesis			Sample 1 Mean <> Sample 2 Mean								
12													
13													
14		Sample 1 Data: TDS (mg/L)											
15		Sample 2 Data: TDS from SC(SC*0.65) (mg/L)											
16													
17													
18		Raw Statistics											
19						Sample 1	Sample 2						
20		Number of Valid Observations				19	19						
21		Number of Distinct Observations				18	16						
22		Minimum				48	67.6						
23		Maximum				360	416						
24		Mean				136.5	169.3						
25		Median				100	130						
26		SD				92.15	114.3						
27		SE of Mean				21.14	26.21						
28													
29		Sample 1 vs Sample 2 Two-Sample t-Test											
30													
31		H0: Mean of Sample 1 = Mean of Sample 2											
32						t-Test	Lower C.Val	Upper C.Val					
33		Method			DF	Value	t (0.025)	t (0.975)	P-Value				
34		Pooled (Equal Variance)			36	-0.974	-2.028	2.028	0.336				
35		Welch-Satterthwaite (Unequal Variance)			34.5	-0.974	-2.032	2.032	0.337				
36		Pooled SD: 103.798											
37		Conclusion with Alpha = 0.050											
38		Student t (Pooled): Do Not Reject H0, Conclude Sample 1 = Sample 2											
39		Welch-Satterthwaite: Do Not Reject H0, Conclude Sample 1 = Sample 2											
40													
41		Test of Equality of Variances											
42													
43		Variance of Sample 1				8492							
44		Variance of Sample 2				13056							
45													
46		Numerator DF		Denominator DF		F-Test Value		P-Value					
47		18		18		1.538		0.370					
48		Conclusion with Alpha = 0.05											
49		Two variances appear to be equal											
50													

	A	B	C	D	E	F	G	H	I	J	K	L	M
1													
2		Wilcoxon-Mann-Whitney Sample 1 vs Sample 2 Comparison Test for Uncensor Full Data Sets without NDs											
3													
4		User Selected Options											
5		Date/Time of Computation			ProUCL 5.2 12/22/2024 2:15:46 PM								
6		From File			2024_ProUCL_Input_Spec.Cond_TDS_a.xls								
7		Full Precision			OFF								
8		Confidence Coefficient			95%								
9		Substantial Difference			0.000								
10		Selected Null Hypothesis			Sample 1 Mean/Median = Sample 2 Mean/Median (Two Sided Alternative)								
11		Alternative Hypothesis			Sample 1 Mean/Median <> Sample 2 Mean/Median								
12													
13													
14		Sample 1 Data: TDS (mg/L)											
15		Sample 2 Data: TDS from SC(SC*0.65) (mg/L)											
16													
17		Raw Statistics											
18						Sample 1	Sample 2						
19		Number of Valid Observations				19	19						
20		Number of Distinct Observations				18	16						
21		Minimum				48	67.6						
22		Maximum				360	416						
23		Mean				136.5	169.3						
24		Median				100	130						
25		SD				92.15	114.3						
26		SE of Mean				21.14	26.21						
27													
28		Wilcoxon-Mann-Whitney (WMW) Test											
29													
30													
31		H0: Mean/Median of Sample 1 = Mean/Median of Sample 2											
32													
33		Sample 1 Rank Sum W-Stat				335							
34		WMW U-Stat				145							
35		Mean (U)				180.5							
36		SD(U) - Adj ties				34.24							
37		Lower U-Stat Critical Value (0.025)				114							
38		Upper U-Stat Critical Value (0.975)				247							
39		Standardized WMW U-Stat				-1.037							
40		Approximate P-Value				0.3							
41													
42		Conclusion with Alpha = 0.05											
43		Do Not Reject H0, Conclude Sample 1 = Sample 2											
44													
45													

Appendix F

NJDEP Water Quality Data Exchange Selected Site Data

NJDEP Ambient Water Quality Data Exchange Chemical Results

Near SWMP Station 6

Run At: 03/14/2024 05:39 pm

Organization	Location	Date	Depth	Ft/m	Media	Characteristic	Form	Fraction	Remark	Result	Units
NJDEP_BFBM	FIBI012	7/12/2010			Other	FIBI Rating				Good	None
NJDEP_BFBM	FIBI012	7/12/2010			Water	Dissolved oxygen (DO)				8.79	mg/l
NJDEP_BFBM	FIBI012	7/12/2010			Water	pH				7.01	None
NJDEP_BFBM	FIBI012	7/12/2010			Water	Specific conductance				198	mS/cm
NJDEP_BFBM	FIBI012	7/12/2010			Water	Temperature, water				20.04	deg C
NJDEP_BFBM	FIBI012	6/21/2017			Air	Barometric pressure				753	mmHg
NJDEP_BFBM	FIBI012	6/21/2017			Air	Temperature, air				23.7	deg C
NJDEP_BFBM	FIBI012	6/21/2017			Other	FIBI Rating				Fair	None
NJDEP_BFBM	FIBI012	6/21/2017			Other	Fish Index of Biotic Integrity				45.78	None
NJDEP_BFBM	FIBI012	6/21/2017			Other	Per. Abun. Cold & Nontolerant Coolwater Sp. (adj)				23.35	None
NJDEP_BFBM	FIBI012	6/21/2017			Other	Per. Abun. Dominant 3 Taxa (not Blacknose Dace)				27.01	None
NJDEP_BFBM	FIBI012	6/21/2017			Other	Percent Abundance Cyprinidae (adj)				19.81	None
NJDEP_BFBM	FIBI012	6/21/2017			Other	Percent Richness Benthic Insectivores				26.49	None
NJDEP_BFBM	FIBI012	6/21/2017			Other	Percent Richness Generalist Feeders				76.58	None
NJDEP_BFBM	FIBI012	6/21/2017			Other	Percent Richness of Rheophilic Species (adj)				60.07	None
NJDEP_BFBM	FIBI012	6/21/2017			Other	Per. Rich. of Lithophilic Spawners (minus w. suck)				57.95	None
NJDEP_BFBM	FIBI012	6/21/2017			Other	Tolerance Index				74.94	None
NJDEP_BFBM	FIBI012	6/21/2017			Water	Dissolved oxygen (DO)				8.48	mg/l
NJDEP_BFBM	FIBI012	6/21/2017			Water	Dissolved oxygen saturation				93.5	%
NJDEP_BFBM	FIBI012	6/21/2017			Water	Flow				13.88	cfs
NJDEP_BFBM	FIBI012	6/21/2017			Water	Inorganic nitrogen (nitrate and nitrite)	as N	Total		0.0816	mg/l
NJDEP_BFBM	FIBI012	6/21/2017			Water	Kjeldahl nitrogen		Total		0.277	mg/l
NJDEP_BFBM	FIBI012	6/21/2017			Water	Phosphate-phosphorus	as P	Total		0.0317	mg/l
NJDEP_BFBM	FIBI012	6/21/2017			Water	Specific conductance				198.6	uS/cm
NJDEP_BFBM	FIBI012	6/21/2017			Water	Temperature, water				20.1	deg C

D = Sample diluted, HT = Holding Time exceeded, J = Estimated, K= Less than, L = Greater than, NRP = No result possible, R = Less than Reporting Limit

NJDEP Ambient Water Quality Data Exchange Chemical Results

Near SWMP Station 7

Run At: 03/14/2024 05:51 pm

Organization	Location	Date	Depth	Ft/m	Media	Characteristic	Form	Fraction	Remark	Result	Units
NJDEP_BFBM	BA50	8/29/2012			Air	Weather comments (text)				No rain day of sample, rain day before sample	None
NJDEP_BFBM	BA50	8/29/2012			Water	Escherichia coli		Total		172.5	#/100ml
NJDEP_BFBM	BA50	8/29/2012			Water	Fecal Coliform		Total		540	#/100ml
NJDEP_BFBM	BA50	8/29/2012			Water	Temperature, water				20.5	deg C
NJDEP_BFBM	BA50	9/5/2012			Air	Weather comments (text)				Rain day before & day of Sample	None
NJDEP_BFBM	BA50	9/5/2012			Water	Escherichia coli		Total		1732.9	#/100ml
NJDEP_BFBM	BA50	9/5/2012			Water	Fecal Coliform		Total		1600	#/100ml
NJDEP_BFBM	BA50	9/5/2012			Water	Temperature, water				23.9	deg C
NJDEP_BFBM	BA50	9/12/2012			Air	Weather comments (text)				No rain day of sample or day before sample	None
NJDEP_BFBM	BA50	9/12/2012			Water	Escherichia coli		Total		52.9	#/100ml
NJDEP_BFBM	BA50	9/12/2012			Water	Fecal Coliform		Total		49	#/100ml
NJDEP_BFBM	BA50	9/12/2012			Water	Temperature, water				18.5	deg C
NJDEP_BFBM	BA50	9/19/2012			Air	Weather comments (text)				Rain day before & day of Sample	None
NJDEP_BFBM	BA50	9/19/2012			Water	Escherichia coli		Total		727	#/100ml
NJDEP_BFBM	BA50	9/19/2012			Water	Fecal Coliform		Total		920	#/100ml
NJDEP_BFBM	BA50	9/19/2012			Water	Temperature, water				20.1	deg C
NJDEP_BFBM	BA50	9/26/2012			Air	Weather comments (text)				Rain day of sample, no rain day before	None
NJDEP_BFBM	BA50	9/26/2012			Water	Escherichia coli		Total		48.8	#/100ml
NJDEP_BFBM	BA50	9/26/2012			Water	Fecal Coliform		Total		23	#/100ml
NJDEP_BFBM	BA50	9/26/2012			Water	Temperature, water				17.1	deg C

D = Sample diluted, HT = Holding Time exceeded, J = Estimated, K= Less than, L = Greater than, NRP = No result possible, R = Less than Reporting Limit

Organization	Location	Date	Depth	Ft/m	Media	Characteristic	Form	Fraction	Remark	Result	Units
NJDEP_BFBM	BA48	8/29/2012			Air	Weather comments (text)				No rain day of sample, rain day before sample	None
NJDEP_BFBM	BA48	8/29/2012			Water	Escherichia coli		Total		5.2	#/100ml
NJDEP_BFBM	BA48	8/29/2012			Water	Temperature, water				23.8	deg C
NJDEP_BFBM	BA48	9/5/2012			Air	Weather comments (text)				Rain day before & day of Sample	None
NJDEP_BFBM	BA48	9/5/2012			Water	Escherichia coli		Total		56.3	#/100ml
NJDEP_BFBM	BA48	9/5/2012			Water	Temperature, water				23.3	deg C
NJDEP_BFBM	BA48	9/12/2012			Air	Weather comments (text)				No rain day of sample or day before sample	None
NJDEP_BFBM	BA48	9/12/2012			Water	Escherichia coli		Total		11	#/100ml
NJDEP_BFBM	BA48	9/12/2012			Water	Temperature, water				21.7	deg C
NJDEP_BFBM	BA48	9/19/2012			Air	Weather comments (text)				Rain day before & day of Sample	None
NJDEP_BFBM	BA48	9/19/2012			Water	Escherichia coli		Total		34.1	#/100ml
NJDEP_BFBM	BA48	9/19/2012			Water	Temperature, water				21.2	deg C
NJDEP_BFBM	BA48	9/26/2012			Air	Weather comments (text)				Rain day of sample, no rain day before	None
NJDEP_BFBM	BA48	9/26/2012			Water	Escherichia coli		Total		8.6	#/100ml
NJDEP_BFBM	BA48	9/26/2012			Water	Temperature, water				19.7	deg C

D = Sample diluted, HT = Holding Time exceeded, J = Estimated, K= Less than, L = Greater than, NRP = No result possible, R = Less than Reporting Limit

NJDEP Ambient Water Quality Data Exchange Chemical Results

Near SWMP Station 10

Run At: 03/15/2024 09:43 am

Organization	Location	Date	Depth	Ft/m	Media	Characteristic	Form	Fraction	Remark	Result	Units
NJDEP_BFBM	FIBI081	7/20/2009			Other	FIBI Rating				Good	None
NJDEP_BFBM	FIBI081	7/20/2009			Water	Dissolved oxygen (DO)				7.95	mg/l
NJDEP_BFBM	FIBI081	7/20/2009			Water	pH				7.8	None
NJDEP_BFBM	FIBI081	7/20/2009			Water	Specific conductance				253	mS/cm
NJDEP_BFBM	FIBI081	7/20/2009			Water	Temperature, water				20.26	deg C
NJDEP_BFBM	FIBI081	7/2/2012			Air	Barometric pressure				749	mmHg
NJDEP_BFBM	FIBI081	7/2/2012			Air	Temperature, air				31.6	deg C
NJDEP_BFBM	FIBI081	7/2/2012			Water	Dissolved oxygen (DO)				7.71	mg/l
NJDEP_BFBM	FIBI081	7/2/2012			Water	Dissolved oxygen saturation				89.3	%
NJDEP_BFBM	FIBI081	7/2/2012			Water	pH				6.88	None
NJDEP_BFBM	FIBI081	7/2/2012			Water	Specific conductance				228	uS/cm
NJDEP_BFBM	FIBI081	7/2/2012			Water	Temperature, water				21.87	deg C
NJDEP_BFBM	FIBI081	6/21/2017			Water	Escherichia coli		Total		157.6	#/100ml
NJDEP_BFBM	FIBI081	6/21/2017			Water	Temperature, water				21.3	deg C
NJDEP_BFBM	FIBI081	6/26/2017			Water	Escherichia coli		Total		224.7	#/100ml
NJDEP_BFBM	FIBI081	6/26/2017			Water	Temperature, water				22.7	deg C
NJDEP_BFBM	FIBI081	7/5/2017			Water	Escherichia coli		Total		344.8	#/100ml
NJDEP_BFBM	FIBI081	7/5/2017			Water	Temperature, water				23.7	deg C
NJDEP_BFBM	FIBI081	7/10/2017			Water	Escherichia coli		Total		579.4	#/100ml
NJDEP_BFBM	FIBI081	7/10/2017			Water	Temperature, water				24	deg C
NJDEP_BFBM	FIBI081	7/19/2017			Water	Escherichia coli		Total		55.4	#/100ml
NJDEP_BFBM	FIBI081	7/19/2017			Water	Temperature, water				25.2	deg C
NJDEP_BFBM	FIBI081	8/21/2017			Air	Barometric pressure				761	mmHg
NJDEP_BFBM	FIBI081	8/21/2017			Air	Temperature, air				23	deg C
NJDEP_BFBM	FIBI081	8/21/2017			Other	FIBI Rating				Fair	None
NJDEP_BFBM	FIBI081	8/21/2017			Water	Dissolved oxygen (DO)				8.43	mg/l
NJDEP_BFBM	FIBI081	8/21/2017			Water	Dissolved oxygen saturation				96.1	%
NJDEP_BFBM	FIBI081	8/21/2017			Water	Flow				17.73	cfs
NJDEP_BFBM	FIBI081	8/21/2017			Water	Inorganic nitrogen (nitrate and nitrite)	as N	Total		0.165	mg/l
NJDEP_BFBM	FIBI081	8/21/2017			Water	Kjeldahl nitrogen		Total		0.215	mg/l
NJDEP_BFBM	FIBI081	8/21/2017			Water	pH				7.77	None
NJDEP_BFBM	FIBI081	8/21/2017			Water	Phosphate-phosphorus	as P	Total		0.0271	mg/l
NJDEP_BFBM	FIBI081	8/21/2017			Water	Specific conductance				251.9	uS/cm
NJDEP_BFBM	FIBI081	8/21/2017			Water	Temperature, water				21.78	deg C
NJDEP_BFBM	FIBI081	8/14/2018			Water	Escherichia coli		Total		131.4	#/100ml
NJDEP_BFBM	FIBI081	8/14/2018			Water	Temperature, water				23.5	deg C
NJDEP_BFBM	FIBI081	8/21/2018			Water	Escherichia coli		Total		88	#/100ml
NJDEP_BFBM	FIBI081	8/21/2018			Water	Temperature, water				22.6	deg C
NJDEP_BFBM	FIBI081	8/28/2018			Water	Escherichia coli		Total		140.1	#/100ml
NJDEP_BFBM	FIBI081	8/28/2018			Water	Temperature, water				24.5	deg C
NJDEP_BFBM	FIBI081	9/4/2018			Water	Escherichia coli		Total		53.7	#/100ml
NJDEP_BFBM	FIBI081	9/4/2018			Water	Temperature, water				24.7	deg C
NJDEP_BFBM	FIBI081	9/11/2018			Water	Escherichia coli		Total		143.9	#/100ml
NJDEP_BFBM	FIBI081	9/11/2018			Water	Temperature, water				20.1	deg C

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