



Memorandum

To: Lake Tohopekaliga Nutrient Reduction Plan Basin Working Group

From: CDM Smith

Date: March 19, 2024

Subject: Lake Tohopekaliga Nutrient Reduction Plan Water Quality Trend Analysis

In 2011, FDEP agreed to revise Lake Tohopekaliga's assessment status from Category 5 (i.e., water quality standards are not attained, and a total maximum daily load (TMDL) is required) to Category 4e (i.e., impaired, but recently completed or on-going restoration activities are underway to restore the designated uses of the waterbody) pending the development of a nutrient reduction plan (NRP) or 4e plan for Lake Tohopekaliga (Toho). The Lake Toho Nutrient Reduction Plan (NRP) was subsequently prepared in 2011 (CDM Smith, 2011) by the NRP stakeholders to address FDEP's requirements to facilitate the change in assessment category. FDEP accepted the NRP in early 2012 and changed the assessment status for Lake Toho and East Lake Toho to category 4e. The NRP contained the following components: 1) an estimation of nutrient loading to the lake by jurisdiction; 2) identification of stakeholder projects and activities since 2009 that result in overall nutrient reduction to Lake Toho; 3) development of a monitoring plan; and 4) identification of research needs to improve the understanding of nutrient dynamics in the lake. As part of the NRP, stakeholders initially committed to preparing biennial update reports. With the adoption of the Lake Okeechobee Basin Management Action Plan (BMAP) and annual reporting required as part of that BMAP, the stakeholders no longer were required by FDEP to produce biennial reports but were required to periodically analyze water quality trends in the watershed.

Activities since 2016 Biennial Report

There have been a number of developments since the last biennial report was produced. Namely:

- Establishment of the Lake Toho NRP Basin Working Group which consists of Osceola County, the City of Orlando, City of Kissimmee, City of St. Cloud, and FDOT District 5;
- A change in water quality database platforms used by FDEP (STORET vs. WIN);
- Changes in annual reporting due to the Lake Okeechobee BMAP;
- Update to the Lake Toho NRP monitoring plan; and,
- Identification of data gaps and reconciliation of water quality monitoring data issues.

All of these items have had an impact on the timing and development of the current water quality trend analysis for the Lake Toho NRP.

Data Gap Analysis

Since the acceptance of the NRP, FDEP changed its platform for uploading and storing water quality data from the Florida STOrage and RETrieval (STORET) database to the Watershed Information Network (WIN). Based on review of the available data in both STORET and WIN, it was observed that there were data inconsistencies and gaps between platforms, as well as missing data from the source provider (South Florida Water Management District (SFWMD)). Namely, a lack of chlorophyll-a data since 2011 for lake stations. Data for Total Kjeldahl Nitrogen (TKN) was only available in STORET through 2014. Additionally, three Osceola County NRP monitoring sites were missing from WIN. As part of the ongoing support to the Lake Toho NRP Basin Working Group, CDM Smith and Osceola County have continued to coordinate with the SFWMD to obtain and review data that were previously not included in the STORET database. It should also be noted in the 2016 NRP Biennial Update, updates for Mill Slough (WBID 3173D) and City Ditch Canal (WBID 3173) were not included in the analysis as the data were not available in STORET at the time the analysis was performed. Data for these two WBIDs were available for the current analysis.

Osceola County requested support from CDM Smith Inc. to address these data inconsistencies as well as upload the County's missing water quality data to the WIN platform. CDM Smith Inc. contracted Applied Ecology, Inc. (AEI) to provide support services to reconcile and address the observed data gaps. AEI was responsible for data acquisition of all NRP stations data within the last 10 years and performing a data gap analysis that identified missing or inconsistent records between data sources (WIN, STORET and SFWMD's DBHYDRO), as well as evaluating the completeness of the existing data for use in the statistical trend analyses for the NRP report. Furthermore, AEI was also responsible for the creation of a database which houses a comprehensive dataset composed of the various data sources to be used for the water quality data analyses.

The Lake Toho NRP specifies that stations within the Lake Toho NRP monitoring network collect both core and supplemental parameters (**Tables 1 and 2**). Table 1 includes revisions proposed by the Lake Toho NRP Working Group in 2019, which were subsequently approved by FDEP.

Table 1 Revised Water Quality Parameters for In-Lake Sampling

Core Parameters	Supplemental Parameters
Total Phosphorus as P (TP)	Orthophosphate as P
Total Nitrogen as N (TN)	Nitrite/nitrate Nitrogen as N (NO ₂ +NO ₃)
Chlorophyll	Ammonium Nitrogen as N
Alkalinity	
Turbidity	
Chloride	
Color	
TSS	

Table 2 Water Quality Parameters for Tributary Sampling

Core Parameters	Supplemental Parameters
Conductivity	Alkalinity
Dissolved Oxygen	Chloride
Nitrite/nitrate Nitrogen as N (NO ₂ +NO ₃)	Orthophosphate as P
pH	Total Organic Carbon
Temperature	TSS
Total Kjeldahl Nitrogen (TKN)	Color
Total phosphorus as P (TP)	Turbidity

Major Findings from Data Gap Analysis

There were several observations noted by AEI as a result of the data gap analysis. These are summarized below:

- There are data after the third quarter of 2016 for Nitrite + Nitrate (NO₂+NO₃) and Orthophosphorus (OrthoP) reported by SFWMD to FDEP WIN as “dissolved” rather than total. However, it was suspected that the previous datasets were reported as “total” in the STORET database incorrectly and no change in method actually has occurred. Based on the current analysis method, dissolved data would be disqualified for use in the trend testing analyses. While mixing total and dissolved results can yield problematic results, if no change in methods took place in data collection or laboratory analysis, the dataset can be used for examining trends over time.
- As WBID 3173A (Lake Toho) and WBID 3172 (East Lake Toho) are those classified for in-lake sampling, the data for TP, NO₂+NO₃, OrthoP, and chlorophyll-a are subjected to water quality trend analyses. TKN was originally included in the NRP but has since been removed from the list of monitored parameters. Overall, it was found that the monitoring data are sufficient for chlorophyll-a and TP but are insufficient for NO₂+NO₃, and OrthoP from 2017 to 2020 for both WBIDs. As these two WBIDs are solely represented by SFWMD stations, from the third quarter of 2016 on, data for these two parameters were reported as the “dissolved” fraction, disqualifying them for use in trend testing analyses, unless the current analysis methods are

changed to allow it. If the dissolved data were to be considered, the POR would be complete for WBID 3173A and 3172.

As a result of the data gap analysis, CDM Smith followed up with the SFWMD to inquire about the reporting issue of dissolved fraction versus total for NO₂+NO₃, and OrthoP. Through this process, the SFWMD indicated the results for NO₂+NO₃ and OrthoP were incorrectly reported in STORET as "total" and should've been reported as the dissolved fraction. The SFWMD is currently looking into how to resolve this inconsistency in the STORET database which will require coordination with FDEP. Correspondence with the SFWMD is included in **Attachment 1**. The SFWMD indicated that NO₂+NO₃ and OrthoP data analyzed by their lab is the dissolved fraction and that the District lab has used this method for more than 20 years. Samples collected by Osceola County are also analyzed by SFWMD. Based on this information, the following tributary WBIDs were affected for the trend analysis (discussed in the next section):

- 3168B Boggy Creek - This included SFWMD data and data by other entities. The SFWMD data were removed from the NO₂+NO₃ trend analysis.
- 3169A Shingle Creek - This included SFWMD data and data by other entities. The SFWMD data were removed from the NO₂+NO₃ trend analysis.
- 3173B St. Cloud Canal - This included SFWMD data and data by other entities. The SFWMD data were removed from the NO₂+NO₃ trend analysis.
- 3172C East Lake Tohopekaliga Drain – this WBID includes SFWMD and Osceola County sites and NO₂+NO₃ is reported as dissolved for the trend analysis.
- 3172A Jim Branch– this WBID includes only SFWMD sites and NO₂+NO₃ is reported as the dissolved fraction for the trend analysis.
- 3173A1 Partin Canal - this WBID includes only Osceola County sites and NO₂+NO₃ is reported as the dissolved fraction for the trend analysis.
- 3173C Lake Tohopekaliga (South Segment) – this WBID includes only SFWMD sites and NO₂+NO₃ is reported as the dissolved fraction for the trend analysis.

It is also important to note the SFWMD no longer analyzes for TKN and results for this parameter are not available after 2014.

Monitoring Results and Trends

Similar to the previous update, the Lake Toho NRP basin working group members elected to consider the water quality data for trends using the monitoring results from at least the last 10 years of the period of record (where data were available). To be consistent with the impaired waters rule (IWR) (Sections 62-303.351 and 62-303.352 of the Florida Administrative Code (FAC)),

the Mann's one-sided, upper-tail test at the 95 percent confidence level was used to identify statistically significant trends. This test is also referred to as the Mann Kendall test.

Water quality results for WBIDs that are tributary to Lake Toho were analyzed for the following:

- Total phosphorus as P (TP)
- Nitrite/nitrate as N (NO₂+NO₃)
- Total Kjeldahl nitrogen (TKN) as N
- Total Nitrogen as N

For East Lake Toho (WBID 3172) and Lake Toho (WBID 3173A), water quality trends were analyzed for the following parameters:

- Total phosphorus as P
- Total Nitrogen as N
- Chlorophyll-a (corrected)

A summary of the statistical analysis is provided in **Tables 3, 4** and **5**. A graphical representation of the data are included in **Attachment 2**. The WBID and sampling station locations are shown on **Figure 1**. While the stakeholders continued to monitor for the core parameters identified in the NRP, only water quality trends for nutrients were evaluated by major WBID based on FDEP's previous feedback and their review of the previous biennial report. It is important to note that the Basin Working Group acknowledges that WBID boundaries have changed since the approval of the Lake Toho NRP. As the water quality trend analysis results are reported by WBID, a decision was made to retain the original WBID boundaries to be able to compare trends over time to determine if changes have occurred. Comparing the current WBIDs with the original NRP WBIDs, the most significant change is in the Hart Branch WBID (original WBID 3171E). Other WBID boundary adjustments are minor. It should be noted that data for Orange County sampling stations within the NRP WBIDs were also retained and used in the analysis.

Table 3 Lake Toho WBID 3173A – Water Quality Summary Statistics (2010 - 2021 (partial))

Parameter	Mean	Geometric Mean	Probability (P)	Statistical Trend	Slope (units /day)	Δ/year	Sample Count
Total Phosphorus as P (mg/l)	0.04	0.04	0.00	decreasing	-0.000003	-0.001	397
Total Nitrogen as N (mg/l)	0.95	0.92	0.14	none	--	--	154
Chlorophyll-a (corrected) (ug/l)	20.4	16.6	0.00	decreasing	-0.001603	-0.58508	256

Note: "Δ/year" means change per year based on Slope x 365 days.

Table 4 East Lake Toho WBID 3172 – Water Quality Summary Statistics (2010 - 2021 (partial))

Parameter	Mean	Geometric Mean	Probability (P)	Statistical Trend	Slope (units /day)	Δ/year	Sample Count
Total Phosphorus as P (mg/l)	0.02	0.019	0.09	none	--	--	84
Total Nitrogen as N (mg/l)	0.63	0.63	0.52	none	--	--	40
Chlorophyll-a (corrected) (ug/l)	3.26	2.9	0.07	none	--	--	84

Note: "Δ/year" means change per year based on Slope x 365 days.

Lake Toho showed a statistically significant decreasing trend in TP and corrected chlorophyll-a during the period of record. No statistically significant trend was observed for TN at Lake Toho. East Lake Toho did not exhibit any statistically significant trends for nutrients. However, it should also be noted that during the period of record, the Florida Fish and Wildlife Conservation Commission (FWC) conducted an artificial drawdown of East Lake Toho during the winter and spring of 2020 to facilitate management of the lake's aquatic habitat. During this time, the water level of East Lake Toho was lowered two feet below the normal low pool stage. Activities conducted to enhance habitat included mechanical scraping to remove large areas of organic sediments and dense vegetation which have accumulated over time due to stabilized water levels, selective herbicide treatment of cattail and noxious plant species, and burning of treated vegetation to reduce leaf litter and woody material deposition (FWC, 2022). As the effects of drawdown on water quality are not known, the water quality data collected during this period should be used with caution.

Tributary WBIDs with discernable trends during the observed period of record are summarized below:

- Hart Branch (WBID 3173E) showed a statistically significant decreasing trend for all nitrogen species. It should be noted that Hart Branch is based on sampling data for station S-62 which is maintained by Orange County.
- Boggy Creek (WBID 3168B) exhibited a statistically significant increasing trend for TKN but a decreasing trend for TN. It should be noted that the analyzed Boggy Creek dataset included samples collected by Orange County.
- Shingle Creek (WBID 3169A) exhibited a statistically significant decreasing trend for TKN but an increasing trend for NO₂+NO₃.
- Jim Branch (WBID 3172A) showed a statistically significant decreasing trend for TP.
- Partin Canal (WBID 3173A1) exhibited a statistically significant decreasing trend for TN but an increasing trend for dissolved NO₂+NO₃.
- Lake Toho South Segment (WBID 3173C) exhibited a statistically significant decreasing trend for TP.

Table 5
Lake Tohopekaliga Nutrient Reduction Plan
Tributary WBIDs - Water Quality Summary Statistics

	Hart Branch: 3171E									Boggy Creek: 3168B								
Parameter	Mean	GeoMean	P	Trend	Slope (units/day)	Δ/year ¹	Count	Period of Record	Mean	GeoMean	P	Trend	Slope (units/day)	Δ/year ¹	Count	Period of Record		
Total Phosphorus as P (mg/l)	0.04	0.03	0.83	none	--	--	64	2/2012 - 3/2021	0.03	0.03	0.35	none	--	--	189	1/2010 - 7/2021		
Nitrate/Nitrite as N (mg/l)	0.10	0.09	0.01	decreasing	-0.000018	-0.007	63	2/2012 - 3/2021	0.05	0.02	0.48	none	--	--	46	1/2010 - 5/2021		
Total Kjeldahl Nitrogen as N (mg/l)	1.10	1.08	0.00	decreasing	-0.000102	-0.037	63	2/2012 - 3/2021	0.67	0.61	0.01	increasing	0.000045	0.016	100	1/2010 - 5/2021		
Total Nitrogen as N (mg/l)	1.21	1.19	0.00	decreasing	-0.000122	-0.045	58	2/2012 - 3/2020	0.65	0.60	0.00	decreasing	-0.000087	-0.032	129	1/2010 - 7/2021		
	Shingle Creek: 3169A									St Cloud Canal: 3173B								
Parameter	Mean	GeoMean	P	Trend	Slope (units/day)	Δ/year ¹	Count	Period of Record	Mean	GeoMean	P	Trend	Slope (units/day)	Δ/year ¹	Count	Period of Record		
Total Phosphorus as P (mg/l)	0.06	0.05	0.00	none	--	--	287	1/2010 - 7/2021	0.04	0.02	0.26	none	--	--	219	1/2010 - 9/2021		
Nitrate/Nitrite as N (mg/l)	0.06	0.05	0.00	increasing	0.000011	0.004	60	2/2010 - 4/2021	0.07	0.04	0.06	none	--	--	65	1/2010 - 9/2021		
Total Kjeldahl Nitrogen as N (mg/l)	0.74	0.60	0.00	decreasing	-0.000101	-0.037	190	1/2010 - 4/2021	0.74	0.59	0.25	none	--	--	117	1/2010 - 11/2019		
Total Nitrogen as N (mg/l)	0.77	0.75	0.52	none	--	--	142	2/2010 - 7/2021	0.67	0.66	0.10	none	--	--	87	6/2014 - 9/2021		
	East Lake Tohopekaliga Drain: 3172C									Jim Branch: 3172A								
Parameter	Mean	GeoMean	P	Trend	Slope (units/day)	Δ/year ¹	Count	Period of Record	Mean	GeoMean	P	Trend	Slope (units/day)	Δ/year ¹	Count	Period of Record		
Total Phosphorus as P (mg/l)	0.04	0.04	0.14	none	--	--	162	3/2010 - 7/2021	0.07	0.06	0.00	decreasing	-0.000004	-0.002	203	1/2010 - 8/2021		
Dissolved Nitrate/Nitrite as N (mg/l) ²	0.04	0.02	0.70	none	--	--	96	9/2011 - 8/2021	0.04	0.03	0.92	none	--	--	9	9/2020 - 8/2021		
Total Kjeldahl Nitrogen as N (mg/l)	1.04	1.02	0.24	none	--	--	38	9/2011 - 5/2014	NA	NA	NA	--	--	--	0	--		
Total Nitrogen as N (mg/l)	0.99	0.98	0.24	none	--	--	85	6/2014 - 8/2021	0.72	0.65	0.16	none	--	--	30	2/2020 - 8/2021		
	Partin Canal: 3173A1									Lake Tohopekaliga (South Segment): 3173C								
Parameter	Mean	GeoMean	P	Trend	Slope (units/day)	Δ/year ¹	Count	Period of Record	Mean	GeoMean	P	Trend	Slope (units/day)	Δ/year ¹	Count	Period of Record		
Total Phosphorus as P (mg/l)	0.13	0.09	0.11	none	--	--	91	9/2011 - 9/2020	0.15	0.13	0.00	decreasing	-0.000015	-0.005	87	1/2010 - 8/2021		
Dissolved Nitrate/Nitrite as N (mg/l) ²	0.05	0.03	0.00	increasing	0.000014	0.005	91	9/2011 - 11/2020	0.18	0.12	0.37	none	--	--	12	10/2020 - 8/2021		
Total Kjeldahl Nitrogen as N (mg/l)	1.38	1.10	0.77	none	--	--	38	9/2011 - 6/2014	NA	NA	NA	--	--	--	0	--		
Total Nitrogen as N (mg/l)	1.22	1.02	0.02	decreasing	-0.000166	-0.061	54	6/2014 - 11/2020	1.20	1.16	0.94	none	--	--	19	2/2020 - 8/2021		
	Mill Slough: 3173D									City Ditch Canal: 3173								
Parameter	Mean	GeoMean	P	Trend	Slope (units/day)	Δ/year ¹	Count	Period of Record	Mean	GeoMean	P	Trend	Slope (units/day)	Δ/year ¹	Count	Period of Record		
Total Phosphorus as P (mg/l)	0.06	0.04	0.26	none	--	--	70	3/2010 - 11/2019	0.08	0.06	0.37	none	--	--	36	3/2010 - 11/2019		
Nitrate/Nitrite as N (mg/l)	0.09	0.05	0.18	none	--	--	68	3/2010 - 11/2019	0.10	0.06	0.73	none	--	--	34	3/2010 - 11/2019		
Total Kjeldahl Nitrogen as N (mg/l)	0.71	0.48	0.17	none	--	--	69	3/2010 - 11/2019	0.80	0.55	0.30	none	--	--	35	3/2010 - 11/2019		
Total Nitrogen as N (mg/l)	NA		NA	--	--	--	0	--	NA		NA	--	--	--	0	--		

Notes:

1. "Δ/year" means change per year based on Slope × 365 days

2. These WBIDs are analyzed by SFWMD and only report the dissolved fraction for Nitrate/Nitrite (mg/l)

3. SFWMD data for Nitrate/Nitrite were removed from the analysis for Boggy Creek, Shingle Creek and St. Cloud Canal as only the dissolved fraction is reported.

Comparison to Numeric Nutrient Criteria and Lake Okeechobee BMAP Targets

CDM Smith compared the current results for Lake Toho and East Lake Toho to FDEP's Numeric Nutrient Criteria (NNC) and the Lake Okeechobee BMAP targets for informational purposes only. While a comprehensive application of the impaired waters rule (IWR) as defined in Chapter 62-303, FAC is beyond the scope of this effort, CDM Smith compared the long-term nutrient concentration geometric means to the current NNC standard as well as the adopted total maximum daily load (TMDL) in-lake TP target of 0.04 mg/l for Lake Okeechobee. The results are summarized in **Table 6** below.

Table 6 Comparison to NNC and Lake Okeechobee TMDL Target

Parameter	Applicable Nutrient Criterion Range ¹	Lake Okeechobee TMDL Target	Lake Toho Geometric Mean	E. Lake Toho Geometric Mean
Total Phosphorus as P (mg/l)	0.05 – 0.16	0.04	0.04	0.02
Total Nitrogen as N (mg/l)	1.27 – 2.23	N/A	0.92	0.63
Chlorophyll-a (corrected) (ug/l)	20	N/A	16.6	2.9

1 – Based on lake color long-term geometric mean greater than 40 PCU

As can be seen, the long-term geometric means are less than the NNC threshold values and equal to or less than the target in-lake concentration of TP for Lake Okeechobee. In addition to this analysis, the lake WBIDs are attaining the applicable NNC for high color lakes. Based on FDEP's most recent biennial assessment cycle (2022-2024), these lakes are not impaired.

Attachment 1

SFWMD Correspondence

Honour, Danielle

From: Nichols, Joel <jdnicho@sfwmd.gov>
Sent: Thursday, October 12, 2023 3:04 PM
To: Honour, Danielle
Cc: Herring, Keith; Smith, Sharon; Burke, Patricia; Danielle Huffner; susan.gosselin@osceola.org
Subject: RE: Lake Toho Monitoring Data Question

Danielle,

If the NOx data comes from SFWMD laboratory it is dissolved. This is the method the District lab has used for the past 20+ years. We are in the process of investigating the information in STORET.

Please contact me if you have any more questions,
Joel

Joel Nichols

Quality Assurance Officer
South Florida Water Management District
Analytical Services Section
Water Resources Division
8894 Belvedere Road
West Palm Beach, Florida 33411
561-681-2500 Ext. 4530

From: Honour, Danielle <HonourDM@cdmsmith.com>
Sent: Thursday, October 12, 2023 2:45 PM
To: Nichols, Joel <jdnicho@sfwmd.gov>
Cc: Herring, Keith <kherrin@sfwmd.gov>; Smith, Sharon <shsmith@sfwmd.gov>; Burke, Patricia <pburke@sfwmd.gov>; Danielle Huffner <dhuffner@appliedecologyinc.com>; susan.gosselin@osceola.org
Subject: RE: Lake Toho Monitoring Data Question

[Please remember, this is an external email]

Joel-

I had a follow up question about the datasets we shared with you a couple of weeks ago. There are a handful of sites that Osceola County collects the sample and SFWMD conducts the lab analysis. I wanted to confirm that the same reporting error is not occurring for those Osceola sites. For example RUNNYMEDE, the sample fraction for Nitrate-Nitrite (N) is reported as total for all samples up until about 2015 (with a few exceptions), after that the field is left blank so I want to confirm if these are indeed all total or something else. There is no "dissolved" entry in any of the records for this site but I want to be sure all of these samples are "total". Thank you.

Danielle M. Honour, P.E., D.WRE | Associate Water Resources Engineer
CDM Smith | 101 Southhall Lane, Suite 200 | Maitland, FL 32751 | T/F: 407.660.2552/407.875.1161 | honourdm@cdmsmith.com | cdmsmith.com

From: Nichols, Joel <jdnicho@sfwmd.gov>
Sent: Friday, September 29, 2023 12:41 PM

To: Danielle Huffner <dhuffner@appliedecologyinc.com>; Honour, Danielle <HonourDM@cdmsmith.com>
Cc: Herring, Keith <kherrin@sfwmd.gov>; Smith, Sharon <shsmith@sfwmd.gov>; Burke, Patricia <pburke@sfwmd.gov>
Subject: RE: Lake Toho Monitoring Data Question

From what we have discerned is that the data loaded to STORET prior to June 2016 was identified as TOTAL in error. The methodology used to analyze OPO4 and NOx by the SFWMD laboratory require the sample be filtered thus, dissolved by definition. We are now investigating how to have this corrected in STORET. As to your data set all of the data in question should be identified as Dissolved. I hope this answers your original question. If you have any other question please ask.

Joel

Joel Nichols

Quality Assurance Officer
South Florida Water Management District
Analytical Services Section
Water Resources Division
8894 Belvedere Road
West Palm Beach, Florida 33411
561-681-2500 Ext. 4530

From: Danielle Huffner <dhuffner@appliedecologyinc.com>
Sent: Friday, September 29, 2023 12:30 PM
To: Honour, Danielle <HonourDM@cdmsmith.com>; Nichols, Joel <jdnicho@sfwmd.gov>
Cc: Herring, Keith <kherrin@sfwmd.gov>; Smith, Sharon <shsmith@sfwmd.gov>
Subject: RE: Lake Toho Monitoring Data Question

Some people who received this message don't often get email from dhuffner@appliedecologyinc.com. [Learn why this is important](#)

[Please remember, this is an external email]

Hi Joel,

Yes, you are correct that DBHYDRO datasets do not include the "Fraction" column/field within the metadata/database output. This column is a field that is housed in both the STORET and WIN FDEP data repositories. In theory, the data in those columns would have been uploaded into one of those repositories (data prior to 2017 into STORET and data after 2017 into WIN) by a SFWMD staff member.

I hope that clears things up, but if you have any questions, just let me know!

Danielle

DANIELLE HUFFNER

Environmental Scientist III | Applied Ecology, Inc.



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A. 2200 Front St., Suite 300 Melbourne, FL 32901

From: Honour, Danielle <HonourDM@cdmsmith.com>
Sent: Friday, September 29, 2023 11:18 AM
To: Nichols, Joel <jdnicho@sfwmd.gov>
Cc: Herring, Keith <kherrin@sfwmd.gov>; Smith, Sharon <shsmith@sfwmd.gov>; Danielle Huffner <dhuffner@appliedecologyinc.com>
Subject: RE: Lake Toho Monitoring Data Question

Joel-

Please see the email below from Danielle Huffner regarding the original data pull – I have cc’ed her for any additional insights – thanks.

Danielle M. Honour, P.E., D.WRE | Associate Water Resources Engineer
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From: Nichols, Joel <jdnicho@sfwmd.gov>
Sent: Friday, September 29, 2023 11:14 AM
To: Honour, Danielle <HonourDM@cdmsmith.com>
Cc: Herring, Keith <kherrin@sfwmd.gov>; Smith, Sharon <shsmith@sfwmd.gov>
Subject: RE: Lake Toho Monitoring Data Question

Danielle,
The total and dissolved column appears to be coming from the storet all stations spreadsheet. Where did this data come from? I have consulted with our data steward and it appears that we don’t load total and dissolved in the DBhydro metadata.

Thanks

Joel Nichols
Quality Assurance Officer
South Florida Water Management District
Analytical Services Section
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From: Honour, Danielle <HonourDM@cdmsmith.com>
Sent: Friday, September 29, 2023 10:30 AM
To: Nichols, Joel <jdnicho@sfwmd.gov>
Subject: FW: Lake Toho Monitoring Data Question

[Please remember, this is an external email]

Joel-

Please see attached for the raw data that were compiled into Excel workbooks.

From: Danielle Huffner <dhuffner@appliedecologyinc.com>
Sent: Thursday, September 28, 2023 5:34 PM
To: Honour, Danielle <HonourDM@cdmsmith.com>
Subject: RE: Lake Toho Monitoring Data Question

Hi Danielle,

The raw data files are all text files, but I do have the Excel workbooks after importing that data. Originally, I had them spread across a few by agency, so I compiled them into individual STORET and WIN workbooks for you. I also attached the DBHYDRO data pulls – those I did not compile because the formats were slightly different; I believe you originally supplied two DBHYDRO datasets for us (one for the three Osceola sites [TOHO_NRP REPORT DATA 07_14_21_CDM] and then another for the rest of SFWMD [UPPER CHAIN DATA_TOHONRP REPORT_CDM]), Therese pulled the three Osceola Sites for us as well (TOHONRP_FromT_East_11-29-21), and then I retrieved BS-59 (DBHYDRO_BS-59). In the datasets you provided, there is a STORET Code column for DBHYDRO.

Let me know if you need anything else!

Danielle

DANIELLE HUFFNER

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From: Honour, Danielle <HonourDM@cdmsmith.com>
Sent: Thursday, September 28, 2023 3:51 PM
To: Danielle Huffner <dhuffner@appliedecologyinc.com>
Subject: RE: Lake Toho Monitoring Data Question

Danielle-

Sorry to bother you with this but SFWMD is digging into the data some more and I'm trying to answer his question below – I don't believe I have the original raw data (STORET/WIN) you extracted from FDEP. I know it also gets complicated because we had to supplement with DBHYDRO data to fill in the gaps. Do you have the original raw data files (downloaded from the agencies) you could send me – I looked in the access database but I don't see them in there. Thanks.

From: Nichols, Joel <jdnicho@sfwmd.gov>
Sent: Thursday, September 28, 2023 3:34 PM
To: Honour, Danielle <HonourDM@cdmsmith.com>
Subject: RE: Lake Toho Monitoring Data Question

Danielle, In your original data pull was there a storet code column?

Joel Nichols

Quality Assurance Officer
South Florida Water Management District
Analytical Services Section
Water Resources Division
8894 Belvedere Road
West Palm Beach, Florida 33411
561-681-2500 Ext. 4530

From: Honour, Danielle <HonourDM@cdmsmith.com>
Sent: Thursday, September 28, 2023 2:44 PM
To: Nichols, Joel <jdnicho@sfwmd.gov>
Cc: Burke, Patricia <pburke@sfwmd.gov>; Herring, Keith <kherrin@sfwmd.gov>
Subject: RE: Lake Toho Monitoring Data Question

[Please remember, this is an external email]

Hi Joel-

I have attached a spreadsheet with the compiled data from both STORET and WIN (exported from an Access database produced by our sub). In particular I have it filtered for a few of the Lake Toho stations B02, B06 and B09. It only goes back to 2010 as that was the period we were interested in. Hope this helps.

From: Nichols, Joel <jdnicho@sfwmd.gov>
Sent: Thursday, September 28, 2023 2:28 PM
To: Honour, Danielle <HonourDM@cdmsmith.com>
Cc: Burke, Patricia <pburke@sfwmd.gov>; Herring, Keith <kherrin@sfwmd.gov>
Subject: RE: Lake Toho Monitoring Data Question

Danielle,
I am looking into your question below and have questions. I have pulled some random Lake Toho data from DBhydro from 2011 to 2023 and all of the results have the same NOx Storet Code of (631) and the dissolved or total is not listed

under the test name (only NITRATE+NITRITE-N). If you could send me some specific station names or your raw data pull so I could better understand what you are seeing and try to discover the discrepancy it would be helpful.

Thanks
Joel

Joel Nichols

Quality Assurance Officer
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8894 Belvedere Road
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From: Honour, Danielle <HonourDM@cdmsmith.com>
Sent: Thursday, August 31, 2023 10:10 AM
To: Burke, Patricia <pburke@sfwmd.gov>
Cc: susan.gosselin@osceola.org; Claudia Listopad <clistopad@appliedecologyinc.com>; Danielle Huffner <dhuffner@appliedecologyinc.com>
Subject: Lake Toho Monitoring Data Question

[Please remember, this is an external email]

Trish-

Hope all is well. Our team recently reviewed the sampling data for the SFWMD stations in Lake Toho and East Lake Toho using the datasets from both STORET and WIN. Our subconsultant found the following discrepancies when reviewing the data – I wanted to share these observations with you in case you can offer any further insight into these parameters? This will be important for us to know as we use the data to perform periodic trend analysis and reporting dissolved vs. total makes a difference.

- There are data after the third quarter of 2016 for Nitrite + Nitrate (NO₂+NO₃) and Orthophosphorus (OrthoP) reported by SFWMD to FDEP WIN as “dissolved” rather than total. However, it is suspected that the previous datasets were reported as “total” in the STORET database incorrectly and no change in method actually has occurred. Based on the current analysis method, dissolved data would be disqualified for use in the trend testing analyses. While mixing total and dissolved results can yield problematic results, if no change in methods took place in data collection or laboratory analysis, the dataset can be used for examining trends over time.
- As WBID 3173A (Lake Toho) and WBID 3172 (East Lake Toho) are those classified for in-lake sampling, the data for TP, NO₂+NO₃, OrthoP, and chlorophyll-a are subjected to water quality trend analyses. TKN was originally included in the NRP but has since been removed from the list of monitored parameters. Overall, it was found that the monitoring data are sufficient for chlorophyll-a and TP but are insufficient for NO₂+NO₃, and OrthoP from 2017 to 2020 for both WBIDs. As these two WBIDs are solely represented by SFWMD stations, from the third quarter of 2016 on, data for these two parameters were reported as the “dissolved” fraction, disqualifying them for use in trend testing analyses, unless the current analysis methods are changed to allow it. If the dissolved data were to be considered, the POR would be complete for WBID 3173A and 3172.

Thank you in advance for any information you can offer.

Danielle M. Honour, P.E., D.WRE | Associate Water Resources Engineer
CDM Smith | 101 Southhall Lane, Suite 200 | Maitland, FL 32751 | T/F: 407.660.2552/407.875.1161 | honourdm@cdmsmith.com | <http://cdmsmith.com>

Attachment 2

Statistical Analysis Graphs

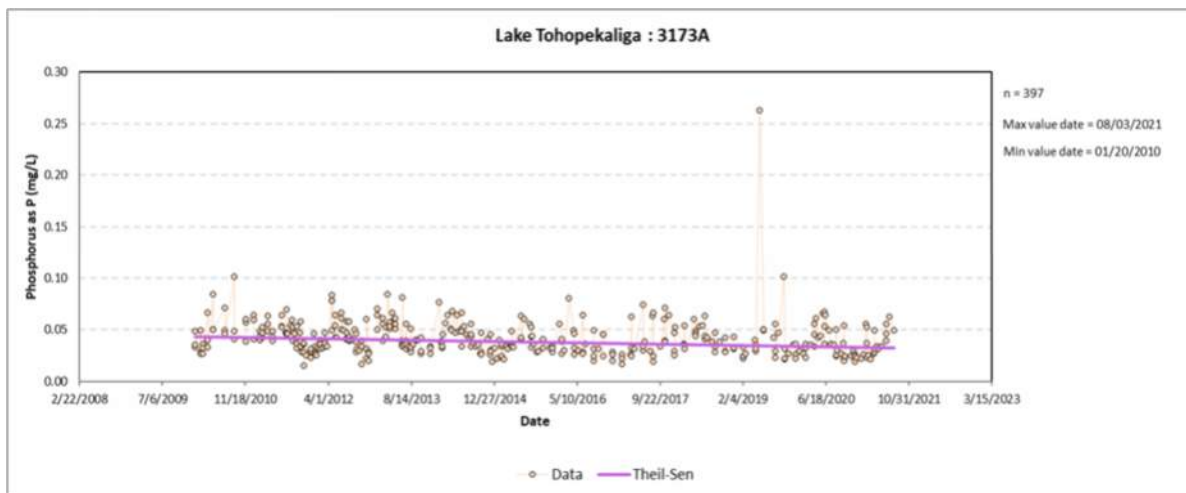


Figure 1 - Lake Tohopekaliga (WBID 3173A) Total Phosphorus

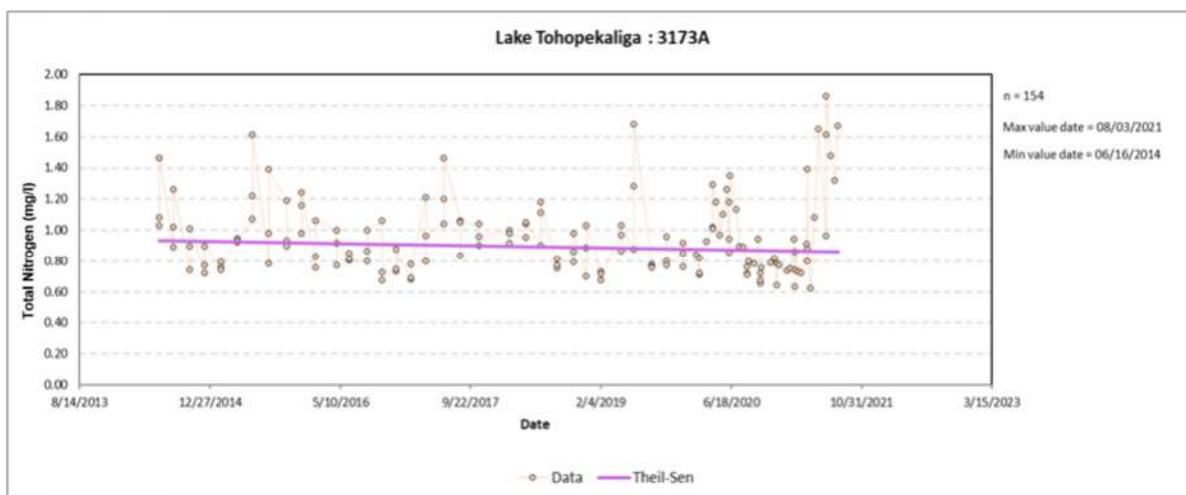


Figure 2 - Lake Tohopekaliga (WBID 3173A) Total Nitrogen

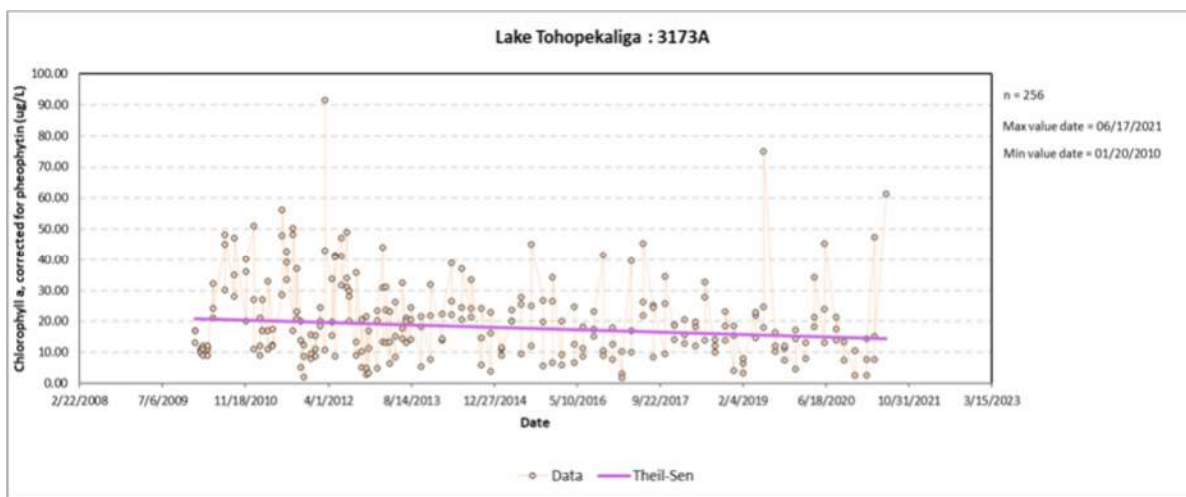


Figure 3 - Lake Tohopekaliga (WBID 3173A) Chlorophyll-a (corrected)

* It should be noted that several potential outliers were observed in the dataset. While these outliers were identified, their legitimacy was not examined further and were included in the analysis.

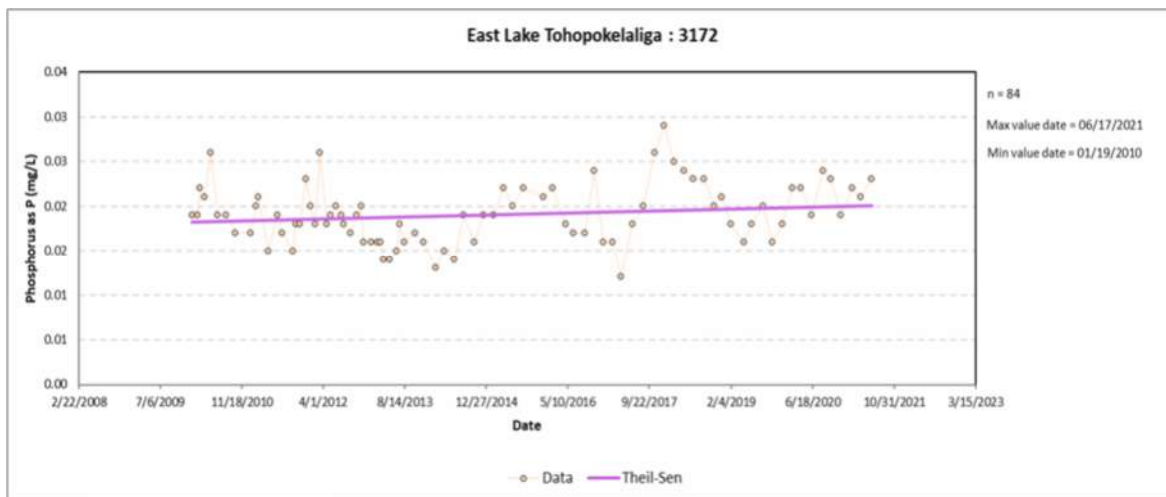


Figure 4- East Lake Tohopekaliga (WBID 3172) Total Phosphorus

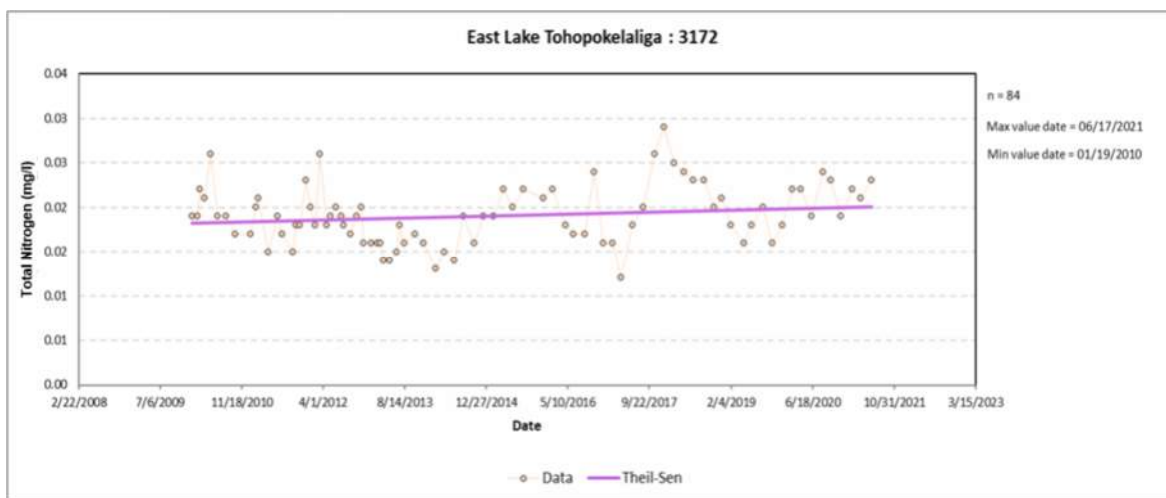


Figure 5 - East Lake Tohopekaliga (WBID 3172) Total Nitrogen

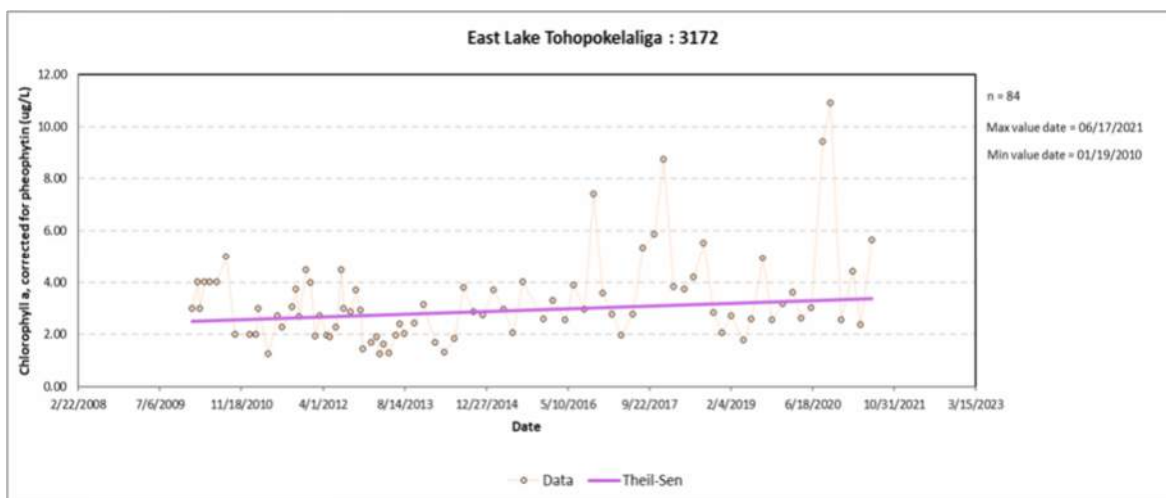


Figure 6 - East Lake Tohopekaliga (WBID 3172) Chlorophyll-a (corrected)

* It should be noted that several potential outliers were observed in the dataset. While these outliers were identified, their legitimacy was not examined further and were included in the analysis.

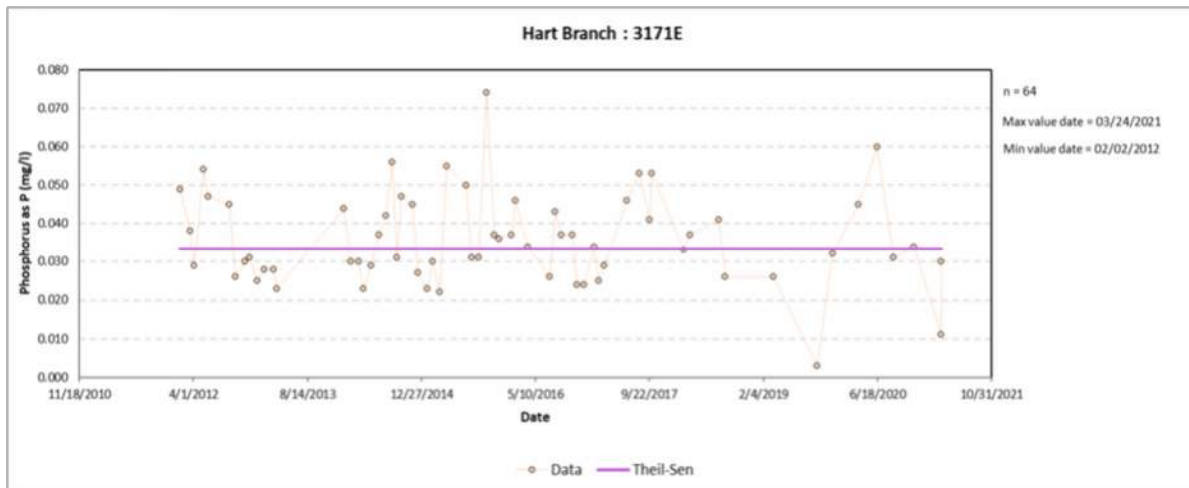


Figure 7 – Hart Branch (WBID 3173E) Total Phosphorus

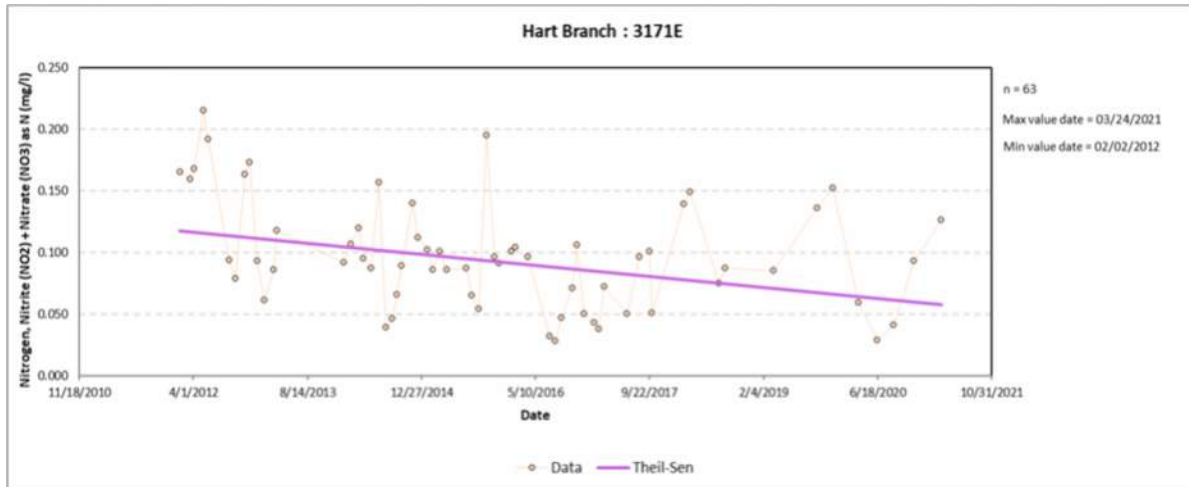


Figure 8 – Hart Branch (WBID 3173E) Nitrite (NO₂) + Nitrate (NO₃)

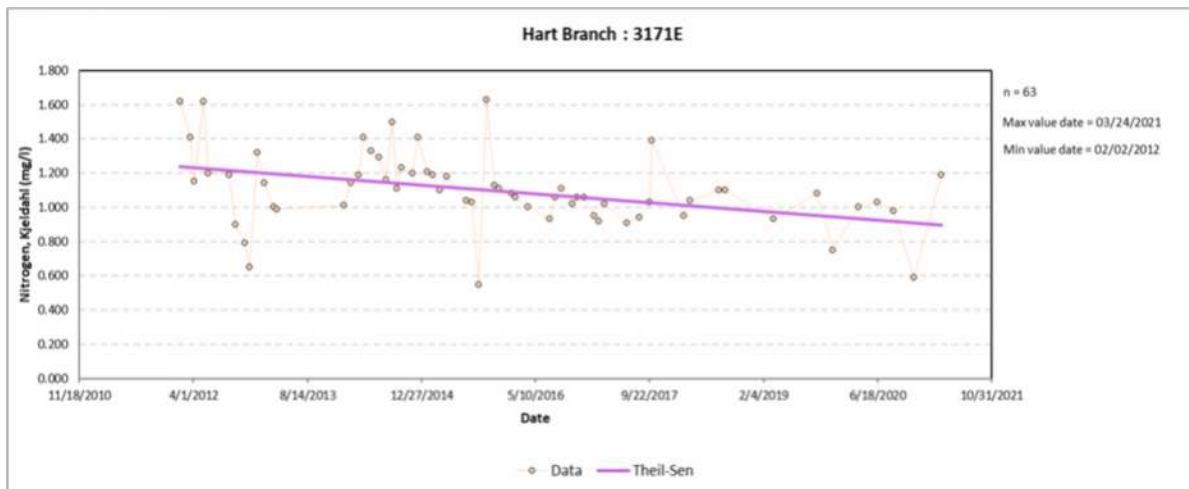


Figure 9 – Hart Branch (WBID 3173E) Total Kjeldahl Nitrogen

* It should be noted that several potential outliers were observed in the dataset. While these outliers were identified, their legitimacy was not examined further and were included in the analysis.

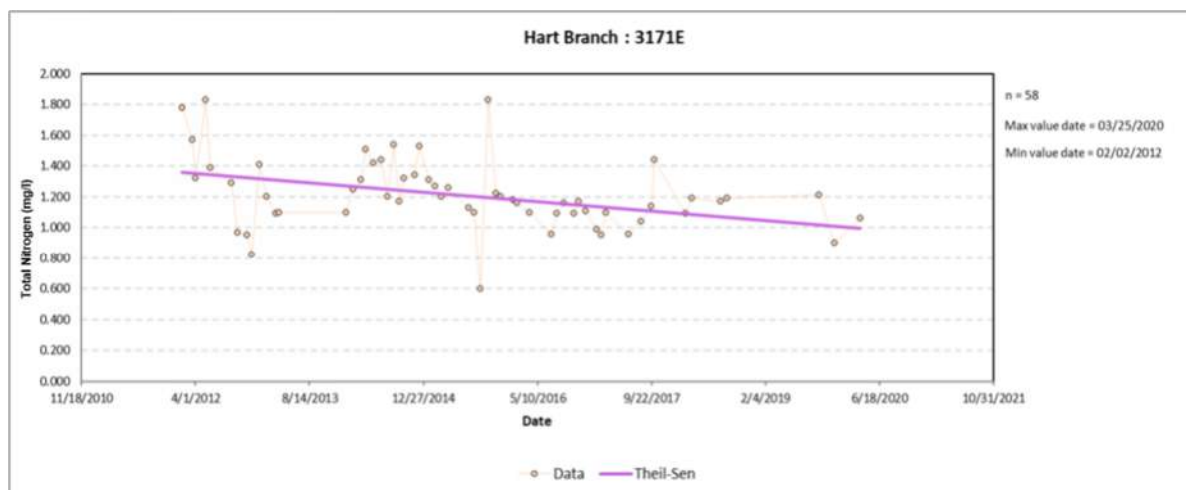


Figure 10 – Hart Branch (WBID 3173E) Total Nitrogen

* It should be noted that several potential outliers were observed in the dataset. While these outliers were identified, their legitimacy was not examined further and were included in the analysis.

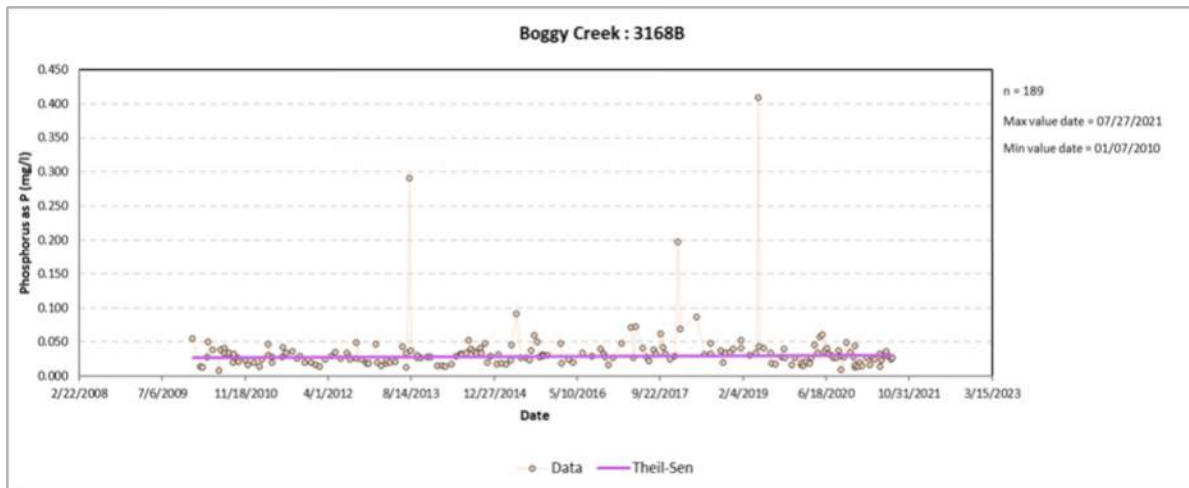


Figure 11 – Boggy Creek (WBID 3168B) Total Phosphorus

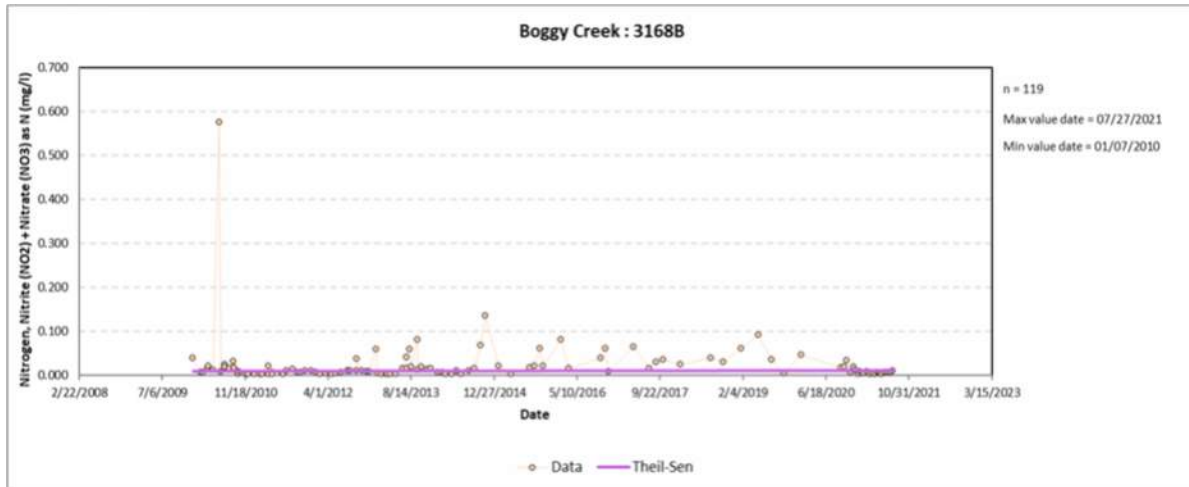


Figure 12 – Boggy Creek (WBID 3168B) Nitrite (NO₂) + Nitrate (NO₃)

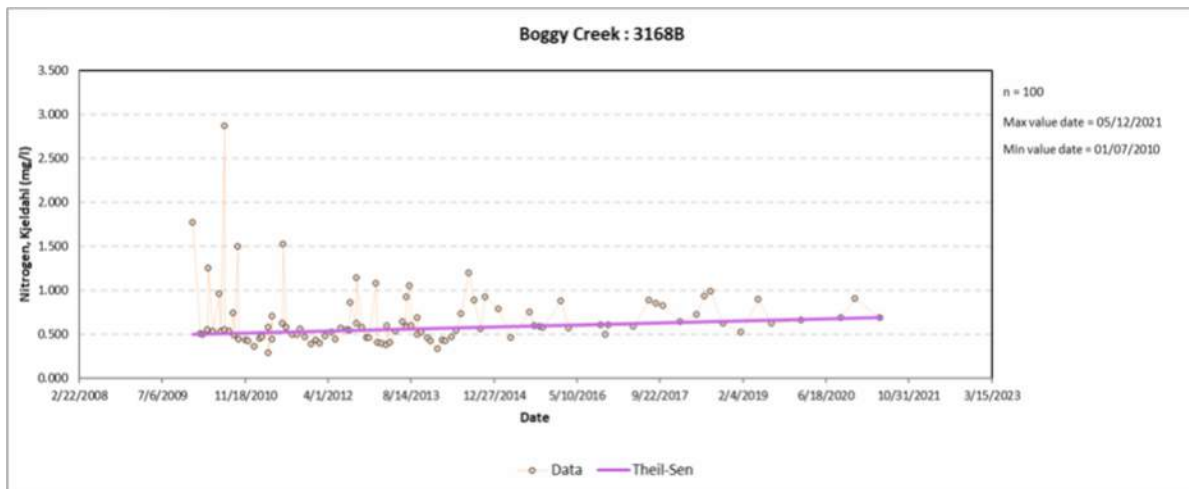


Figure 13 – Boggy Creek (WBID 3168B) Total Kjeldahl Nitrogen

* It should be noted that several potential outliers were observed in the dataset. While these outliers were identified, their legitimacy was not examined further and were included in the analysis.

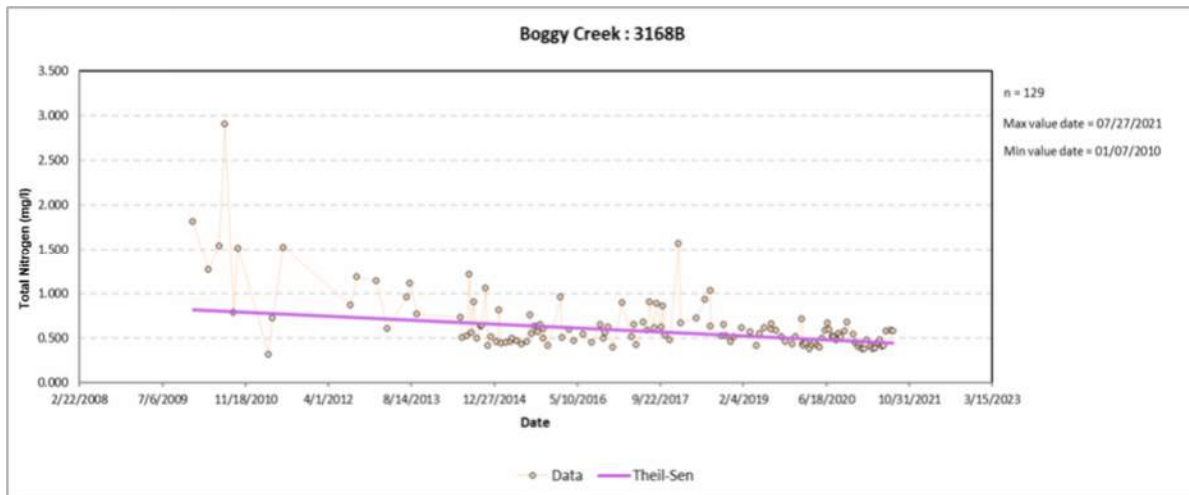


Figure 14 – Boggy Creek (WBID 3168B) Total Nitrogen

* It should be noted that several potential outliers were observed in the dataset. While these outliers were identified, their legitimacy was not examined further and were included in the analysis.

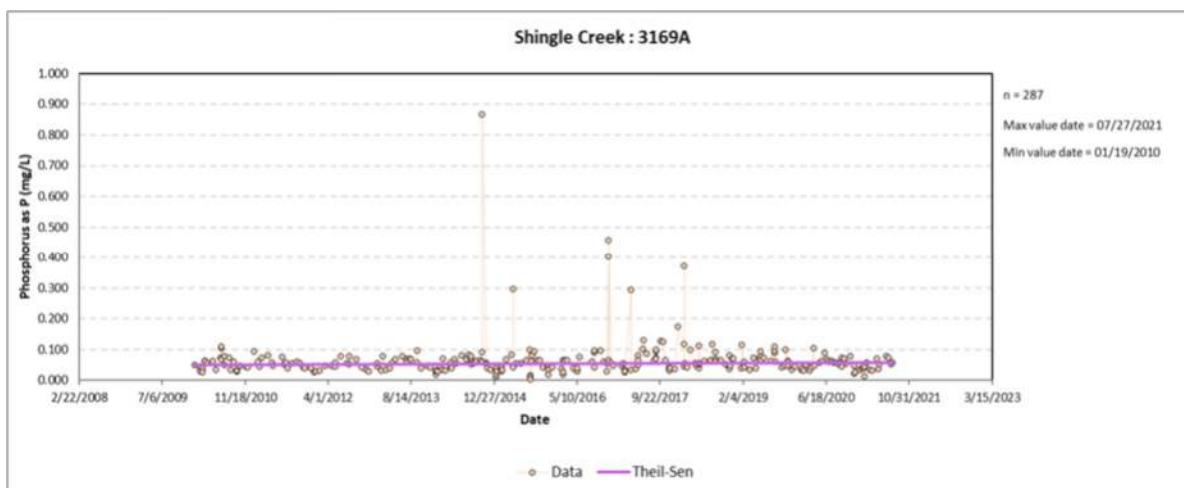


Figure 15 – Shingle Creek (WBID 3169A) Total Phosphorus

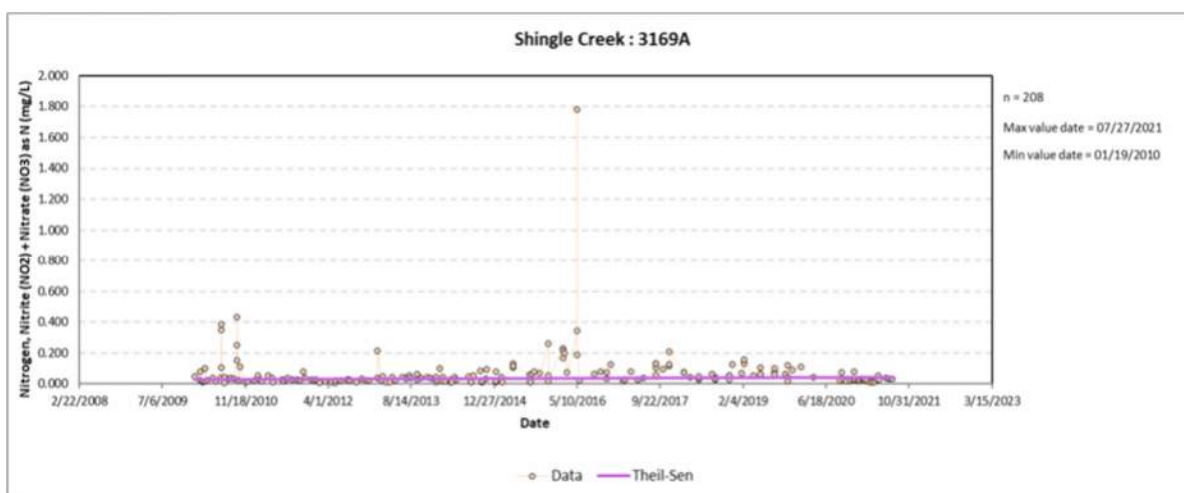


Figure 16 – Shingle Creek (WBID 3169A) Nitrite (NO_2) + Nitrate (NO_3)

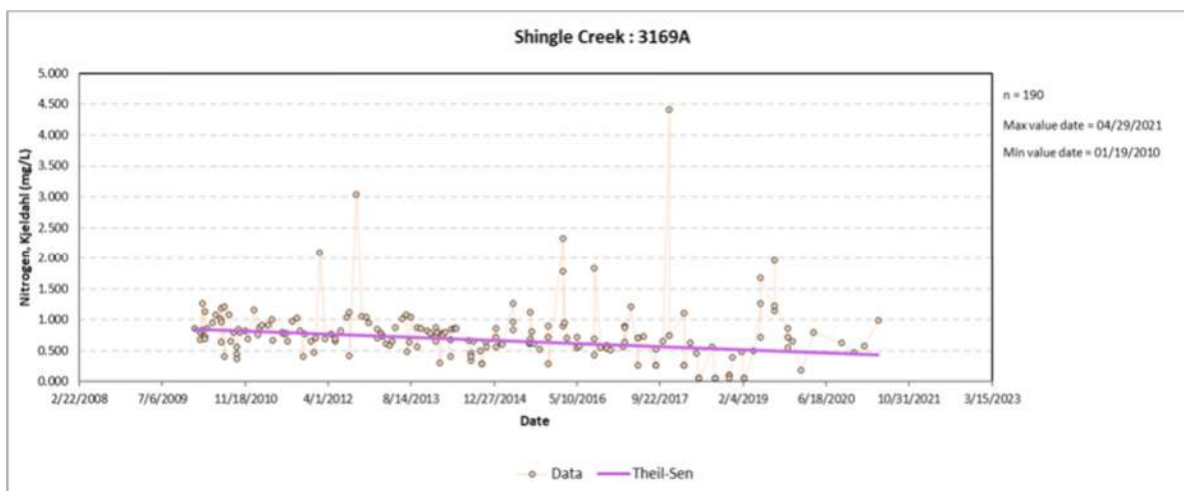


Figure 17 – Shingle Creek (WBID 3169A) Total Kjeldahl Nitrogen

* It should be noted that several potential outliers were observed in the dataset. While these outliers were identified, their legitimacy was not examined further and were included in the analysis.

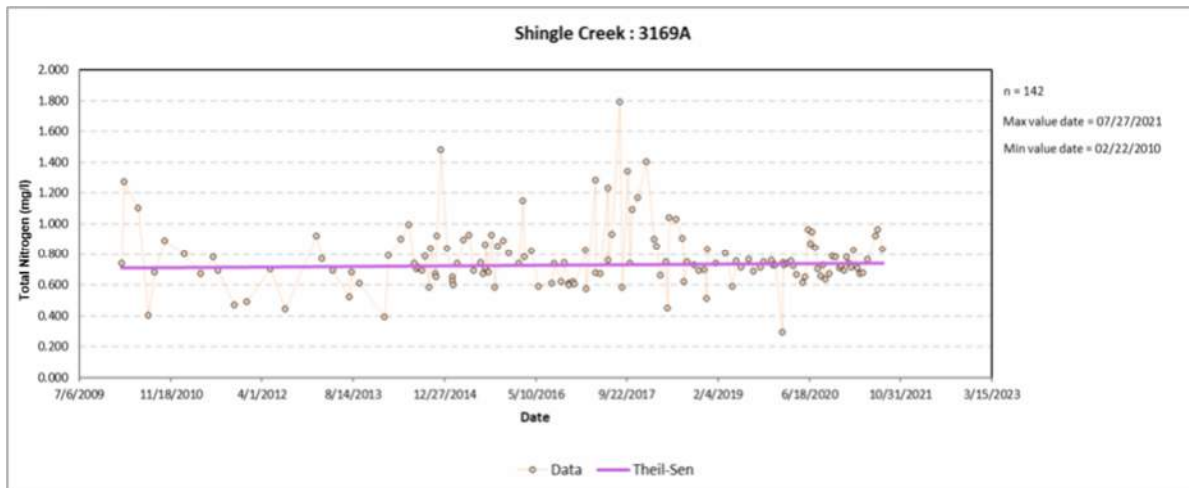


Figure 18 – Shingle Creek (WBID 3169A) Total Nitrogen

* It should be noted that several potential outliers were observed in the dataset. While these outliers were identified, their legitimacy was not examined further and were included in the analysis.

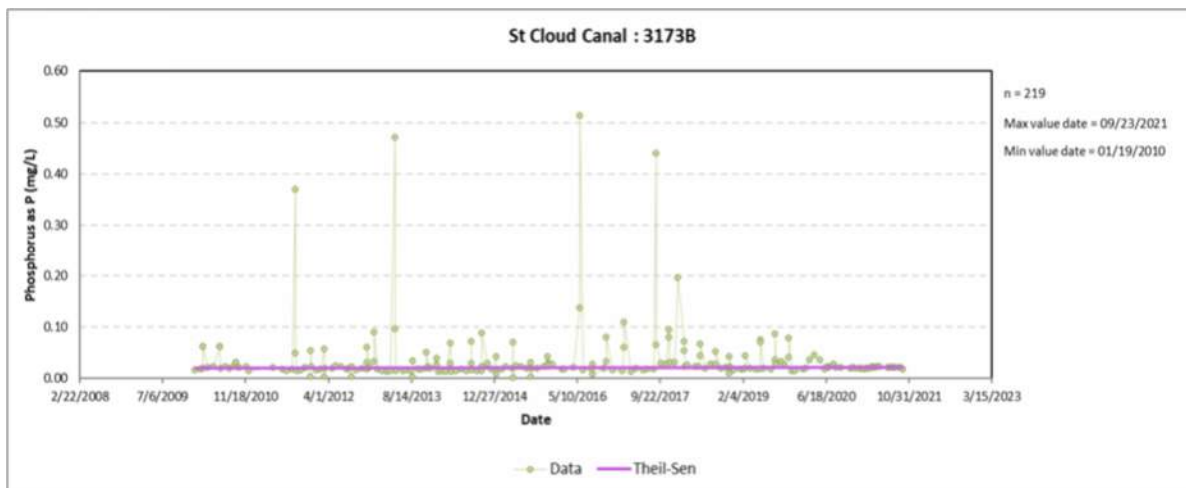


Figure 19 – St. Cloud Canal (WBID 3173B) Total Phosphorus

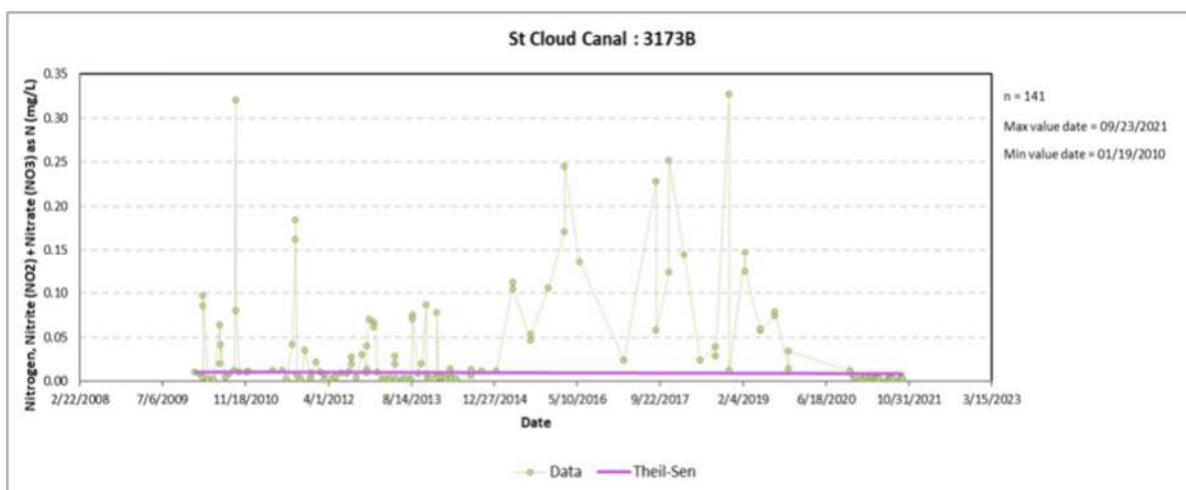


Figure 20 – St. Cloud Canal (WBID 3173B) Nitrite (NO₂) + Nitrate (NO₃)

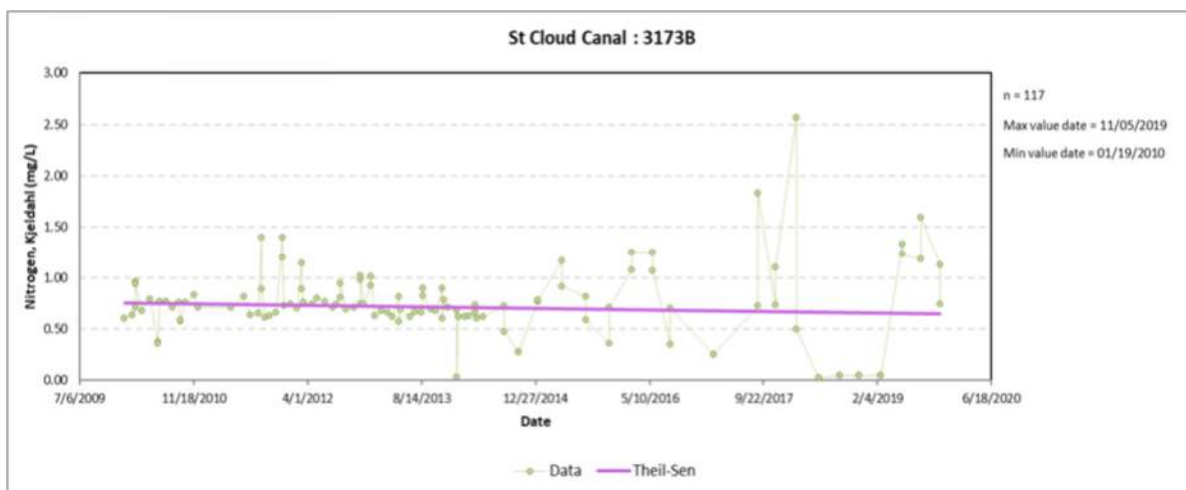


Figure 21 – St. Cloud Canal (WBID 3173B) Total Kjeldahl Nitrogen

* It should be noted that several potential outliers were observed in the dataset. While these outliers were identified, their legitimacy was not examined further and were included in the analysis.

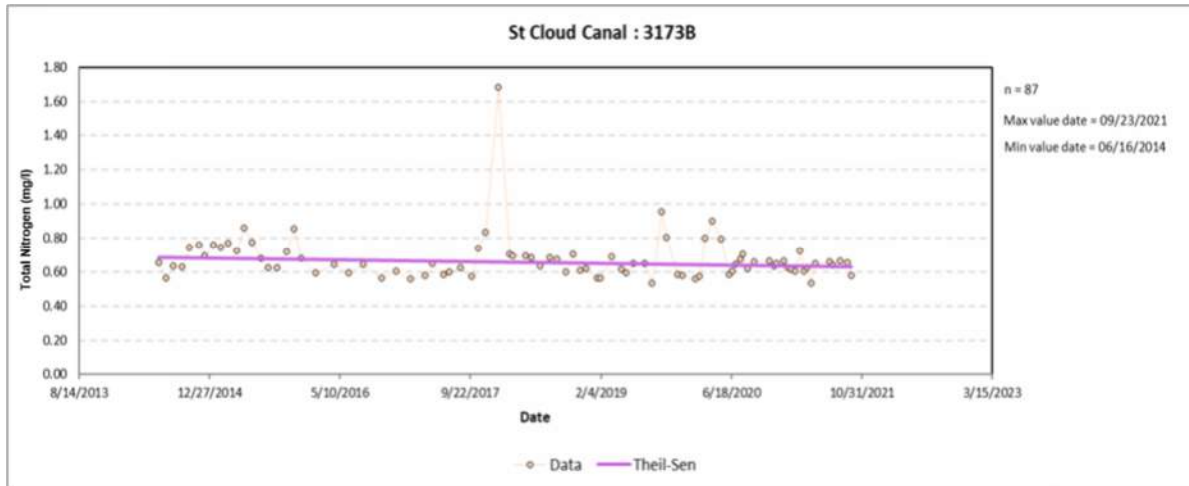


Figure 22 – St. Cloud Canal (WBID 3173B) Total Nitrogen

* It should be noted that several potential outliers were observed in the dataset. While these outliers were identified, their legitimacy was not examined further and were included in the analysis.

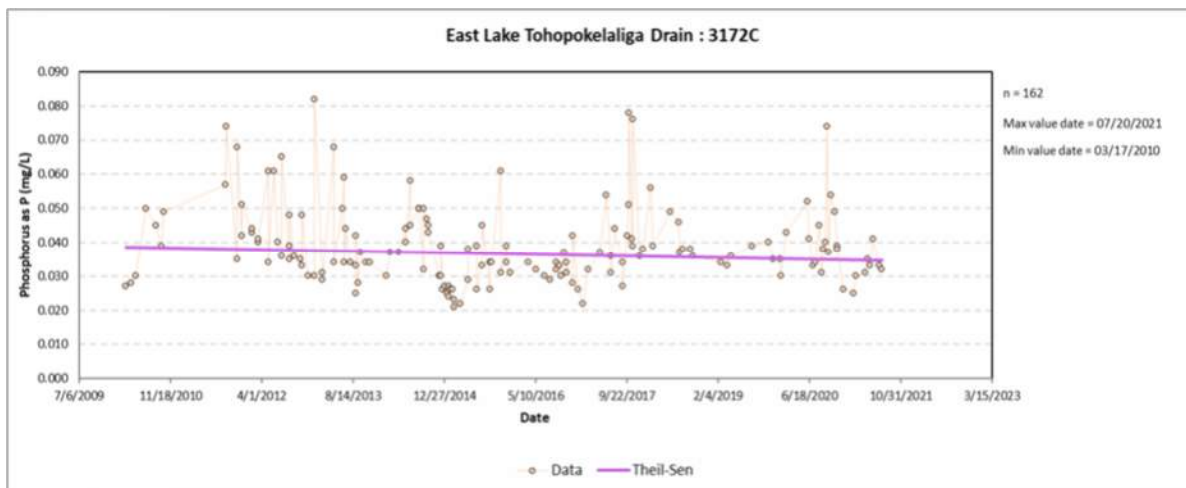


Figure 23 – East Lake Tohopekaliga Drain (WBID 3172C) Total Phosphorus

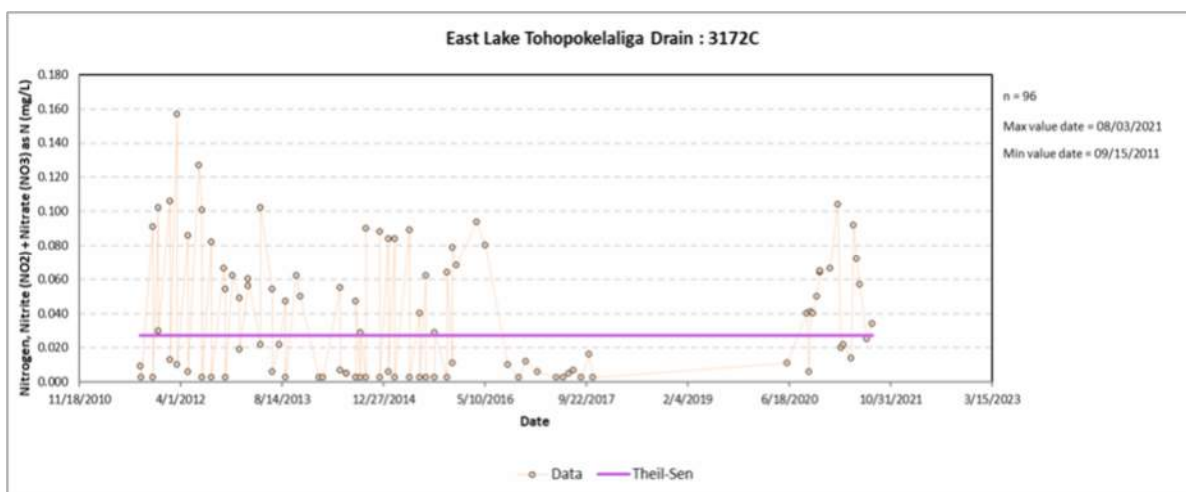


Figure 24 – East Lake Tohopekaliga Drain (WBID 3172C) Nitrite (NO₂) + Nitrate (NO₃)

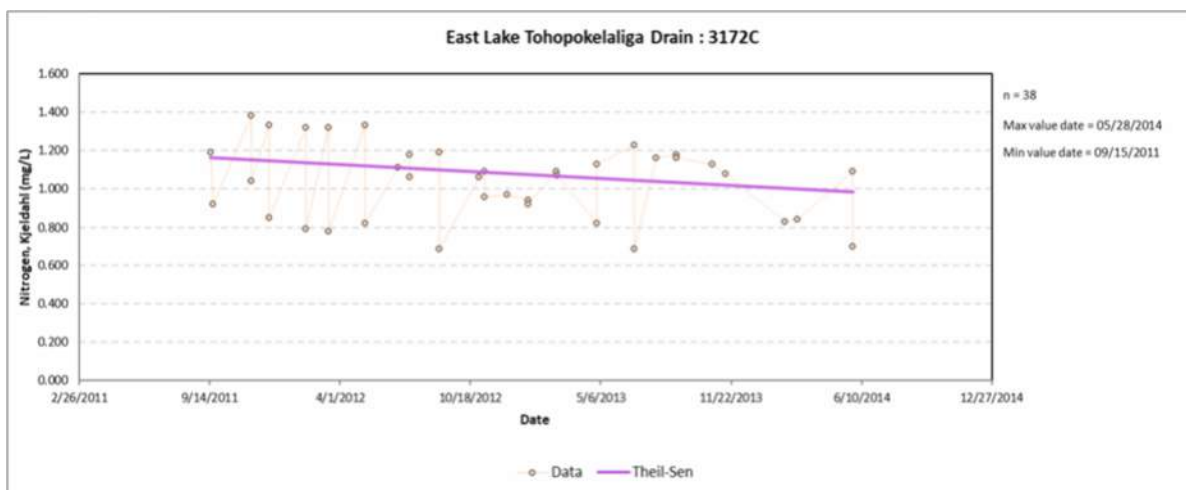


Figure 25 – East Lake Tohopekaliga Drain (WBID 3172C) Total Kjeldahl Nitrogen

* It should be noted that several potential outliers were observed in the dataset. While these outliers were identified, their legitimacy was not examined further and were included in the analysis.

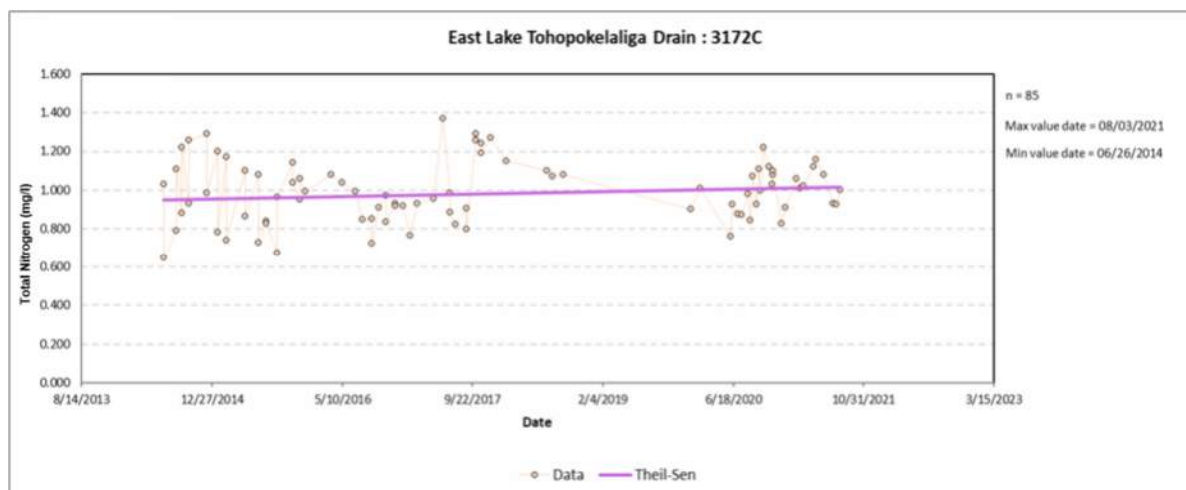


Figure 26 – East Lake Tohopekaliga Drain (WBID 3172C) Total Nitrogen

* It should be noted that several potential outliers were observed in the dataset. While these outliers were identified, their legitimacy was not examined further and were included in the analysis.

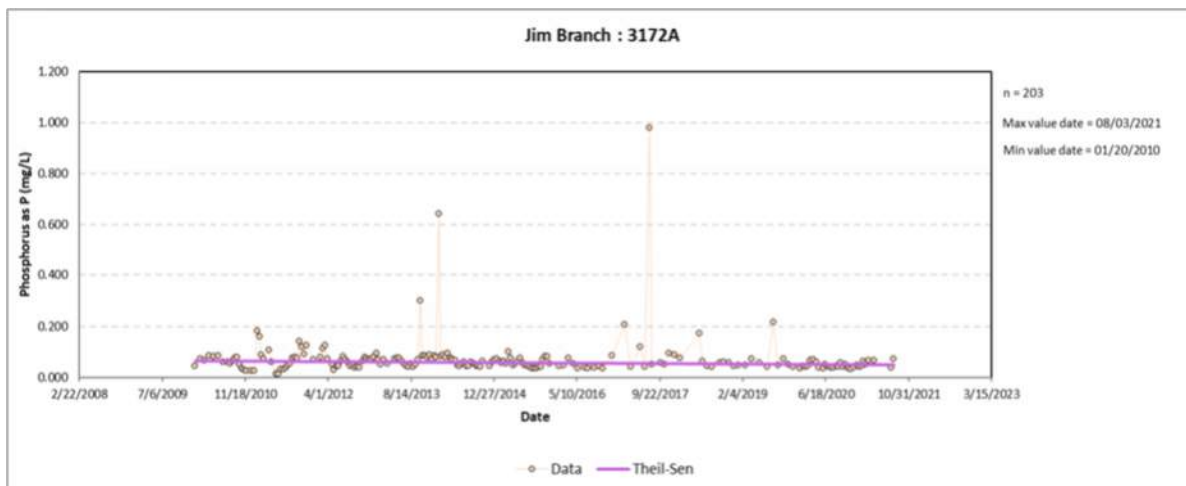


Figure 27 – Jim Branch (WBID 3172A) Total Phosphorus

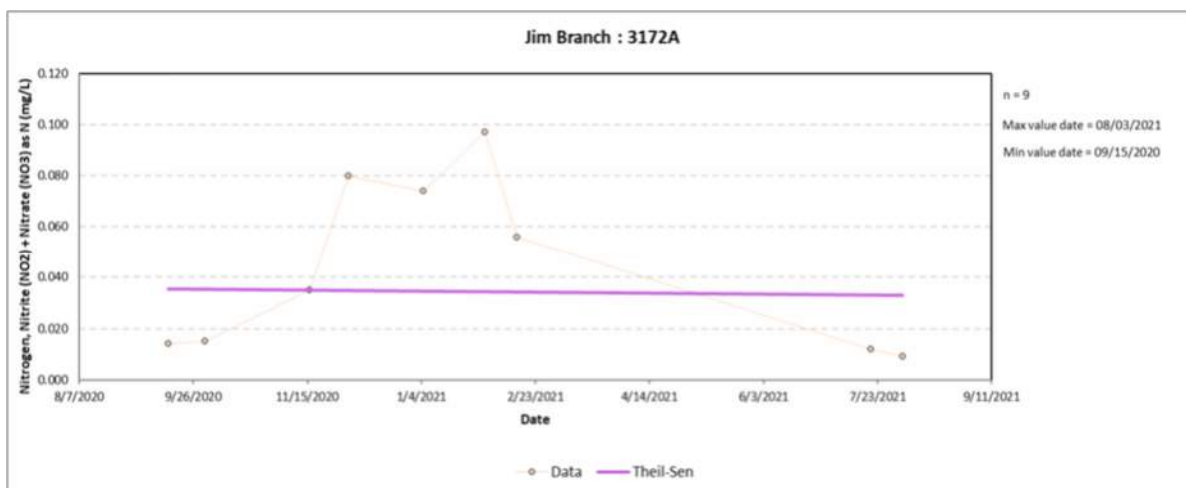


Figure 28 – Jim Branch (WBID 3172A) Nitrite (NO₂) + Nitrate (NO₃)

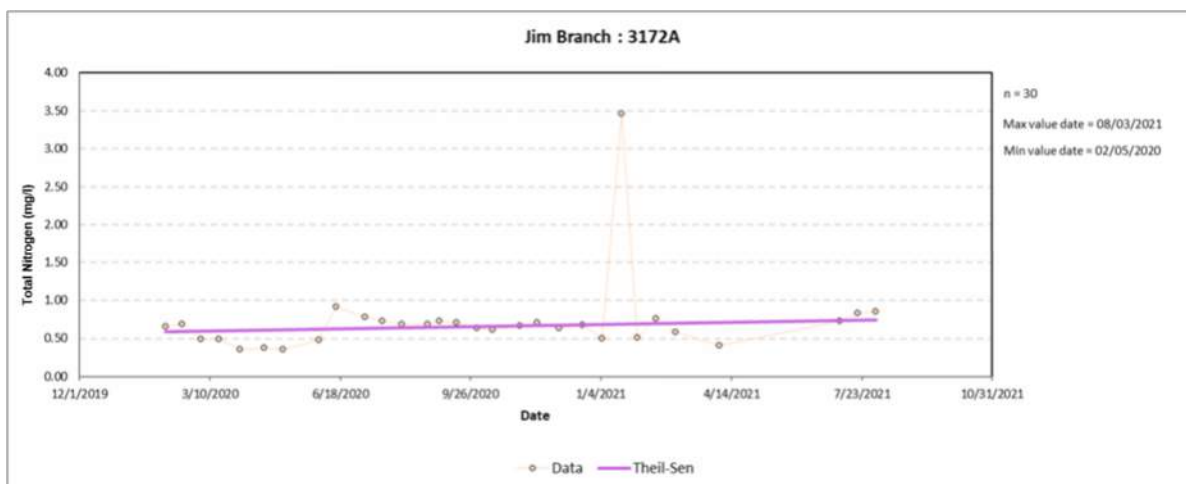


Figure 29 – Jim Branch (WBID 3172A) Total Nitrogen

* It should be noted that several potential outliers were observed in the dataset. While these outliers were identified, their legitimacy was not examined further and were included in the analysis.

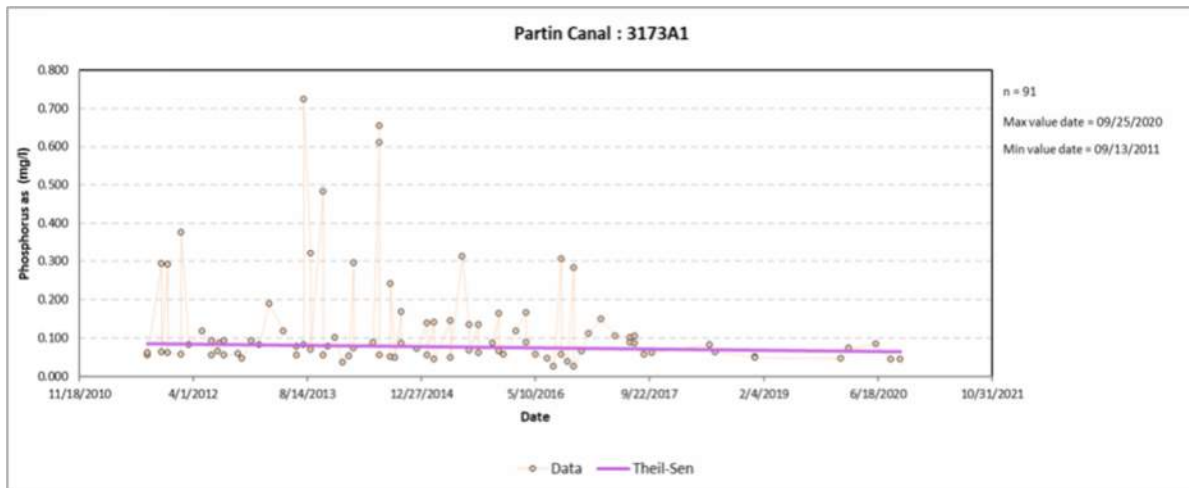


Figure 30 – Partin Canal (WBID 3173A1) Total Phosphorus

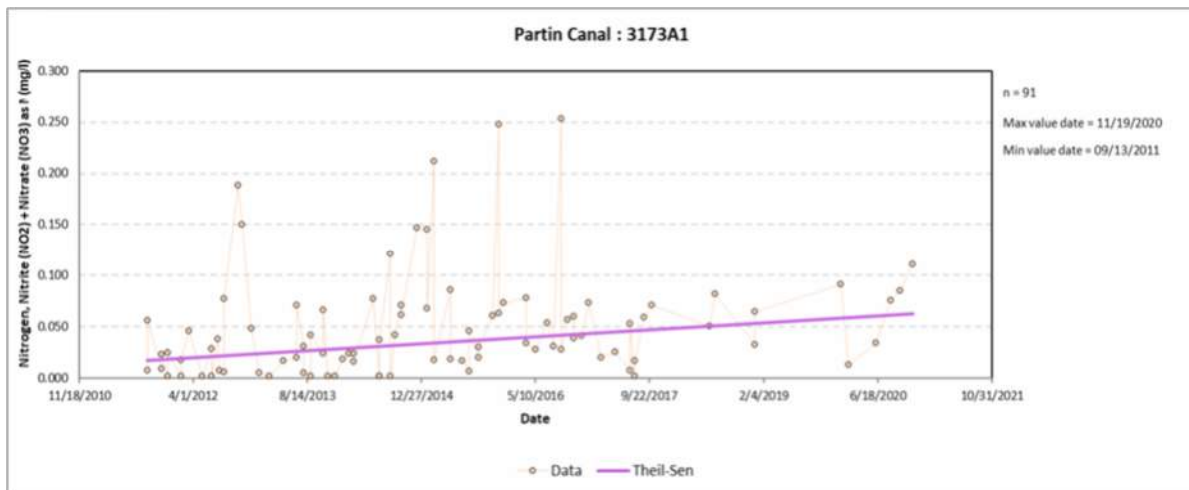


Figure 31 – Partin Canal (WBID 3173A1) Nitrite (NO₂) + Nitrate (NO₃)

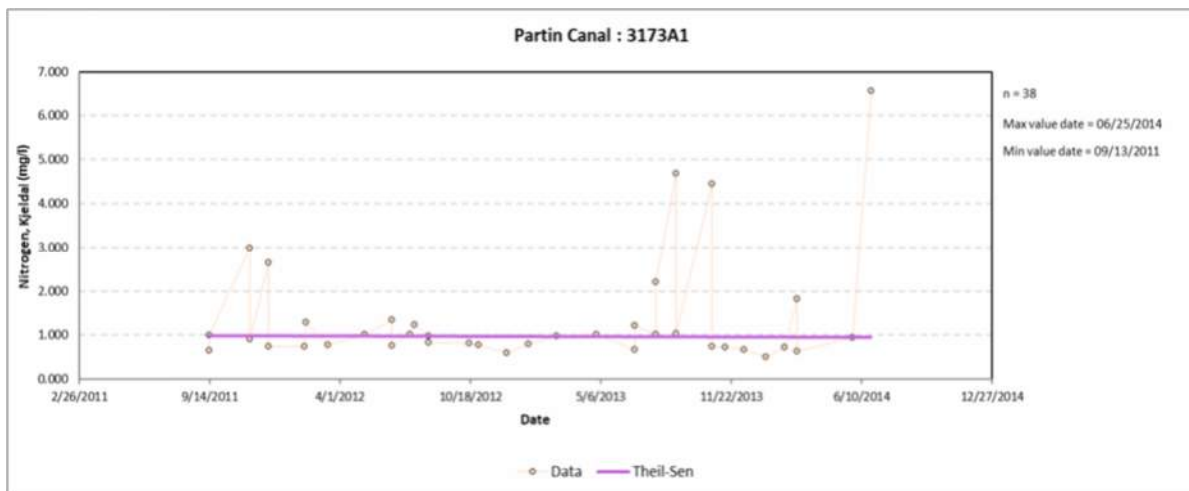


Figure 32 – Partin Canal (WBID 3173A1) Total Kjeldahl Nitrogen

* It should be noted that several potential outliers were observed in the dataset. While these outliers were identified, their legitimacy was not examined further and were included in the analysis.

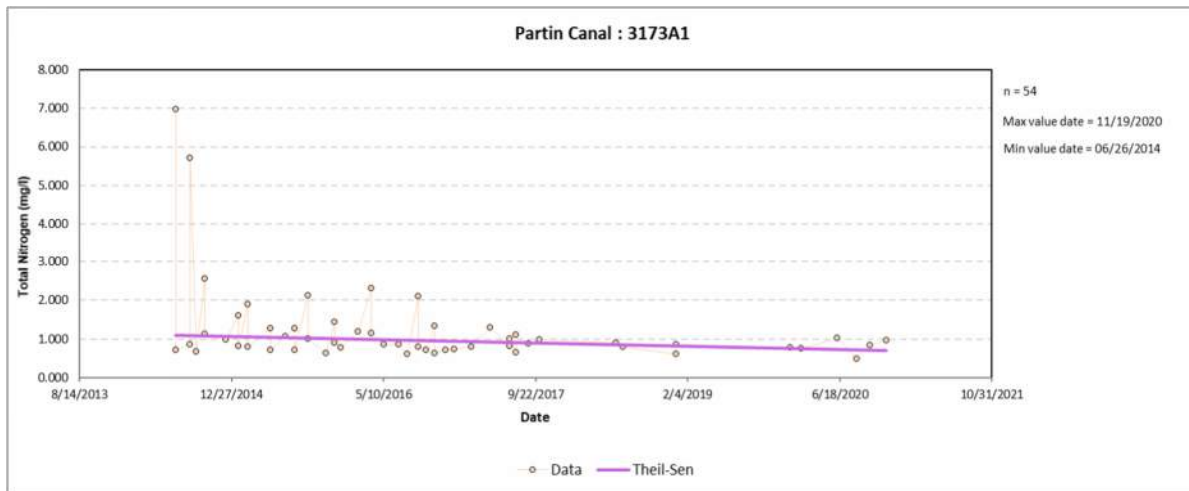


Figure 33 – Partin Canal (WBID 3173A1) Total Nitrogen

* It should be noted that several potential outliers were observed in the dataset. While these outliers were identified, their legitimacy was not examined further and were included in the analysis.

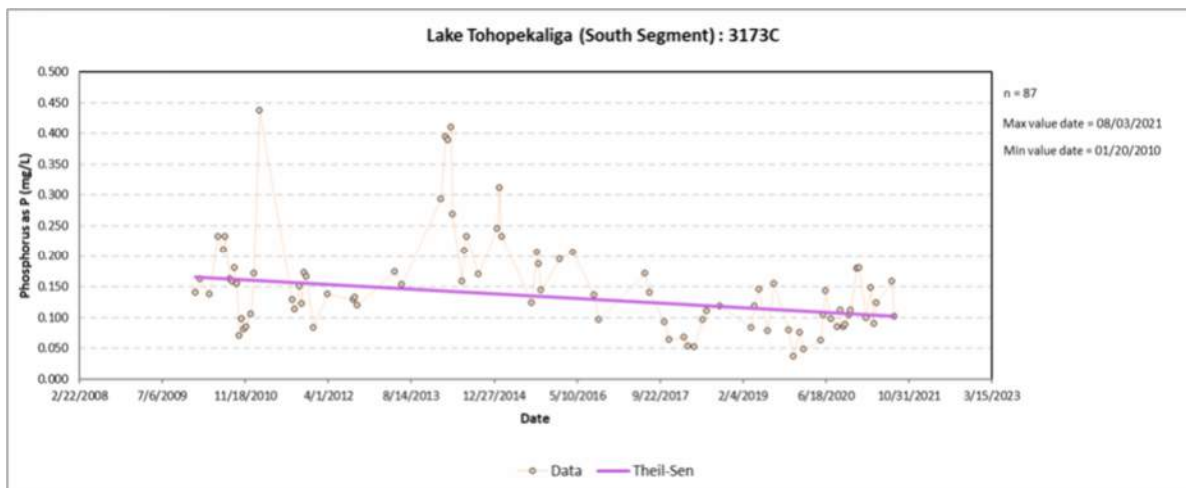


Figure 34 Lake Tohopekalgia (South Segment) (WBID 3173C) Total Phosphorus

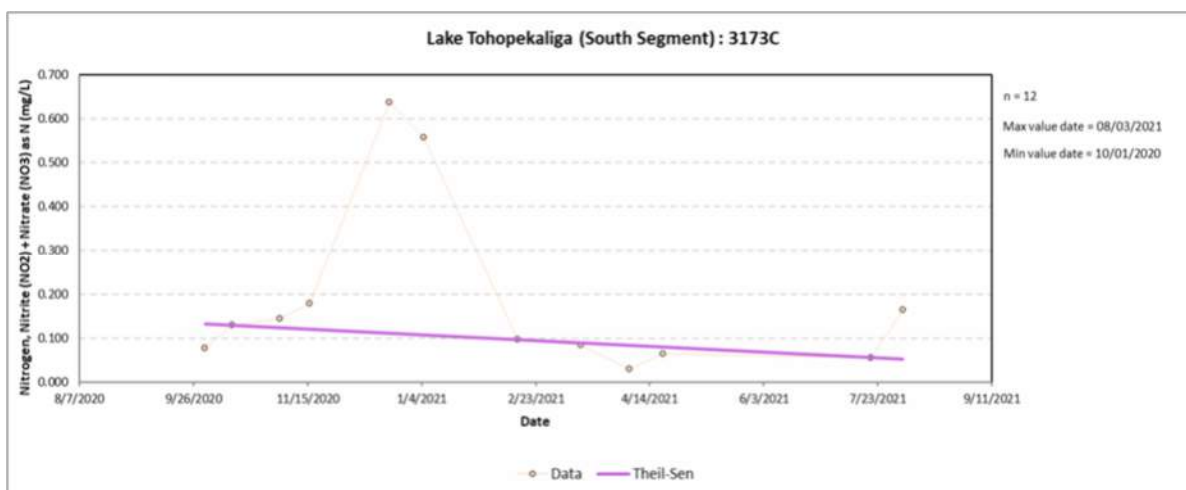


Figure 35 Lake Tohopekalgia (South Segment) (WBID 3173C) Nitrite (NO₂) + Nitrate (NO₃)

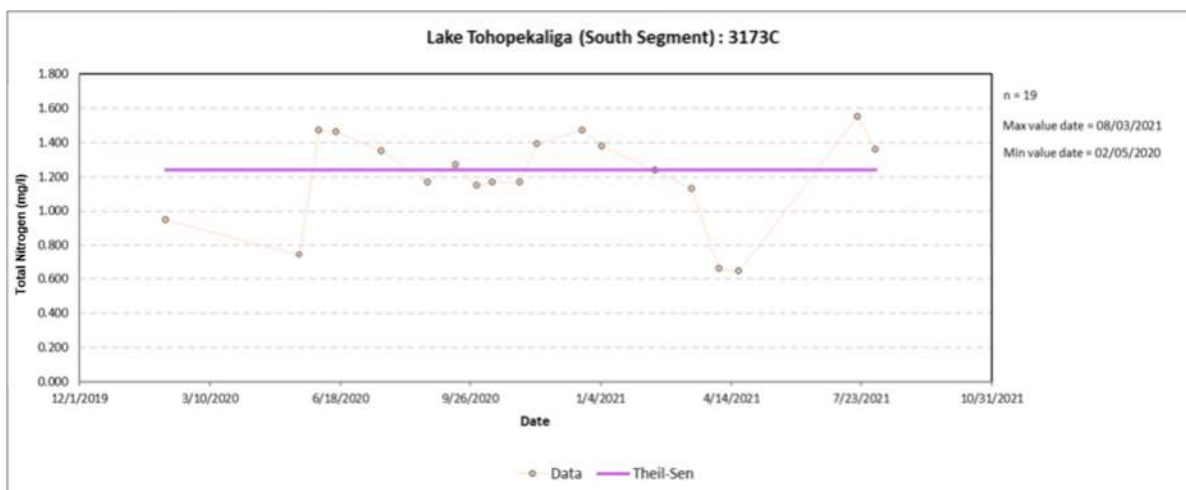


Figure 36 Lake Tohopekalgia (South Segment) (WBID 3173C) Total Nitrogen

* It should be noted that several potential outliers were observed in the dataset. While these outliers were identified, their legitimacy was not examined further and were included in the analysis.

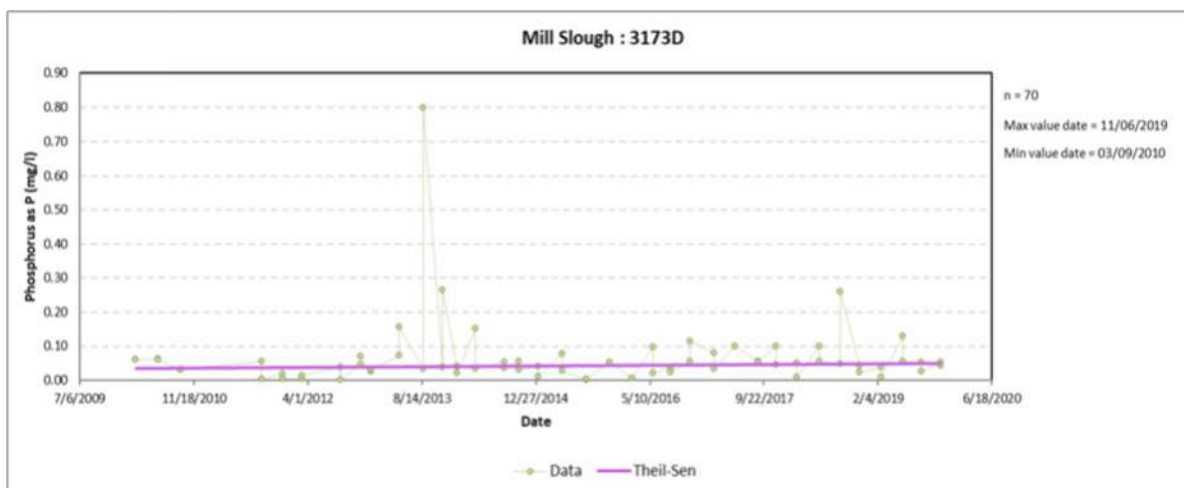


Figure 37 Mill Slough (WBID 3173D) Total Phosphorus

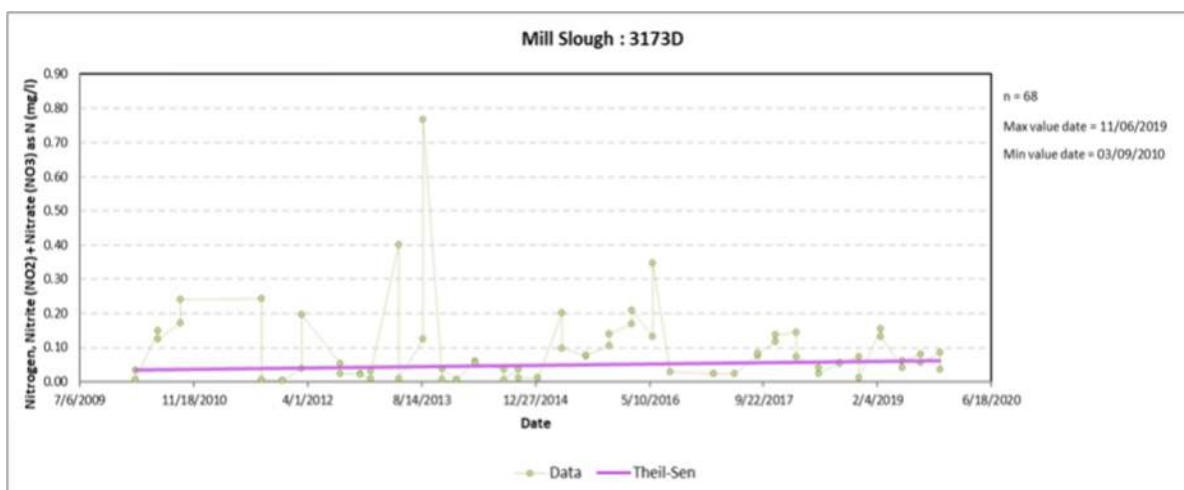


Figure 38 Mill Slough (WBID 3173D) Nitrite (NO_2) + Nitrate (NO_3)

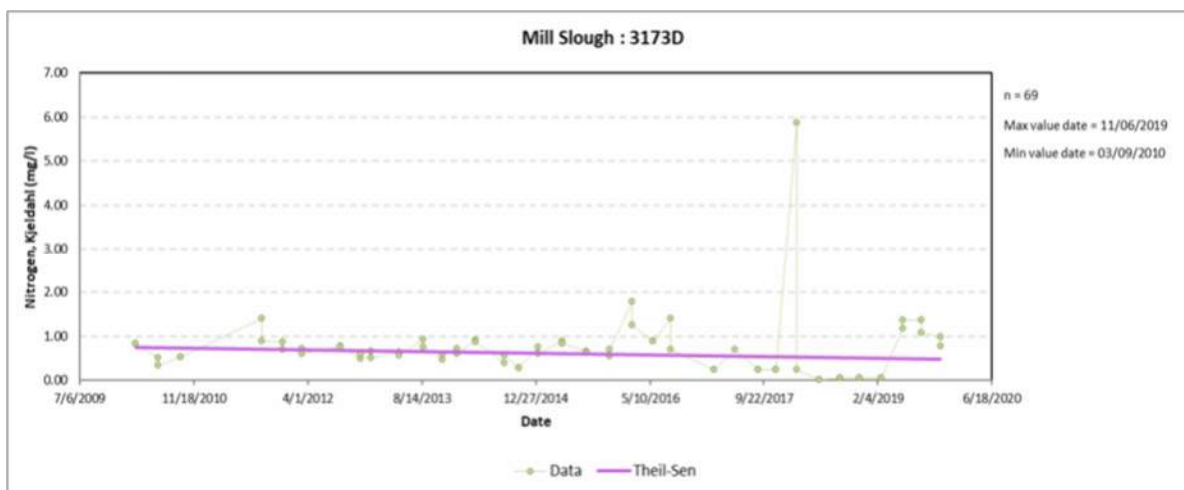


Figure 39 Mill Slough (WBID 3173D) Total Kjeldahl Nitrogen

* It should be noted that several potential outliers were observed in the dataset. While these outliers were identified, their legitimacy was not examined further and were included in the analysis.

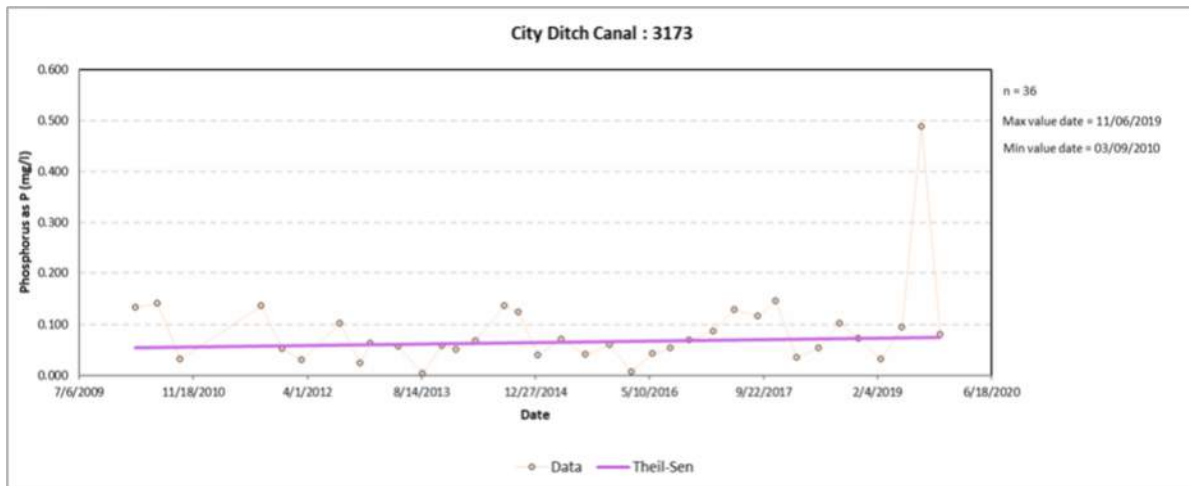


Figure 40 City Ditch Canal (WBID 3173) Total Phosphorus

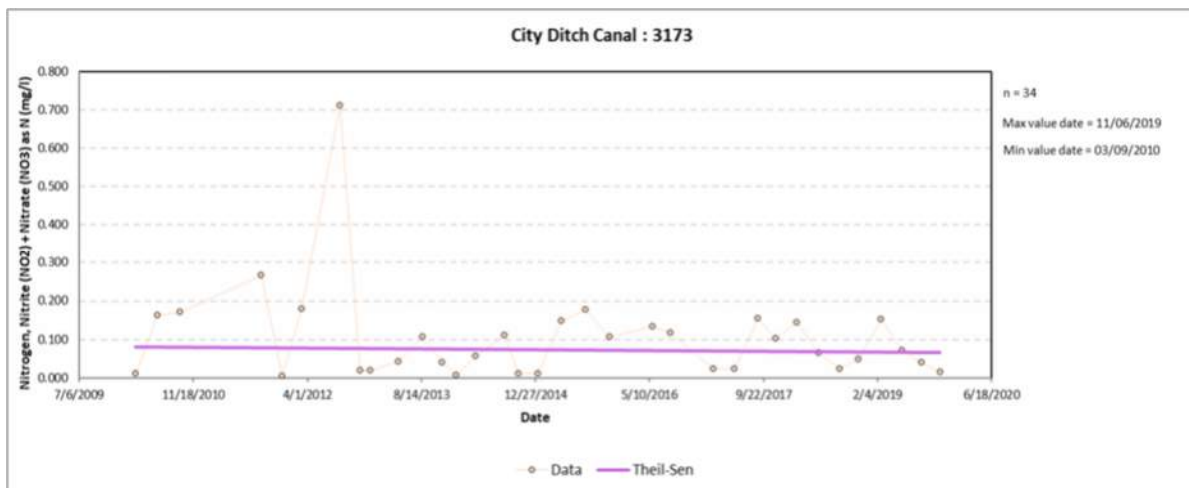


Figure 41 City Ditch Canal (WBID 3173) Nitrite (NO₂) + Nitrate (NO₃)

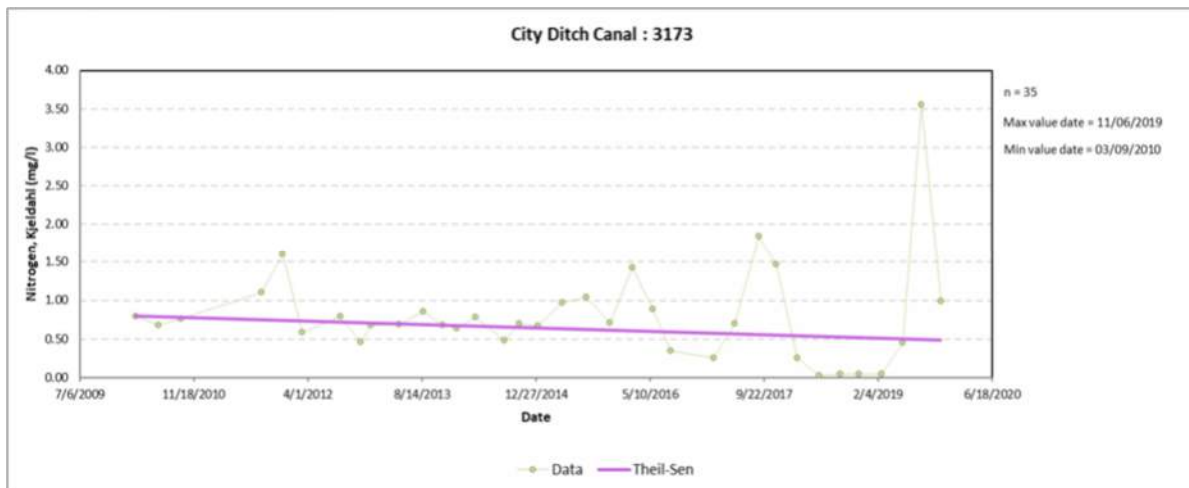


Figure 42 City Ditch Canal (WBID 3173) Total Kjeldahl Nitrogen

* It should be noted that several potential outliers were observed in the dataset. While these outliers were identified, their legitimacy was not examined further and were included in the analysis.