February 2021

Atmospheric Bulk Deposition of Nutrients

Progress Report and Reviews

Dr Wood Miller, Brigham Young University

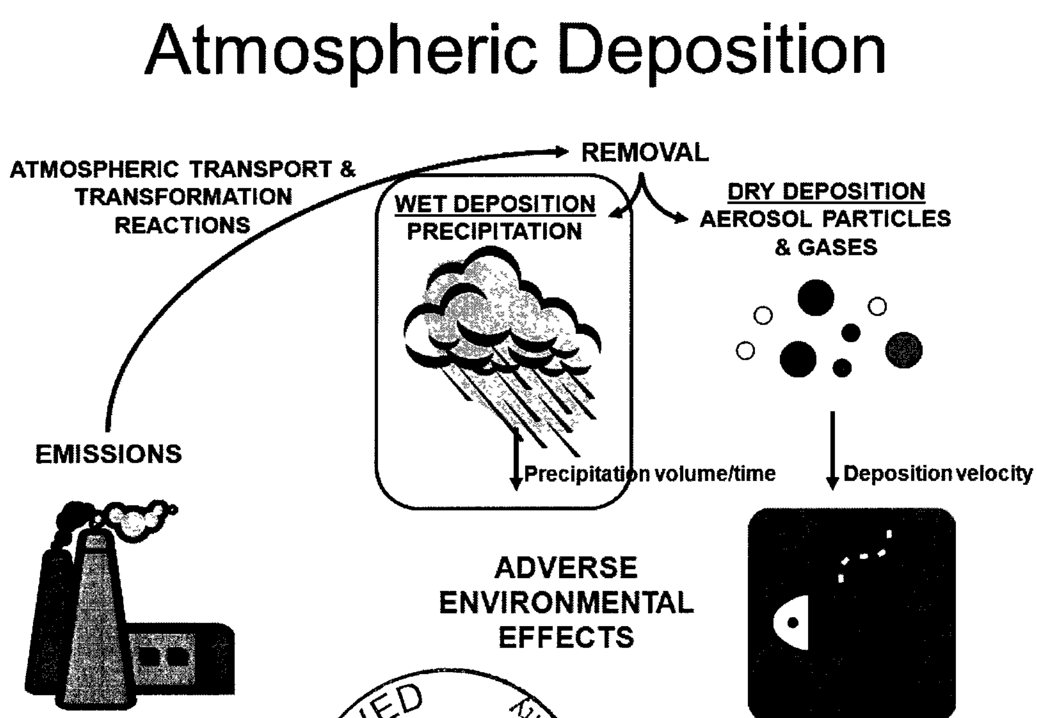
With review and collaboration from

Dr. Theron Miller, Wasatch Front Water Quality Council,

And

Dr. David Gay, National Atmospheric Deposition Program

DWQ-2021-005381



WASATCH FRONT
WATER QUALITY
COUNCIL

PROTECTING WASATCH FRONT WATERS THROUGH COLLABORATIVE, APPLIED RESEARCH

RECEIVED
MAR 23 2021
Utah D... Water Quality

March 15, 2021

Utah Division of Water Quality
195 North 1950 West
PO Box 144870
Salt Lake City, UT 84114-4870
Attention: Mr. James Harris, Assistant Director

DWQ-2021-005381

Subject: Atmospheric Bulk Deposition of Nutrients
Progress Report and Reviews—February 2021

Dear Mr. Harris:

The Wasatch Front Water Quality Council (WFWQC) is pleased to present the accompanying *Atmospheric Bulk Deposition of Nutrients- Progress Report and Reviews- February 2021* (hereinafter the "Progress Report") which provides an update on the status, sampling protocols, data and current conclusions developed with regard to atmospheric bulk deposition of nutrients to Utah Lake. The Progress Report includes an updated interim report by Dr. Wood Miller (BYU), a third-party review of Dr. Wood Miller's update by Dr. David Gay (National Atmospheric Deposition Program), a response to Dr. Gay's comments by Dr. Miller, and a revised set of comments from Dr. Gay addressing Dr. Miller's response.

The updated interim report by Dr. Wood Miller presents new sampling data for TP, TN and Ortho-P at nine sampling sites and includes computed loading rates (tons/year) to Utah Lake. Annual TP load to Utah Lake is reported between 50.2 and 77.1 tons/year, depending upon truncation of outlier data. Annual OP load is reported at 24.9 tons/year. Annual TN load to Utah Lake is reported between 249.2 and 316.0 tons/year, again depending upon truncation of outlier data. The interim report also presents seasonal variability and trending in the reported precipitation, concentration and load data at the nine sampling sites around Utah Lake.

Dr. Gay's review of the interim report concludes it to be straightforward and scientifically credible, but offers thoughtful concerns and suggestions related to better use of the NWS gage samplers, suggested calculation methods for determining more accurate deposition flux, selected precipitation data, and use of the Mann Kendal Seasonal test for better trend analyses. He offered minor questions related to some data at specific sampling sites.

Dr. Miller's response to Dr. Gay's comments includes a more detailed precipitation weighted load computation of TP and TN deposition flux, clarifies selection of 12.0 inches as the annual precipitation over Utah Lake, applies the Mann Kendall Test to the nutrient data for trend analyses, and addresses Dr. Gay's minor questions related to sampling protocols and some data at specific sampling sites. Dr. Miller also introduced wind rose data and nutrient data outliers to potential dry-depositional nutrient load correlation with major wind events for consideration.

Dr. Gay's revised report comments suggest computation of total nutrient load using weekly concentration and precipitation data, but with use of a Precipitation Weighted Mean Concentration (PWMC) value where concentration data is missing. He positively acknowledges Dr. Miller's responses to his other previous comments, and introduces application of the NOAA HYSPLIT atmospheric air movement model to clarify sources of atmospheric soil movement over previously-occurring wind events.

WFWQC requests that DWQ disseminate the accompanying Progress Report to the Utah Lake Science Panel for their information. WFWQC appreciates your attention to this request. Please direct any written comments via email to Dr. Wood Miller at wood_miller@byu.edu and to Dr. Theron Miller (WFWQC) at theron.miller12@gmail.com with copy to Mr. Leland Myers, Executive Director at lelandmyers@gmail.com.

Kind regards,

Thomas A. Holstrom, P.E.

Enclosure
cc. Dr. Wood Miller, BYU
Dr. Theron Miller, WFWQC
Mr. Leland Myers, WFWQC Executive Director

Progress Report Sections:

Section 1

Updated Interim Report on Nutrients in Precipitation on Utah Lake – Dr Wood Miller

Section 2

Updated Report Review – Dr. David Gay

Section 3

Revised Report Responding to Comments – Dr. Miller

Section 4

Revised Report Comments - Dr. Gay

Section 1

Updated Interim Report on Nutrients in Precipitation on Utah Lake – Dr Wood Miller

Updated Interim Report on Nutrients in Precipitation on Utah Lake
July 2020 - Wood Miller

I think it's time to submit another update to my interim report on the bulk deposition of nutrients to Utah Lake. I have collected more than **100 new samples** since my last update. I have also **added loading rates** (tons/year) on the lake to the evaluations. There are new and different average TP and TN concentrations and loading rates for each of the 9 locations and there are new and updated overall averages.

About a year ago, I also **added Ortho-P** to the sample analysis. There are now also concentrations and loading rates for OP. And I have determined and reported the **OP / TP ratios** as percentages. These ratios indicate what percentage the OP is of the TP.

I have included several tables and figures in this updated report. These are in the Appendix in the order they are referred to in the text. There are probably too many tables & figures to study, even glance at. I apologize, but I wanted to show most everything I have, if there's interest.

The purpose of this study remains the same; to evaluate the impact of atmospheric deposition of phosphorus and nitrogen onto the surface of the lake. This contribution of TP and TN to the nutrient budget is not insignificant. We have found that the phosphorus in the rain on the lake alone is likely enough phosphorus to keep the lake eutrophic and produce algae blooms.

We have collected precipitation samples from the rain and snow storms for more than 3 years at 9 locations around Utah Lake. I have made more than 50 sampling trips. Over 400 samples have been obtained and they have been analyzed for Total Phosphorus, Ortho Phosphorus, and Total Nitrogen concentrations at Chemtech-Ford Lab; all the analysis done at no charge.

I have developed a large spreadsheet with all the Utah Lake precipitation phosphorus and nitrogen data for the study of atmospheric deposition on the lake. I have summarized much of the data in the spreadsheet into Tables 1a, 1b and 1c which give TP, OP and TN averages at all 9 locations and the overall summary averages. These 3 tables are given in the Appendix.

Figures 1a – 1c respectively show all months', summer months' and winter months' TP averages from Table 1a. Each figure shows average TP concentrations for all data, data < 5 mg/l, data < 1 mg/l, and for Ortho-P data at each of the 9 locations. As shown in Figures 1d – 1f, I also plotted OP and only TP < 5 mg/l concentrations to better define the contrast. These are shown in the 3 figures for all months, summer months and winter months, respectively.

Figures 1g – 1i respectively show all months', summer months' and winter months' TN averages from Table 1c. Each figure shows average TN concentrations for all data and data < 10 mg/l at each location. Notice; the average TP, OP and TN concentrations are quite different at the different locations. All these 9 figures are in the Appendix.

We also determined the **loading rates** (tons/year) of TP, OP and TN. Loads were calculated using an average annual precipitation of 12 inches and a typical lake area of 83,800 acres. Figure 1j shows the TP loads for all months, summer months, and winter months, and loads for all data, data < 1 mg/l and data < 5 mg/l, and OP loads for all months, summer months, and winter months. These 3 OP loads are shown alone for more detail in Figure 1k. Finally, Figure 1l shows the TN loads for all months, summer months, and winter months, and loads for all data and data < 10 mg/l. These 3 figures are also in the Appendix.

Here are a few of the TP results in Table 1a. The average concentrations and loading rates of all the TP samples, no outliers, are 0.68 mg/l & 77 T/yr, with 0.96 mg/l & 54 T/yr in summer and 0.32 mg/l & 19 T/yr in winter. For TP < 5 mg/l, 14 outliers, the averages are 0.44 & 50, with 0.58 & 33 in summer and 0.27 & 15 in winter, and for TP < 1 mg/l, 63 outliers, the averages are 0.22 & 25, with 0.27 & 15 in summer and 0.18 & 10 in winter.

Summer TP concentrations are higher than the all-months concentrations, and winter TP concentrations are lower than the all-months concentrations. Summer overall averages are about 2 or 3 times higher than winter overall averages. The individual locations' TP summer averages are as much as 4 or 5 times higher than winter averages.

As far as outliers are concerned, TP < 1 mg/l values are most conservative, but this arbitrary cutoff for outliers is likely too low. There is the distinct possibility of having reasonable TP concentrations larger than 1 mg/l. Often the rain collected is dirty, particularly during and after a dusty windstorm, which is common. Therefore, we also evaluated all TP values < 5 mg/l.

The highest < 1 mg/l TP concentrations are 0.34 and 0.31 mg/l at Elberta and Mosida, south and west of the lake. Most rain storms, along with dust storms, come from the southwest. The lowest < 1 mg/l TP concentrations are 0.09 and 0.13 mg/l at BYU and Spanish Fork, east and away from the lake. The high concentrations are ~ 3 times higher than the low concentrations.

Table 1b shows average concentrations and loadings of Ortho-P samples based on only 1 year of data. Values for all months are 0.22 mg/l & 25 T/yr, with 0.30 mg/l & 58 T/yr in summer and 0.09 mg/l & 44 T/yr in winter. The highest OP concentrations are 0.75 and 0.40 mg/l at Mosida and Lincoln Pt. The lowest OP concentrations are 0.01 and 0.08 mg/l at BYU and Spanish Fork, east and away from the lake. The highest values are several times higher than the lowest.

Table 1b also shows the ratios, expressed as percentages, of Ortho-P to Total-P. These ratios indicate what percentage the OP is of the TP. The ratios are for all OP data compared to all TP data, to TP < 1 and to TP < 5 mg/l, and for all months, summer months, and winter months. The ratios at different locations are extremely variable, but overall averages are around 30% for all data, around 40% for TP < 5, but between 40 & 90% for TP < 1 mg/l.

Here are a few of the TN results from Table 1c. The average concentrations and loading rates of all the TN samples, no outliers, are 2.77 mg/l & 316 T/yr, with 3.15 mg/l & 180 T/yr in summer and 2.28 mg/l & 130 T/yr in winter. For TN < 10 mg/l, 13 outliers, the averages are 2.19 & 249, with 2.32 & 132 in summer and 1.81 & 103 in winter.

Summer TN concentrations are generally slightly higher than the all-months concentrations, and winter TN concentrations are generally slightly lower. The summer TN averages are generally only slightly higher than the winter averages, but not higher in all cases.

The highest < 10 mg/l TN concentrations are 2.89, 2.55 and 2.49 mg/l at Elberta, Lehi and Mosida, mostly in the southern part of the lake. The lowest < 10 mg/l TN concentrations are 1.47 and 1.69 mg/l at Spanish Fork and Genola, east of the lake. These results are quite different from the TP and OP results. High concentrations are not much larger than low concentrations.

I also developed Tables 2 – 10 as separate tables with all the sample data and all averages for each of the 9 locations. Each table is followed by 6 time-series plots which show the dates and concentrations in the tables. The tables and figures also show the concentrations without some outliers. For TP values, outliers are > 5 and > 1 mg/l, and for TN values, outliers are > 10 mg/l. The OP concentrations are also plotted. These tables and figures, lots of them, are all given in the Appendix.

The 3 TP and 2 TN figures for each of the 9 locations show time **trend** lines over 3 plus years for all TP data, TP < 5, and TP < 1 mg/l, and for all TN data and TN < 10 mg/l. For TP < 5, probably the most reasonable data, there are 2 trend lines decreasing, 1 increasing, 2 slightly increasing, and 4 flat over time. For TN < 10, most reasonable, there are 3 trends decreasing, 4 slightly decreasing, and 2 flat; TN mostly decreasing over time. See the table of trends below.

The final figures below each table are the Ortho-P plots for the 9 locations which show the trends over only 1 year, which may be too short for significant trends. For OP concentrations there are 4 trend lines slightly decreasing, 2 strongly increasing, and 3 flat over time.

Table of Trends for TP, OP and TN

Location	**TP < 5 mg/l**	**TN < 10 mg/l**	**Ortho-P**
BYU	decreasing	flat	flat
Lincoln Pt.	sl. increasing	decreasing	sl. decreasing
Pelican Pt.	increasing	sl. decreasing	flat
Genola	decreasing	decreasing	sl. decreasing
Elberta	flat	sl. decreasing	str. increasing
Mosida	flat	sl. decreasing	sl. decreasing
Lehi	sl. increasing	sl. decreasing	str. increasing
Orem	flat	decreasing	flat
Spanish Fork	flat	flat	sl. decreasing

That's the update to my interim report on the bulk deposition of nutrients to Utah Lake. I trust you will look at the tables and figures. Let me know is you have comments and questions.

Table 1a. Averages at all 9 locations for all phosphorus samples for the whole year and for summer (Apr-Sept) and winter (Oct-

Location	Total Phos (mg/l) **all data**	Total Phos (mg/l) **summer**	Total Phos (mg/l) **winter**	Total Phos (mg/l) **TP < 1**	Total Phos (mg/l) **summer**	Total Phos (mg/l) **winter**	Total Phos (mg/l) **TP < 5**	Total Phos (mg/l) **summer**	Total Phos (mg/l) **winter**	all TP samples	TP outliers >1 mg/l	>5 mg/l
BYU	0.09	0.12	0.08	0.09	0.12	0.08	0.09	0.12	0.08	47	0	0
Lincoln Pt	1.04	1.62	0.45	0.23	0.35	0.13	0.51	0.78	0.24	51	12	4
Pelican Pt	0.74	0.75	0.74	0.23	0.23	0.24	0.43	0.41	0.44	43	7	2
Genola	1.21	1.93	0.20	0.22	0.25	0.20	0.44	0.65	0.20	48	10	5
Elberta	0.43	0.42	0.44	0.34	0.35	0.32	0.43	0.42	0.44	46	4	0
Mosida	0.99	1.46	0.31	0.31	0.39	0.23	0.99	1.46	0.31	39	11	0
Lehi	0.79	1.17	0.35	0.22	0.28	0.16	0.47	0.58	0.35	52	10	2
Orem	0.57	0.77	0.27	0.22	0.26	0.16	0.38	0.46	0.27	45	7	1
Sp Fork	0.23	0.37	0.08	0.13	0.17	0.08	0.23	0.37	0.08	45	2	0
averages	0.68	0.96	0.32	0.22	0.27	0.18	0.44	0.58	0.27	416	63	14
no.samples	416	217	199	353	168	185	402	205	197	416 plus 14 BDL as of July 1, 2020		
tonsTP/yr at avg area 83,800 ac & 12"/yr rain or 6"/half yr at given avg TP conc.	77.1	54.4	18.5	25.1	15.2	10.2	50.2	33.2	15.3			

Table 1b. Averages at all 9 locations for all ortho-phosphorus samples for the whole year and for summer (Apr-Sept) and winter (Oct-Mar).

Location	Ortho-P (mg/l) **all data**	Ortho-P (mg/l) **summer**	Ortho-P (mg/l) **winter**	all Ortho-P samples	OP/TP % **all data**	OP/TP % **summer**	OP/TP % **winter**	OP/TP % **TP < 1**	OP/TP % **summer**	OP/TP % **winter**	OP/TP % **TP < 5**	OP/TP % **summer**	OP/TP % **winter**
BYU	0.01	0 02	0 00	2	10.83	16.57	0.00	10 83	16.57	0.00	10.83	16 57	0.00
Lincoln Pt	0 40	0.68	0.04	16	37.95	41.79	8.01	175.13	190.46	28 26	77.90	86.18	14.68
Pelican Pt	0.11	0 11	0.10	11	14.28	15.00	13 69	45 48	48 81	42.66	24.89	27 25	22 87
Genola	0 12	0 17	0.04	13	10.07	9.02	19 00	54 92	70 92	19.00	27.49	26 62	19 00
Elberta	0.19	0 14	0.26	12	43.87	32.62	59.21	55 61	38 89	81.02	43.87	32.62	59 21
Mosida	0.75	1.09	0.14	11	75.64	74 99	45.51	244.15	280.77	60.90	75.64	74.99	45.51
Lehi	0.15	0.16	0.15	13	19.56	13 96	41 18	69.01	57.38	88.26	33.02	28.30	41.18
Orem	0.17	0.25	0.08	16	29.28	32.87	29 79	76 86	98 49	49.81	43.84	55 45	29 79
Sp Fork	0.08	0.10	0.02	8	33.98	26.68	18 23	62 36	58 01	18.23	33.98	26.68	98 76
averages	0.22	0.30	0 09	102	30 61	29.28	26.07	88.26	95.59	43 13	41 27	41.63	36.78
no.samples	102	58	44	102 plus 25 BDL as of July 1, 2020									
tonsOP/yr at avg area 83,800 ac & 12"/yr rain or 6"/half yr at given avg OP conc.	24.9	17 3	5.2										

Table 1c. Averages at 9 locations for nitrogen samples for whole year and for summer and winter.

Location	Total Nitro (mg/l) **all data**	Total Nitro (mg/l) **summer**	Total Nitro (mg/l) **winter**	Total Nitro (mg/l) **TN <10**	Total Nitro (mg/l) **summer**	Total Nitro (mg/l) **winter**	all TN samples	TN outliers >10 mg/l
BYU	2.15	2.14	2.16	2.15	2.14	2.16	43	0
Lincoln Pt	4.73	5.61	3.48	2.19	2.53	1.73	46	6
Pelican Pt	2.43	2.33	2.54	2.23	2.33	2.13	41	1
Genola	1.92	2.54	1.12	1.69	2.15	1.12	44	1
Elberta	1.97	1.64	2.28	2.89	1.64	2.28	39	0
Mosida	5.73	6.67	4.38	2.49	2.65	2.29	39	5
Lehi	2.55	3.35	1.71	2.55	3.35	1.71	49	0
Orem	2.03	2.22	1.76	2.03	2.22	1.76	43	0
Sp Fork	1.47	1.88	1.09	1.47	1.88	1.09	52	0
averages	2.77	3.15	2.28	2.19	2.32	1.81	396	13
no.samples	396	205	191	383	196	187	396 plus 32 BDL as of July 1, 2020	
tonsTN/yr at avg area 83,800 ac & 12"/yr rain or 6"/half yr at given avg TN conc.	316.0	179.5	129.7	249.2	132.2	102.8		

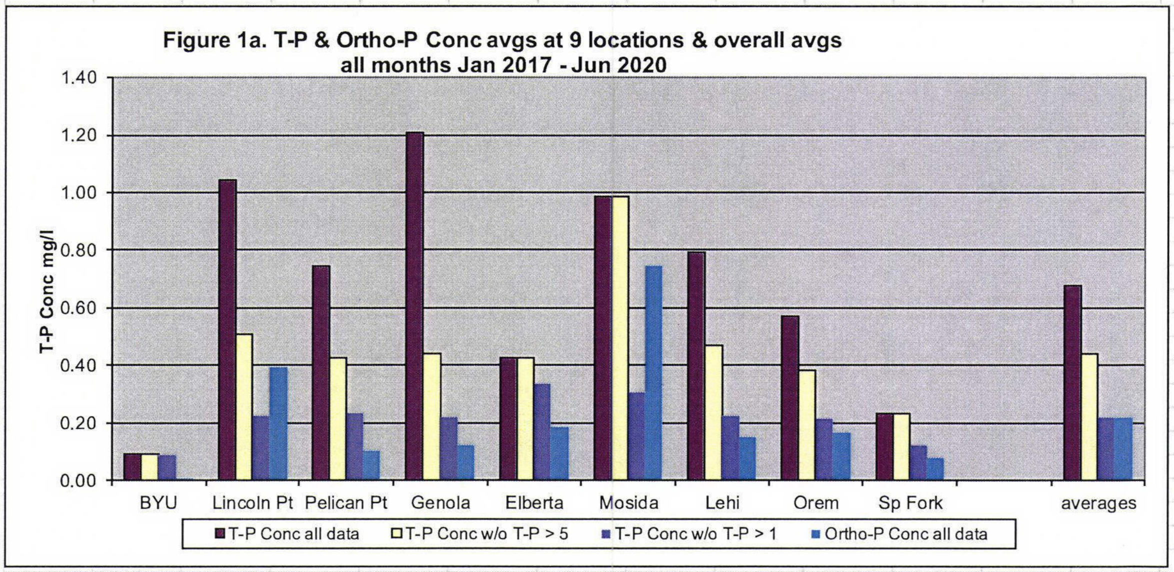


Figure 1a. T-P & Ortho-P Conc avgs at 9 locations & overall avgs
all months Jan 2017 - Jun 2020
T-P Conc mg/l
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
BYU
Lincoln Pt
Pelican Pt
Genola
Elberta
Mosida
Lehi
Orem
Sp Fork
averages
T-P Conc all data
T-P Conc w/o T-P > 5
T-P Conc w/o T-P > 1
Ortho-P Conc all data

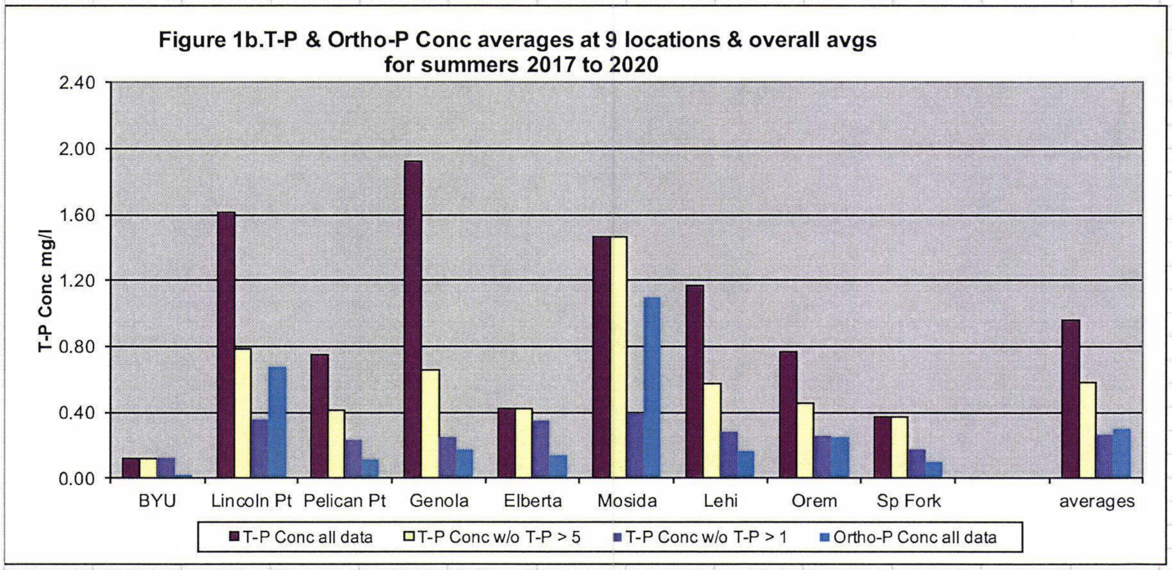


Figure 1b.T-P & Ortho-P Conc averages at 9 locations & overall avgs
for summers 2017 to 2020
T-P Conc mg/l
2.40
2.00
1.60
1.20
0.80
0.40
0.00
BYU
Lincoln Pt
Pelican Pt
Genola
Elberta
Mosida
Lehi
Orem
Sp Fork
averages
T-P Conc all data
T-P Conc w/o T-P > 5
T-P Conc w/o T-P > 1
Ortho-P Conc all data

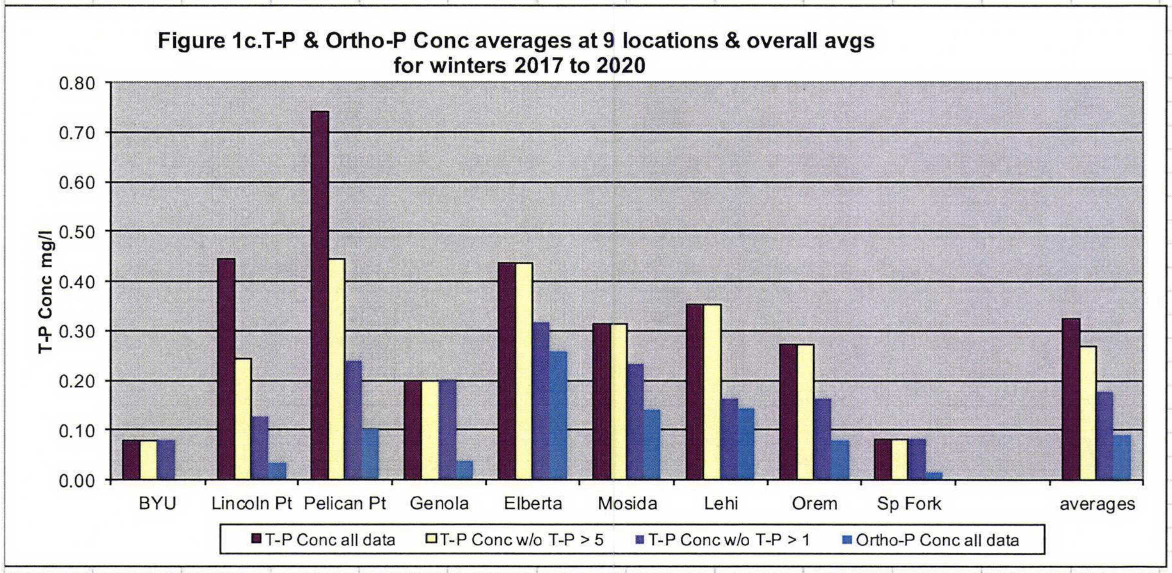


Figure 1c.T-P & Ortho-P Conc averages at 9 locations & overall avgs
for winters 2017 to 2020
T-P Conc mg/l
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
BYU
Lincoln Pt
Pelican Pt
Genola
Elberta
Mosida
Lehi
Orem
Sp Fork
averages
T-P Conc all data
T-P Conc w/o T-P > 5
T-P Conc w/o T-P > 1
Ortho-P Conc all data

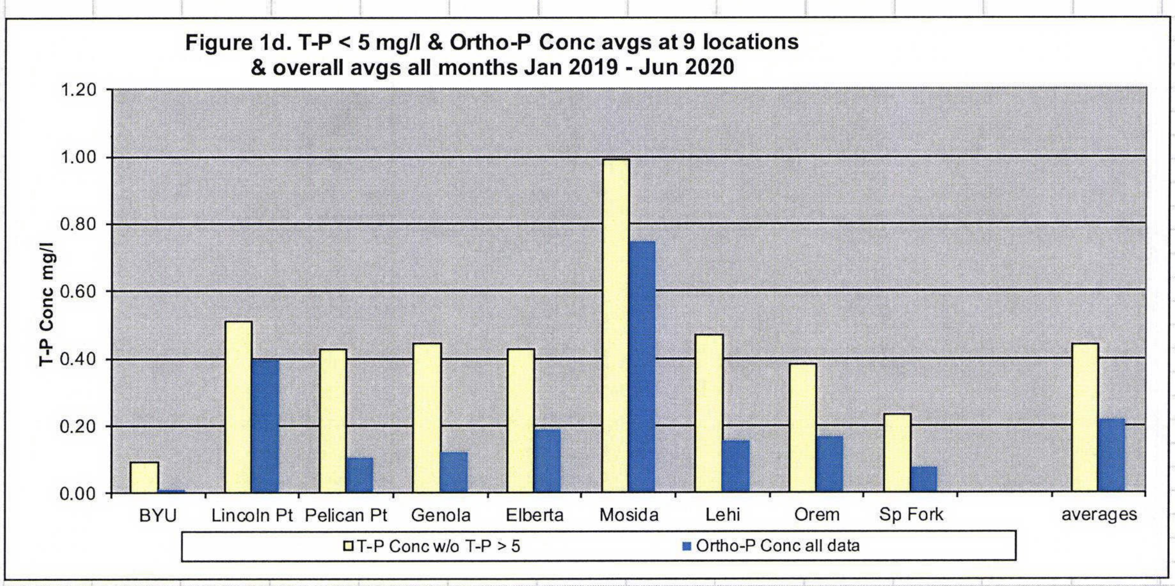


Figure 1d. T-P < 5 mg/l & Ortho-P Conc avgs at 9 locations
& overall avgs all months Jan 2019 - Jun 2020
T-P Conc mg/l
1.20
1.00
0.80
0.60
0.40
0.20
0.00
BYU
Lincoln Pt
Pelican Pt
Genola
Elberta
Mosida
Lehi
Orem
Sp Fork
averages
T-P Conc w/o T-P > 5
Ortho-P Conc all data

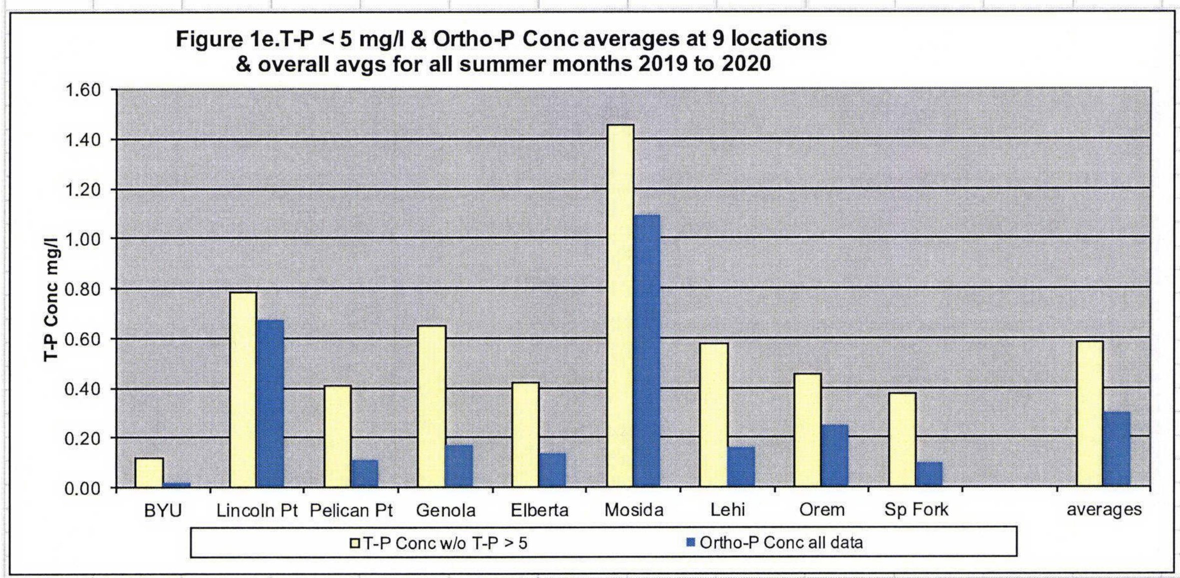


Figure 1e.T-P < 5 mg/l & Ortho-P Conc averages at 9 locations
& overall avgs for all summer months 2019 to 2020
T-P Conc mg/l
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
BYU
Lincoln Pt
Pelican Pt
Genola
Elberta
Mosida
Lehi
Orem
Sp Fork
averages
T-P Conc w/o T-P > 5
Ortho-P Conc all data

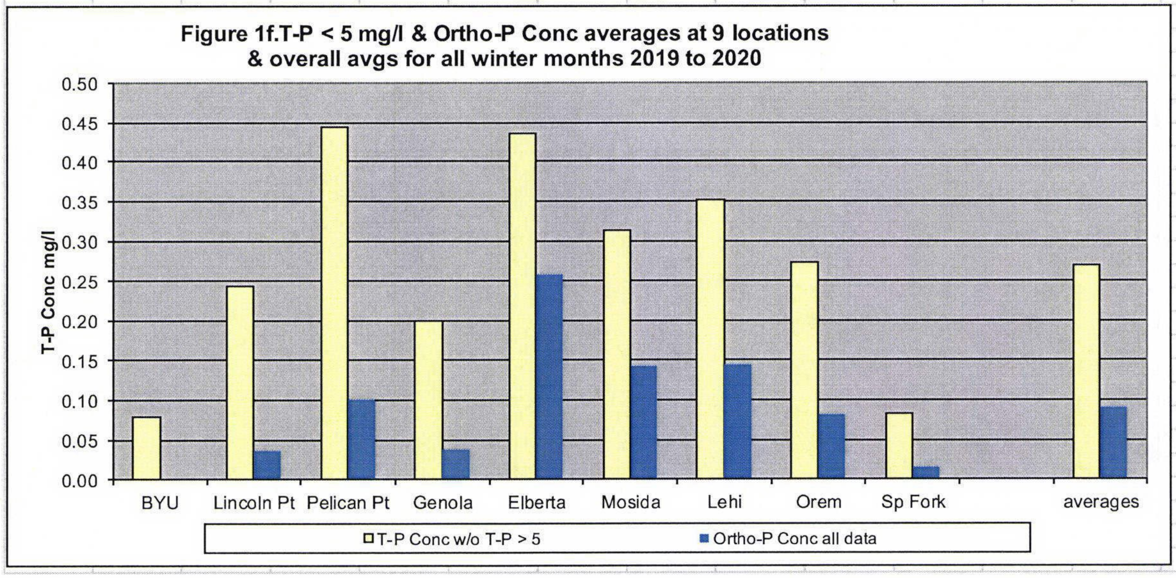


Figure 1f.T-P < 5 mg/l & Ortho-P Conc averages at 9 locations
& overall avgs for all winter months 2019 to 2020
T-P Conc mg/l
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
BYU
Lincoln Pt
Pelican Pt
Genola
Elberta
Mosida
Lehi
Orem
Sp Fork
averages
T-P Conc w/o T-P > 5
Ortho-P Conc all data

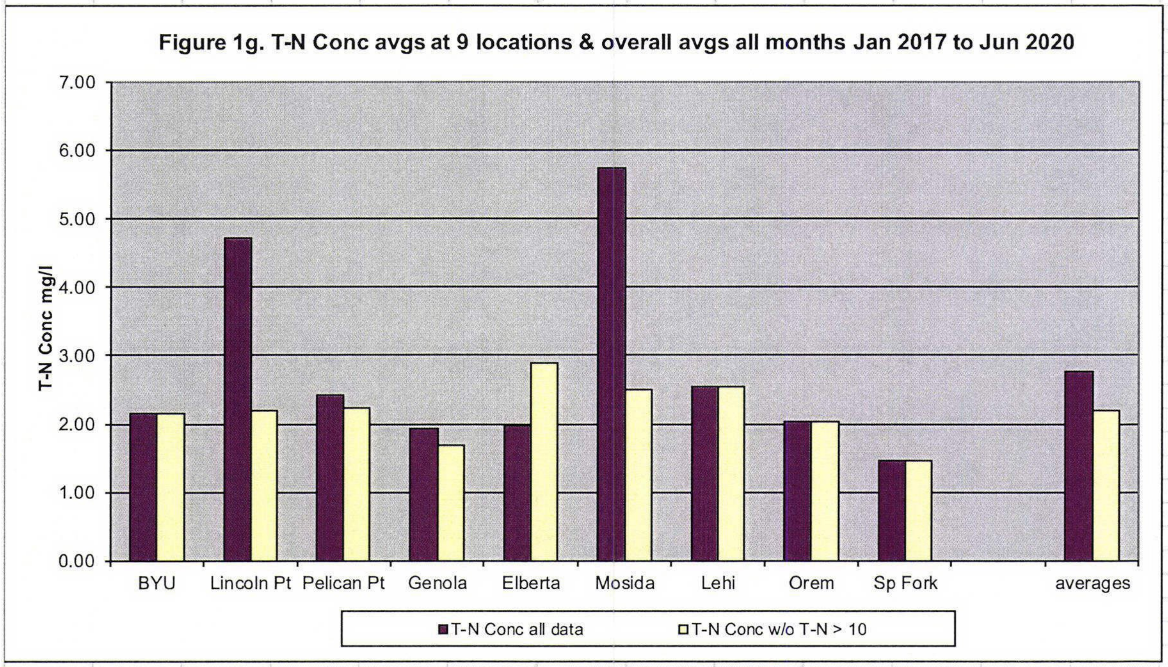


Figure 1g. T-N Conc avgs at 9 locations & overall avgs all months Jan 2017 to Jun 2020
T-N Conc mg/l
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
BYU
Lincoln Pt
Pelican Pt
Genola
Elberta
Mosida
Lehi
Orem
Sp Fork
averages
T-N Conc all data
T-N Conc w/o T-N > 10

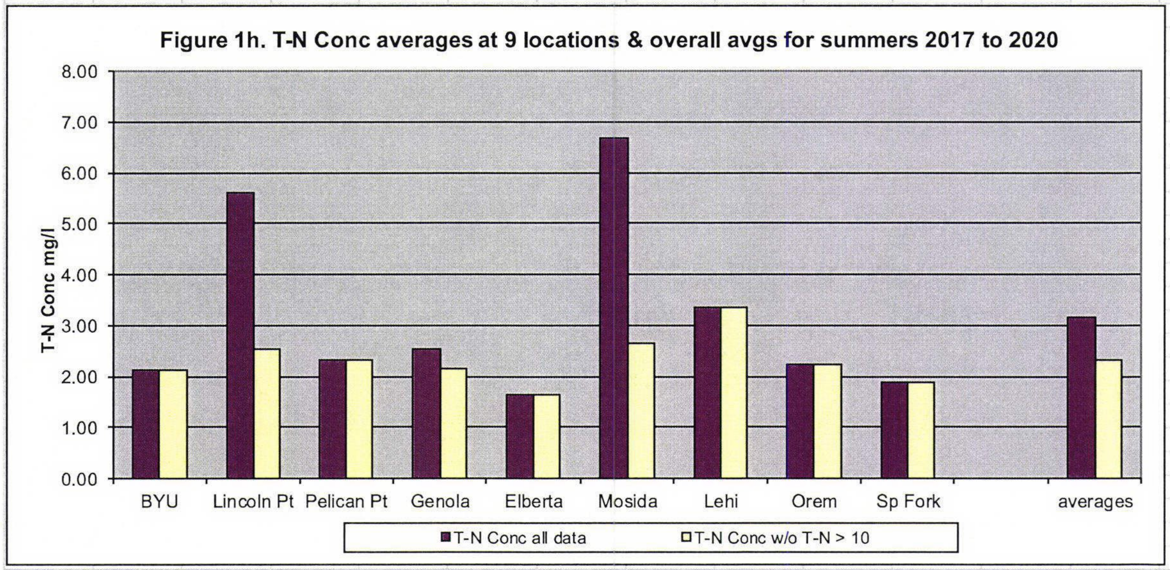


Figure 1h. T-N Conc averages at 9 locations & overall avgs for summers 2017 to 2020
T-N Conc mg/l
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
BYU
Lincoln Pt
Pelican Pt
Genola
Elberta
Mosida
Lehi
Orem
Sp Fork
averages
T-N Conc all data
T-N Conc w/o T-N > 10

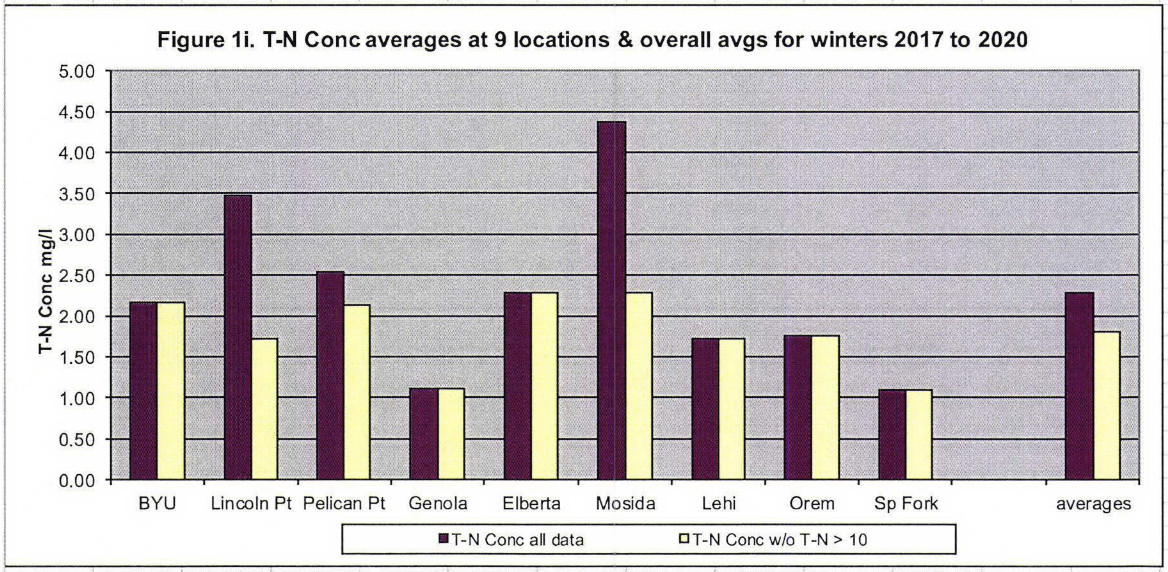


Figure 1i. T-N Conc averages at 9 locations & overall avgs for winters 2017 to 2020
T-N Conc mg/l
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
BYU
Lincoln Pt
Pelican Pt
Genola
Elberta
Mosida
Lehi
Orem
Sp Fork
averages
T-N Conc all data
T-N Conc w/o T-N > 10

Figure 1j. T-P & Ortho-P Loads (tons/yr) at 2-yr avg lake area 83,800 ac & 12"/yr or 6"/half yr precip & all data, T-P <1, T-P <5, sum & win overall avg T-P conc 2017 to 2020

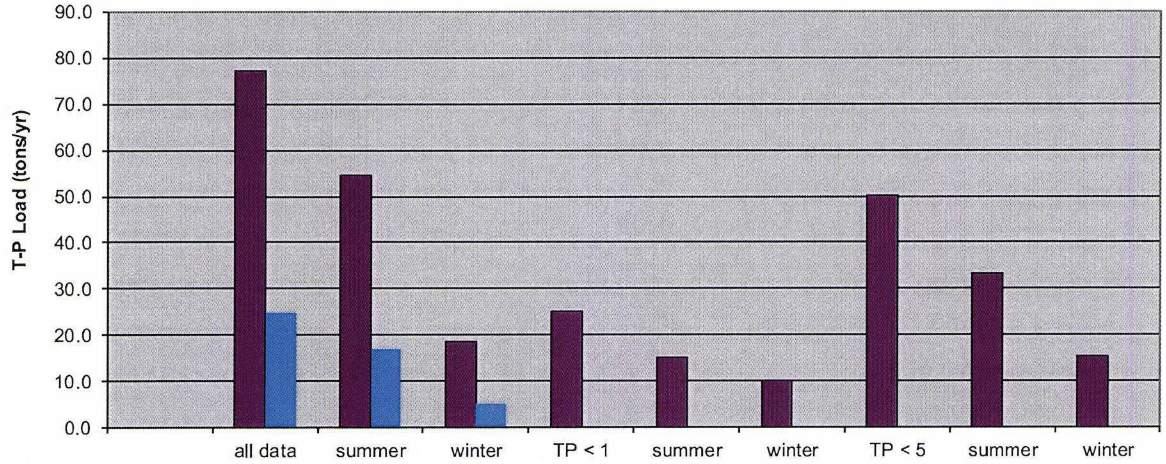


Figure 1k. Ortho-P Loads (tons/yr) at 2-yr avg lake area 83,800 ac & 12"/yr or 6"/half yr precip for all data, summer & winter overall avg O-P conc 2019-2020

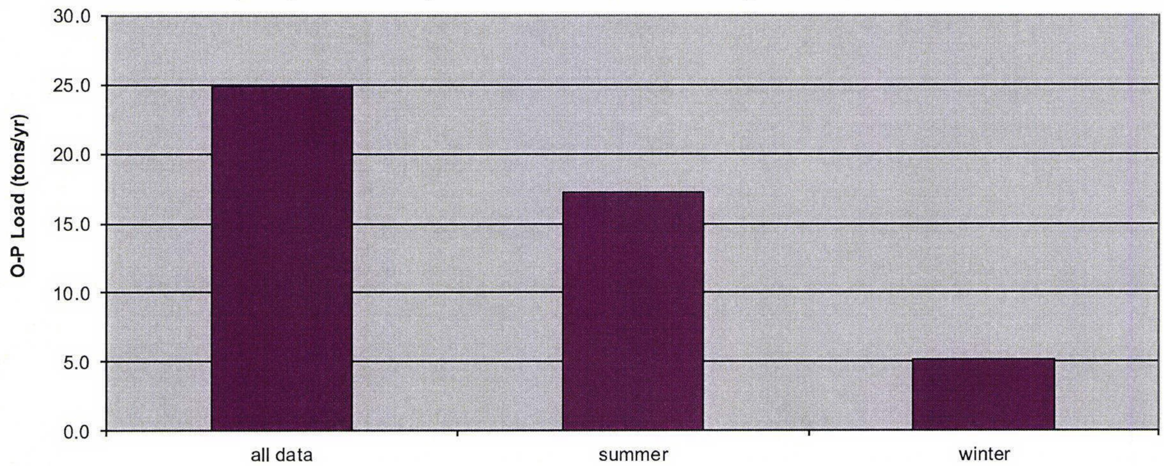


Figure 1l. T-N Loads (tons/yr) at 2-yr avg lake area 83,800 ac & 12"/yr or 6"/half yr precip & all data, T-N < 10, summer & winter overall avg T-N conc 2017 to 2020

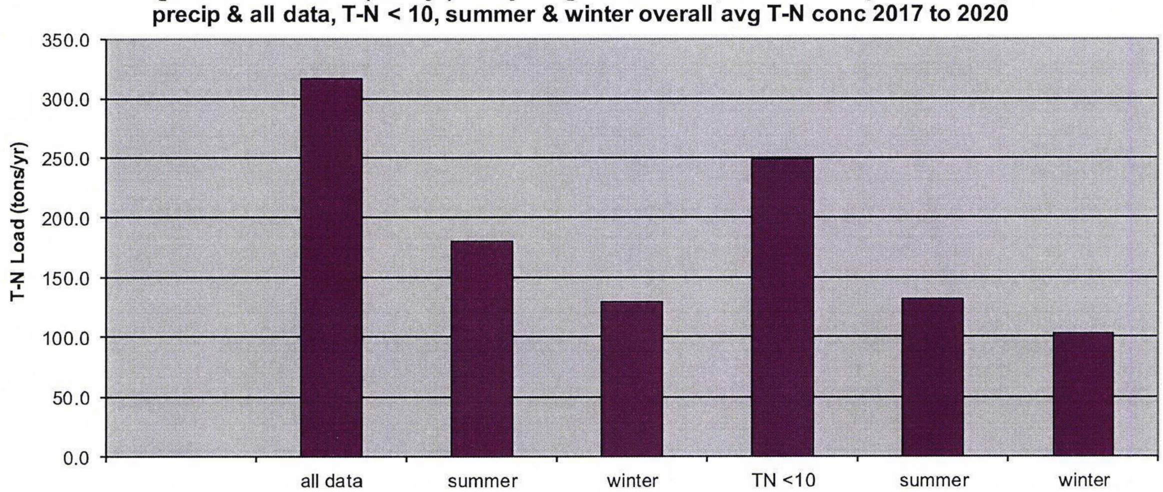


Table 2. BYU

Sampling Date	TP>1 outliers	Total Phos (mg/l) w/o outlrs	TP>5 outliers	Total Phos (mg/l) w/o outlrs	Total Phos (mg/l) all data	OrthoPhos mg/l all data	TN>10 outliers	Total Nitro (mg/l) w/o outlrs	Total Nitro (mg/l) all data
31-Oct-16	none	0.03	none	0.03	0.03		none		
21-Nov-16		0.04		0.04	0.04				
29-Nov-16		0.02		0.02	0.02				
1-Dec-16		0.21		0.21	0.21				
10-Dec-16		0.15		0.15	0.15				
12-Dec-16		0.06		0.06	0.06			0.82	0.82
16-Dec-16		0.13		0.13	0.13			0.43	0.43
3-Jan-17		BDL		BDL	BDL			0.72	0.72
8-Jan-17		0.28		0.28	0.28			9.59	9.59
19-Jan-17		0.21		0.21	0.21			1.51	1.51
21-Jan-17		BDL		BDL	BDL			1.24	1.24
7-Feb-17		0.07		0.07	0.07			1.91	1.91
10-Feb-17		0.01		0.01	0.01			BDL	BDL
18-Feb-17		0.09		0.09	0.09			BDL	BDL
19-Feb-17		0.05		0.05	0.05			1.65	1.65
23-Feb-17		0.01		0.01	0.01			1.04	1.04
27-Feb-17		0.02		0.02	0.02			0.88	0.88
5-Mar-17		0.14		0.14	0.14			1.87	1.87
23-Mar-17		0.06		0.06	0.06			3.06	3.06
27-Mar-17		BDL		BDL	BDL			1.25	1.25
30-Mar-17		0.04		0.04	0.04			2.27	2.27
8-Apr-17		0.14		0.14	0.14			2.81	2.81
19-Apr-17		0.23		0.23	0.23			3.22	3.22
25-Apr-17		0.01		0.01	0.01			0.80	0.80
13-Jun-17		0.34		0.34	0.34			2.03	2.03
10-Aug-17		0.15		0.15	0.15			2.88	2.88
15-Sep-17		0.13		0.13	0.13			0.91	0.91
5-Nov-17		0.29		0.29	0.29			6.30	6.30
17-Nov-17		0.10		0.10	0.10			1.80	1.80
9-Jan-18		0.11		0.11	0.11			5.60	5.60
15-Feb-18		0.14		0.14	0.14			3.10	3.10
16-Mar-18		0.01		0.01	0.01			1.30	1.30
7-Apr-18		0.18		0.18	0.18			2.70	2.70
30-Apr-18		0.03		0.03	0.03			0.60	0.60
11-May-18		0.05		0.05	0.05			2.10	2.10
22-Aug-18		0.21		0.21	0.21			5.80	5.80
3-Oct-18		0.11		0.11	0.11			1.80	1.80
10-Oct-18		0.02		0.02	0.02			0.60	0.60
30-Nov-18		0.01		0.01	0.01			0.50	0.50
18-Jan-19		0.02		0.02	0.02	BDL		BDL	BDL
6-Mar-19		0.02		0.02	0.02	BDL		0.80	0.80
29-Mar-19		BDL		BDL	BDL	0.00		1.40	1.40
21-Apr-19		0.01		0.01	0.01			1.90	1.90
21-May-19		0.05		0.05	0.05			1.40	1.40
9-Aug-19		0.10		0.10	0.10			2.00	2.00
11-Sep-19		0.05		0.05	0.05	BDL		1.60	1.60
20-Nov-19		0.04		0.04	0.04	BDL		5.10	5.10
23-Jan-20		0.01		0.01	0.01	BDL		1.20	1.20
13-Mar-20		0.01		0.01	0.01	BDL		2.20	2.20
25-Mar-20		0.02		0.02	0.02	BDL		0.40	0.40
8-Jun-20		0.13		0.13	0.13	0.02		1.30	1.30
	0	47	0	47	47	2	0	43	43
averages	#DIV/0!	0.092	#DIV/0!	0.092	0.092	0.010	#DIV/0!	2.149	2.149
summer (Apr-Se	#DIV/0!	0.121	#DIV/0!	0.121	0.121	0.020	#DIV/0!	2.137	2.137
winter (Oct-Mar)	#DIV/0!	0.079	#DIV/0!	0.079	0.079	0.000	#DIV/0!	2.155	2.155
summer count	0	15	0	15	15	1	0	15	15
winter count	0	32	0	32	32	1	0	28	28

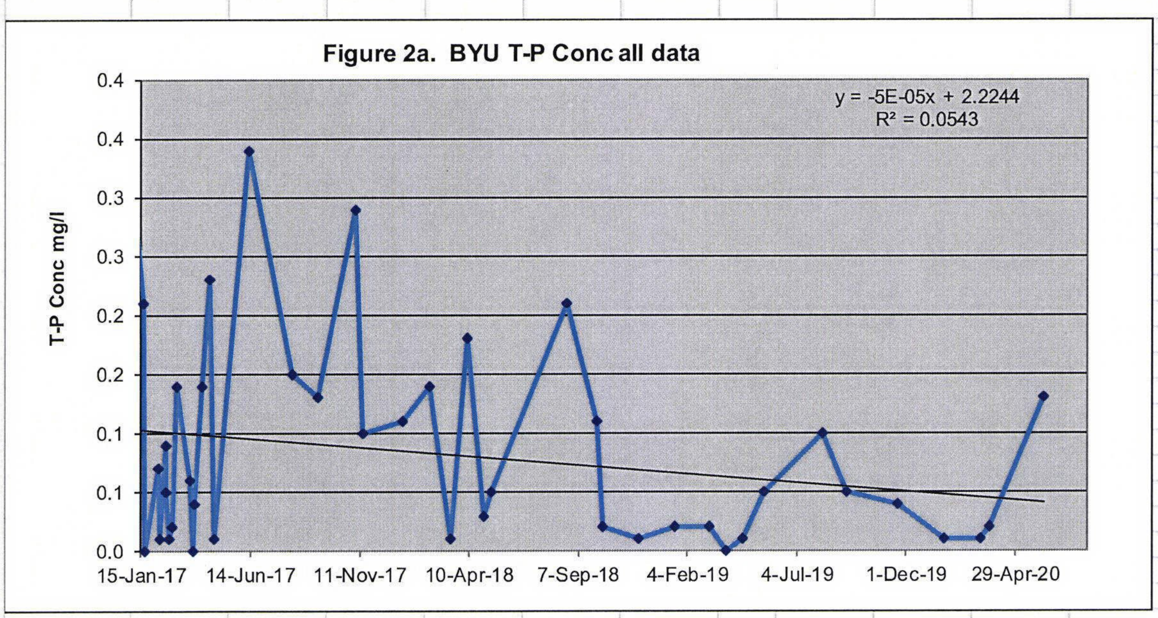


Figure 2a. BYU T-P Conc all data
y = -5E-05x + 2.2244
R² = 0.0543
T-P Conc mg/l
0.4
0.4
0.3
0.3
0.2
0.2
0.1
0.1
0.0
15-Jan-17
14-Jun-17
11-Nov-17
10-Apr-18
7-Sep-18
4-Feb-19
4-Jul-19
1-Dec-19
29-Apr-20

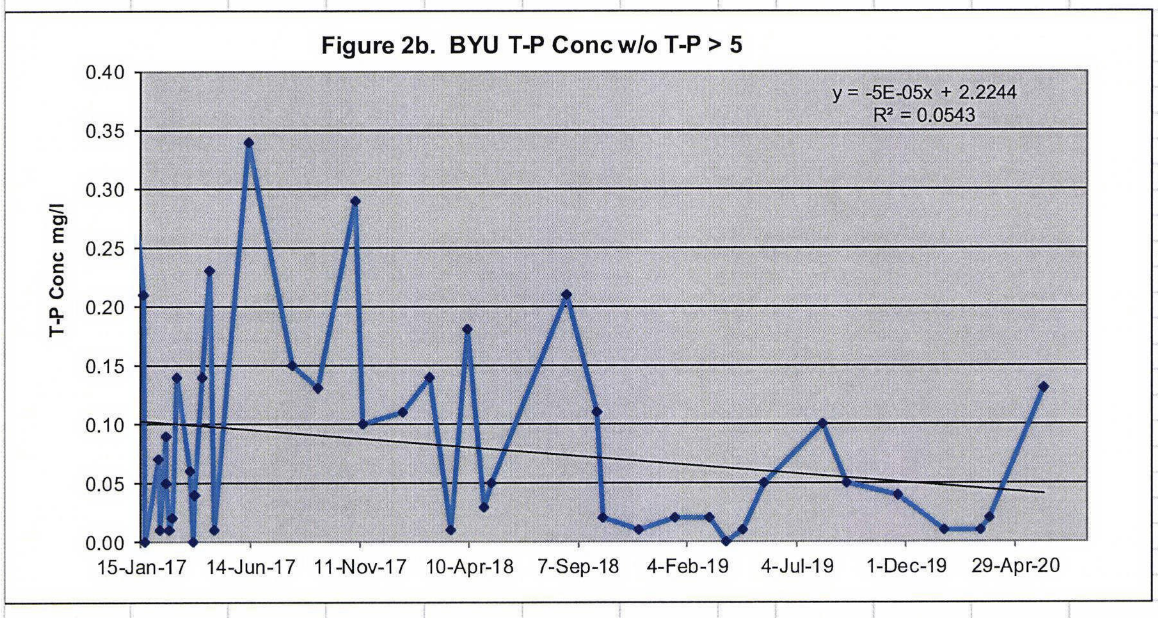


Figure 2b. BYU T-P Conc w/o T-P > 5
y = -5E-05x + 2.2244
R² = 0.0543
T-P Conc mg/l
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
15-Jan-17
14-Jun-17
11-Nov-17
10-Apr-18
7-Sep-18
4-Feb-19
4-Jul-19
1-Dec-19
29-Apr-20

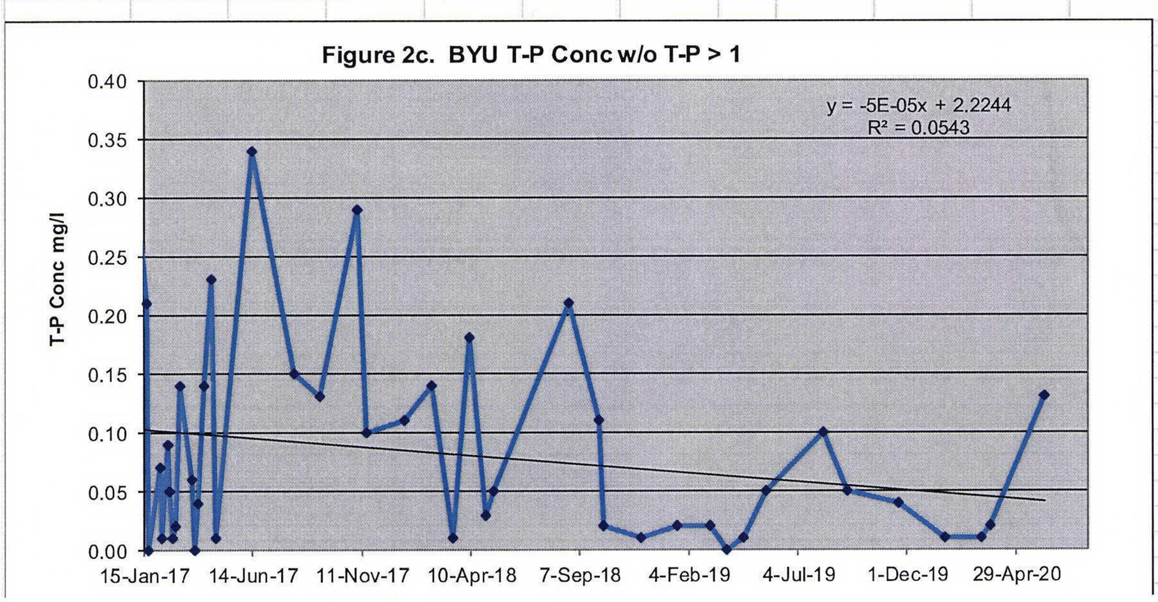


Figure 2c. BYU T-P Conc w/o T-P > 1
y = -5E-05x + 2.2244
R² = 0.0543
T-P Conc mg/l
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
15-Jan-17
14-Jun-17
11-Nov-17
10-Apr-18
7-Sep-18
4-Feb-19
4-Jul-19
1-Dec-19
29-Apr-20

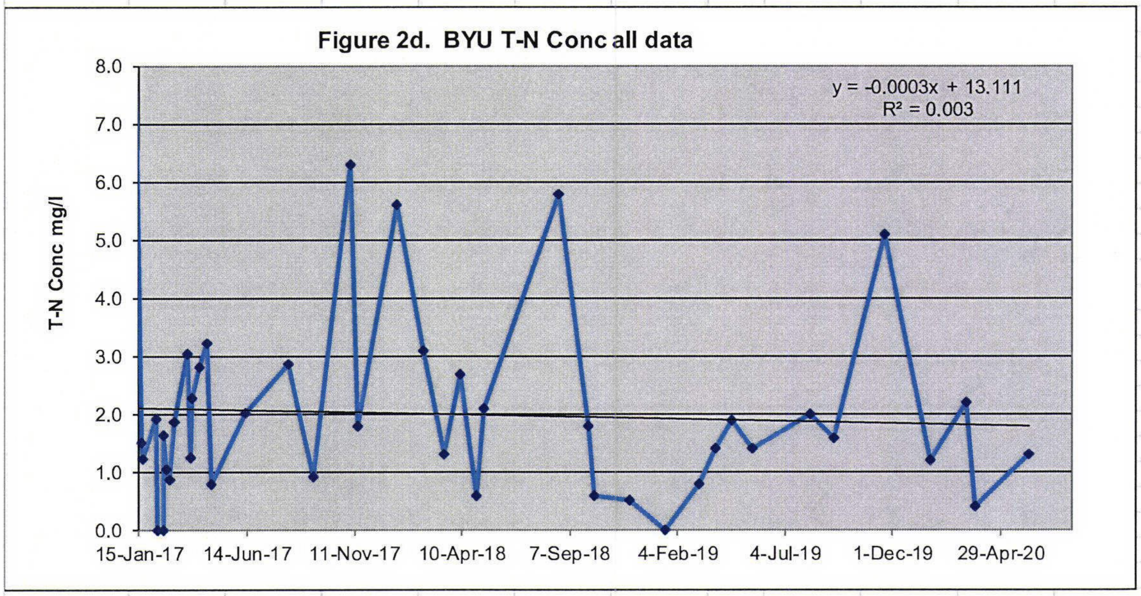


Figure 2d. BYU T-N Conc all data

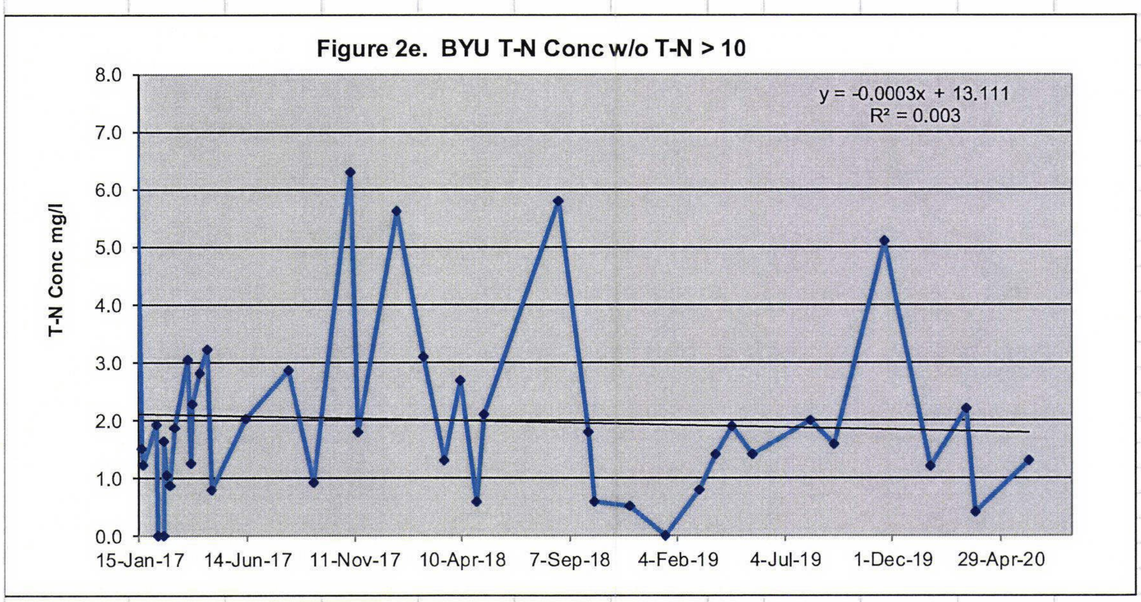


Figure 2e. BYU T-N Conc w/o T-N > 10

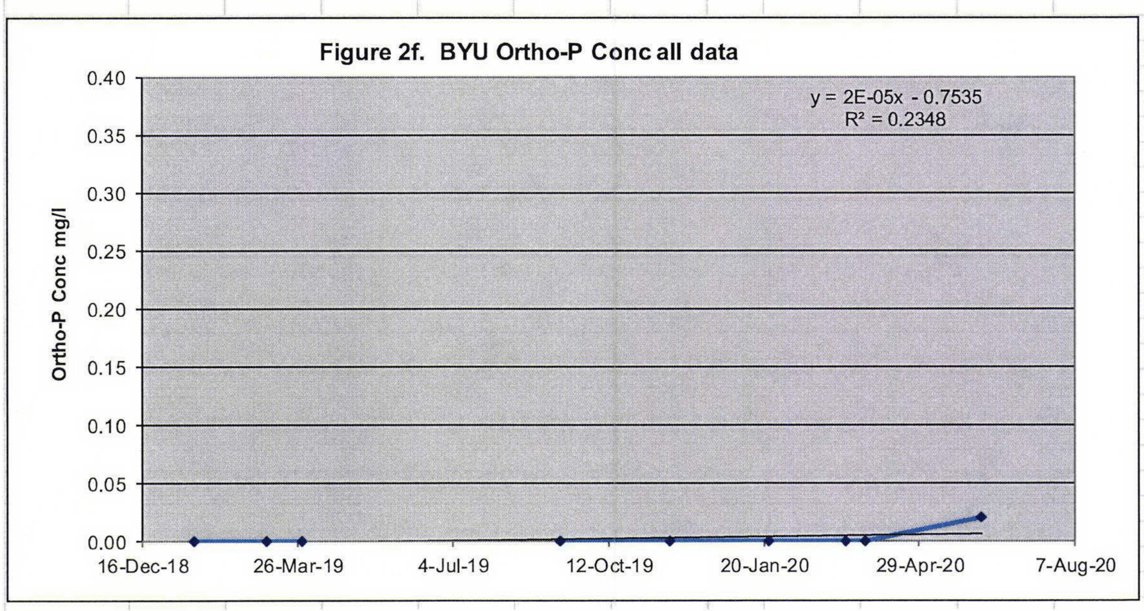


Figure 2f. BYU Ortho-P Conc all data

Table 3. Lincoln Point

too big	Sampling Date	TP>1 outliers	Total Phos (mg/l) w/o outlrs	TP>5 outliers	Total Phos (mg/l) w/o outlrs	Total Phos (mg/l) all data	OrthoPhos mg/l all data	TN>10 outliers	Total Nitro (mg/l) w/o outlrs	Total Nitro (mg/l) all data
	10-Feb-17		0.08		0.08	0.08			1.42	1.42
	22-Feb-17	1.96			1.96	1.96		24.40		24.40
	27-Feb-17		0.17		0.17	0.17			5.31	5.31
	5-Mar-17		0.20		0.20	0.20			4.83	4.83
	23-Mar-17		0.37		0.37	0.37			3.06	3.06
	27-Mar-17		0.08		0.08	0.08			1.35	1.35
	30-Mar-17		0.06		0.06	0.06			2.46	2.46
	8-Apr-17		0.07		0.07	0.07			2.11	2.11
	19-Apr-17		0.07		0.07	0.07			0.95	0.95
	21-Apr-17		0.06		0.06	0.06			5.03	5.03
	25-Apr-17		0.06		0.06	0.06			1.00	1.00
	6-May-17		0.37		0.37	0.37			1.50	1.50
	17-May-17	8.90		8.90		8.90			6.90	6.90
	21-May-17	1.40			1.40	1.40			1.70	1.70
25	13-Jun-17							14.00		14.00
	25-Jul-17	8.80		8.80		8.80		23.60		23.60
21	10-Aug-17							21.40		21.40
	15-Sep-17		0.69		0.69	0.69			1.00	1.00
	24-Sep-17		0.18		0.18	0.18			1.05	1.05
	5-Nov-17	1.10			1.10	1.10			BDL	BDL
	17-Nov-17		0.18		0.18	0.18			0.90	0.90
	9-Jan-18		0.10		0.10	0.10			1.20	1.20
	15-Feb-18		0.03		0.03	0.03			2.40	2.40
	16-Mar-18		0.01		0.01	0.01			0.50	0.50
	23-Mar-18		0.03		0.03	0.03			0.50	0.50
	7-Apr-18	1.60			1.60	1.60			1.20	1.20
	20-Apr-18		0.55		0.55	0.55			0.40	0.40
	30-Apr-18		0.49		0.49	0.49			1.30	1.30
	3-May-18		0.23		0.23	0.23			1.70	1.70
	11-May-18		0.18		0.18	0.18			2.70	2.70
	22-Aug-18	6.30		6.30		6.30		34.20		34.20
	3-Oct-18	5.30		5.30		5.30		12.40		12.40
	10-Oct-18		0.09		0.09	0.09			0.70	0.70
	30-Nov-18		0.40		0.40	0.40			0.30	0.30
	18-Jan-19		0.04		0.04	0.04	0.01		BDL	BDL
	6-Mar-19		0.11		0.11	0.11	0.02		BDL	BDL
	29-Mar-19		0.04		0.04	0.04	0.04		BDL	BDL
	10-Apr-19		0.57		0.57	0.57	0.29		2.60	2.60
	21-Apr-19		0.60		0.60	0.60	0.10		1.20	1.20
	7-May-19		0.23		0.23	0.23	0.08		1.30	1.30
	21-May-19		0.39		0.39	0.39	0.27		1.00	1.00
	21-Jun-19	2.20			2.20	2.20	0.51		3.60	3.60
	1-Aug-19	3.70			3.70	3.70	2.20		9.60	9.60
	9-Aug-19	1.40			1.40	1.40	1.00		4.80	4.80
	11-Sep-19	1.70			1.70	1.70	1.40		3.70	3.70
	20-Nov-19		0.12		0.12	0.12	BDL		BDL	BDL
	16-Jan-20		0.42		0.42	0.42	0.11		1.80	1.80
	23-Jan-20		0.04		0.04	0.04	0.03		1.20	1.20
	8-Feb-20		0.04		0.04	0.04	BDL		BDL	BDL
	13-Mar-20		0.11		0.11	0.11	0.02		1.10	1.10
	25-Mar-20		0.06		0.06	0.06	0.02		0.30	0.30
	23-May-20		0.94		0.94	0.94	BDL		BDL	BDL
	8-Jun-20		0.35		0.35	0.35	0.23		1.80	1.80
	count	12	39	4	47	51	16	6	40	46
	averages	3.697	0.226	7.325	0.508	1.043	0.396	21.667	2.187	4.728
summer (Apr-S		4.000	0.355	8.000	0.784	1.617	0.676	23.300	2.528	5.605
winter (Oct-Mar		2.787	0.126	5.300	0.243	0.446	0.036	18.400	1.725	3.481
summer count		9	17	3	23	26	9	4	23	27
winter count		3	22	1	24	25	7	2	17	19

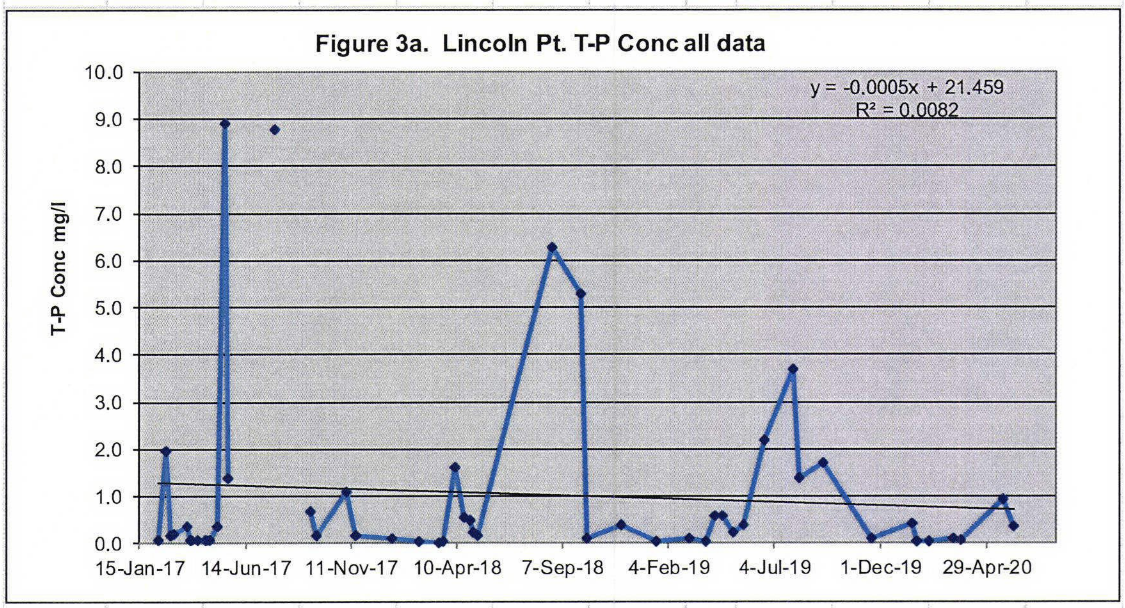


Figure 3a. Lincoln Pt. T-P Conc all data
y = -0.0005x + 21.459
R² = 0.0082
T-P Conc mg/l
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
15-Jan-17
14-Jun-17
11-Nov-17
10-Apr-18
7-Sep-18
4-Feb-19
4-Jul-19
1-Dec-19
29-Apr-20

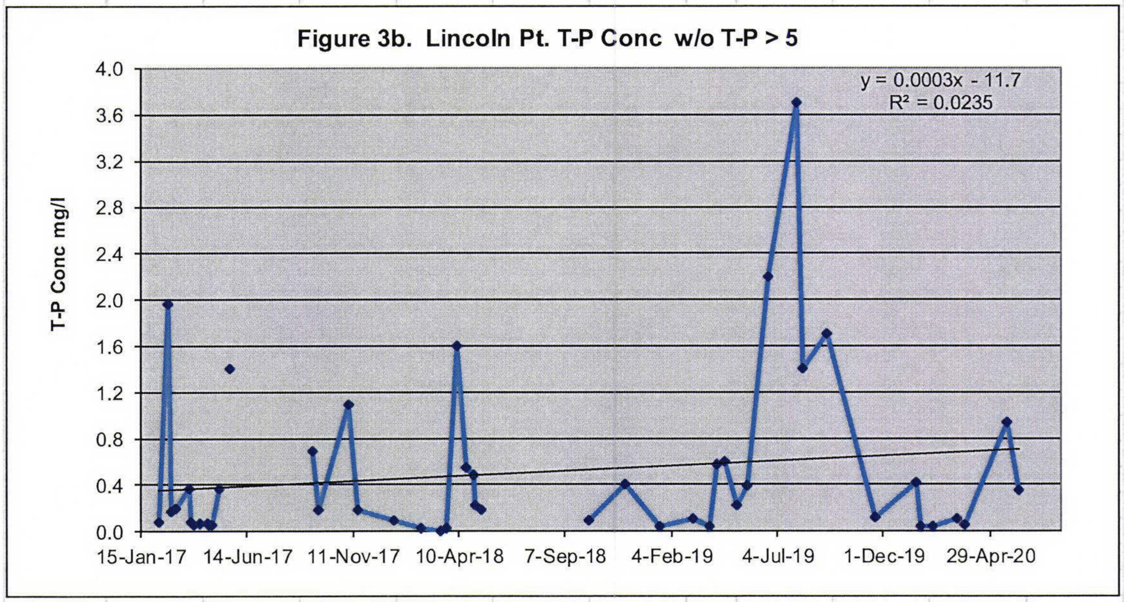


Figure 3b. Lincoln Pt. T-P Conc w/o T-P > 5
y = 0.0003x - 11.7
R² = 0.0235
T-P Conc mg/l
4.0
3.6
3.2
2.8
2.4
2.0
1.6
1.2
0.8
0.4
0.0
15-Jan-17
14-Jun-17
11-Nov-17
10-Apr-18
7-Sep-18
4-Feb-19
4-Jul-19
1-Dec-19
29-Apr-20

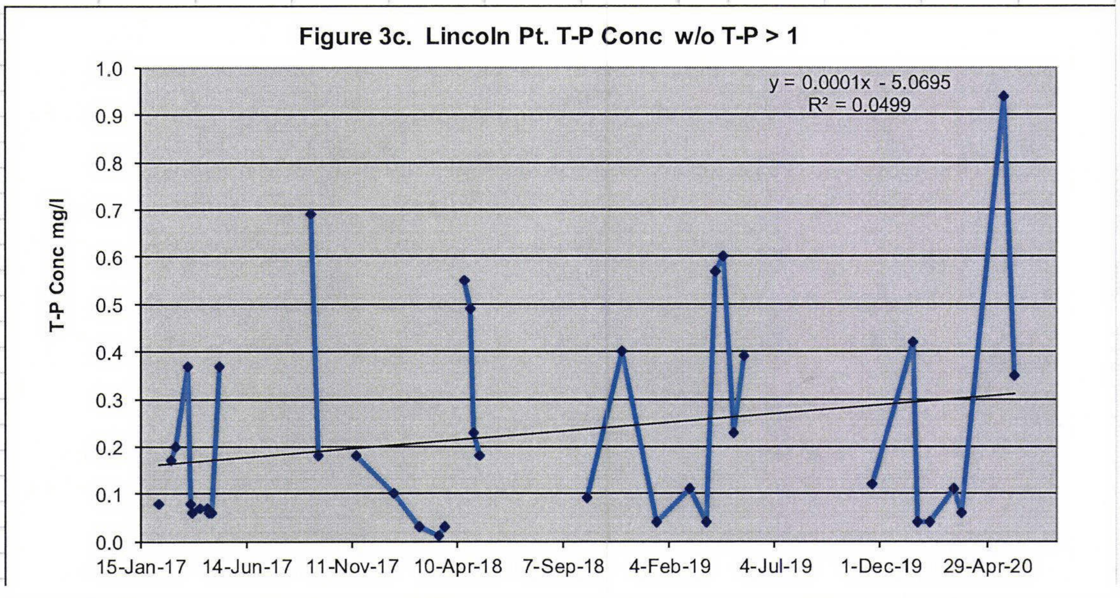


Figure 3c. Lincoln Pt. T-P Conc w/o T-P > 1
y = 0.0001x - 5.0695
R² = 0.0499
T-P Conc mg/l
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
15-Jan-17
14-Jun-17
11-Nov-17
10-Apr-18
7-Sep-18
4-Feb-19
4-Jul-19
1-Dec-19
29-Apr-20

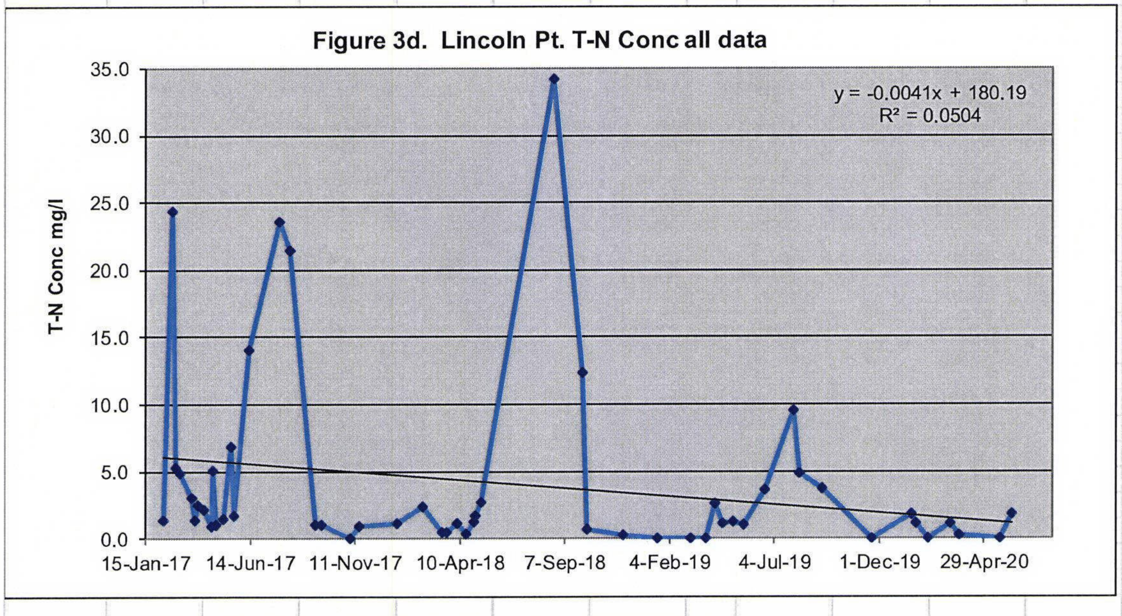


Figure 3d. Lincoln Pt. T-N Conc all data
y = -0.0041x + 180.19
R² = 0.0504
T-N Conc mg/l
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
15-Jan-17
14-Jun-17
11-Nov-17
10-Apr-18
7-Sep-18
4-Feb-19
4-Jul-19
1-Dec-19
29-Apr-20

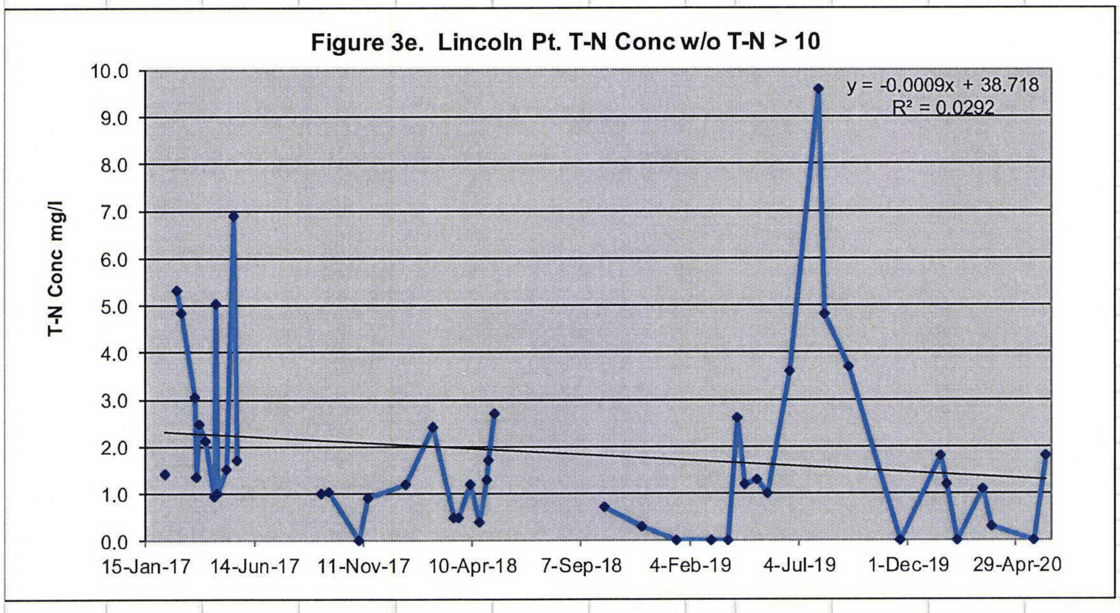


Figure 3e. Lincoln Pt. T-N Conc w/o T-N > 10
y = -0.0009x + 38.718
R² = 0.0292
T-N Conc mg/l
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
15-Jan-17
14-Jun-17
11-Nov-17
10-Apr-18
7-Sep-18
4-Feb-19
4-Jul-19
1-Dec-19
29-Apr-20

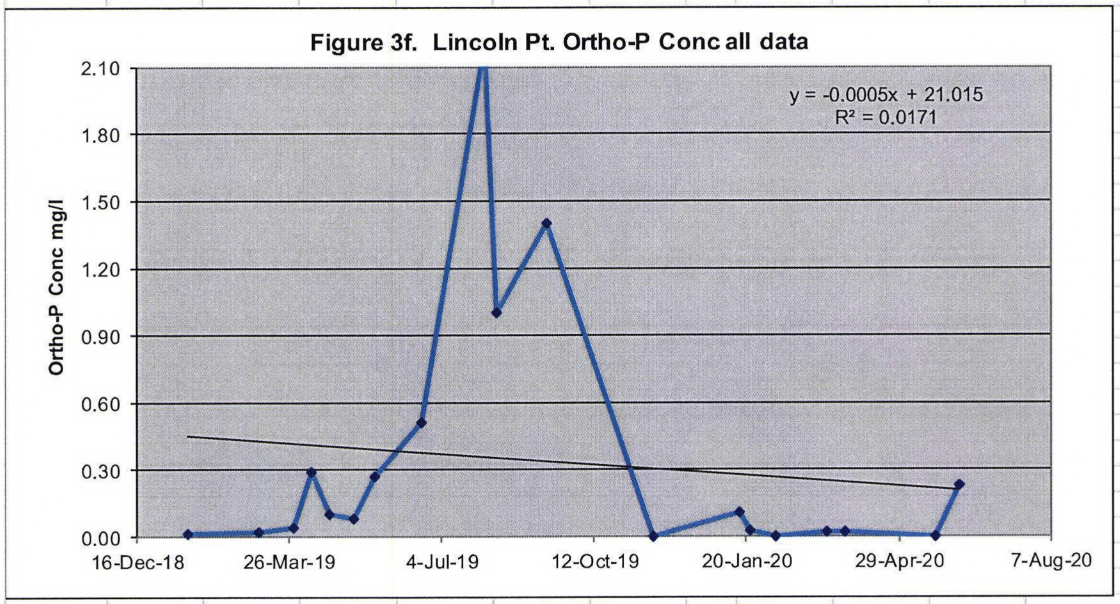


Figure 3f. Lincoln Pt. Ortho-P Conc all data
y = -0.0005x + 21.015
R² = 0.0171
Ortho-P Conc mg/l
2.10
1.80
1.50
1.20
0.90
0.60
0.30
0.00
16-Dec-18
26-Mar-19
4-Jul-19
12-Oct-19
20-Jan-20
29-Apr-20
7-Aug-20

Table 4. Pelican Point

too big	Sampling Date	TP>1 outliers	Total Phos (mg/l) w/o outlrs	TP>5 outliers	Total Phos (mg/l) w/o outlrs	Total Phos (mg/l) all data	OrthoPhos mg/l all data		TN>10 outliers	Total Nitro (mg/l) w/o outlrs	Total Nitro (mg/l) all data
	10-Feb-17		0.09		0.09	0.09				BDL	BDL
	22-Feb-17		0.18		0.18	0.18				1.04	1.04
	27-Feb-17		0.05		0.05	0.05				3.33	3.33
	5-Mar-17		0.21		0.21	0.21				3.33	3.33
	23-Mar-17		0.11		0.11	0.11				1.36	1.36
	27-Mar-17		0.16		0.16	0.16				2.04	2.04
	30-Mar-17		0.06		0.06	0.06				2.20	2.20
	8-Apr-17		0.14		0.14	0.14				4.07	4.07
	19-Apr-17		0.06		0.06	0.06				0.84	0.84
	21-Apr-17		0.14		0.14	0.14				2.76	2.76
	25-Apr-17		0.05		0.05	0.05				1.30	1.30
	6-May-17		0.10		0.10	0.10				1.10	1.10
	17-May-17		0.04		0.04	0.04				1.10	1.10
	21-May-17		0.21		0.21	0.21				0.70	0.70
66	13-Jun-17									BDL	BDL
	20-Jun-17		1.00		1.00	1.00				9.91	9.91
83	10-Aug-17							####			
	15-Sep-17		0.14		0.14	0.14				0.70	0.70
	24-Sep-17		0.06		0.06	0.06				0.66	0.66
	5-Nov-17		0.82		0.82	0.82				3.60	3.60
	17-Nov-17		0.12		0.12	0.12				1.70	1.70
	9-Jan-18		0.03		0.03	0.03				0.80	0.80
	15-Feb-18	6.70		6.70		6.70				1.60	1.60
	16-Mar-18		0.67		0.67	0.67				3.60	3.60
	23-Mar-18	2.50			2.50	2.50				6.30	6.30
	7-Apr-18		0.55		0.55	0.55				0.70	0.70
	20-Apr-18	1.80			1.80	1.80				7.80	7.80
	30-Apr-18		0.30		0.30	0.30				0.70	0.70
	3-May-18		0.02		0.02	0.02				0.90	0.90
	11-May-18	1.40			1.40	1.40				2.40	2.40
	22-Aug-18	1.30			1.30	1.30				5.70	5.70
21	3-Oct-18								10.20		10.20
	10-Oct-18		0.04		0.04	0.04				0.40	0.40
	30-Nov-18		0.19		0.19	0.19				0.40	0.40
	18-Jan-19		0.01		0.01	0.01	0.02			0.20	0.20
	29-Mar-19		0.40		0.40	0.40	0.12			3.10	3.10
	10-Apr-19		0.19		0.19	0.19	0.08			1.80	1.80
	7-May-19		0.53		0.53	0.53	0.23			1.30	1.30
	21-May-19		0.08		0.08	0.08	0.02			0.50	0.50
	11-Sep-19	7.800		7.800		7.800					
	20-Nov-19		0.62		0.62	0.62	0.17			4.10	4.10
	23-Jan-20		0.43		0.43	0.43	0.07			1.10	1.10
	13-Mar-20	2.10			2.10	2.10	0.21			BDL	BDL
	25-Mar-20		0.10		0.10	0.10	0.02			0.30	0.30
	23-May-20		0.25		0.25	0.25	0.08			2.60	2.60
	8-Jun-20		0.27		0.27	0.27	0.15			1.30	1.30
		7	36	2	41	43	11		1	40	41
	averages	3.371	0.234	7.250	0.427	0.745	0.106		10.200	2.234	2.428
summer (Apr-S		3.075	0.229	7.800	0.411	0.747	0.112		#DIV/0!	2.326	2.326
winter (Oct-Mar		3.767	0.238	6.700	0.445	0.742	0.102		10.200	2.132	2.535
summer count		4	18	1	21	22	5		0	21	21
winter count		3	18	1	20	21	6		1	19	20

Figure 4a. Pelican Pt. T-P Conc all data

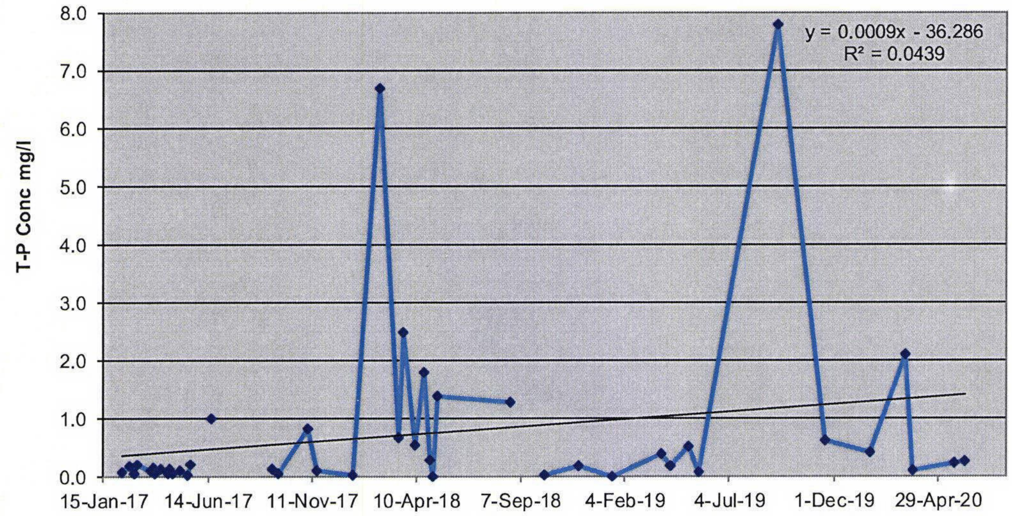


Figure 4b. Pelican Pt. T-P Conc w/o T-P > 5

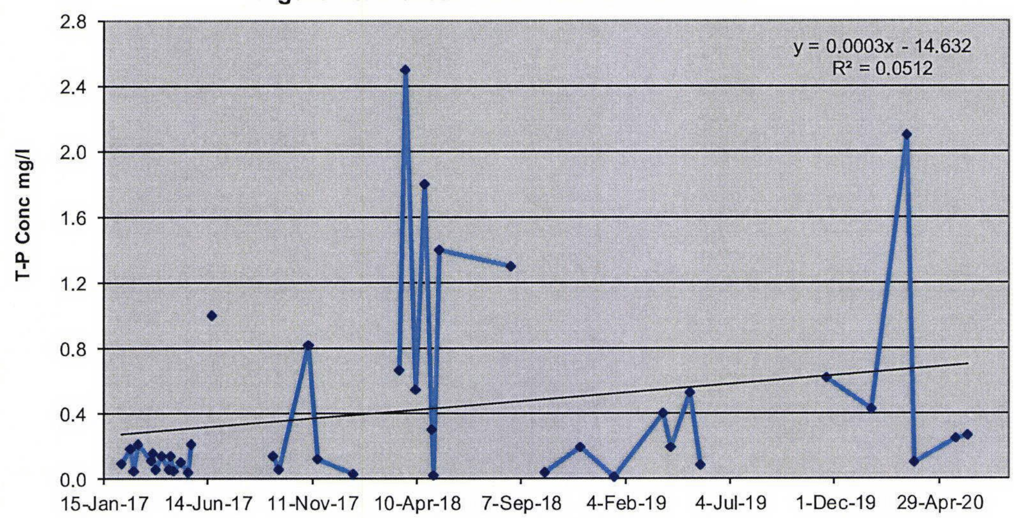
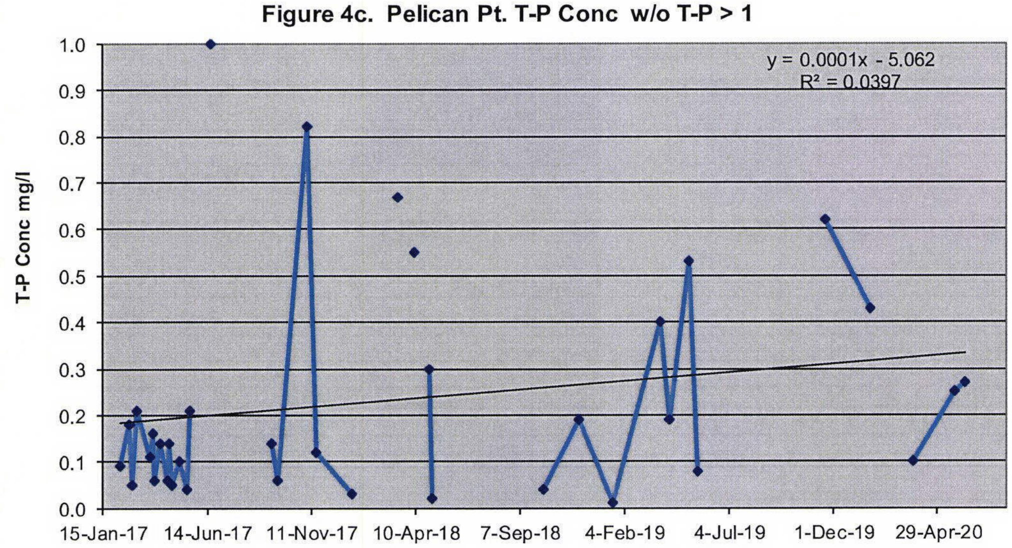


Figure 4c. Pelican Pt. T-P Conc w/o T-P > 1



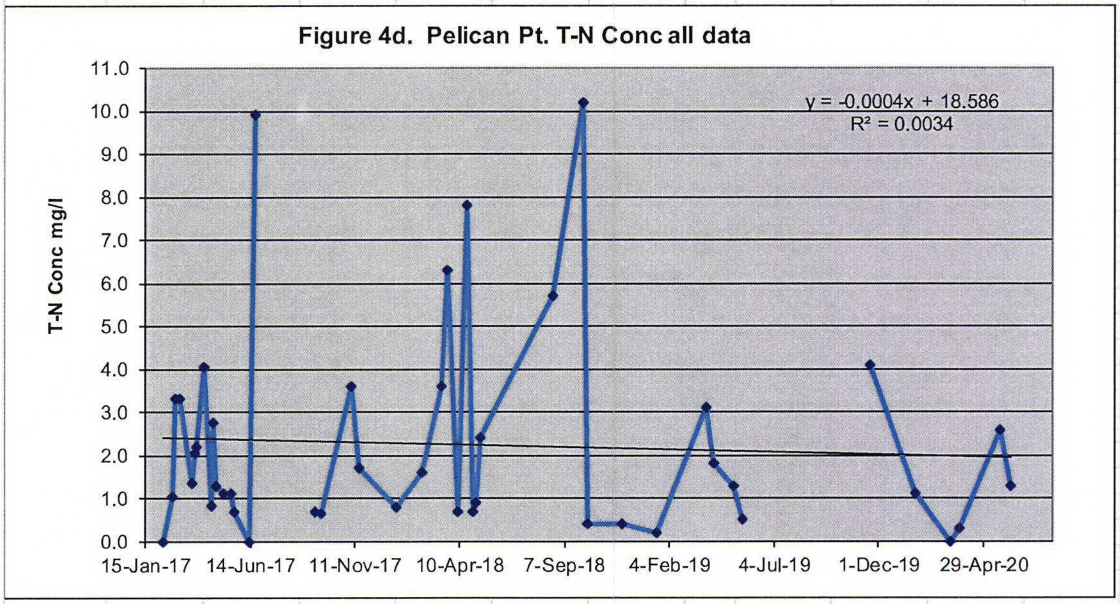


Figure 4d. Pelican Pt. T-N Conc all data
y = -0.0004x + 18.586
R² = 0.0034
T-N Conc mg/l
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
15-Jan-17
14-Jun-17
11-Nov-17
10-Apr-18
7-Sep-18
4-Feb-19
4-Jul-19
1-Dec-19
29-Apr-20

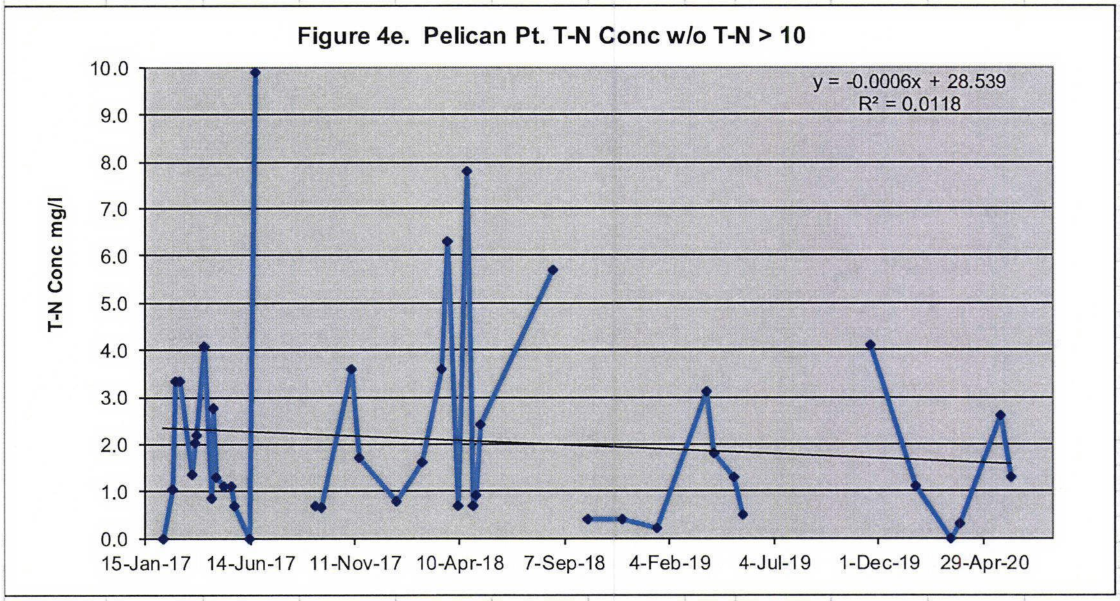


Figure 4e. Pelican Pt. T-N Conc w/o T-N > 10
y = -0.0006x + 28.539
R² = 0.0118
T-N Conc mg/l
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
15-Jan-17
14-Jun-17
11-Nov-17
10-Apr-18
7-Sep-18
4-Feb-19
4-Jul-19
1-Dec-19
29-Apr-20

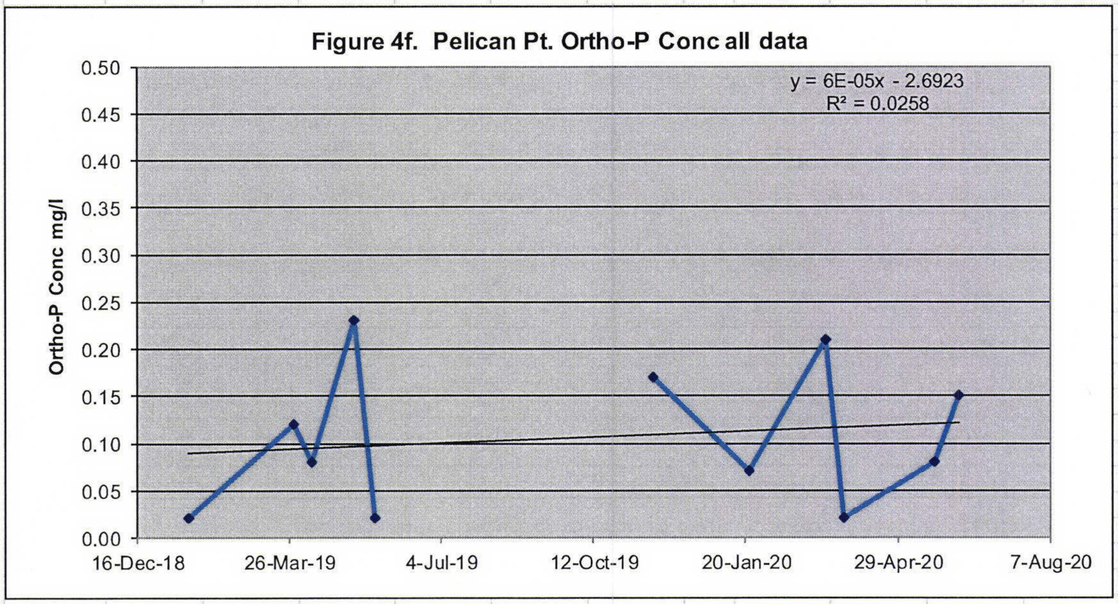


Figure 4f. Pelican Pt. Ortho-P Conc all data
y = 6E-05x - 2.6923
R² = 0.0258
Ortho-P Conc mg/l
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
16-Dec-18
26-Mar-19
4-Jul-19
12-Oct-19
20-Jan-20
29-Apr-20
7-Aug-20

Table 5. Genola

Sampling Date	TP>1 outliers	Total Phos (mg/l) w/o outlrs	TP>5 outliers	Total Phos (mg/l) w/o outlrs	Total Phos (mg/l) all data	OrthoPhos mg/l all data	TN>10 outliers	Total Nitro (mg/l) w/o outlrs	Total Nitro (mg/l) all data
10-Feb-17									
22-Feb-17									
27-Feb-17									
5-Mar-17		BDL		BDL	BDL			2.19	2.19
23-Mar-17		0.28		0.28	0.28			1.89	1.89
27-Mar-17		0.02		0.02	0.02			1.19	1.19
30-Mar-17		0.04		0.04	0.04			1.43	1.43
8-Apr-17		0.28		0.28	0.28			2.37	2.37
19-Apr-17		0.09		0.09	0.09			1.24	1.24
21-Apr-17		0.03		0.03	0.03			1.31	1.31
25-Apr-17	10.00		10.00		10.00			1.60	1.60
6-May-17	2.10			2.10	2.10			2.30	2.30
17-May-17	2.60			2.60	2.60			7.30	7.30
21-May-17	9.80		9.80		9.80			0.90	0.90
17-Jul-17	7.80		7.80		7.80		11.80		11.80
25-Jul-17	5.30		5.30		5.30			3.55	3.55
10-Aug-17		0.64		0.64	0.64			BDL	BDL
15-Sep-17		0.07		0.07	0.07			0.51	0.51
24-Sep-17		0.07		0.07	0.07			1.10	1.10
5-Nov-17		0.62		0.62	0.62			1.80	1.80
17-Nov-17		0.34		0.34	0.34			1.50	1.50
9-Jan-18		0.06		0.06	0.06			1.00	1.00
15-Feb-18		0.16		0.16	0.16			2.20	2.20
16-Mar-18		0.04		0.04	0.04			0.40	0.40
23-Mar-18		0.02		0.02	0.02			0.40	0.40
7-Apr-18		0.09		0.09	0.09			0.80	0.80
20-Apr-18		0.55		0.55	0.55			1.60	1.60
30-Apr-18		0.91		0.91	0.91			1.10	1.10
3-May-18	2.70			2.70	2.70			8.90	8.90
11-May-18	1.80			1.80	1.80			1.00	1.00
22-Aug-18	6.00		6.00		6.00			4.40	4.40
3-Oct-18		0.73		0.73	0.73			1.30	1.30
10-Oct-18		0.07		0.07	0.07			0.50	0.50
30-Nov-18		0.10		0.10	0.10			BDL	BDL
18-Jan-19		0.46		0.46	0.46	0.01		BDL	BDL
7-Mar-19		0.24		0.24	0.24	0.07		1.10	1.10
29-Mar-19		0.05		0.05	0.05	0.02		1.00	1.00
10-Apr-19		0.26		0.26	0.26	0.02		1.50	1.50
21-Apr-19		0.06		0.06	0.06	0.02			
7-May-19		0.05		0.05	0.05	0.02		0.80	0.80
21-May-19		0.10		0.10	0.10	0.09		0.40	0.40
21-Jun-19		0.39		0.39	0.39	0.08		1.00	1.00
1-Aug-19		0.44		0.44	0.44	0.04		0.90	0.90
9-Aug-19	1.40			1.40	1.40	1.10		4.10	4.10
11-Sep-19		0.02		0.02	0.02	BDL		BDL	BDL
20-Nov-19		0.10		0.10	0.10	0.04		0.60	0.60
23-Jan-20		0.47		0.47	0.47	0.05		1.10	1.10
8-Feb-20		0.04		0.04	0.04	BDL		0.90	0.90
13-Mar-20		0.10		0.10	0.10	BDL		0.50	0.50
25-Mar-20		0.06		0.06	0.06	BDL		0.20	0.20
23-May-20		0.28		0.28	0.28			2.40	2.40
8-Jun-20		0.08		0.08	0.08	0.02		0.50	0.50
	10	38	5	43	48	13	1	43	44
averages	4.950	0.221	7.780	0.442	1.206	0.122	11.800	1.693	1.922
summer (Apr-S	4.950	0.245	7.780	0.653	1.925	0.174	11.800	2.149	2.535
winter (Oct-Mar	#DIV/0!	0.200	#DIV/0!	0.200	0.200	0.038	#DIV/0!	1.116	1.116
summer count	10	18	5	23	28	8	1	24	25
winter count	0	20	0	20	20	5	0	19	19

Figure 5a. Genola T-P Conc all data

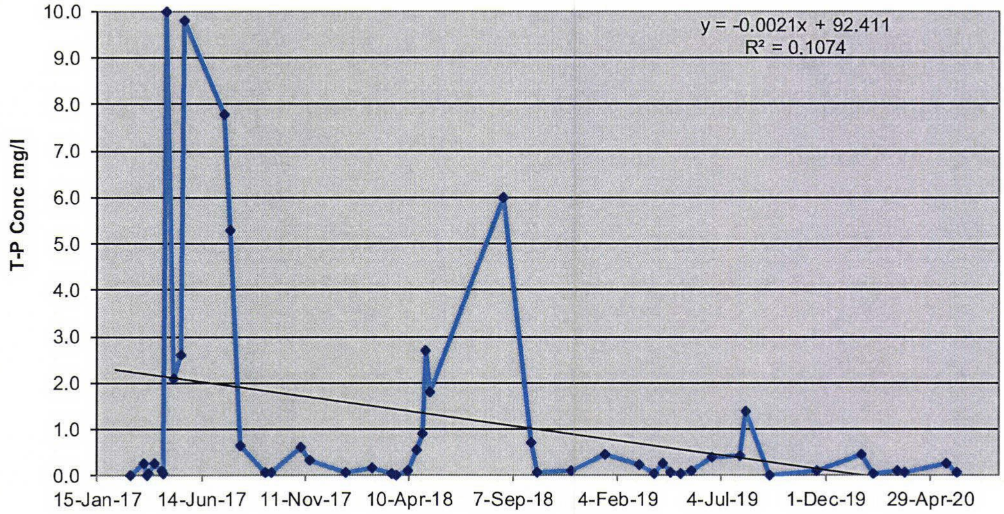


Figure 5b. Genola T-P Conc w/o T-P > 5

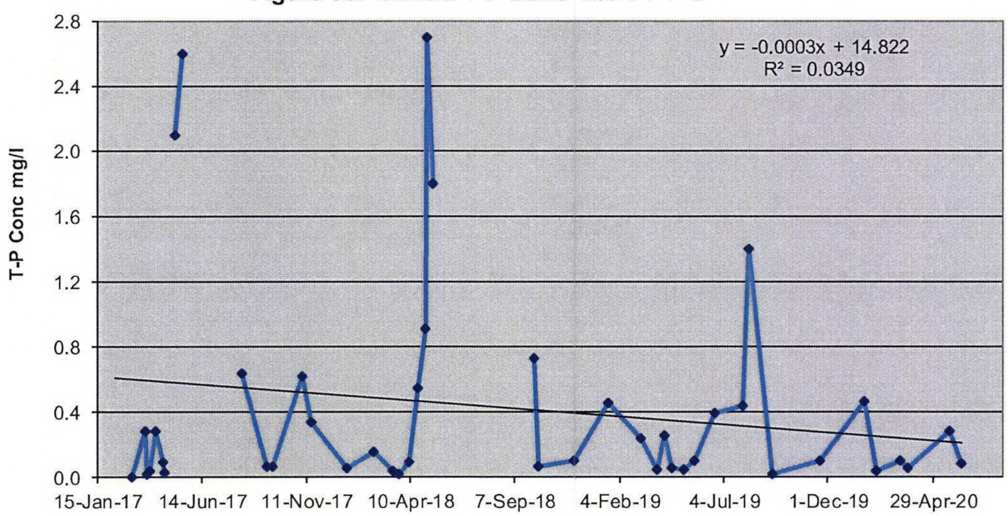


Figure 5c. Genola T-P Conc w/o T-P > 1

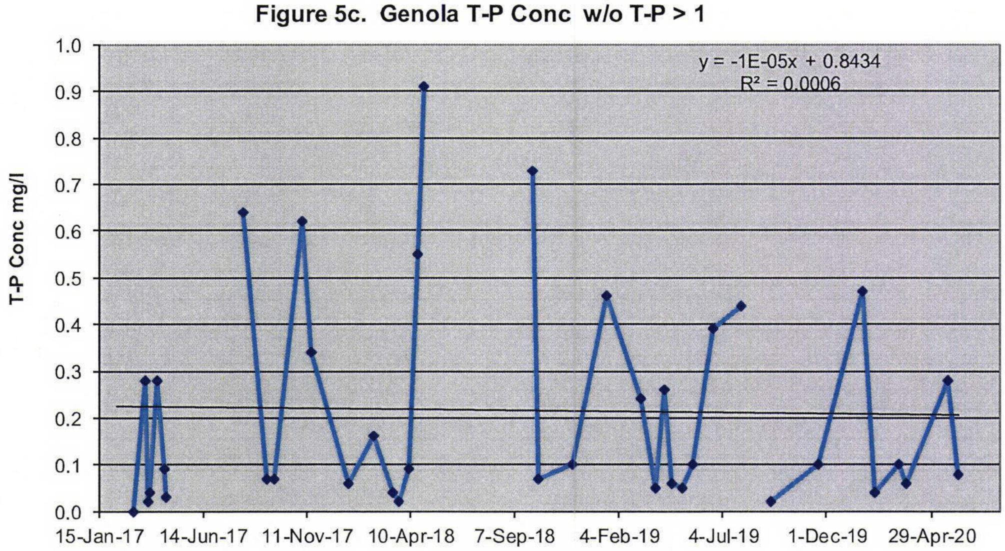


Figure 5d. Genola T-N Conc all data

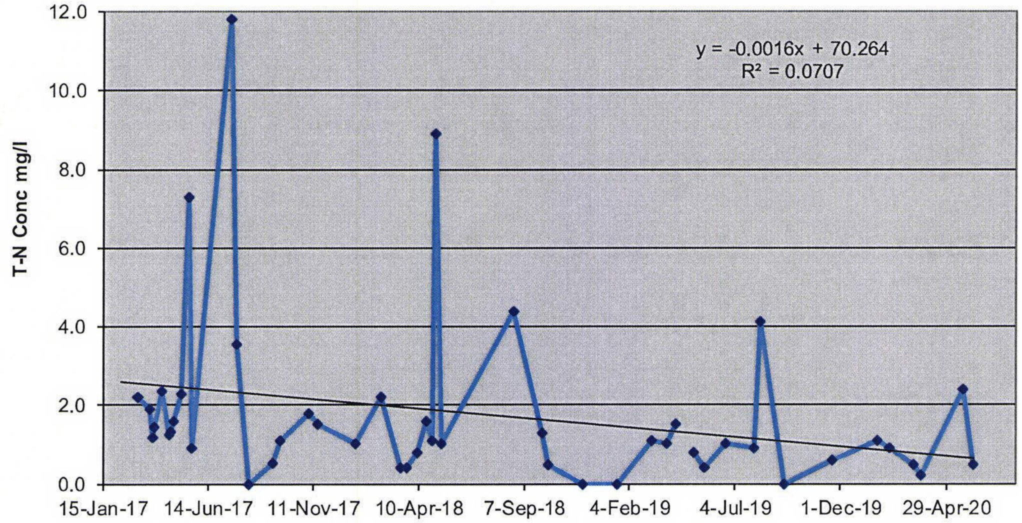


Figure 5e. Genola T-N Conc w/o T-N > 10

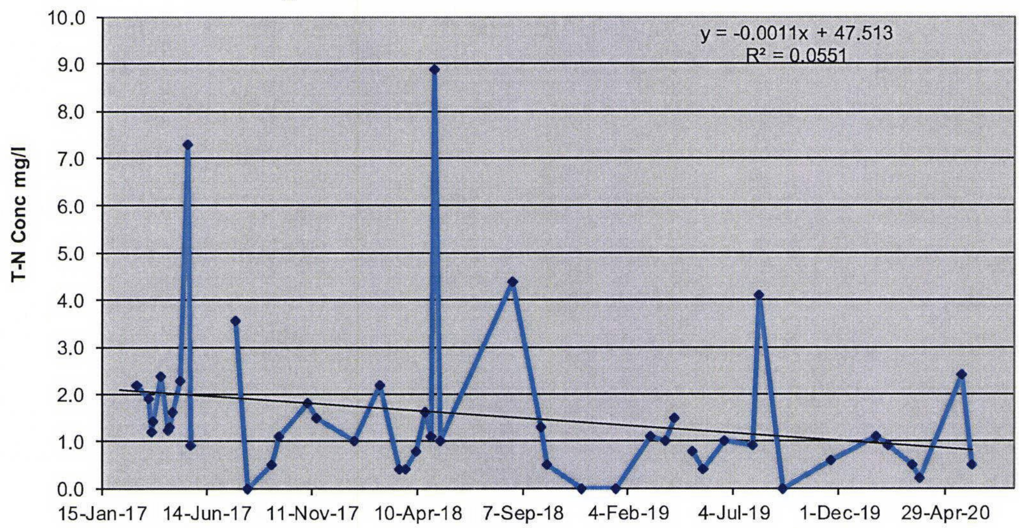


Figure 5f. Genola Ortho-P Conc all data

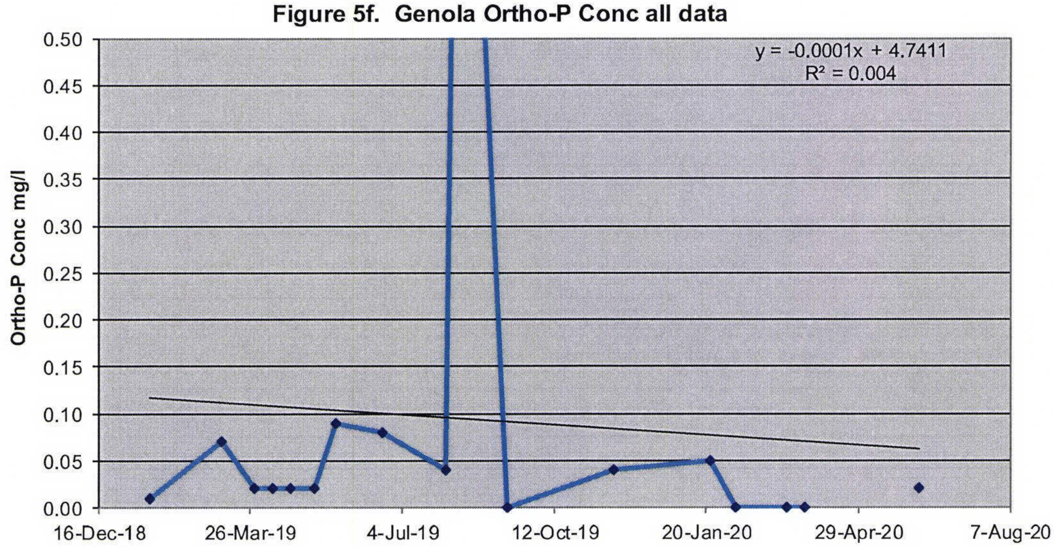


Table 6. Elberta

Sampling Date	TP>1 outliers	Total Phos (mg/l) w/o outlrs	TP>5 outliers	Total Phos (mg/l) w/o outlrs	Total Phos (mg/l) all data	OrthoPhos mg/l all data	TN>10 outliers	Total Nitro (mg/l) w/o outlrs	Total Nitro (mg/l) all data
10-Feb-17		0.09	none	0.09	0.09		none	0.50	0.50
22-Feb-17		0.12		0.12	0.12			0.95	0.95
27-Feb-17		0.15		0.15	0.15			6.26	6.26
23-Mar-17		0.48		0.48	0.48			3.33	3.33
27-Mar-17		0.06		0.06	0.06			1.12	1.12
30-Mar-17		0.26		0.26	0.26			1.79	1.79
19-Apr-17		0.32		0.32	0.32			1.21	1.21
21-Apr-17		0.07		0.07	0.07			1.30	1.30
6-May-17		0.64		0.64	0.64			2.10	2.10
17-May-17		0.52		0.52	0.52			1.70	1.70
21-May-17		0.18		0.18	0.18			1.80	1.80
13-Jun-17	1.20			1.20	1.20			BDL	BDL
17-Jul-17		0.79		0.79	0.79			BDL	BDL
25-Jul-17		0.56		0.56	0.56			2.81	2.81
10-Aug-17		0.66		0.66	0.66			BDL	BDL
15-Sep-17		0.12		0.12	0.12			0.94	0.94
24-Sep-17		0.11		0.11	0.11			1.25	1.25
5-Nov-17		0.99		0.99	0.99			0.43	0.43
17-Nov-17	1.80			1.80	1.80			6.90	6.90
9-Jan-18		0.14		0.14	0.14			1.80	1.80
15-Feb-18		0.27		0.27	0.27			2.00	2.00
16-Mar-18	1.30			1.30	1.30			8.50	8.50
23-Mar-18		0.05		0.05	0.05			1.20	1.20
7-Apr-18		0.14		0.14	0.14			1.20	1.20
3-May-18		0.80		0.80	0.80			2.70	2.70
11-May-18		0.38		0.38	0.38			1.40	1.40
22-Aug-18		0.08		0.08	0.08			1.30	1.30
3-Oct-18		0.95		0.95	0.95			2.20	2.20
10-Oct-18		0.06		0.06	0.06			0.70	0.70
30-Nov-18		0.17		0.17	0.17			0.60	0.60
18-Jan-19		0.66		0.66	0.66	BDL		BDL	BDL
6-Mar-19		0.13		0.13	0.13	0.04		1.50	1.50
29-Mar-19		0.23		0.23	0.23	0.18		1.10	1.10
10-Apr-19		0.30		0.30	0.30	0.16		1.70	1.70
21-Apr-19		0.09		0.09	0.09	0.01			
7-May-19		0.26		0.26	0.26	0.13		0.50	0.50
21-May-19		0.58		0.58	0.58	BDL		BDL	BDL
21-Jun-19		0.63		0.63	0.63	0.28		3.00	3.00
1-Aug-19		0.26		0.26	0.26	BDL		0.3	0.3
9-Aug-19		0.12		0.12	0.12	0.03		4.10	4.10
11-Sep-19		0.140		0.140	0.140	0.080		0.300	0.300
20-Nov-19		0.25		0.25	0.25	0.20		0.90	0.90
13-Mar-20		0.15		0.15	0.15	0.06		1.80	1.80
25-Mar-20		0.84		0.84	0.84	0.81		2.00	2.00
23-May-20	1.2			1.20	1.20			BDL	BDL
8-Jun-20		0.36		0.36	0.36	0.27		1.60	1.60
	4	42	0	46	46	12	0	39	39
averages		0.337		0.427	0.427	0.188		2.895	1.969
summer (Apr-S	1.200	0.353	#DIV/0!	0.420	0.420	0.137	#DIV/0!	1.643	1.643
winter (Oct-Ma	1.550	0.318	#DIV/0!	0.436	0.436	0.258	#DIV/0!	2.279	2.279
summer count	2	23	0	25	25	7	0	19	19

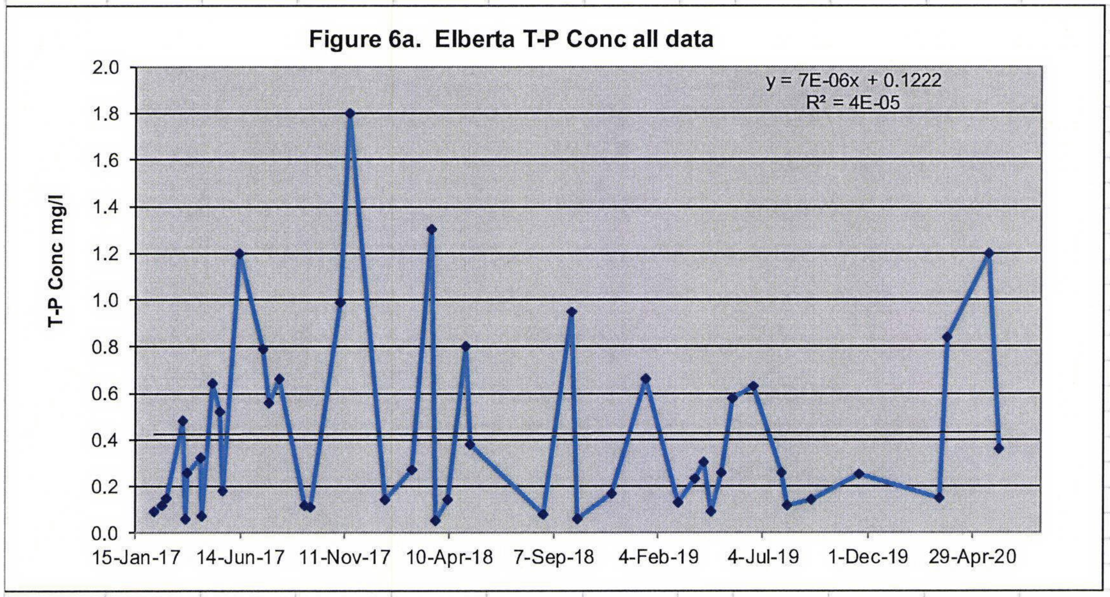


Figure 6a. Elberta T-P Conc all data
y = 7E-06x + 0.1222
R² = 4E-05
T-P Conc mg/l
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
15-Jan-17
14-Jun-17
11-Nov-17
10-Apr-18
7-Sep-18
4-Feb-19
4-Jul-19
1-Dec-19
29-Apr-20

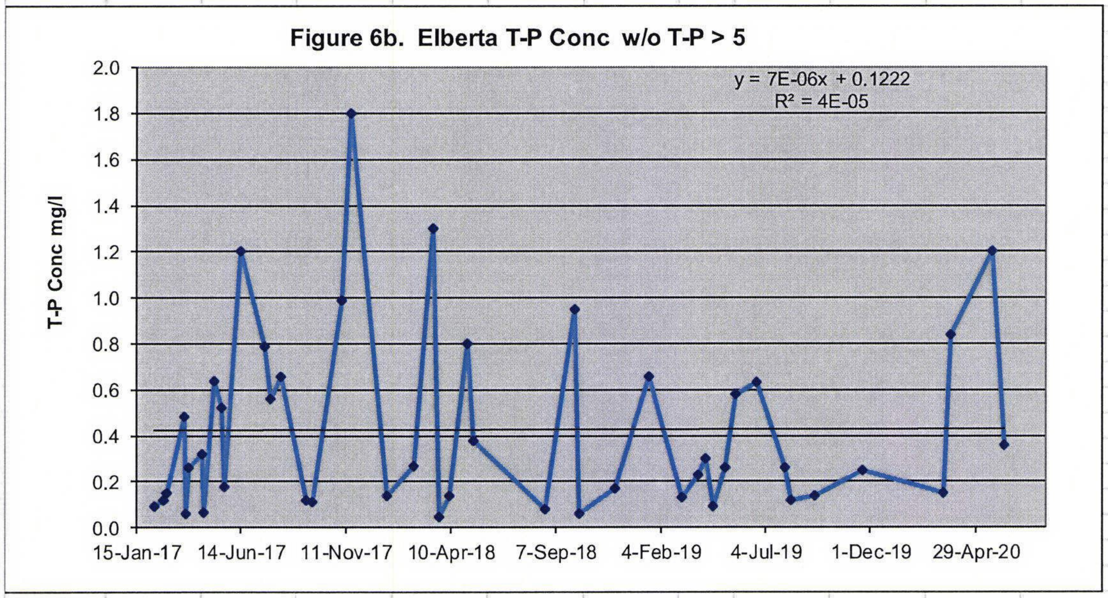


Figure 6b. Elberta T-P Conc w/o T-P > 5
y = 7E-06x + 0.1222
R² = 4E-05
T-P Conc mg/l
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
15-Jan-17
14-Jun-17
11-Nov-17
10-Apr-18
7-Sep-18
4-Feb-19
4-Jul-19
1-Dec-19
29-Apr-20

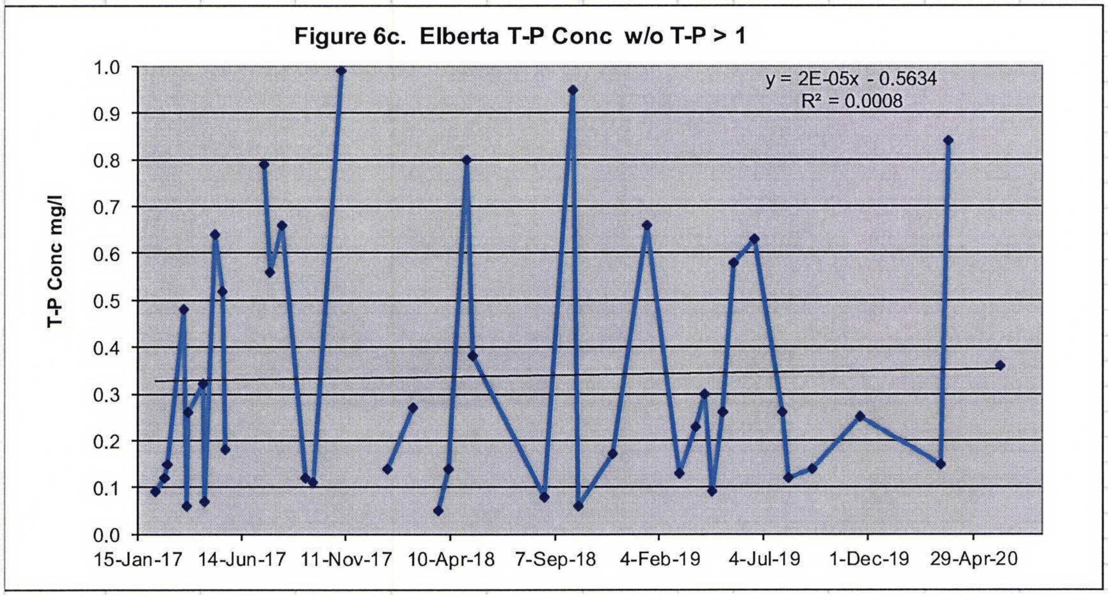


Figure 6c. Elberta T-P Conc w/o T-P > 1
y = 2E-05x - 0.5634
R² = 0.0008
T-P Conc mg/l
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
15-Jan-17
14-Jun-17
11-Nov-17
10-Apr-18
7-Sep-18
4-Feb-19
4-Jul-19
1-Dec-19
29-Apr-20

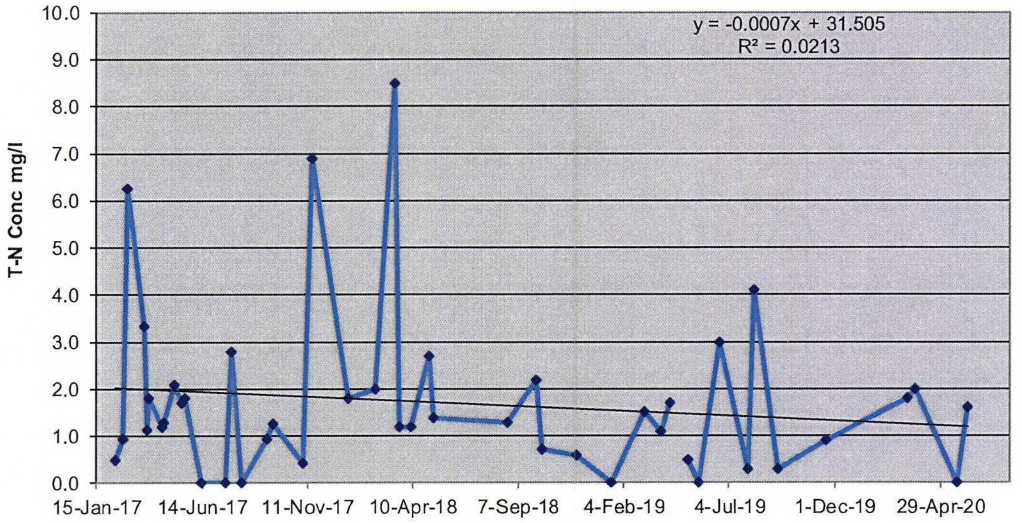


Figure 6d. Elberta T-N Conc all data

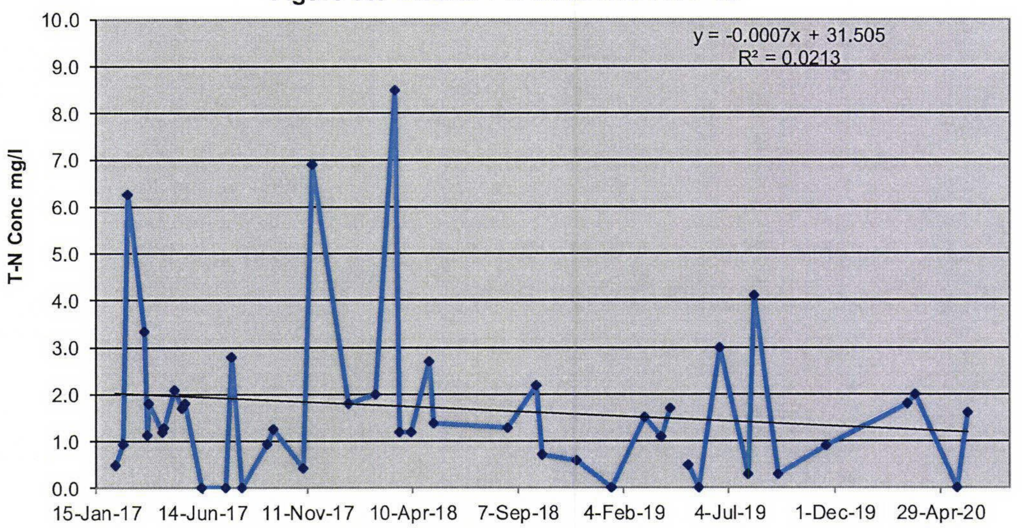


Figure 6e. Elberta T-N Conc w/o T-N > 10

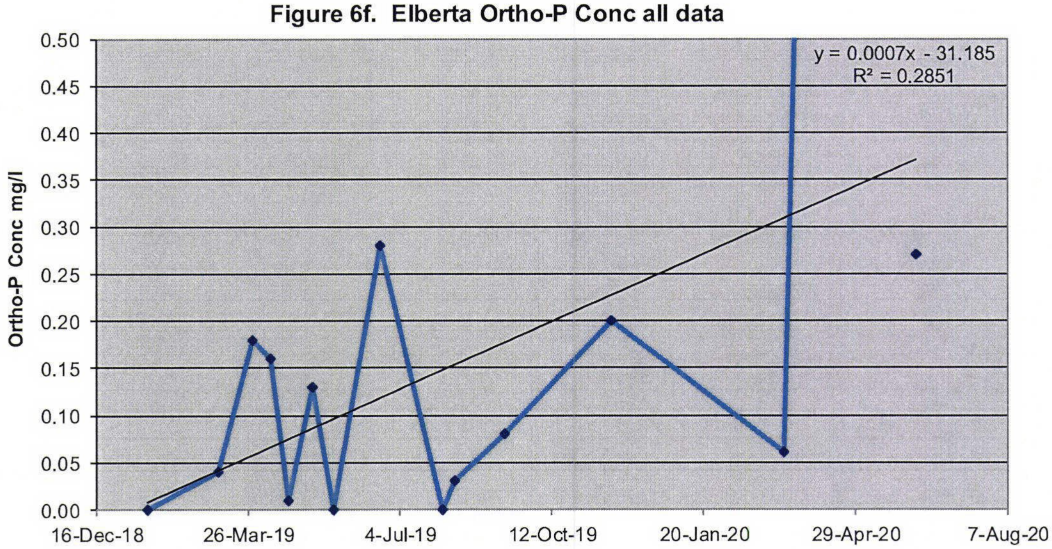


Figure 6f. Elberta Ortho-P Conc all data

too big	Sampling Date	TP>1 outliers	Total Phos (mg/l) w/o outlrs	TP>5 outliers	Total Phos (mg/l) w/o outlrs	Total Phos (mg/l) all data	OrthoPhos mg/l all data	TN>10 outliers	Total Nitro (mg/l) w/o outlrs	Total Nitro (mg/l) all data
	Table 7. Mosida									
	10-Feb-17		0.10	none	0.10	0.10			1.38	1.38
	22-Feb-17		0.07		0.07	0.07			1.24	1.24
	27-Feb-17		0.09		0.09	0.09			2.28	2.28
	5-Mar-17		0.13		0.13	0.13			2.63	2.63
	23-Mar-17		0.21		0.21	0.21			1.61	1.61
	27-Mar-17		0.15		0.15	0.15			2.23	2.23
	30-Mar-17		0.16		0.16	0.16			2.14	2.14
	8-Apr-17	1.66			1.66	1.66			7.24	7.24
	19-Apr-17		0.20		0.20	0.20			1.75	1.75
	21-Apr-17		0.10		0.10	0.10			1.81	1.81
	25-Apr-17		0.90		0.90	0.90			1.50	1.50
	6-May-17	4.00			4.00	4.00			4.80	4.80
	17-May-17		0.42		0.42	0.42			1.90	1.90
	21-May-17	2.60			2.60	2.60			2.70	2.70
	25-Jul-17	4.60			4.60	4.60			BDL	BDL
	15-Sep-17		0.55		0.55	0.55			1.20	1.20
	24-Sep-17		0.75		0.75	0.75			2.60	2.60
	17-Nov-17		0.86		0.86	0.86			3.80	3.80
	9-Jan-18	1.50			1.50	1.50			7.20	7.20
	16-Mar-18		0.16		0.16	0.16			1.70	1.70
	7-Apr-18		0.21		0.21	0.21			1.00	1.00
	30-Apr-18		0.45		0.45	0.45			1.40	1.40
	3-May-18		0.10		0.10	0.10			1.90	1.90
	11-May-18		0.04		0.04	0.04			0.90	0.90
	22-Aug-18	4.90			4.90	4.90		49.30		49.30
34	3-Oct-18							35.70		35.70
	10-Oct-18		0.58		0.58	0.58			5.00	5.00
	7-Mar-19		0.38		0.38	0.38	0.32		BDL	BDL
	29-Mar-19		0.04		0.04	0.04	0.03		0.80	0.80
	10-Apr-19	1.80			1.80	1.80	BDL		2.8	2.80
	7-May-19		0.77		0.77	0.77	0.52		2.90	2.90
	21-May-19		0.05		0.05	0.05	0.02		0.70	0.70
	21-Jun-19	3.1			3.10	3.10	1.90	10.30		10.30
	1-Aug-19	2			2.00	2.00	1.50		6.40	6.40
	9-Aug-19	2.5			2.50	2.50	2.20	10.10		10.10
	11-Sep-19	1.3			1.30	1.30	1.10		3.70	3.70
	23-Jan-20		0.13		0.13	0.13	0.02		1.30	1.30
	8-Feb-20		0.05		0.05	0.05	BDL		0.80	0.80
	25-Mar-20		0.40		0.40	0.40	0.20		0.20	0.20
11	23-May-20							33.4		33.40
	8-Jun-20		0.52		0.52	0.52	0.41		3.20	3.20
		11	28	0	39	39	11	5	34	39
	averages	2.724	0.306	#DIV/0!	0.988	0.988	0.747	27.760	2.491	5.731
summer (Apr-S		2.846	0.389	#DIV/0!	1.457	1.457	1.093	25.775	2.653	6.674
winter (Oct-Mar		1.500	0.234	#DIV/0!	0.313	0.313	0.143	35.700	2.287	4.376
summer count		10	13	0	23	23	7	4	19	23
winter count		1	15	0	16	16	4	1	15	16

Figure 7a. Mosida T-P Conc all data

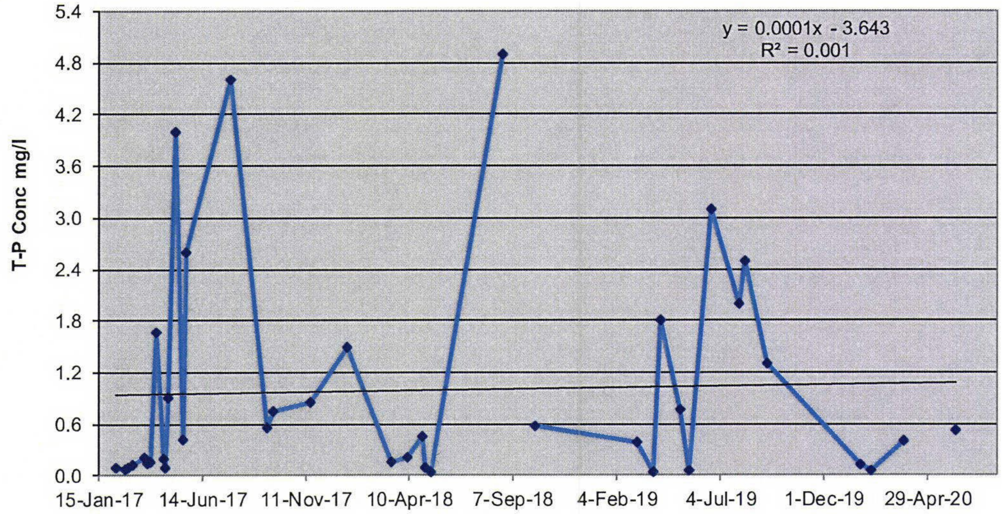


Figure 7b. Mosida T-P Conc w/o T-P > 5

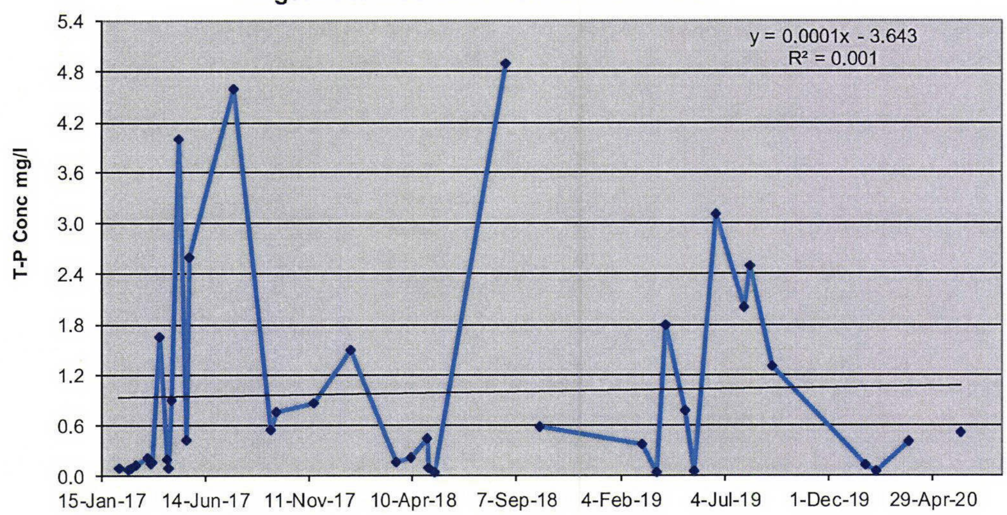
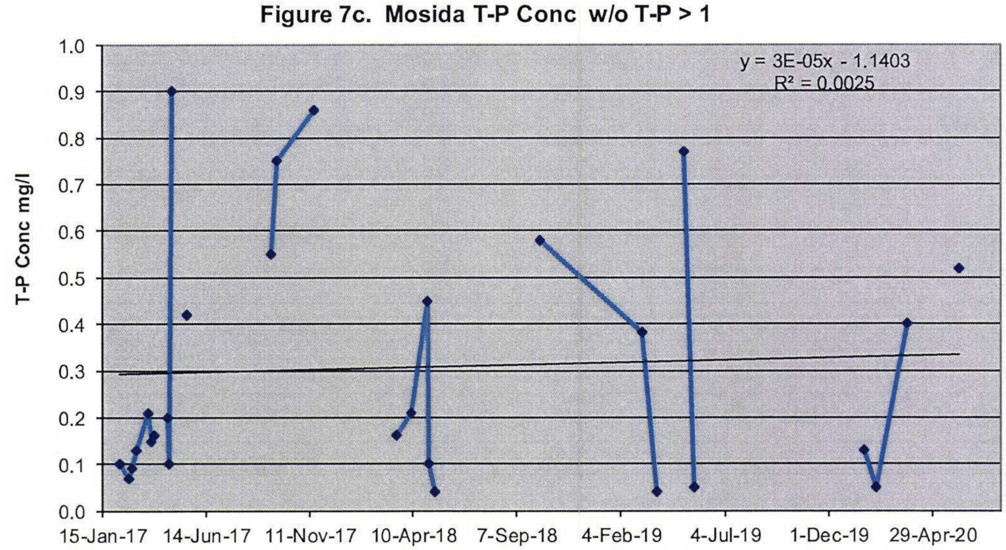


Figure 7c. Mosida T-P Conc w/o T-P > 1



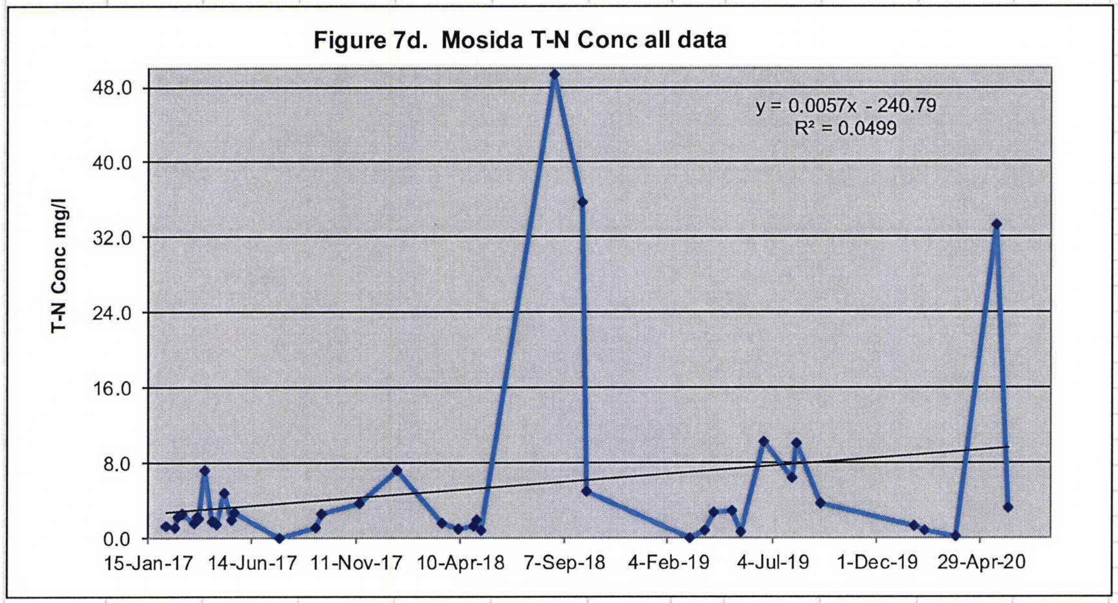


Figure 7d. Mosida T-N Conc all data
y = 0.0057x - 240.79
R² = 0.0499
T-N Conc mg/l
48.0
40.0
32.0
24.0
16.0
8.0
0.0
15-Jan-17
14-Jun-17
11-Nov-17
10-Apr-18
7-Sep-18
4-Feb-19
4-Jul-19
1-Dec-19
29-Apr-20

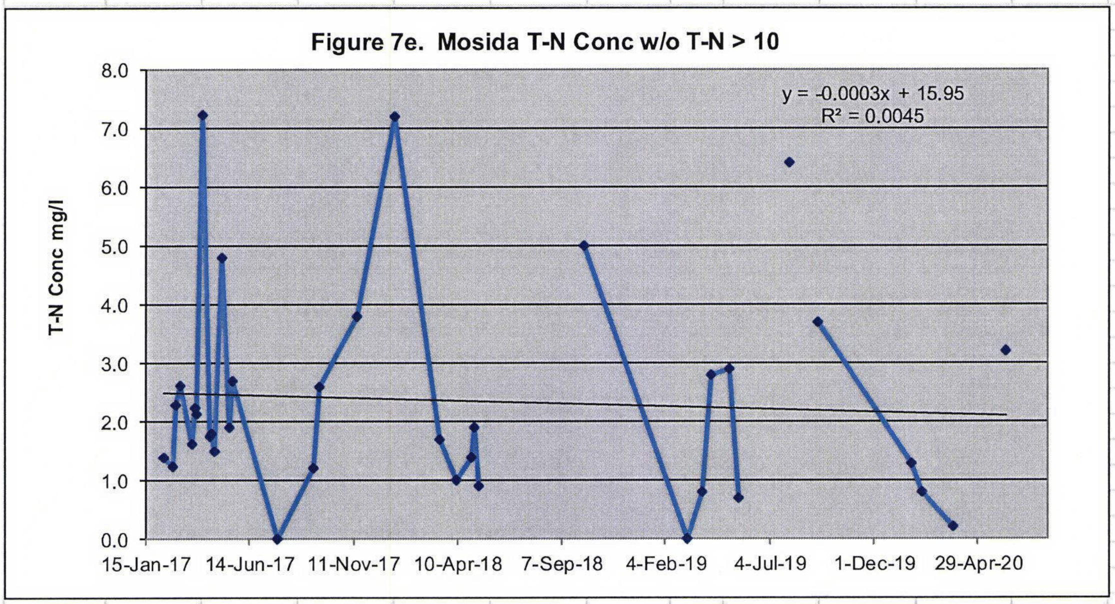


Figure 7e. Mosida T-N Conc w/o T-N > 10
y = -0.0003x + 15.95
R² = 0.0045
T-N Conc mg/l
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
15-Jan-17
14-Jun-17
11-Nov-17
10-Apr-18
7-Sep-18
4-Feb-19
4-Jul-19
1-Dec-19
29-Apr-20

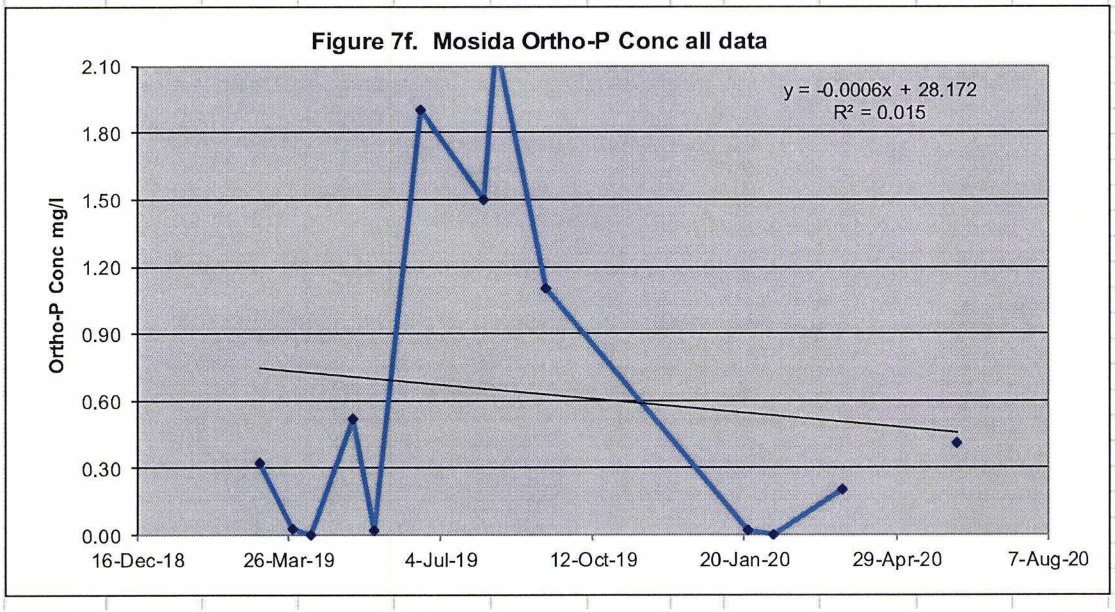


Figure 7f. Mosida Ortho-P Conc all data
y = -0.0006x + 28.172
R² = 0.015
Ortho-P Conc mg/l
2.10
1.80
1.50
1.20
0.90
0.60
0.30
0.00
16-Dec-18
26-Mar-19
4-Jul-19
12-Oct-19
20-Jan-20
29-Apr-20
7-Aug-20

Table 8. Lehi

Sampling Date	TP>1 outliers	Total Phos (mg/l) w/o outlrs	TP>5 outliers	Total Phos (mg/l) w/o outlrs	Total Phos (mg/l) all data	OrthoPhos mg/l all data		TN>10 outliers	Total Nitro (mg/l) w/o outlrs	Total Nitro (mg/l) all data
21-Jan-17		0.02		0.02	0.02			none	0.33	0.33
10-Feb-17		0.07		0.07	0.07				2.94	2.94
11-Feb-17		0.02		0.02	0.02				1.07	1.07
21-Feb-17		0.05		0.05	0.05				2.94	2.94
23-Feb-17		0.02		0.02	0.02				2.33	2.33
23-Mar-17		0.05		0.05	0.05				2.31	2.31
27-Mar-17		0.01		0.01	0.01				1.40	1.40
30-Mar-17		0.01		0.01	0.01				5.33	5.33
8-Apr-17		0.18		0.18	0.18				8.05	8.05
19-Apr-17		0.46		0.46	0.46				3.91	3.91
21-Apr-17		0.06		0.06	0.06				2.13	2.13
25-Apr-17		0.10		0.10	0.10				4.30	4.30
17-May-17		0.06		0.06	0.06				3.20	3.20
21-May-17		0.76		0.76	0.76				2.10	2.10
20-Jun-17	11.00		11.00		11.00				BDL	BDL
23-Jul-17	6.70		6.70		6.70				BDL	BDL
25-Jul-17		0.71		0.71	0.71				3.47	3.47
10-Aug-17	1.50			1.50	1.50				7.11	7.11
15-Sep-17	1.30			1.30	1.30				2.33	2.33
22-Sep-17		0.47		0.47	0.47				1.21	1.21
24-Sep-17		0.40		0.40	0.40				2.70	2.70
17-Nov-17	2.30			2.30	2.30				1.50	1.50
9-Jan-18		0.43		0.43	0.43				2.00	2.00
16-Mar-18		0.07		0.07	0.07				1.20	1.20
20-Mar-18		0.34		0.34	0.34				1.00	1.00
23-Mar-18	1.60			1.60	1.60				0.60	0.60
7-Apr-18		0.10		0.10	0.10				3.00	3.00
20-Apr-18		0.14		0.14	0.14				0.90	0.90
30-Apr-18	1.30			1.30	1.30				5.00	5.00
3-May-18		0.07		0.07	0.07				2.50	2.50
11-May-18		0.16		0.16	0.16				3.70	3.70
21-Aug-18	2.10			2.10	2.10				5.70	5.70
22-Aug-18		0.42		0.42	0.42				2.40	2.40
3-Oct-18	1.10			1.10	1.10				0.40	0.40
10-Oct-18		0.04		0.04	0.04				1.20	1.20
30-Nov-18		0.02		0.02	0.02				1.60	1.60
18-Jan-19		0.03		0.03	0.03	BDL			0.80	0.80
8-Mar-19		0.29		0.29	0.29	0.11			1.00	1.00
13-Mar-19		0.13		0.13	0.13	0.01			1.90	1.90
29-Mar-19		BDL		BDL	BDL				1.80	1.80
10-Apr-19		0.03		0.03	0.03	0.02			2.50	2.50
21-Apr-19		0.03		0.03	0.03	0.01			2.60	2.60
7-May-19		0.09		0.09	0.09	0.02			0.90	0.90
21-May-19		0.24		0.24	0.24	0.05			1.20	1.20
9-Aug-19		0.10		0.10	0.10	0.04			0.40	0.40
11-Sep-19		0.76		0.76	0.76	0.52			BDL	BDL
20-Nov-19		0.90		0.90	0.90	0.22			2.70	2.70
23-Jan-20		0.11		0.11	0.11	0.02			1.70	1.70
8-Feb-20		0.08		0.08	0.08				1.40	1.40
13-Mar-20		0.70		0.70	0.70	0.44			BDL	BDL
25-Mar-20		0.06		0.06	0.06	0.07			1.70	1.70
23-May-20		0.62		0.62	0.62	0.48			3.90	3.90
8-Jun-20	2.8			2.80	2.80		2.30		8.50	8.50
	10	42	2	50	52	13		0	49	49
averages	3.170	0.224	8.850	0.468	0.791	0.155		#DIV/0!	2.548	2.548
summer (Apr	3.814	0.284	8.850	0.575	1.166	0.163		#DIV/0!	3.348	3.348
winter (Oct-M	1.667	0.164	#DIV/0!	0.352	0.352	0.145		#DIV/0!	1.715	1.715
summer coui	7	21	2	26	28	7		0	25	25
winter count	3	21	0	24	24	6		0	24	24

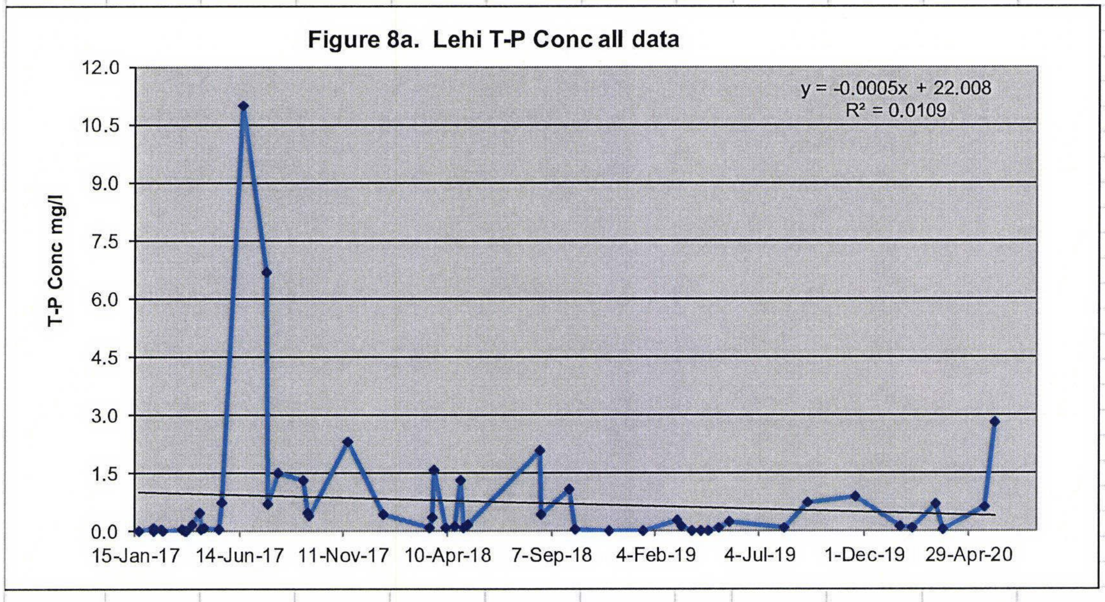


Figure 8a. Lehi T-P Conc all data
y = -0.0005x + 22.008
R² = 0.0109
T-P Conc mg/l
12.0
10.5
9.0
7.5
6.0
4.5
3.0
1.5
0.0
15-Jan-17
14-Jun-17
11-Nov-17
10-Apr-18
7-Sep-18
4-Feb-19
4-Jul-19
1-Dec-19
29-Apr-20

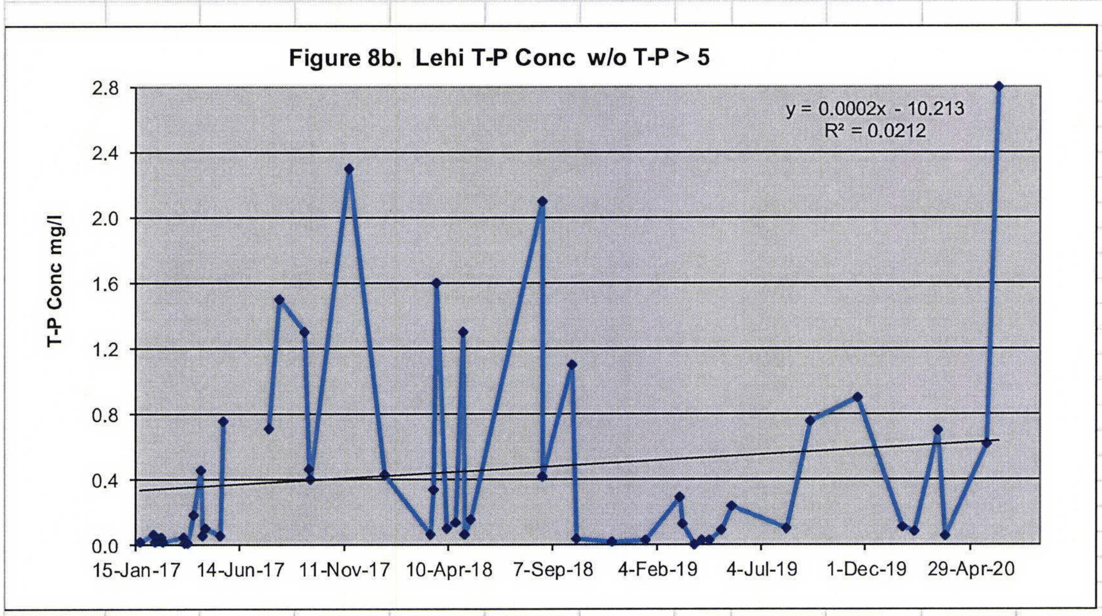


Figure 8b. Lehi T-P Conc w/o T-P > 5
y = 0.0002x - 10.213
R² = 0.0212
T-P Conc mg/l
2.8
2.4
2.0
1.6
1.2
0.8
0.4
0.0
15-Jan-17
14-Jun-17
11-Nov-17
10-Apr-18
7-Sep-18
4-Feb-19
4-Jul-19
1-Dec-19
29-Apr-20

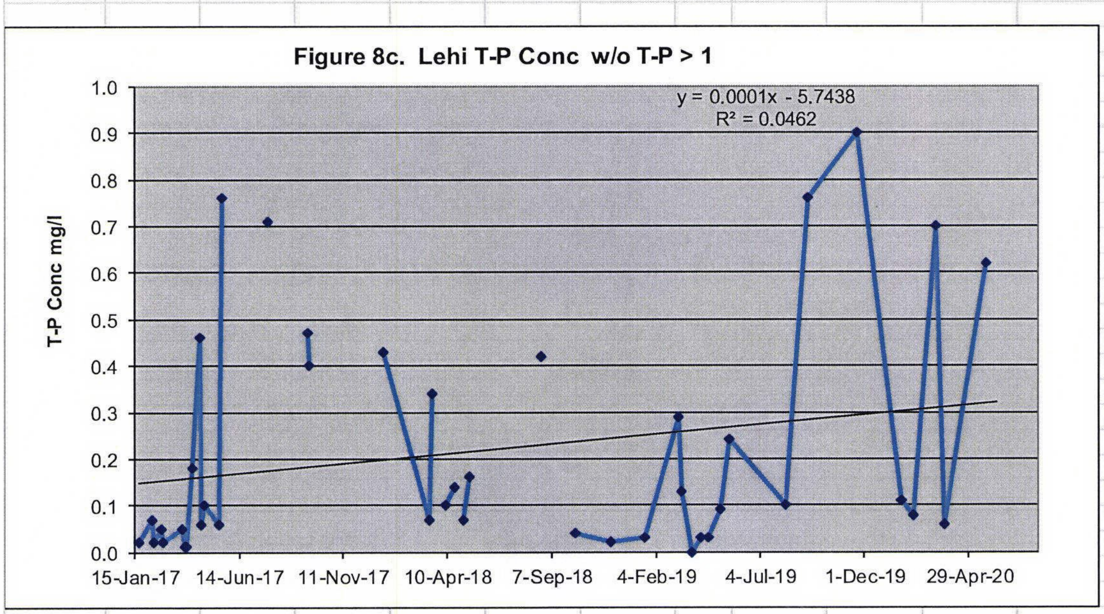


Figure 8c. Lehi T-P Conc w/o T-P > 1
y = 0.0001x - 5.7438
R² = 0.0462
T-P Conc mg/l
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
15-Jan-17
14-Jun-17
11-Nov-17
10-Apr-18
7-Sep-18
4-Feb-19
4-Jul-19
1-Dec-19
29-Apr-20

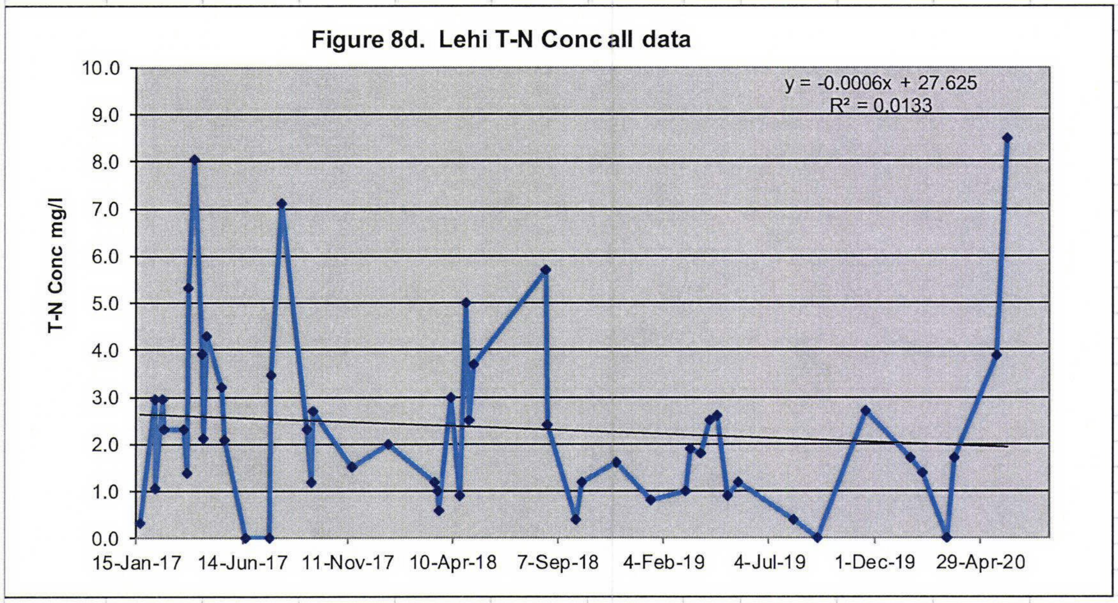


Figure 8d. Lehi T-N Conc all data
y = -0.0006x + 27.625
R² = 0.0133
T-N Conc mg/l
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
15-Jan-17
14-Jun-17
11-Nov-17
10-Apr-18
7-Sep-18
4-Feb-19
4-Jul-19
1-Dec-19
29-Apr-20

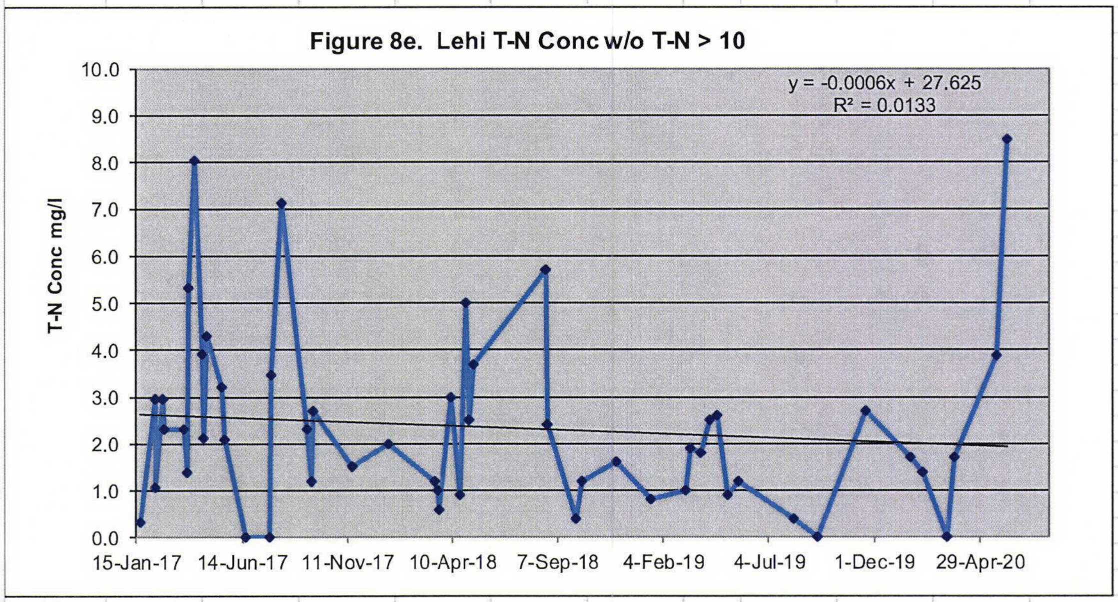


Figure 8e. Lehi T-N Conc w/o T-N > 10
y = -0.0006x + 27.625
R² = 0.0133
T-N Conc mg/l
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
15-Jan-17
14-Jun-17
11-Nov-17
10-Apr-18
7-Sep-18
4-Feb-19
4-Jul-19
1-Dec-19
29-Apr-20

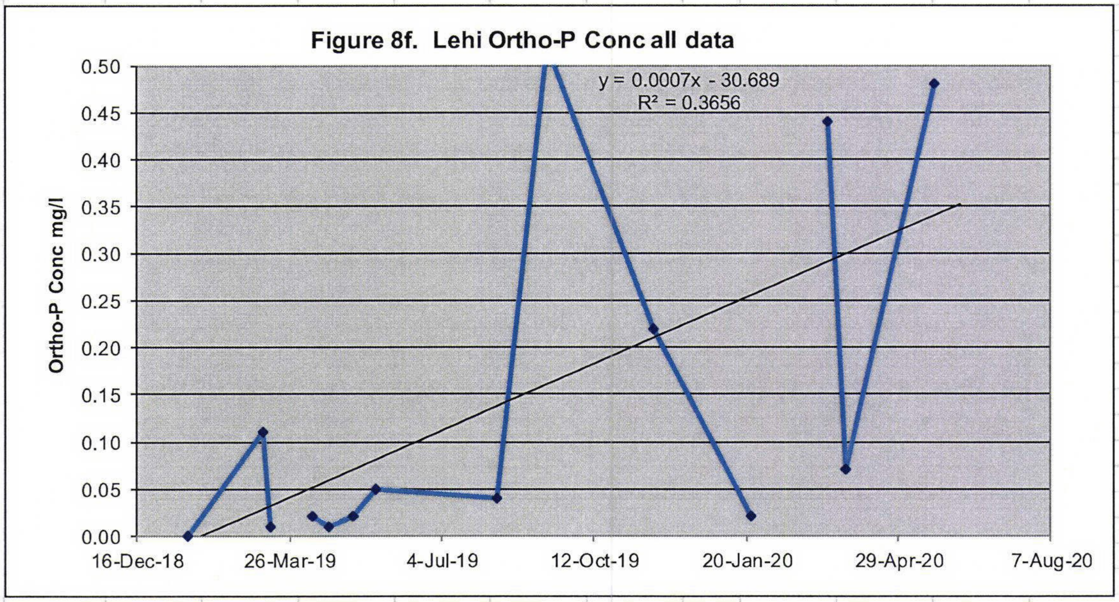


Figure 8f. Lehi Ortho-P Conc all data
y = 0.0007x - 30.689
R² = 0.3656
Ortho-P Conc mg/l
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
16-Dec-18
26-Mar-19
4-Jul-19
12-Oct-19
20-Jan-20
29-Apr-20
7-Aug-20

Table 9. Orem

Sampling Date	TP>1 outliers	Total Phos (mg/l) w/o outlrs	TP>5 outliers	Total Phos (mg/l) w/o outlrs	Total Phos (mg/l) all data	OrthoPhos mg/l all data		TN>10 outliers	Total Nitro (mg/l) w/o outlrs	Total Nitro (mg/l) all data
11-Feb-17										
21-Feb-17										
23-Feb-17										
5-Mar-17										
23-Mar-17		0.07		0.07	0.07				1.38	1.38
27-Mar-17		0.02		0.02	0.02				1.13	1.13
30-Mar-17		0.16		0.16	0.16				3.10	3.10
8-Apr-17		0.24		0.24	0.24				2.90	2.90
19-Apr-17		0.14		0.14	0.14				1.91	1.91
21-Apr-17		0.18		0.18	0.18				2.67	2.67
25-Apr-17		0.15		0.15	0.15				4.40	4.40
6-May-17		0.37		0.37	0.37				3.30	3.30
17-May-17		0.50		0.50	0.50				1.60	1.60
21-May-17		0.46		0.46	0.46				1.40	1.40
20-Jun-17	1.10			1.10	1.10				4.25	4.25
20-Jul-17									1.53	1.53
25-Jul-17	2.00			2.00	2.00		11.40			
10-Aug-17		0.46		0.46	0.46				BDL	BDL
15-Sep-17		0.16		0.16	0.16				1.16	1.16
24-Sep-17	1.30			1.30	1.30				4.70	4.70
5-Nov-17	1.10			1.10	1.10				4.40	4.40
17-Nov-17		0.29		0.29	0.29				2.40	2.40
9-Jan-18		0.16		0.16	0.16				2.50	2.50
15-Feb-18		0.14		0.14	0.14				3.00	3.00
16-Mar-18		BDL		BDL	BDL				1.00	1.00
7-Apr-18		0.30		0.30	0.30				2.50	2.50
20-Apr-18		0.23		0.23	0.23				2.40	2.40
30-Apr-18		0.12		0.12	0.12				0.80	0.80
3-May-18		0.04		0.04	0.04				1.40	1.40
11-May-18		0.07		0.07	0.07				1.60	1.60
22-Aug-18		0.18		0.18	0.18				2.50	2.50
3-Oct-18		0.52		0.52	0.52				2.10	2.10
10-Oct-18		0.06		0.06	0.06				0.70	0.70
30-Nov-18		0.16		0.16	0.16				0.80	0.80
18-Jan-19		0.44		0.44	0.44	0.06			BDL	BDL
6-Mar-19		0.15		0.15	0.15	0.02			0.60	0.60
29-Mar-19	1.20			1.20	1.20	0.36			1.50	1.50
21-Apr-19		0.18		0.18	0.18	0.01			0.50	0.50
7-May-19		0.06		0.06	0.06	0.05			1.30	1.30
21-May-19		0.08		0.08	0.08	0.05			1.00	1.00
21-Jun-19		0.61		0.61	0.61	0.03			0.90	0.90
1-Aug-19	1.8			1.80	1.80	1.10			4.10	4.10
9-Aug-19	8.9		8.9		8.90		22.2			
11-Sep-19		0.27		0.27	0.27	0.22			2.10	2.10
20-Nov-19		0.18		0.18	0.18	0.06			1.60	1.60
16-Jan-20		0.05		0.05	0.05	0.01			1.10	1.10
23-Jan-20		0.05		0.05	0.05	0.03			2.70	2.70
13-Mar-20		0.12		0.12	0.12	0.05			1.20	1.20
25-Mar-20		0.04		0.04	0.04	0.06			0.40	0.40
23-May-20		0.58		0.58	0.58	0.40			2.90	2.90
8-Jun-20		0.26		0.26	0.26	0.16			1.80	1.80
	7	38	1	44	45	16		0	43	43
averages	2.486	0.217	8.900	0.381	0.570	0.167		#DIV/0!	2.029	2.029
summer (Apr-	3.020	0.256	8.900	0.455	0.768	0.253		#DIV/0!	2.225	2.225
winter (Oct-M	1.150	0.163	#DIV/0!	0.273	0.273	0.081		#DIV/0!	1.756	1.756
summer cour	5	22	1	26	27	8		0	25	25
winter count	2	16	0	18	18	8		0	18	18

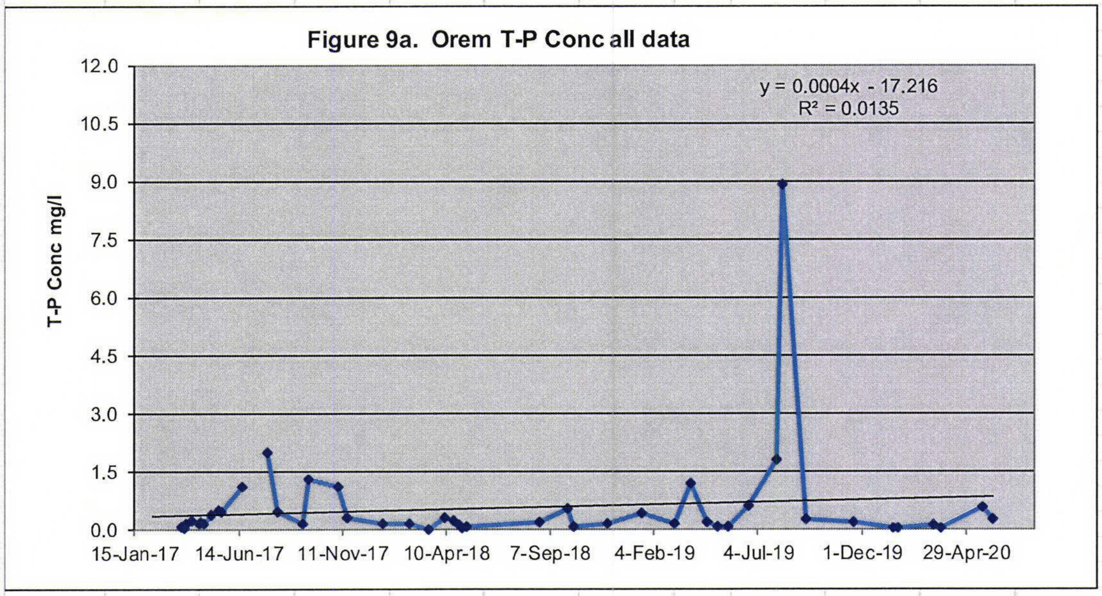


Figure 9a. Orem T-P Conc all data
y = 0.0004x - 17.216
R² = 0.0135
T-P Conc mg/l
12.0
10.5
9.0
7.5
6.0
4.5
3.0
1.5
0.0
15-Jan-17
14-Jun-17
11-Nov-17
10-Apr-18
7-Sep-18
4-Feb-19
4-Jul-19
1-Dec-19
29-Apr-20

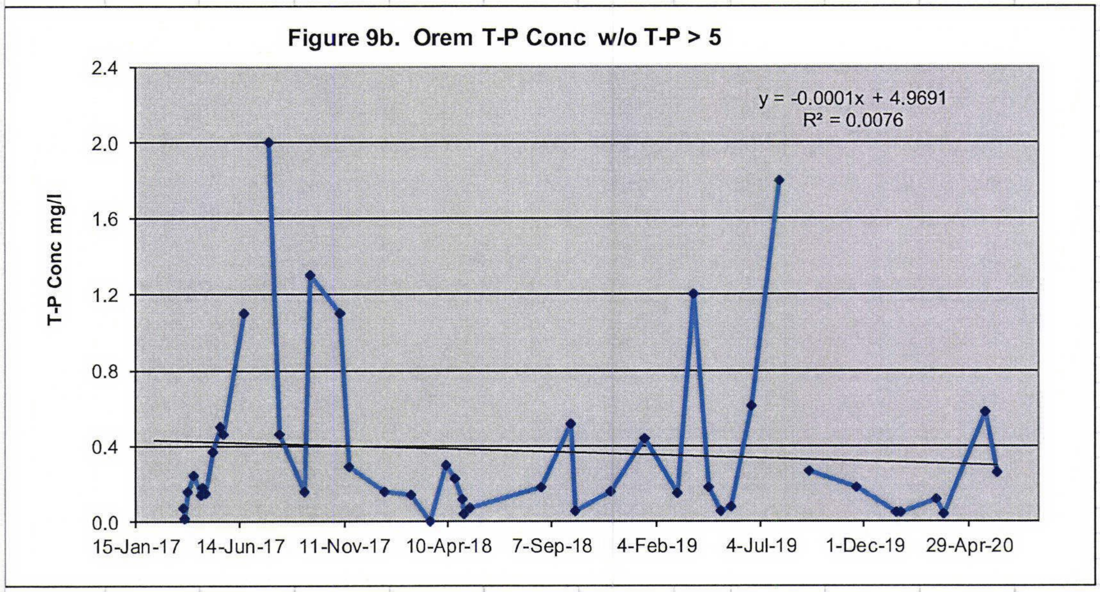


Figure 9b. Orem T-P Conc w/o T-P > 5
y = -0.0001x + 4.9691
R² = 0.0076
T-P Conc mg/l
2.4
2.0
1.6
1.2
0.8
0.4
0.0
15-Jan-17
14-Jun-17
11-Nov-17
10-Apr-18
7-Sep-18
4-Feb-19
4-Jul-19
1-Dec-19
29-Apr-20

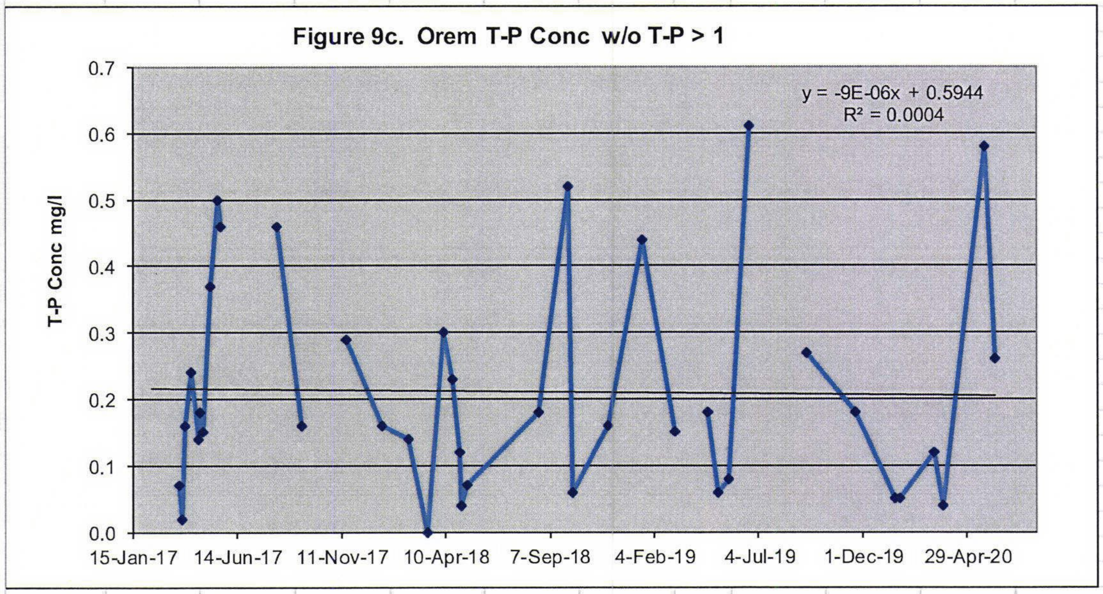


Figure 9c. Orem T-P Conc w/o T-P > 1
y = -9E-06x + 0.5944
R² = 0.0004
T-P Conc mg/l
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
15-Jan-17
14-Jun-17
11-Nov-17
10-Apr-18
7-Sep-18
4-Feb-19
4-Jul-19
1-Dec-19
29-Apr-20

Figure 9d. Orem T-N Conc all data

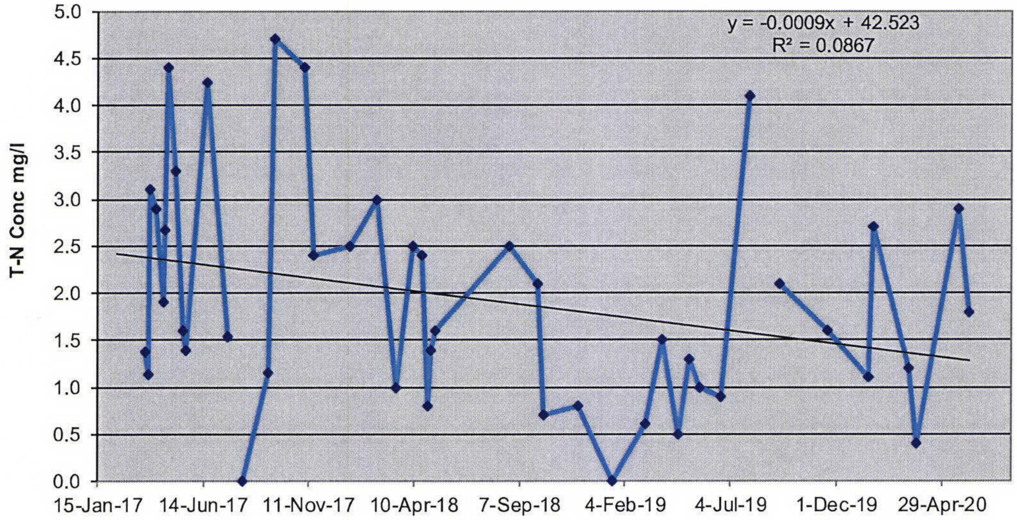


Figure 9e. Orem T-N Conc w/o T-N > 10

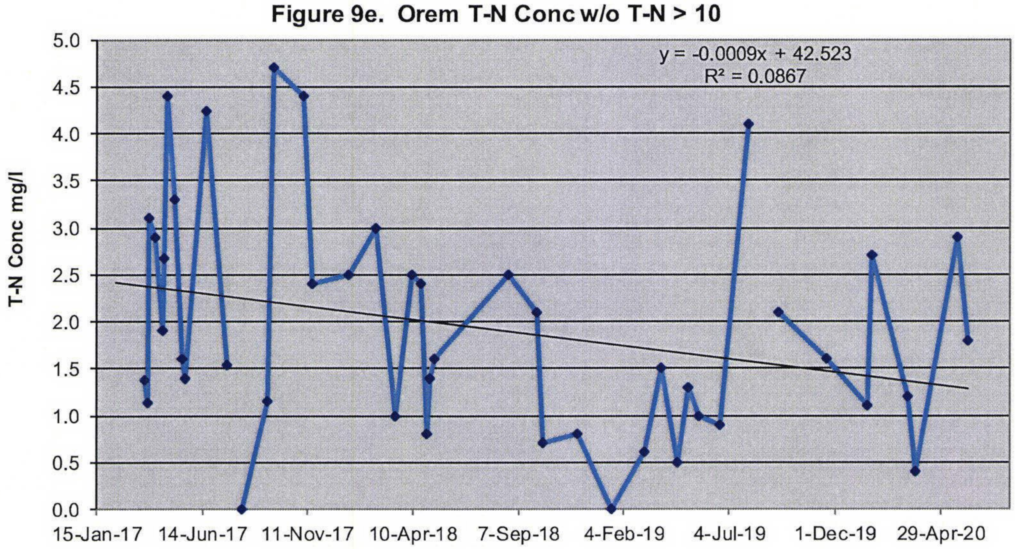


Figure 9f. Orem Ortho-P Conc all data

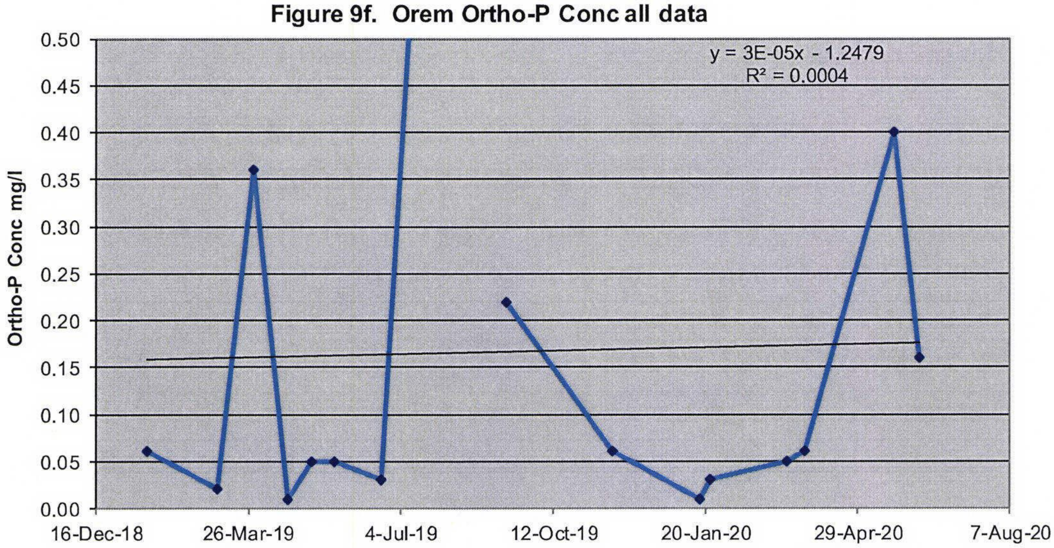


Table 10. Sp Fork

Sampling Date	TP>1 outliers	Total Phos (mg/l) w/o outlrs	TP>5 outliers	Total Phos (mg/l) w/o outlrs	Total Phos (mg/l) all data	OrthoPhos mg/l all data	TN>10 outliers	Total Nitro (mg/l) w/o outlrs	Total Nitro (mg/l) all data
10-Feb-17			none						
11-Feb-17		0.01		0.01	0.01			2.04	2.04
17-Feb-17		BDL		BDL	BDL			1.80	1.80
22-Feb-17		BDL		BDL	BDL			1.23	1.23
23-Feb-17		BDL		BDL	BDL			1.17	1.17
24-Feb-17		0.01		0.01	0.01			1.36	1.36
27-Feb-17		0.01		0.01	0.01			0.70	0.70
5-Mar-17		0.08		0.08	0.08			1.18	1.18
23-Mar-17		0.34		0.34	0.34			1.36	1.36
27-Mar-17		0.01		0.01	0.01			1.30	1.30
30-Mar-17		0.08		0.08	0.08			2.28	2.28
8-Apr-17		0.02		0.02	0.02			1.35	1.35
19-Apr-17		0.09		0.09	0.09			1.14	1.14
25-Apr-17		0.07		0.07	0.07			0.70	0.70
17-May-17		0.08		0.08	0.08			2.70	2.70
21-May-17		BDL		BDL	BDL			0.70	0.70
13-Jun-17	2.70			2.70	2.70			3.34	3.34
20-Jul-17		0.22		0.22	0.22			0.78	0.78
25-Jul-17		0.24		0.24	0.24			3.31	3.31
10-Aug-17		0.11		0.11	0.11			1.41	1.41
15-Sep-17		0.05		0.05	0.05			0.90	0.90
17-Nov-17		0.02		0.02	0.02			0.60	0.60
9-Jan-18		0.24		0.24	0.24			2.00	2.00
15-Feb-18		0.06		0.06	0.06			1.70	1.70
19-Feb-18		0.01		0.01	0.01			0.60	0.60
16-Mar-18		0.02		0.02	0.02			0.50	0.50
23-Mar-18		BDL		BDL	BDL			0.50	0.50
7-Apr-18		0.02		0.02	0.02			0.70	0.70
20-Apr-18		0.53		0.53	0.53			1.70	1.70
30-Apr-18		0.05		0.05	0.05			0.70	0.70
3-May-18		0.31		0.31	0.31			1.80	1.80
21-Aug-18		0.13		0.13	0.13			3.50	3.50
22-Aug-18		0.69		0.69	0.69			5.20	5.20
3-Oct-18		0.40		0.40	0.40			1.10	1.10
10-Oct-18		0.06		0.06	0.06			0.60	0.60
30-Nov-18		0.23		0.23	0.23			0.80	0.80
18-Jan-19		0.02		0.02	0.02	BDL		0.20	0.20
2-Mar-19		0.01		0.01	0.01	0.02		0.80	0.80
29-Mar-19		0.07		0.07	0.07			0.20	0.20
10-Apr-19		0.01		0.01	0.01	0.01		0.80	0.80
21-Apr-19		BDL		BDL	BDL			1.10	1.10
7-May-19		0.46		0.46	0.46	0.34		1.30	1.30
21-May-19		0.01		0.01	0.01			0.50	0.50
1-Aug-19		0.08		0.08	0.08	0.04		0.90	0.90
9-Aug-19		0.22		0.22	0.22	0.10		1.80	1.80
28-Aug-19	2.3			2.30	2.30			6.70	6.70
20-Nov-19		0.06		0.06	0.06	0.01		2.30	2.30
16-Jan-20		0.02		0.02	0.02	BDL		0.70	0.70
23-Jan-20		0.01		0.01	0.01	BDL		1.10	1.10
13-Mar-20		BDL		BDL	BDL	BDL		0.70	0.70
25-Mar-20		0.04		0.04	0.04	BDL		0.50	0.50
23-May-20		0.06		0.06	0.06	0.02		1.90	1.90
8-Jun-20		0.17		0.17	0.17	0.09		2.00	2.00
	2	43	0	45	45	8	0	52	52
averages	2.500	0.126	#DIV/0!	0.232	0.232	0.079	#DIV/0!	1.466	1.466
summer (Apr	2.500	0.172	#DIV/0!	0.375	0.375	0.100	#DIV/0!	1.877	1.877
winter (Oct-M	#DIV/0!	0.082	#DIV/0!	0.082	0.082	0.015	#DIV/0!	1.086	1.086
summer cou	2	21	0	23	23	6	0	25	25
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

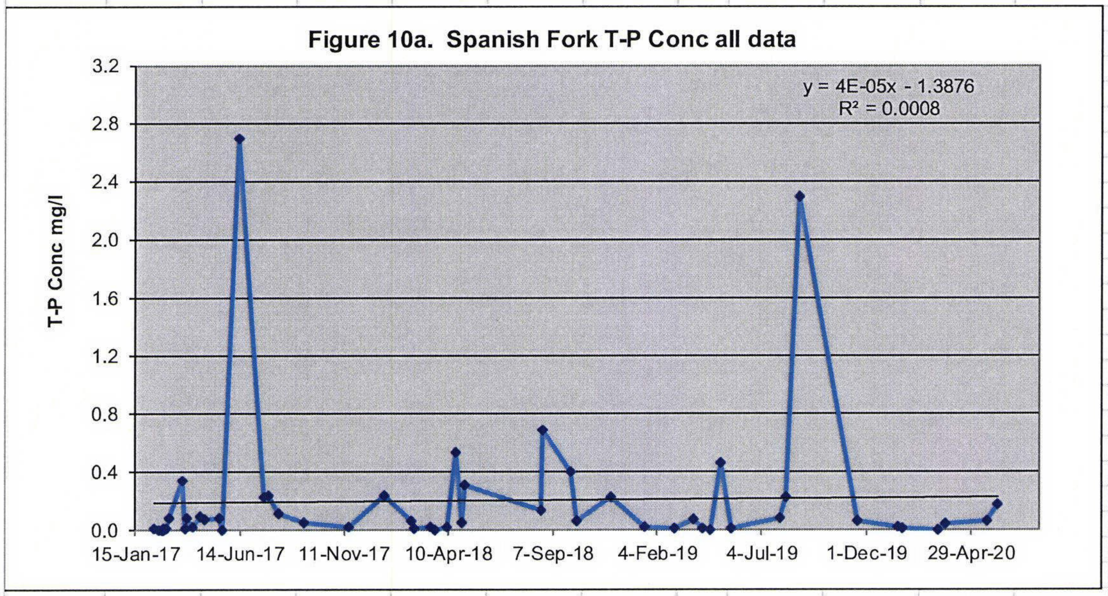


Figure 10a. Spanish Fork T-P Conc all data
y = 4E-05x - 1.3876
R² = 0.0008
T-P Conc mg/l
3.2
2.8
2.4
2.0
1.6
1.2
0.8
0.4
0.0
15-Jan-17 14-Jun-17 11-Nov-17 10-Apr-18 7-Sep-18 4-Feb-19 4-Jul-19 1-Dec-19 29-Apr-20

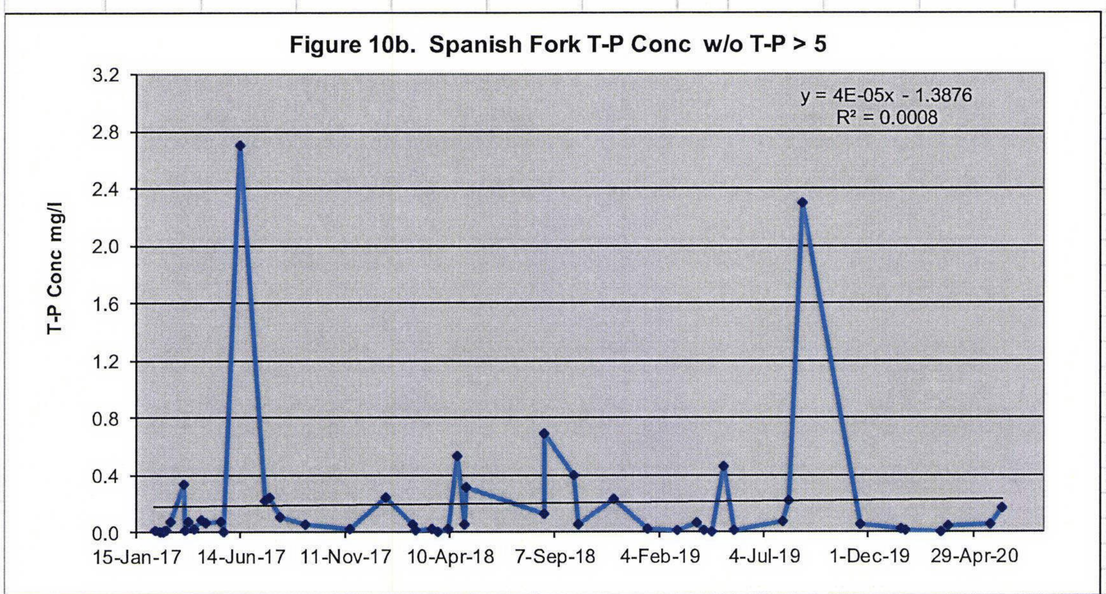


Figure 10b. Spanish Fork T-P Conc w/o T-P > 5
y = 4E-05x - 1.3876
R² = 0.0008
T-P Conc mg/l
3.2
2.8
2.4
2.0
1.6
1.2
0.8
0.4
0.0
15-Jan-17 14-Jun-17 11-Nov-17 10-Apr-18 7-Sep-18 4-Feb-19 4-Jul-19 1-Dec-19 29-Apr-20

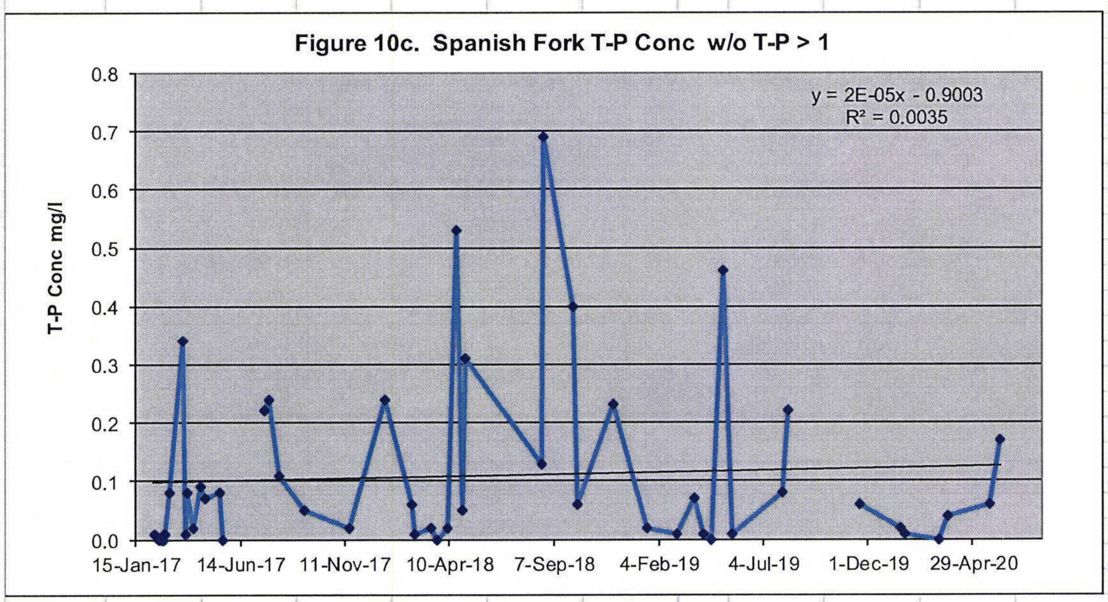


Figure 10c. Spanish Fork T-P Conc w/o T-P > 1
y = 2E-05x - 0.9003
R² = 0.0035
T-P Conc mg/l
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
15-Jan-17 14-Jun-17 11-Nov-17 10-Apr-18 7-Sep-18 4-Feb-19 4-Jul-19 1-Dec-19 29-Apr-20

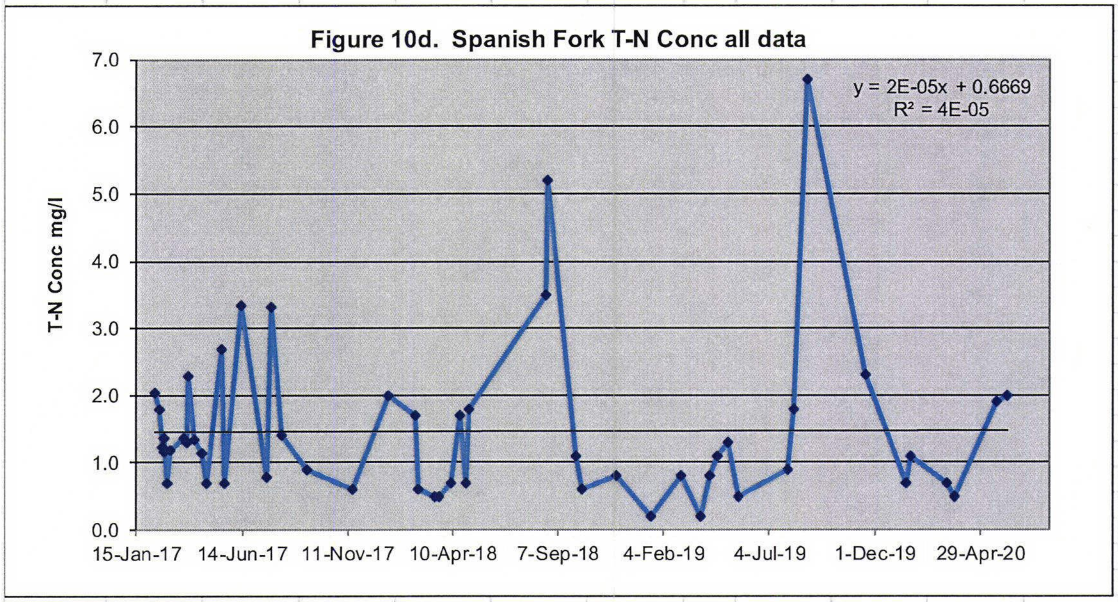


Figure 10d. Spanish Fork T-N Conc all data
y = 2E-05x + 0.6669
R² = 4E-05
T-N Conc mg/l
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
15-Jan-17
14-Jun-17
11-Nov-17
10-Apr-18
7-Sep-18
4-Feb-19
4-Jul-19
1-Dec-19
29-Apr-20

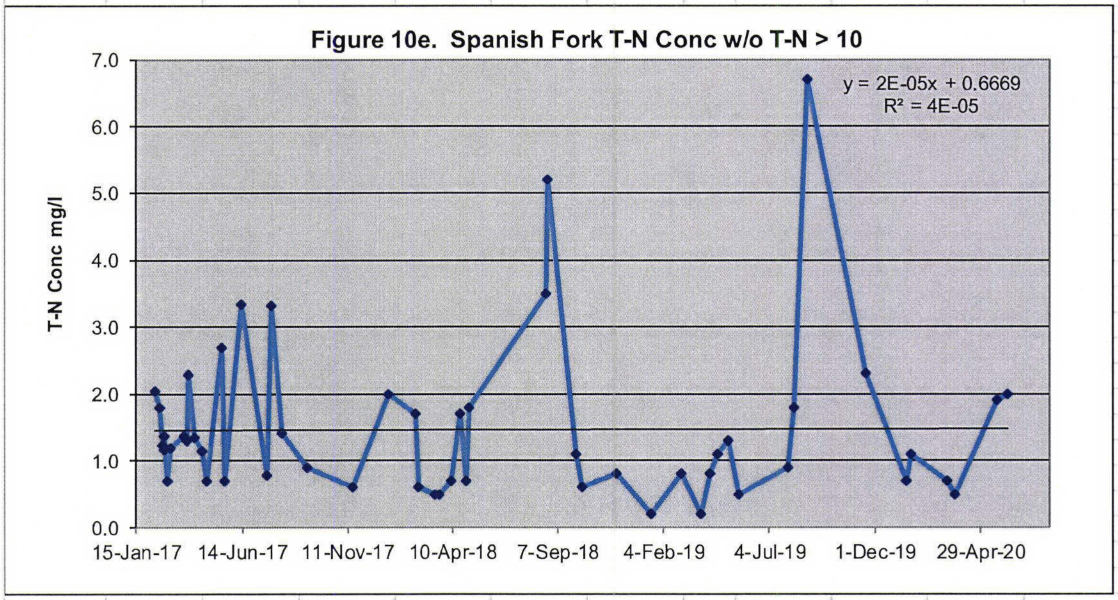


Figure 10e. Spanish Fork T-N Conc w/o T-N > 10
y = 2E-05x + 0.6669
R² = 4E-05
T-N Conc mg/l
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
15-Jan-17
14-Jun-17
11-Nov-17
10-Apr-18
7-Sep-18
4-Feb-19
4-Jul-19
1-Dec-19
29-Apr-20

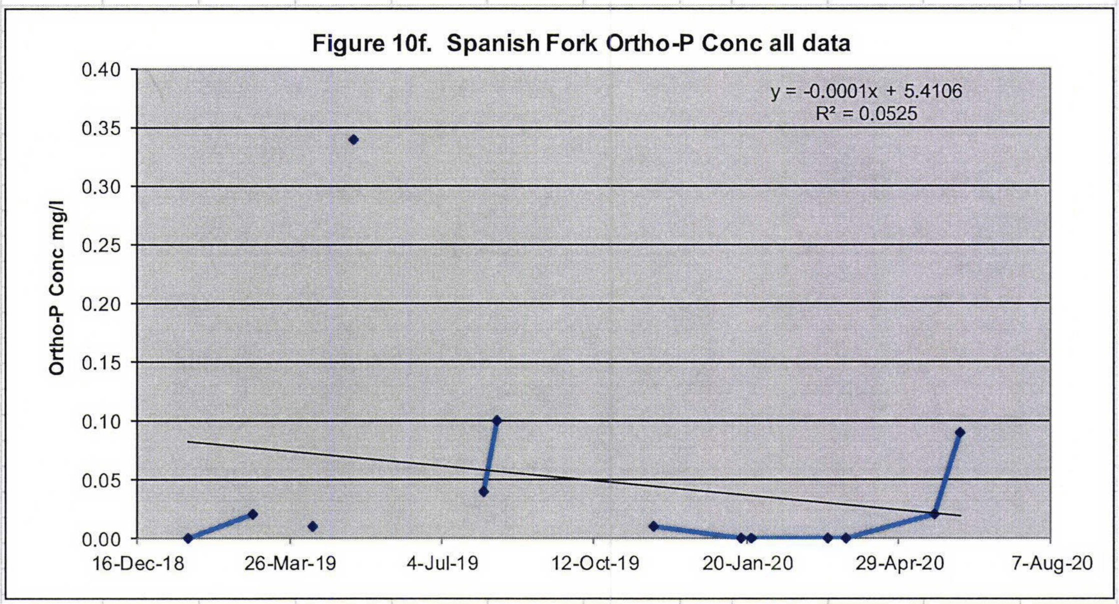


Figure 10f. Spanish Fork Ortho-P Conc all data
y = -0.0001x + 5.4106
R² = 0.0525
Ortho-P Conc mg/l
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
16-Dec-18
26-Mar-19
4-Jul-19
12-Oct-19
20-Jan-20
29-Apr-20
7-Aug-20

Section 2

Updated Report Review – Dr. David Gay

Review of Document
David A. Gay, Ph.D.
August 3, 2020

Document: *Updated Interim Report on Nutrients in Precipitation on Utah Lake July 2020* (UtahLakePrecipInterimReport5), by Dr. Wood Miller, 4 April 2019, 13 pages.

As I have stated previously, this study seems to be a straightforward and scientifically credible study of bulk deposition to Utah Lake. It uses direct measurements of bulk deposition to sample sites distributed around the lake, and provides a consistent and long-term historical record of these concentrations. I do have a few issues with the measurements as stated below. The study has a few scientific issues, but I think it was a good use of available precipitation, and done at a minimum cost. Bulk deposition is a first order approximation of deposition, but it does not capture all dry deposition, so there is a bias vs. deposition measurements or estimates. Also, I do not think that the precipitation collectors are the best collectors for wet or dry deposition, or bulk collection. But the study does show a low-cost method for collecting basic deposition information for the area.

Furthermore, I support the change to this version of the report to include deposition fluxes (tons per year). For scientist or policy professionals reading this report, they are most interested in the amount of contaminant moving into the lake and not necessarily the concentrations in the precipitation samples. There are several ways to make these calculations, and the answer will change as these methods change (more on this later).

<u>Assumptions:</u>

1. That the same conditions of sampling have continued: National Weather Service precipitation samples are made in standard NWS precipitation gages, open all week for bulk samples, etc.
2. That the Chemtech-Ford Laboratories have done appropriate quality assurance of their analytical methods, and that this data is available for review (calibrations, blanks, any blind testing, etc.).

Continued Concern From the Previous Reviewed Report Version

1. I have noted my previous concerns from the earlier report again here:
   a. The NWS gage samples, although available and inexpensive, are not necessarily a good collector of dry deposition (i.e. gases, small particles) since they do not represent natural surfaces and aerodynamic conditions.
   b. Evaporation from the sampler during the week could be an issue, particularly during the dry summer, affecting concentration (toward higher concentrations).
   c. Contamination from one sample to the next, as the quality assurance between sample collection is unclear.
   d. Total phosphorus loss to the walls of gages could be an issue; however, I am not certain about this. But it could lead to (c) above.
   e. Loss of analyte due to evaporation (N compounds), and bacterial action reducing concentrations (N&P) during the week.
   f. Accurate collection of snow during the winter. Typically, the NWS removes the funnels during the winter months, which should increase collection of snow and make for better measurements. I do not know if this occurred.
   g. NWS rain gages typically measures precipitation near the ground, leading to possible activity near the sampler adding unwanted dust and deposition to the measurements.

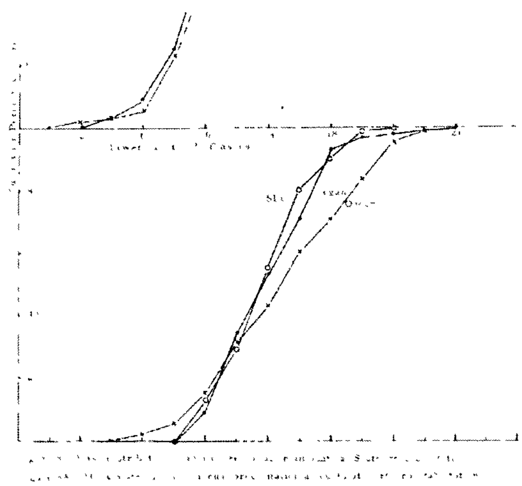
Major Concerns

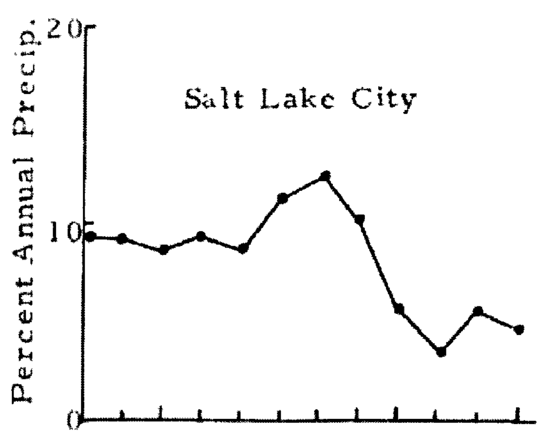
1. Using Precipitation Weighted Mean values for the flux (tons per year) calculation: It would seem that the arithmetic average concentration was used to estimate deposition flux for the year. I would not recommend this method. I would suggest one of two other methods: The first would be to include weekly precipitation with weekly concentration, calculate weekly flux estimates, and sum up annual deposition. This method is perfectly fine if no samples are invalidated week to week. The second method would be to estimate the precipitation weighted concentration for the year or for season/month/etc. This is important when there are dryer/wetter seasons and there are samples where concentrations are missing or invalidated, but the weekly precipitation is known (this is the NADP method). By not using one of these methods, the arithmetic concentration mean is biased by outlier concentrations that could have occurred with very little precipitation. This bias is usually toward

higher concentrations. It is well known that low precipitation events typically have very high concentrations, but usually result in very little deposition/flux. However, by weighting average concentrations by the precipitation amount, this problem is avoided.

2. Average precipitation for the area of 12 inches per year: Using a resource found through the Utah State Climatology Office (*Chang, Tsing-Yuan, "A Study of Precipitation Characteristics for Utah" (1969), Masters Thesis, Utah State University, https://digitalcommons.usu.edu/etd/2931)*, it would seem that the average precipitation amount is higher that 12 inches per year, at least for Salt Lake City. However, subtle terrain and elevation differences could be important when compared to Utah Lake. But it is also clear that precipitation amount is skewed towards higher precipitation amounts during the winter months, and particularly high in March through May. Higher precipitation would mean greater deposition to the Lake during the winter and spring. This comment also refers back to #1 above.

From the graph below (Chang), the median precipitation is approximately 13.5 to 14 inches at Salt Lake City (left). This assumption of 12 inches is likely to be low,





and biases the flux estimates, making them lower. Again, a better estimate may exist and should be used. Second, referring to the annual monthly percentage of precipitation at SLC (graph on the right, with month along the X axis starting in October {left} and ending in September {right}): This significant change in precipitation percentage between winter and summer precipitation and deposition suggests further that a precipitation weighted mean value should be used to estimate deposition. My estimate would be that this would bring the used concentration lower and the deposition would also be lower. Concentrations tend to be higher under light precipitation conditions and this is likely to be in the summer. Further, this point is also confirmed by the arithmetic means of the two season concentrations (Table 1a, 1b, 1c).

3. Trend lines in figures and in "Table of Trends" (page 3 of report): Although linear best fit trend lines are standard in reports, I would suggest some changes to this report. For a field campaign, there are a large number of samples available to estimate change over time. However, due to the high variability of precipitation in the American West, a three year trend line in bulk deposition is a bit short for a robust trend line. Five or more years would be preferable for consistent determination, but this data is not available. I would also suggest that a different trend method be used; specifically a non-parametric trend method. I would further recommend Mann Kendall Seasonal Test. The method would improve the estimate, particularly because it does not require normality of distribution (precipitation is notorious for this condition), and it is not affected by missing data which is present here. Also, the Seasonal Mann Kendall Test accounts for the seasonal cycles of precipitation chemistry quite nicely. This method has gained prominence in wet deposition and is used extensively by USGS (see here: https://pubs.usgs.gov/sir/2005/5275/). The table on page 3 suggests a lack of consistency across the lake, which could be in part due to the linear trend determination. The MK Seasonal test may remove some of the variability. It works by comparing summer to summer values (or July to July obs.), then winter to winter, etc. and summarizing the entire year's values.

Other More Minor Comments:

1. Unfiltered/Filtered samples: I am assuming that the bulk deposition samples are run for unfiltered samples (including solids suspended in the precipitation samples). However, if they are filtered samples (as NADP samples are run), then the bias for TN and TP will be present towards lower concentration and deposition. For TP in particular, much of TP is expected to be soil particulates washed out of the atmosphere and suspended in solution. Unfiltered samples are preferred in this analysis. Unfiltered samples are likely here, but I am unclear on this point.

My reply to Dr. Gay:

Major Concerns

1. *Using Precipitation Weighted Mean values for the flux (tons per year) calculation: It would seem that the arithmetic average concentration was used to estimate deposition flux for the year. I would not recommend this method. I would suggest one of two other methods: The first would be to include weekly precipitation with weekly concentration, calculate weekly flux estimates, and sum up annual deposition. This method is perfectly fine if no samples are invalidated week to week. The second method would to estimate the precipitation weighted concentration for the year or for season/month/etc. This is important when there are dryer/wetter seasons and there are samples where concentrations are missing or invalidated, but the weekly precipitation is known (this is the NADP method). By not using one of these methods, the arithmetic concentration mean is biased by outlier concentrations that could have occurred with very little precipitation. This bias is usually toward higher concentrations. It is well known that low precipitation events typically have very high concentrations, but usually result in very little deposition/flux. However, by weighting average concentrations by the precipitation amount, this problem is avoided.*

I agree that using the arithmetic average method to determine the mean concentrations of nutrients is not an accurate way to analyze the data, the data that should be weighted. The data in question are those in Tables 1a and 1c in the previous report which is included again here in order to show comparisons.

Table 1a. Averages at all 9 locations for all phosphorus samples for the whole year and for summer (Apr-Sept) and winter (Oct-

Location	Total Phos (mg/l) all data	Total Phos (mg/l) summer	Total Phos (mg/l) winter	Total Phos (mg/l) TP < 1	Total Phos (mg/l) summer	Total Phos (mg/l) winter	Total Phos (mg/l) TP < 5	Total Phos (mg/l) summer	Total Phos (mg/l) winter	all TP samples	TP outliers >1 mg/l	>5 mg/l
BYU	0.09	0.12	0.08	0.09	0.12	0.08	0.09	0.12	0.08	47	0	0
Lincoln Pt	1.04	1.62	0.45	0.23	0.35	0.13	0.51	0.78	0.24	51	12	4
Pelican Pt	0.74	0.75	0.74	0.23	0.23	0.24	0.43	0.41	0.44	43	7	2
Genola	1.21	1.93	0.20	0.22	0.25	0.20	0.44	0.65	0.20	48	10	5
Elberta	0.43	0.42	0.44	0.34	0.35	0.32	0.43	0.42	0.44	46	4	0
Mosida	0.99	1.46	0.31	0.31	0.39	0.23	0.99	1.46	0.31	39	11	0
Lehi	0.79	1.17	0.35	0.22	0.28	0.16	0.47	0.58	0.35	52	10	2
Orem	0.57	0.77	0.27	0.22	0.26	0.16	0.38	0.46	0.27	45	7	1
Sp Fork	0.23	0.37	0.08	0.13	0.17	0.08	0.23	0.37	0.08	45	2	0
averages	0.68	0.96	0.32	0.22	0.27	0.18	0.44	0.58	0.27	416	63	14
no.samples	416	217	199	353	168	185	402	205	197	416 plus 14 BDL as of July 1, 2020		
tonsTP/yr at avg area 83,800 ac & 12"/yr rain or 6"/half yr at given avg TP conc.	77.1	54.4	18.5	25.1	15.2	10.2	50.2	33.2	15.3			

Table 1c. Averages at 9 locations for nitrogen samples for whole year and for summer and winter.

Location	Total Nitro (mg/l) **all data**	Total Nitro (mg/l) **summer**	Total Nitro (mg/l) **winter**	Total Nitro (mg/l) **TN <10**	Total Nitro (mg/l) **summer**	Total Nitro (mg/l) **winter**	all TN samples	TN outliers >10 mg/l
BYU	2.149	2.137	2.155	2.149	2.137	2.155	43	0
Lin Pt	4.728	5.605	3.481	2.187	2.528	1.725	46	6
Pel Pt	2.428	2.326	2.535	2.234	2.326	2.132	41	1
Genola	1.922	2.535	1.116	1.693	2.149	1.116	44	1
Elberta	1.969	1.643	2.279	1.969	1.643	2.279	39	0
Mosida	5.731	6.674	4.376	2.491	2.653	2.287	39	5
Lehi	2.548	3.348	1.715	2.548	3.348	1.715	49	0
Orem	2.029	2.225	1.756	2.029	2.225	1.756	43	0
Sp Fork	1.466	1.877	1.086	1.466	1.877	1.086	52	0
averages	2.774	3.152	2.278	2.085	2.321	1.806	396	13
no.samples	396	205	191	383	196	187	396 plus 32 BDL as of July 1, 2020	

Using these simple average concentrations with an estimated annual precipitation and an average lake surface area is not at all accurate in determining annual deposition flux (load rates). Therefore, I used weekly and monthly values for concentration, precipitation, and surface area to determine more accurate weekly and monthly bulk atmospheric deposition load rates.

Furthermore, the precip weighted method can't be applied to the avg concentration values in the original Tables 1a and 1c because the precip can't be separated out for each location. So I applied the precip weighting and "number of samples" and non-weighting to the weekly and monthly data for all locations.

TP Analysis: I attempted to use Dr. Gay's suggested first method "*to include weekly precipitation with weekly concentration, calculate weekly flux estimates, and sum up annual deposition. This method is perfectly fine if no samples are invalidated week to week.*" But, in fact, on a year to year basis, there are too many weeks without sampling data. I thought I had been vigilant, but apparently not.

FEEL FREE TO SKIP ALL THIS AND GO RIGHT TO SUMMARY TABLE 1-TP, PAGE 17.

THE CRITICAL REPORT FOR WIND VS. TP & TN OUTLIERS STARTS ON PAGE 69.

During 2017 there were 16 weeks without any precip, 36 with precip. I only sampled 25 of the weeks with precip, so there were 11 weeks with precip, but without samples. I think that's too many weeks without samples and therefore without load rates (fluxes???).

During 2018 there were 23 weeks without any precip, 29 with precip. I only sampled 13 of the weeks with precip, so there were 16 weeks with precip, but without samples. Again, I think that's too many weeks without samples and therefore without load rates.

During 2019 there were only 14 weeks without any precip, 38 with precip. I only sampled 15 of the weeks with precip, so there were 23 weeks with precip, but without samples. Again, I think that's too many weeks without samples, and therefore without load rates.

In total, during those 3 years, I sampled 53 weeks. Seems like a lot, but apparently not enough. I also sampled 7 weeks in 2016 and 7 weeks in 2020. But the weekly sampling for each year isn't good enough for total annual fluxes each year.

However, when I combine all 3 years and look at each week, there are only 2 weeks without precip, 50 with precip, over the 3 years. I sampled 39 of the weeks with precip, so there are only 11 weeks without samples over the 3-yr period. There are 39 of the 50 weeks with precip with sampling and therefore load rate data. First I looked at not weighting. See Table 1A.

The non-weighted TP concentration averages for those 39 weeks are (I have the calculations):
all TP data = 0.830 mg/l, TP < 5 mg/l = 0.561 mg/l, and TP < 1 mg/l = 0.252 mg/l.
And the total TP load rates for those 39 weeks are (I have the calcs):
all TP data = 73.5 T/yr, TP < 5 mg/l = 47.0 T/yr, and TP < 1 mg/l = 23. 4 T/yr.

In order to fill in the 11 weeks of missing samples, I substituted in these 39-week averages for the 11 missing weeks. The non-weighted TP concentration average for all 50 weeks with precip are the same (of course, I used the averages), but the TP load rates for the 50 weeks are higher because there are 11 more weeks of load rates. See Table 1B.

The non-weighted TP concentration averages for those 50 weeks are (I have cals):
all TP data = 0.830 mg/l, TP < 5 mg/l = 0.561 mg/l, and TP < 1 mg/l = 0.252 mg/l.
And the total TP load rates for those 50 weeks are (I have calcs):
all TP data = 82.6 T/yr, TP < 5 mg/l = 53.1 T/yr, and TP < 1 mg/l = 26.5 T/yr.

Next, I used Dr. Gay's suggested second method which is *"to estimate the precipitation weighted TP concentration for the year or for season/month/week/etc."* Again, there are too many weeks without sampling data to apply this method each year. However, again, when I combine all 3 years and look at each week, there are only 11 weeks without samples. So I adjusted the 39 (50 – 11) values of the 3-yr avg actual TP concentrations using the precip weighted method.

The 2017-2019 3-yr average annual precip at Utah Lake (see discussion on the annual precip later) is 11.7 inches. The avg weekly precip is 11.7 / 52 = 0.225 inches. I divided each actual weekly precip by this avg weekly of 0.225 to determine the weighting factor. I multiplied the

TABLE 1A

week	all data number samples per week	TP < 5 number samples per week	TP <= 1 number samples per week	3-yr avg Utah Lake avg precip (in) weekly	3-yr avg monthly lake area (acre) weekly	all data TP conc (mg/l)	*not weighted* TP < 5 conc (mg/l)	TP <= 1 conc (mg/l)	all data load x1.133E-4 (T/yr)	TP < 5 load x1.133E-4 (T/yr)	TP <= 1 load x1.133E-4 (T/yr)
1				0.243	84290				0.000	0.000	0.000
2	10	10	9	0.467	84290	0.305	0.305	0.172	1.360	1.360	0.767
3	13	13	13	0.857	84290	0.185	0.185	0.185	1.514	1.514	1.514
4	8	8	8	0.093	84290	0.156	0.156	0.156	0.139	0.139	0.139
5				0.093	85722				0.000	0.000	0.000
6	13	13	13	0.360	85722	0.058	0.058	0.058	0.203	0.203	0.203
7	8	7	7	0.190	85722	0.949	0.127	0.127	1.751	0.234	0.234
8	10	10	9	0.360	85722	0.248	0.248	0.058	0.867	0.867	0.203
9	7	7	7	0.127	86916	0.071	0.071	0.071	0.089	0.089	0.089
10	12	12	12	0.297	86916	0.173	0.173	0.173	0.506	0.506	0.506
11	16	16	14	0.333	86916	0.356	0.356	0.164	1.167	1.167	0.538
12	24	24	22	0.633	86916	0.339	0.339	0.183	2.113	2.113	1.141
13	24	24	23	0.343	86916	0.142	0.142	0.096	0.480	0.480	0.324
14	17	17	15	0.227	88108	0.348	0.348	0.177	0.789	0.789	0.401
15	7	7	5	0.490	88108	0.451	0.451	0.227	2.206	2.206	1.110
16	28	28	27	0.360	88108	0.253	0.253	0.195	0.909	0.909	0.701
17	8	7	7	0.213	88108	1.418	0.191	0.191	3.015	0.406	0.406
18	22	22	19	0.337	89258	0.705	0.705	0.300	2.403	2.403	1.022
19	16	16	14	0.313	89258	0.408	0.408	0.238	1.292	1.292	0.753
20	8	7	6	0.317	89258	1.640	0.603	0.270	5.258	1.933	0.866
21	23	22	19	0.527	89258	0.910	0.505	0.312	4.850	2.692	1.663
22				0.140	89258				0.000	0.000	0.000
23	9	9	8	0.117	89675	0.549	0.549	0.268	0.653	0.653	0.319
24	3	3	1	0.017	89675	1.413	1.413	0.340	0.244	0.244	0.059
25	8	7	4	0.063	89675	2.504	2.504	0.658	1.603	1.603	0.421
26				0.000	89675				0.000	0.000	0.000
27				0.007	88589				0.000	0.000	0.000
28				0.013	88589				0.000	0.000	0.000
29	3	2	2	0.117	88589	2.937	0.505	0.505	3.449	0.593	0.593
30	8	5	3	0.377	88589	3.614	1.622	0.503	13.676	6.138	1.903
31	6	6	3	0.077	85869	1.380	1.380	0.260	1.034	1.034	0.195
32	14	13	9	0.227	85869	1.304	0.720	0.284	2.880	1.590	0.627
33				0.027	85869				0.000	0.000	0.000
34	11	9	6	0.223	85869	2.028	1.112	0.285	4.400	2.413	0.618
35				0.000	85869				0.000	0.000	0.000
36	1	1		0.160	84478	2.300	2.300		3.522	3.522	0.000
37	17	16	13	0.323	84478	0.897	0.466	0.242	2.773	1.441	0.748
38	1	1	1	0.203	84478	0.470	0.470	0.470	0.913	0.913	0.913
39	7	7	6	0.323	84478	0.410	0.410	0.262	1.268	1.268	0.810
40	7	6	5	0.303	83893	1.301	0.635	0.542	3.747	1.829	1.561
41	9	9	9	0.257	83893	0.113	0.113	0.113	0.276	0.276	0.276
42				0.067	83893				0.000	0.000	0.000
43				0.033	83893				0.000	0.000	0.000
44	1	1	1	0.023	84975	0.030	0.030	0.030	0.007	0.007	0.007
45	6	6	4	0.013	84975	0.820	0.820	0.680	0.103	0.103	0.085
46	9	9	7	0.103	84975	0.668	0.668	0.273	0.662	0.662	0.271
47	9	9	9	0.320	84975	0.257	0.257	0.257	0.792	0.792	0.792
48	10	10	10	0.350	84975	0.151	0.151	0.151	0.509	0.509	0.509
49				0.323	85476				0.000	0.000	0.000
50	3	3	3	0.110	85476	0.113	0.113	0.113	0.120	0.120	0.120
51				0.003	85476				0.000	0.000	0.000
52				0.170	85476				0.000	0.000	0.000
total/avg	416	402	353	11.669	86462	0.830	0.561	0.252	73.543	47.011	23.408

TABLE 1B

week	all data number samples per week	TP < 5 number samples per week	TP <= 1 number samples per week	3-yr avg Utah Lake avg precip (in) weekly	3-yr avg monthly lake area (acre) weekly	all data TP conc (mg/l)	*not weighted* TP < 5 conc (mg/l)	TP <= 1 conc (mg/l)	all data load x1.133E-4 (T/yr)	TP < 5 load x1.133E-4 (T/yr)	TP <= 1 load x1.133E-4 (T/yr)
1				0.243	84290	0.830	0.561	0.252	1.926	1.302	0.585
2	10	10	9	0.467	84290	0.305	0.305	0.172	1.360	1.360	0.767
3	13	13	13	0.857	84290	0.185	0.185	0.185	1.514	1.514	1.514
4	8	8	8	0.093	84290	0.156	0.156	0.156	0.139	0.139	0.139
5				0.093	85722	0.830	0.561	0.252	0.750	0.507	0.228
6	13	13	13	0.360	85722	0.058	0.058	0.058	0.203	0.203	0.203
7	8	7	7	0.190	85722	0.949	0.127	0.127	1.751	0.234	0.234
8	10	10	9	0.360	85722	0.248	0.248	0.058	0.867	0.867	0.203
9	7	7	7	0.127	86916	0.071	0.071	0.071	0.089	0.089	0.089
10	12	12	12	0.297	86916	0.173	0.173	0.173	0.506	0.506	0.506
11	16	16	14	0.333	86916	0.356	0.356	0.164	1.167	1.167	0.538
12	24	24	22	0.633	86916	0.339	0.339	0.183	2.113	2.113	1.141
13	24	24	23	0.343	86916	0.142	0.142	0.096	0.480	0.480	0.324
14	17	17	15	0.227	88108	0.348	0.348	0.177	0.789	0.789	0.401
15	7	7	5	0.490	88108	0.451	0.451	0.227	2.206	2.206	1.110
16	28	28	27	0.360	88108	0.253	0.253	0.195	0.909	0.909	0.701
17	8	7	7	0.213	88108	1.418	0.191	0.191	3.015	0.406	0.406
18	22	22	19	0.337	89258	0.705	0.705	0.300	2.403	2.403	1.022
19	16	16	14	0.313	89258	0.408	0.408	0.238	1.292	1.292	0.753
20	8	7	6	0.317	89258	1.640	0.603	0.270	5.258	1.933	0.866
21	23	22	19	0.527	89258	0.910	0.505	0.312	4.850	2.692	1.663
22				0.140	89258	0.830	0.561	0.252	1.175	0.794	0.357
23	9	9	8	0.117	89675	0.549	0.549	0.268	0.653	0.653	0.319
24	3	3	1	0.017	89675	1.413	1.413	0.340	0.244	0.244	0.059
25	8	7	4	0.063	89675	2.504	2.504	0.658	1.603	1.603	0.421
26				0.000	89675						
27				0.007	88589	0.830	0.561	0.252	0.058	0.039	0.018
28				0.013	88589	0.830	0.561	0.252	0.108	0.073	0.033
29	3	2	2	0.117	88589	2.937	0.505	0.505	3.449	0.593	0.593
30	8	5	3	0.377	88589	3.614	1.622	0.503	13.676	6.138	1.903
31	6	6	3	0.077	85869	1.380	1.380	0.260	1.034	1.034	0.195
32	14	13	9	0.227	85869	1.304	0.720	0.284	2.880	1.590	0.627
33				0.027	85869	0.830	0.561	0.252	0.218	0.147	0.066
34	11	9	6	0.223	85869	2.028	1.112	0.285	4.400	2.413	0.618
35				0.000	85869						
36	1	1		0.160	84478	2.300	2.300	0.252	3.522	3.522	0.386
37	17	16	13	0.323	84478	0.897	0.466	0.242	2.773	1.441	0.748
38	1	1	1	0.203	84478	0.470	0.470	0.470	0.913	0.913	0.913
39	7	7	6	0.323	84478	0.410	0.410	0.262	1.268	1.268	0.810
40	7	6	5	0.303	83893	1.301	0.635	0.542	3.747	1.829	1.561
41	9	9	9	0.257	83893	0.113	0.113	0.113	0.276	0.276	0.276
42				0.067	83893	0.830	0.561	0.252	0.529	0.357	0.160
43				0.033	83893	0.830	0.561	0.252	0.260	0.176	0.079
44	1	1	1	0.023	84975	0.030	0.030	0.030	0.007	0.007	0.007
45	6	6	4	0.013	84975	0.820	0.820	0.680	0.103	0.103	0.085
46	9	9	7	0.103	84975	0.668	0.668	0.273	0.662	0.662	0.271
47	9	9	9	0.320	84975	0.257	0.257	0.257	0.792	0.792	0.792
48	10	10	10	0.350	84975	0.151	0.151	0.151	0.509	0.509	0.509
49				0.323	85476	0.830	0.561	0.252	2.596	1.755	0.788
50	3	3	3	0.110	85476	0.113	0.113	0.113	0.120	0.120	0.120
51				0.003	85476	0.830	0.561	0.252	0.024	0.016	0.007
52				0.170	85476	0.830	0.561	0.252	1.367	0.924	0.415
totals	416	402	353	11.669	86462	0.830	0.561	0.252	82.555	53.103	26.530

actual weekly TP concentrations by the weighting factors to determine the precip weighted concentrations.

For example, the 3rd week "TP all data" 3-yr avg precip was 0.857 inches and the weighting factor is 0.857 / 0.225 = 3.809. The 3rd week actual TP concentration is 0.185 mg/l and when multiplied by the weighting factor of 3.809, the precip weighted TP conc is 0.705 mg/l, about 4 times higher. This procedure gives 39 of the 50 weeks with precip weighted TP conc values which are used to determine the 39 weekly load rates. See Table 1C.

The precip weighted TP concentration for those 39 weeks are:

all TP data = 0.851 mg/l, TP < 5 mg/l = 0.546 mg/l, and TP < 1 mg/l = 0.272 mg/l.

And the total TP load rates for those 39 weeks are:

all TP data = 105.2 T/yr, TP < 5 mg/l = 69.8 T/yr, and TP < 1 mg/l = 38.3 T/yr.

The precip weighted conc averages are about the same as non-weighted, but the load rates are higher, much higher. The precip weighting has increased the load rates when the weekly precip is high and the resulting weighting factor is high. Continuing the example above, the 3rd week non-weighted load rate is 1.514 T/yr and when multiplied by the weighting factor of 3.809, the weighted TP load rate is 5.77 T/yr.

As described above, I substituted in these 39-week averages for the missing 11 weeks. The precip weighted TP concentration average for all 50 weeks with precip are the same, of course, but the precip weighted TP load rates for the 50 weeks are higher because there are 11 more weeks of load rates. See Table 1D.

The precip weighted TP concentration for those 50 weeks are:

all TP data = 0.851 mg/l, TP < 5 mg/l = 0.546 mg/l, and TP < 1 mg/l = 0.272 mg/l.

And the total TP load rates for those 50 weeks are:

all TP data = 114.5 T/yr, TP < 5 mg/l = 75.7 T/yr, and TP < 1 mg/l = 41.2 T/yr.

Based on Dr. Gay's suggestion to use a weighted average, I decided to also apply a "number of samples" weighted avg to the data. Just like with differences in precip each week, there are significant differences in the number of samples each week, and these difference should be taken into account.

Again, there are too many weeks without sampling data to apply this method to each year. However, again, when I combine all 3 years and look at each week, there are only 11 weeks which have precip, but without samples. So I adjusted the 39 values of the 3-yr avg actual TP concentrations using the "number of samples" weighted method.

week	TABLE 1C all data number samples per week	TP < 5 number samples per week	TP <= 1 number samples per week	3-yr avg Utah Lake avg precip (in) weekly	3-yr avg monthly lake area (acre) weekly	*precip weighted* all data TP conc (mg/l)	TP < 5 conc (mg/l)	TP <= 1 conc (mg/l)	all data load x1.133E-4 (T/yr)	TP < 5 load x1.133E-4 (T/yr)	TP <= 1 load x1.133E-4 (T/yr)
1				0.243	84290				0.000	0.000	0.000
2	10	10	9	0.467	84290	0.635	0.635	0.358	2.831	2.831	1.596
3	13	13	13	0.857	84290	0.707	0.707	0.707	5.783	5.783	5.783
4	8	8	8	0.093	84290	0.065	0.065	0.065	0.057	0.057	0.057
5				0.093	85722				0.000	0.000	0.000
6	13	13	13	0.360	85722	0.093	0.093	0.093	0.325	0.325	0.325
7	8	7	7	0.190	85722	0.804	0.108	0.108	1.483	0.198	0.198
8	10	10	9	0.360	85722	0.398	0.398	0.093	1.391	1.391	0.325
9	7	7	7	0.127	86916	0.040	0.040	0.040	0.050	0.050	0.050
10	12	12	12	0.297	86916	0.229	0.229	0.229	0.670	0.670	0.670
11	16	16	14	0.333	86916	0.528	0.528	0.243	1.732	1.732	0.798
12	24	24	22	0.633	86916	0.956	0.956	0.516	5.961	5.961	3.218
13	24	24	23	0.343	86916	0.217	0.217	0.147	0.733	0.733	0.496
14	17	17	15	0.227	88108	0.352	0.352	0.179	0.798	0.798	0.406
15	7	7	5	0.490	88108	0.985	0.985	0.496	4.817	4.817	2.425
16	28	28	27	0.360	88108	0.406	0.406	0.313	1.459	1.459	1.124
17	8	7	7	0.213	88108	1.346	0.181	0.181	2.862	0.386	0.386
18	22	22	19	0.337	89258	1.059	1.059	0.451	3.608	3.608	1.536
19	16	16	14	0.313	89258	0.569	0.569	0.332	1.801	1.801	1.051
20	8	7	6	0.317	89258	2.317	0.852	0.381	7.427	2.731	1.223
21	23	22	19	0.527	89258	2.137	1.186	0.733	11.390	6.321	3.905
22				0.140	89258				0.000	0.000	0.000
23	9	9	8	0.117	89675	0.286	0.286	0.140	0.340	0.340	0.166
24	3	3	1	0.017	89675	0.107	0.107	0.026	0.018	0.018	0.004
25	8	7	4	0.063	89675	0.703	0.703	0.185	0.450	0.450	0.118
26				0.000	89675				0.000	0.000	0.000
27				0.007	88589				0.000	0.000	0.000
28				0.013	88589				0.000	0.000	0.000
29	3	2	2	0.117	88589	1.531	0.263	0.263	1.798	0.309	0.309
30	8	5	3	0.377	88589	6.072	2.725	0.845	22.976	10.312	3.198
31	6	6	3	0.077	85869	0.474	0.474	0.089	0.355	0.355	0.067
32	14	13	9	0.227	85869	1.319	0.728	0.287	2.913	1.609	0.635
33				0.027	85869				0.000	0.000	0.000
34	11	9	6	0.223	85869	2.015	1.105	0.283	4.373	2.398	0.614
35				0.000	85869				0.000	0.000	0.000
36	1	1		0.160	84478	1.640	1.640	0.000	2.512	2.512	0.000
37	17	16	13	0.323	84478	1.291	0.671	0.348	3.992	2.074	1.077
38	1	1	1	0.203	84478	0.425	0.425	0.425	0.826	0.826	0.826
39	7	7	6	0.323	84478	0.590	0.590	0.377	1.825	1.825	1.166
40	7	6	5	0.303	83893	1.757	0.857	0.732	5.060	2.470	2.108
41	9	9	9	0.257	83893	0.129	0.129	0.129	0.316	0.316	0.316
42				0.067	83893				0.000	0.000	0.000
43				0.033	83893				0.000	0.000	0.000
44	1	1	1	0.023	84975	0.003	0.003	0.003	0.001	0.001	0.001
45	6	6	4	0.013	84975	0.048	0.048	0.039	0.006	0.006	0.005
46	9	9	7	0.103	84975	0.307	0.307	0.125	0.304	0.304	0.124
47	9	9	9	0.320	84975	0.366	0.366	0.366	1.129	1.129	1.129
48	10	10	10	0.350	84975	0.236	0.236	0.236	0.794	0.794	0.794
49				0.323	85476				0.000	0.000	0.000
50	3	3	3	0.110	85476	0.055	0.055	0.055	0.059	0.059	0.059
51				0.003	85476				0.000	0.000	0.000
52				0.170	85476				0.000	0.000	0.000
total/avg	416	402	353	11.669	86462	0.851	0.546	0.272	105.227	69.759	38.289

	TABLE 1D			3-yr avg	3-yr avg						
	all data	TP < 5	TP <= 1	Utah Lake	monthly		***precip weighted***		all data	TP < 5	TP <= 1
week	number samples per week	number samples per week	number samples per week	avg precip (in) weekly	lake area (acre) weekly	all data TP conc (mg/l)	TP < 5 conc (mg/l)	TP <= 1 conc (mg/l)	load x1.133E-4 (T/yr)	load x1.133E-4 (T/yr)	load x1.133E-4 (T/yr)
1				0.243	84290	0.851	0.546	0.272	1.975	1.267	0.631
2	10	10	9	0.467	84290	0.635	0.635	0.358	2.831	2.831	1.596
3	13	13	13	0.857	84290	0.707	0.707	0.707	5.783	5.783	5.783
4	8	8	8	0.093	84290	0.065	0.065	0.065	0.057	0.057	0.057
5				0.093	85722	0.851	0.546	0.272	0.769	0.493	0.246
6	13	13	13	0.360	85722	0.093	0.093	0.093	0.325	0.325	0.325
7	8	7	7	0.190	85722	0.804	0.108	0.108	1.483	0.198	0.198
8	10	10	9	0.360	85722	0.398	0.398	0.093	1.391	1.391	0.325
9	7	7	7	0.127	86916	0.040	0.040	0.040	0.050	0.050	0.050
10	12	12	12	0.297	86916	0.229	0.229	0.229	0.670	0.670	0.670
11	16	16	14	0.333	86916	0.528	0.528	0.243	1.732	1.732	0.798
12	24	24	22	0.633	86916	0.956	0.956	0.516	5.961	5.961	3.218
13	24	24	23	0.343	86916	0.217	0.217	0.147	0.733	0.733	0.496
14	17	17	15	0.227	88108	0.352	0.352	0.179	0.798	0.798	0.406
15	7	7	5	0.490	88108	0.985	0.985	0.496	4.817	4.817	2.425
16	28	28	27	0.360	88108	0.406	0.406	0.313	1.459	1.459	1.124
17	8	7	7	0.213	88108	1.346	0.181	0.181	2.862	0.386	0.386
18	22	22	19	0.337	89258	1.059	1.059	0.451	3.608	3.608	1.536
19	16	16	14	0.313	89258	0.569	0.569	0.332	1.801	1.801	1.051
20	8	7	6	0.317	89258	2.317	0.852	0.381	7.427	2.731	1.223
21	23	22	19	0.527	89258	2.137	1.186	0.733	11.390	6.321	3.905
22				0.140	89258	0.851	0.546	0.272	1.205	0.773	0.385
23	9	9	8	0.117	89675	0.286	0.286	0.140	0.340	0.340	0.166
24	3	3	1	0.017	89675	0.107	0.107	0.026	0.018	0.018	0.004
25	8	7	4	0.063	89675	0.703	0.703	0.185	0.450	0.450	0.118
26				0.000	89675						
27				0.007	88589	0.851	0.546	0.272	0.060	0.038	0.019
28				0.013	88589	0.851	0.546	0.272	0.111	0.071	0.035
29	3	2	2	0.117	88589	1.531	0.263	0.263	1.798	0.309	0.309
30	8	5	3	0.377	88589	6.072	2.725	0.845	22.976	10.312	3.198
31	6	6	3	0.077	85869	0.474	0.474	0.089	0.355	0.355	0.067
32	14	13	9	0.227	85869	1.319	0.728	0.287	2.913	1.609	0.635
33				0.027	85869	0.851	0.546	0.272	0.224	0.143	0.071
34	11	9	6	0.223	85869	2.015	1.105	0.283	4.373	2.398	0.614
35				0.000	85869						
36	1	1		0 160	84478	1.640	1.640	0.000	2.512	2.512	0.000
37	17	16	13	0.323	84478	1.291	0.671	0.348	3.992	2.074	1.077
38	1	1	1	0.203	84478	0.425	0.425	0.425	0.826	0.826	0.826
39	7	7	6	0.323	84478	0.590	0.590	0.377	1.825	1.825	1.166
40	7	6	5	0.303	83893	1.757	0.857	0.732	5.060	2.470	2.108
41	9	9	9	0.257	83893	0.129	0.129	0.129	0.316	0.316	0.316
42				0.067	83893	0.851	0.546	0.272	0.542	0.348	0.173
43				0.033	83893	0.851	0.546	0.272	0.267	0.171	0.085
44	1	1	1	0.023	84975	0.003	0.003	0.003	0.001	0.001	0.001
45	6	6	4	0.013	84975	0.048	0.048	0.039	0.006	0.006	0.005
46	9	9	7	0.103	84975	0.307	0.307	0.125	0.304	0.304	0.124
47	9	9	9	0.320	84975	0.366	0.366	0.366	1.129	1.129	1.129
48	10	10	10	0.350	84975	0.236	0.236	0.236	0.794	0.794	0.794
49				0.323	85476	0.851	0.546	0.272	2.662	1.708	0.851
50	3	3	3	0.110	85476	0.055	0.055	0.055	0.059	0.059	0.059
51				0.003	85476	0.851	0.546	0.272	0.025	0.016	0.008
52				0.170	85476	0.851	0.546	0.272	1.401	0.899	0.448
totals	416	402	353	11.669	86462	0.851	0.546	0.272	114.467	75.687	41.242

This is different from the precip weighted method. There is only one avg 3-yr annual precip, but there are 3 different numbers of weekly samples. For "TP all data" there are 416 samples, "TP < 5" has 402, and "TP < 1" has 353. The weekly avg number of samples for "TP all data" is 416 / 39 = 10.667, the avg "TP < 5" is 402 / 39 = 10.308, and the avg "TP < 1" is 353 / 38 = 9.289.

I divided each weekly number of samples by the appropriate weekly avg to determine the weighting factors. I multiplied the actual weekly TP concentrations by the weighting factors to determine the "number of samples" weighted concentrations.

For example, the 16th week "TP all data" number of samples is 28 and the weighting factor is 28 / 10.667 = 2.625. The 16rd week actual TP concentration is 0.253 mg/l and when multiplied by the weighting factor of 2.625, the "number of samples" weighted TP conc is 0.664 mg/l. This procedure gives 39 of the 50 weeks with "number of samples" weighted TP conc values which are used to determine the 39 weekly load rates. See Table 1E.

The "number of samples" weighted TP concentration for those 39 weeks are:

all TP data = 0.680 mg/l, TP < 5 mg/l = 0.453 mg/l, and TP < 1 mg/l = 0.209 mg/l.

And the total TP load rates for those 39 weeks are (I have the calcs):

all TP data = 74.6 T/yr, TP < 5 mg/l = 49.1 T/yr, and TP < 1 mg/l = 26.1 T/yr.

The "number of samples" weighted conc averages are lower than the non-weighted, but the load rates are about the same. Both the "number of samples" weighted conc averages and load rates are lower than the precip weighted. Continuing the example above, the 16th week non-weighted load rate is 0.909 T/yr and when multiplied by the weighting factor of 2.625, the "number of samples" weighted TP load rate is 2.386 T/yr.

As also described above, I substituted in these 39-week "number of samples" weighted TP conc averages for the 11 missing weeks. The "number of samples" weighted TP concentration average for all 50 weeks with precip are the same, of course, but the precip weighted TP load rates for the 50 weeks are higher because there are 11 more weeks of load rated. See Table 1F.

The "number of samples" weighted TP concentration for those 50 weeks are:

all TP data = 0.680 mg/l, TP < 5 mg/l = 0.453 mg/l, and TP < 1 mg/l = 0.209 mg/l.

And the total TP load rates for the 50 weeks are:

all TP data = 81.9 T/yr, TP < 5 mg/l = 54.0 T/yr, and TP < 1 mg/l = 28.4 T/yr.

I also used Dr. Gay's suggested first method using TP monthly data for each year. First I looked at not weighting. During 2017 there were no months without any precip but I only sampled during 10 of the months, so there were 2 months with precip, but without samples. That's probably too many months without samples in 1 year and therefore without load rates (fluxes).

During 2018 there was 1 month without any precip. I only sampled during 8 months, so there were 3 months with precip, but without samples. Again, that's too many months without samples

week	TABLE 1E all data number samples per week	TP < 5 number samples per week	TP <= 1 number samples per week	3-yr avg Utah Lake avg precip (in) weekly	3-yr avg monthly lake area (acre) weekly	***# samples weighted*** all data TP conc (mg/l)	TP < 5 conc (mg/l)	TP <= 1 conc (mg/l)	all data load x1.133E-4 (T/yr)	TP < 5 load x1.133E-4 (T/yr)	TP <= 1 load x1.133E-4 (T/yr)
1				0.243	84290				0.000	0.000	0.000
2	10	10	9	0.467	84290	0.286	0.296	0.167	1.275	1.320	0.743
3	13	13	13	0.857	84290	0.225	0.233	0.259	1.845	1.910	2.119
4	8	8	8	0.093	84290	0.117	0.121	0.134	0.104	0.108	0.119
5				0.093	85722						
6	13	13	13	0.360	85722	0.071	0.073	0.081	0.247	0.256	0.284
7	8	7	7	0.190	85722	0.712	0.086	0.096	1.313	0.159	0.177
8	10	10	9	0.360	85722	0.233	0.241	0.056	0.813	0.841	0.196
9	7	7	7	0.127	86916	0.047	0.048	0.054	0.058	0.060	0.067
10	12	12	12	0.297	86916	0.195	0.201	0.223	0.569	0.589	0.654
11	16	16	14	0.333	86916	0.534	0.553	0.247	1.751	1.812	0.811
12	24	24	22	0.633	86916	0.763	0.789	0.433	4.755	4.920	2.702
13	24	24	23	0.343	86916	0.320	0.331	0.238	1.079	1.117	0.803
14	17	17	15	0.227	88108	0.555	0.574	0.286	1.257	1.301	0.648
15	7	7	5	0.490	88108	0.296	0.306	0.122	1.448	1.498	0.598
16	28	28	27	0.360	88108	0.664	0.687	0.567	2.387	2.470	2.037
17	8	7	7	0.213	88108	1.064	0.130	0.144	2.261	0.276	0.306
18	22	22	19	0.337	89258	1.454	1.505	0.614	4.956	5.128	2.091
19	16	16	14	0.313	89258	0.612	0.633	0.359	1.937	2.005	1.135
20	8	7	6	0.317	89258	1.230	0.410	0.174	3.943	1.313	0.559
21	23	22	19	0.527	89258	1.962	1.078	0.638	10.458	5.745	3.401
22				0.140	89258						
23	9	9	8	0.117	89675	0.463	0.479	0.231	0.551	0.570	0.274
24	3	3	1	0.017	89675	0.397	0.411	0.037	0.069	0.071	0.006
25	8	7	4	0.063	89675	1.878	1.700	0.283	1.202	1.089	0.181
26				0.000	89675						
27				0.007	88589						
28				0.013	88589						
29	3	2	2	0.117	88589	0.826	0.098	0.109	0.970	0.115	0.128
30	8	5	3	0.377	88589	2.711	0.787	0.162	10.257	2.977	0.615
31	6	6	3	0.077	85869	0.776	0.803	0.084	0.582	0.602	0.063
32	14	13	9	0.227	85869	1.712	0.908	0.275	3.780	2.006	0.608
33				0.027	85869						
34	11	9	6	0.223	85869	2.091	0.971	0.184	4.538	2.107	0.399
35				0.000	85869						
36	1	1		0.160	84478	0.216	0.223	0.000	0.330	0.342	0.000
37	17	16	13	0.323	84478	1.430	0.723	0.339	4.420	2.236	1.047
38	1	1	1	0.203	84478	0.044	0.046	0.051	0.086	0.089	0.098
39	7	7	6	0.323	84478	0.269	0.278	0.169	0.832	0.861	0.523
40	7	6	5	0.303	83893	0.854	0.370	0.292	2.459	1.065	0.840
41	9	9	9	0.257	83893	0.095	0.099	0.109	0.233	0.241	0.267
42				0.067	83893						
43				0.033	83893						
44	1	1	1	0.023	84975	0.003	0.003	0.003	0.001	0.001	0.001
45	6	6	4	0.013	84975	0.461	0.477	0.293	0.058	0.060	0.037
46	9	9	7	0.103	84975	0.564	0.583	0.206	0.559	0.578	0.204
47	9	9	9	0.320	84975	0.217	0.224	0.249	0.668	0.691	0.767
48	10	10	10	0.350	84975	0.142	0.146	0.163	0.477	0.494	0.548
49				0.323	85476						
50	3	3	3	0.110	85476	0.032	0.033	0.036	0.034	0.035	0.039
51				0.003	85476						
52				0.170	85476						
total/avg	416	402	353	11.669	86462	0.680	0.453	0.209	74.563	49.055	26.096

TABLE 1F

week	all data number samples per week	TP < 5 number samples per week	TP <= 1 number samples per week	3-yr avg Utah Lake avg precip (in) weekly	3-yr avg monthly lake area (acre) weekly	*# samples weighted* all data TP conc (mg/l)	TP < 5 conc (mg/l)	TP <= 1 conc (mg/l)	all data load x1.133E-4 (T/yr)	TP < 5 load x1.133E-4 (T/yr)	TP <= 1 load x1.133E-4 (T/yr)
1				0.243	84290	0.680	0.453	0.209	1.578	1.051	0.485
2	10	10	9	0.467	84290	0.286	0.296	0.167	1.275	1.320	0.743
3	13	13	13	0.857	84290	0.225	0.233	0.259	1.845	1.910	2.119
4	8	8	8	0.093	84290	0.117	0.121	0.134	0.104	0.108	0.119
5				0.093	85722	0.680	0.453	0.209	0.614	0.409	0.189
6	13	13	13	0.360	85722	0.071	0.073	0.081	0.247	0.256	0.284
7	8	7	7	0.190	85722	0.712	0.086	0.096	1.313	0.159	0.177
8	10	10	9	0.360	85722	0.233	0.241	0.056	0.813	0.841	0.196
9	7	7	7	0.127	86916	0.047	0.048	0.054	0.058	0.060	0.067
10	12	12	12	0.297	86916	0.195	0.201	0.223	0.569	0.589	0.654
11	16	16	14	0.333	86916	0.534	0.553	0.247	1.751	1.812	0.811
12	24	24	22	0.633	86916	0.763	0.789	0.433	4.755	4.920	2.702
13	24	24	23	0.343	86916	0.320	0.331	0.238	1.079	1.117	0.803
14	17	17	15	0.227	88108	0.555	0.574	0.286	1.257	1.301	0.648
15	7	7	5	0.490	88108	0.296	0.306	0.122	1.448	1.498	0.598
16	28	28	27	0.360	88108	0.664	0.687	0.567	2.387	2.470	2.037
17	8	7	7	0.213	88108	1.064	0.130	0.144	2.261	0.276	0.306
18	22	22	19	0.337	89258	1.454	1.505	0.614	4.956	5.128	2.091
19	16	16	14	0.313	89258	0.612	0.633	0.359	1.937	2.005	1.135
20	8	7	6	0.317	89258	1.230	0.410	0.174	3.943	1.313	0.559
21	23	22	19	0.527	89258	1.962	1.078	0.638	10.458	5.745	3.401
22				0.140	89258	0.680	0.453	0.209	0.963	0.641	0.296
23	9	9	8	0.117	89675	0.463	0.479	0.231	0.551	0.570	0.274
24	3	3	1	0.017	89675	0.397	0.411	0.037	0.069	0.071	0.006
25	8	7	4	0.063	89675	1.878	1.700	0.283	1.202	1.089	0.181
26				0.000	89675						
27				0.007	88589	0.680	0.453	0.209	0.048	0.032	0.015
28				0.013	88589	0.680	0.453	0.209	0.089	0.059	0.027
29	3	2	2	0.117	88589	0.826	0.098	0.109	0.970	0.115	0.128
30	8	5	3	0.377	88589	2.711	0.787	0.162	10.257	2.977	0.615
31	6	6	3	0.077	85869	0.776	0.803	0.084	0.582	0.602	0.063
32	14	13	9	0.227	85869	1.712	0.908	0.275	3.780	2.006	0.608
33				0.027	85869	0.680	0.453	0.209	0.179	0.119	0.055
34	11	9	6	0.223	85869	2.091	0.971	0.184	4.538	2.107	0.399
35				0.000	85869						
36	1	1		0.160	84478	0.216	0.223	0.000	0.330	0.342	0.000
37	17	16	13	0.323	84478	1.430	0.723	0.339	4.420	2.236	1.047
38	1	1	1	0.203	84478	0.044	0.046	0.051	0.086	0.089	0.098
39	7	7	6	0.323	84478	0.269	0.278	0.169	0.832	0.861	0.523
40	7	6	5	0.303	83893	0.854	0.370	0.292	2.459	1.065	0.840
41	9	9	9	0.257	83893	0.095	0.099	0.109	0.233	0.241	0.267
42				0.067	83893	0.680	0.453	0.209	0.433	0.289	0.133
43				0.033	83893	0.680	0.453	0.209	0.213	0.142	0.066
44	1	1	1	0.023	84975	0.003	0.003	0.003	0.001	0.001	0.001
45	6	6	4	0.013	84975	0.461	0.477	0.293	0.058	0.060	0.037
46	9	9	7	0.103	84975	0.564	0.583	0.206	0.559	0.578	0.204
47	9	9	9	0.320	84975	0.217	0.224	0.249	0.668	0.691	0.767
48	10	10	10	0.350	84975	0.142	0.146	0.163	0.477	0.494	0.548
49				0.323	85476	0.680	0.453	0.209	2.127	1.417	0.654
50	3	3	3	0.110	85476	0.032	0.033	0.036	0.034	0.035	0.039
51				0.003	85476	0.680	0.453	0.209	0.020	0.013	0.006
52				0.170	85476	0.680	0.453	0.209	1.120	0.746	0.344
totals	416	402	353	11.669	86462	0.680	0.453	0.209	81.946	53.974	28.365

and therefore without load rates. During 2019 there were no months without any precip, but I only sampled during 8 of the months, so there were 4 months with precip, but without samples. That's too many months without samples and therefore without load rates. During those 3 years, I sampled during 26 months, albeit multiple times during some months. So the monthly sampling for each year isn't good enough for total annual load rates each year.

However, when I combine all 3 years and look at each month, there are no months without precip. And there are no months that I didn't sample over the 3-yr period. So there are 12 months with precip and with sampling and therefore with load rate data. See Table 1G.

The non-weighted TP conc averages for the 12 months are (I have the calculations):

all TP data = 0.875 mg/l, TP < 5 mg/l = 0.509 mg/l, and TP < 1 mg/l = 0.250 mg/l.

And the total TP load rates for those 12 months are (I have the calcs):

all TP data = 73.9 T/yr, TP < 5 mg/l = 46.1 T/yr, and TP < 1 mg/l = 24.9 T/yr.

Next, again, I used Dr. Gay's suggested second method which is to estimate the precip weighted TP conc for the year or for season/month/etc. Again, there are too many months without sampling data to apply this method to each year. However, again, when I combine all 3 years and look at each month, there are no months without samples. So I adjusted the 12 values of the 3-yr avg actual TP concentrations using the precip weighted method.

The 2017-2019 average 3-yr annual precip at Utah Lake is 11.7 inches. The avg monthly precip is 11.7 / 12 = 0.975 inches. I divided each monthly precip by this avg of 0.975 to determine the weighting factor. I multiplied the actual monthly TP concentration values by the weighting factors to determine the precip weighted concentrations.

For example, the Jan "TP all data" 3-yr avg precip was 1.66 inches and the weighting factor is 1.66 / 0.975 = 1.7. The Jan actual TP concentration is 0.216 mg/l and when multiplied by the weighting factor of 1.7, the precip weighted TP conc is 0.367 mg/l. This procedure gives 12 months with precip weighted TP conc values which are used to find the 12 monthly load rates. See Table 1H.

The precip weighted TP concentrations for those 12 months are:

all TP data = 0.640 mg/l, TP < 5 mg/l = 0.400 mg/l, and TP < 1 mg/l = 0.217 mg/l.

And the total TP load rates for those 12 months are:

all TP data = 72.5 T/yr, TP < 5 mg/l = 49.3 T/yr, and TP < 1 mg/l = 28.6 T/yr.

The precip weighted conc averages are lower than the non-weighted, because they're weighted, but the load rates are about the same. Continuing the example above, the Jan non-weighted load rate is 3.424 T/yr and when multiplied by the weighting factor of 1.7, the weighted TP load rate is 5.82 T/yr.

month	TABLE 1G all data number samples per week	TP < 5 number samples per week	TP <= 1 number samples per week	3-yr avg Utah Lake avg precip (in) weekly	3-yr avg monthly lake area (acre) weekly	all data TP conc (mg/l)	*not weighted* TP < 5 conc (mg/l)	TP <= 1 conc (mg/l)	all data load x1.133E-4 (T/yr)	TP < 5 load x1.133E-4 (T/yr)	TP <= 1 load x1.133E-4 (T/yr)
jan	31	31	30	1.660	84290	0.216	0.216	0.173	3.424	3.424	2.743
feb	37	36	35	1.043	85722	0.306	0.128	0.076	3.100	1.297	0.770
mar	77	77	72	1.710	86916	0.251	0.251	0.148	4.227	4.227	2.492
apr	68	67	62	1.567	88108	0.458	0.316	0.209	7.165	4.943	3.270
may	61	59	50	1.373	89258	0.859	0.572	0.278	11.928	7.943	3.860
jun	20	19	13	0.197	89675	1.461	0.958	0.393	2.924	1.918	0.787
jul	11	7	5	0.523	88589	3.429	1.303	0.504	18.001	6.840	2.646
aug	32	29	18	0.543	85869	1.598	1.033	0.281	8.442	5.457	1.485
sep	25	24	20	1.010	84478	0.744	0.450	0.26	7.193	4.350	2.514
oct	17	16	15	0.660	83893	0.598	0.304	0.251	3.752	1.907	1.575
nov	33	33	29	0.653	84975	0.441	0.441	0.284	2.773	2.773	1.786
dec	4	4	4	0.763	85476	0.138	0.138	0.138	1.020	1.020	1.020
sum/avg	416	402	353	11.702	86437	0.875	0.509	0.250	73.949	46.100	24.946

TABLE 1H

month	all data number samples per week	TP < 5 number samples per week	TP <= 1 number samples per week	3-yr avg Utah Lake avg precip (in) weekly	3-yr avg monthly lake area (acre) weekly	**precip weighted** all data TP conc (mg/l)	**precip weighted** TP < 5 conc (mg/l)	**precip weighted** TP <= 1 conc (mg/l)	all data load x1.133E-4 (T/yr)	TP < 5 load x1.133E-4 (T/yr)	TP <= 1 load x1.133E-4 (T/yr)
jan	31	31	30	1.660	84290	0.368	0.368	0.294	5.829	5.829	4.669
feb	37	36	35	1.043	85722	0.327	0.137	0.081	3.316	1.387	0.823
mar	77	77	72	1.710	86916	0.440	0.440	0.260	7.412	7.412	4.370
apr	68	67	62	1.567	88108	0.736	0.508	0.336	11.513	7.944	5.254
may	61	59	50	1.373	89258	1.209	0.805	0.391	16.794	11.183	5.435
jun	20	19	13	0.197	89675	0.295	0.194	0.079	0.591	0.387	0.159
jul	11	7	5	0.523	88589	1.839	0.699	0.270	9.654	3.669	1.419
aug	32	29	18	0.543	85869	0.890	0.575	0.156	4.701	3.039	0.827
sep	25	24	20	1.010	84478	0.771	0.466	0.269	7.450	4.506	2.603
oct	17	16	15	0.660	83893	0.405	0.206	0.170	2.539	1.291	1.066
nov	33	33	29	0.653	84975	0.295	0.295	0.190	1.857	1.857	1.196
dec	4	4	4	0.763	85476	0.108	0.108	0.108	0.798	0.798	0.798
sum/avg	416	402	353	11.702	86437	0.640	0.400	0.217	72.454	49.301	28.619

Again, based on Dr. Gay's suggestion to use a weighted average, I applied a "number of samples" weighted avg to the monthly data. Just like with differences in precip each month, there are significant differences in the number of samples each month. Again, there are too many months without sampling data to apply this method to each year.

However, again, when I combine all 3 years and look at each month, there are no months without precip and without samples. So I adjusted the 12 values of the 3-yr avg actual TP concentrations using the "number of samples" weighted method.

This is different from the precip weighted method. There is only one avg 3-yr annual precip, but there are different numbers of monthly samples. For "TP all data" there are 416 samples, "TP < 5" has 402, and "TP < 1" has 353. The avg monthly number of samples for "TP all data" is 416 / 12 = 34.667, the avg "TP < 5" is 402 / 12 = 33.50, and the avg "TP < 1" is 353 / 12 = 29.417.

I divided each monthly number of samples by each avg monthly number of samples to determine the weighting factor. I multiplied the actual weekly TP concentration values by the weighting factors to determine the "number of samples" weighted concentrations.

For example, March "TP all data" number of samples is 77 and the weighting factor is 77 / 34.667 = 2.221. The March actual TP concentration is 0.251 mg/l and when multiplied by the weighting factor of 2.221, the "number of samples" weighted TP conc is 0.558 mg/l. This procedure gives 12 months with "number of samples" weighted TP conc values which are used to determine the 12 monthly load rates. See Table 1I.

The "number of samples" weighted TP concentration for those 12 months are:

all TP data = 0.680 mg/l, TP < 5 mg/l = 0.432 mg/l, and TP < 1 mg/l = 0.215 mg/l.

And the total TP load rates for those 12 months are:

all TP data = 75.8 T/yr, TP < 5 mg/l = 52.3 T/yr, and TP < 1 mg/l = 29.4 T/yr.

The "number of samples" weighted conc averages are lower than the non-weighted, but the load rates are quite close. Both the "number of samples" weighted conc averages and load rates are about the same as the precip weighted. Continuing the example above, March non-weighted load rate is 4.227 T/yr and when multiplied by the weighting factor of 2.221, the "number of samples" weighted TP load rate is 9.388 T/yr.

A summary of the above results is given in Table 1-TP below. Also see 4 groups of figures, each with the 3 weightings of non-weighted, precip-weighted, and "number of samples" weighted. The 4 groups are: Figures 1A – 1C for weekly concentrations, Figures 1D – 1F for weekly load rates, Figures 1G – 1I for monthly concentrations, and Figures 1J – 1L for monthly load rates.

month	TABLE 1I all data number samples per week	TP < 5 number samples per week	TP <= 1 number samples per week	3-yr avg Utah Lake avg precip (in) weekly	3-yr avg monthly lake area (acre) weekly	# samples weighted all data TP conc (mg/l)	TP < 5 conc (mg/l)	TP <= 1 conc (mg/l)	all data load x1.133E-4 (T/yr)	TP < 5 load x1.133E-4 (T/yr)	TP <= 1 load x1.133E-4 (T/yr)
jan	31	31	30	1.660	84290	0.193	0.200	0.176	3.062	3.169	2.797
feb	37	36	35	1.043	85722	0.327	0.138	0.090	3.309	1.393	0.916
mar	77	77	72	1.710	86916	0.558	0.577	0.362	9.389	9.716	6.100
apr	68	67	62	1.567	88108	0.898	0.632	0.440	14.054	9.887	6.891
may	61	59	50	1.373	89258	1.512	1.007	0.473	20.989	13.989	6.561
jun	20	19	13	0.197	89675	0.843	0.543	0.174	1.687	1.088	0.348
jul	11	7	5	0.523	88589	1.088	0.272	0.086	5.712	1.429	0.450
aug	32	29	18	0.543	85869	1.475	0.894	0.172	7.793	4.724	0.908
sep	25	24	20	1.010	84478	0.537	0.322	0.177	5.187	3.117	1.709
oct	17	16	15	0.660	83893	0.293	0.145	0.128	1.840	0.911	0.803
nov	33	33	29	0.653	84975	0.420	0.434	0.280	2.639	2.731	1.760
dec	4	4	4	0.763	85476	0.016	0.016	0.019	0.118	0.122	0.139
sum/avg	416	402	353	11.702	86437	0.680	0.432	0.215	75.778	52.276	29.383

Summary Table 1-TP. TP Concentrations (mg/l) / Load Rate (T/yr)				
Weighting	**Week/Month**	**All TP data**	**TP < 5 mg/l**	**TP < 1 mg/l**
No	39	0.830 / 74	0.561 / 47	0.252 / 23
No	50	0.830 / 83	0.561 / 53	0.252 / 27
Precipitation	39	0.851 / 105	0.546 / 70	0.272 / 38
Precipitation	50	0.851 / 115	0.546 / 76	0.272 / 41
Number of Samples	39	0.680 / 75	0.453 / 49	0.209 / 26
Number of Samples	50	0.680 / 82	0.453 / 54	0.209 / 28
No	12	0.875 / 74	0.509 / 46	0.250 / 25
Precipitation	12	0.640 / 73	0.400 / 49	0.217 / 29
Number of Samples	12	0.680 / 76	0.432 / 52	0.215 / 29

Here are some observations from the TP table above. "All data" weekly precip-weighted load rates are higher than the other load rates, but not the monthly precip-weighted load rates. Possibly high weekly precip's are attenuated in monthly precip's.

There are just a couple of high weekly precip-weighted conc's (with outliers) and precip's (week 21 and 30 in Table 1D) that make the weekly load rates so high. The 39 weekly non-precip-weighted load rates are similar to the monthly load rates.

"TP < 5" load rates (few outliers) are closer to each other, around 50, except precip-weighted, around 70. "TP < 1" load rates (no outliers) are even closer, around 25, except precip-weighted, around 40. I think we have a good idea of what the range of TP load rates are on Utah Lake.

Observations from the figures: As mentioned above, because precip and concentrations in weeks 21 and 30 are fairly high (Figures 1A – 1C), weekly load rates in those weeks are high (Figures 1D – 1F). Again, precip-weighted values are higher than the others. Higher precip is more influential when weighted.

Monthly results are inconsistent. Non-weighted load rates and concentration values are high in July (Figures 1J and 1G), but precip-weighted load rates are high in May (Figure 1K) while concentrations are high in July (Figure 1H). "Number of sample" weighted load rates are high also in May (Figure 1L), but concentrations are high in May and also August (Figure 1I).

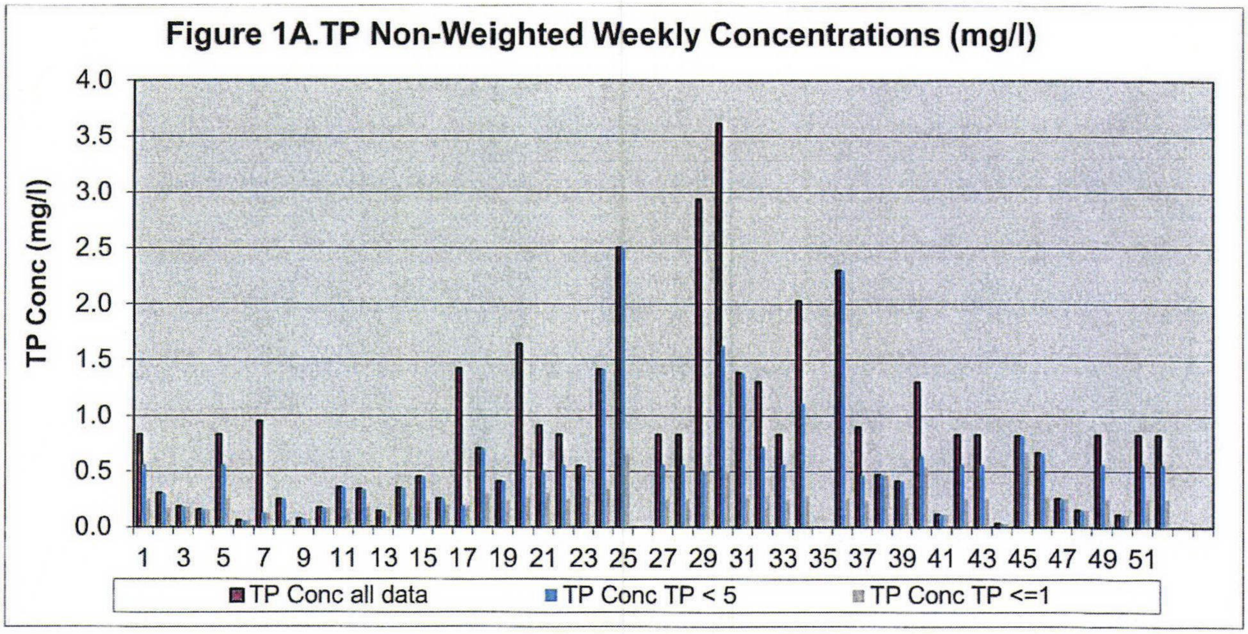


Figure 1A.TP Non-Weighted Weekly Concentrations (mg/l)
TP Conc (mg/l)
TP Conc all data
TP Conc TP < 5
TP Conc TP <=1

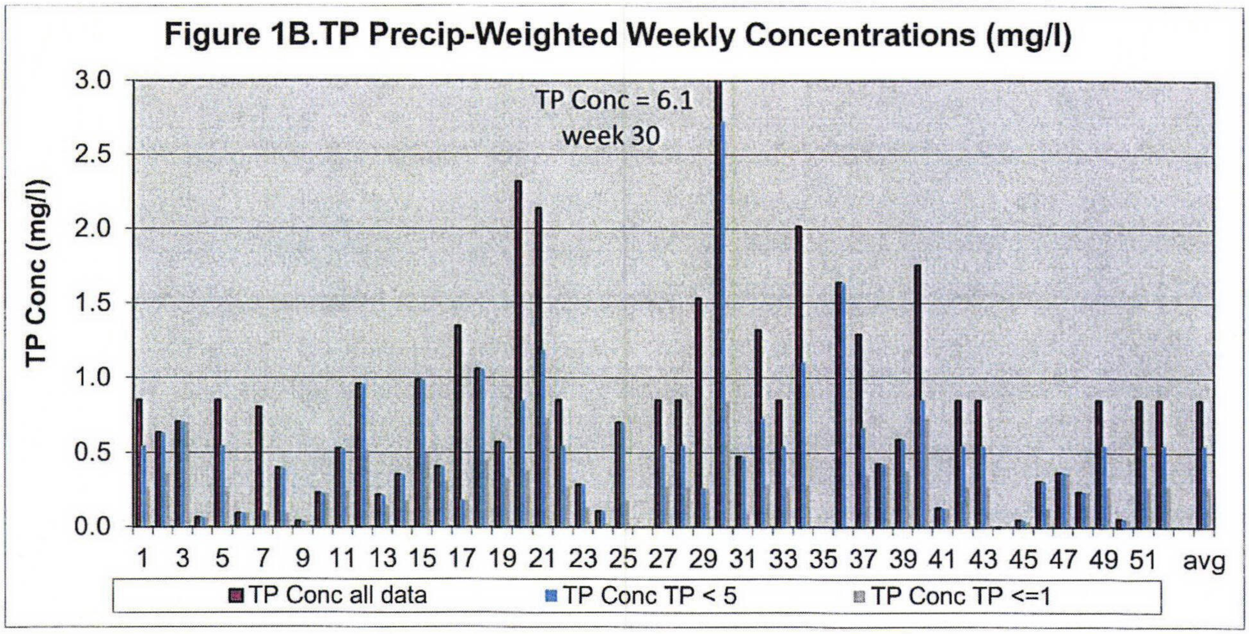


Figure 1B.TP Precip-Weighted Weekly Concentrations (mg/l)
TP Conc = 6.1
week 30
TP Conc (mg/l)
TP Conc all data
TP Conc TP < 5
TP Conc TP <=1

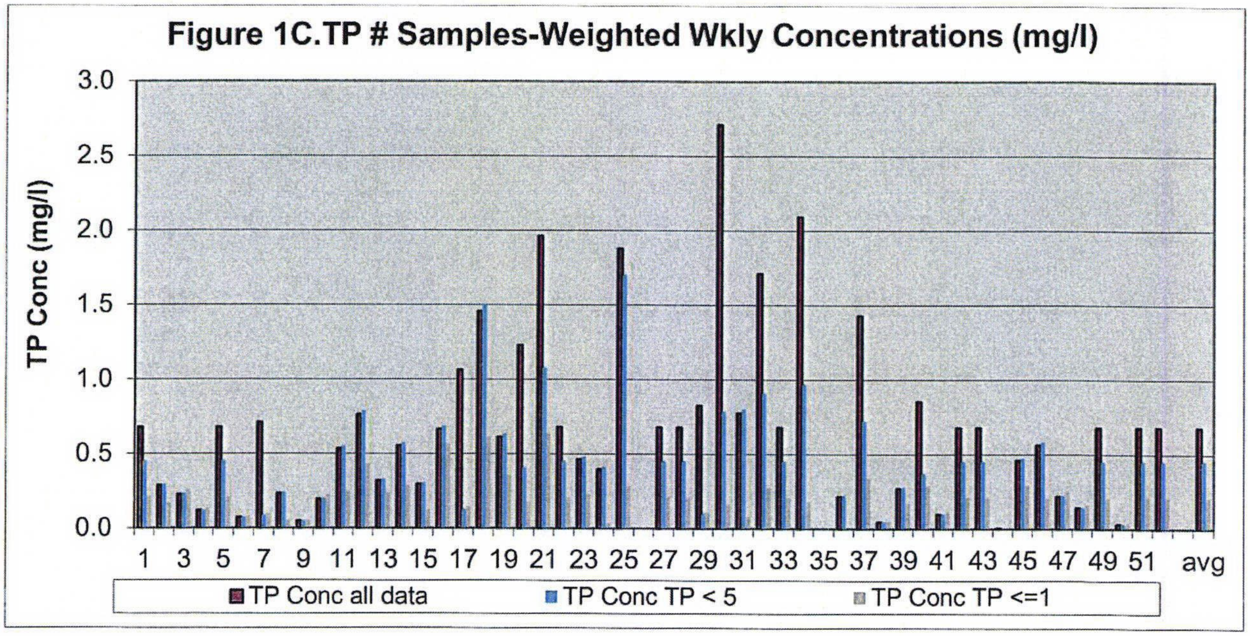


Figure 1C.TP # Samples-Weighted Wkly Concentrations (mg/l)
TP Conc (mg/l)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 avg
TP Conc all data
TP Conc TP < 5
TP Conc TP <=1

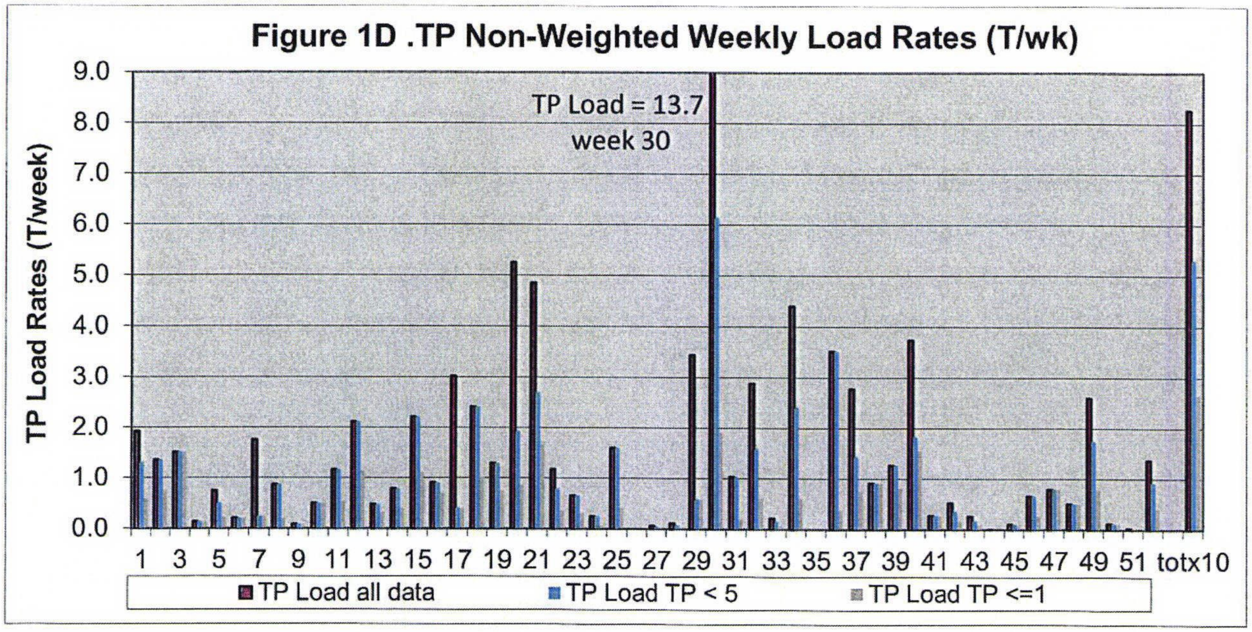


Figure 1D .TP Non-Weighted Weekly Load Rates (T/wk)
TP Load Rates (T/week)
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
TP Load = 13.7
week 30
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 totx10
TP Load all data
TP Load TP < 5
TP Load TP <=1

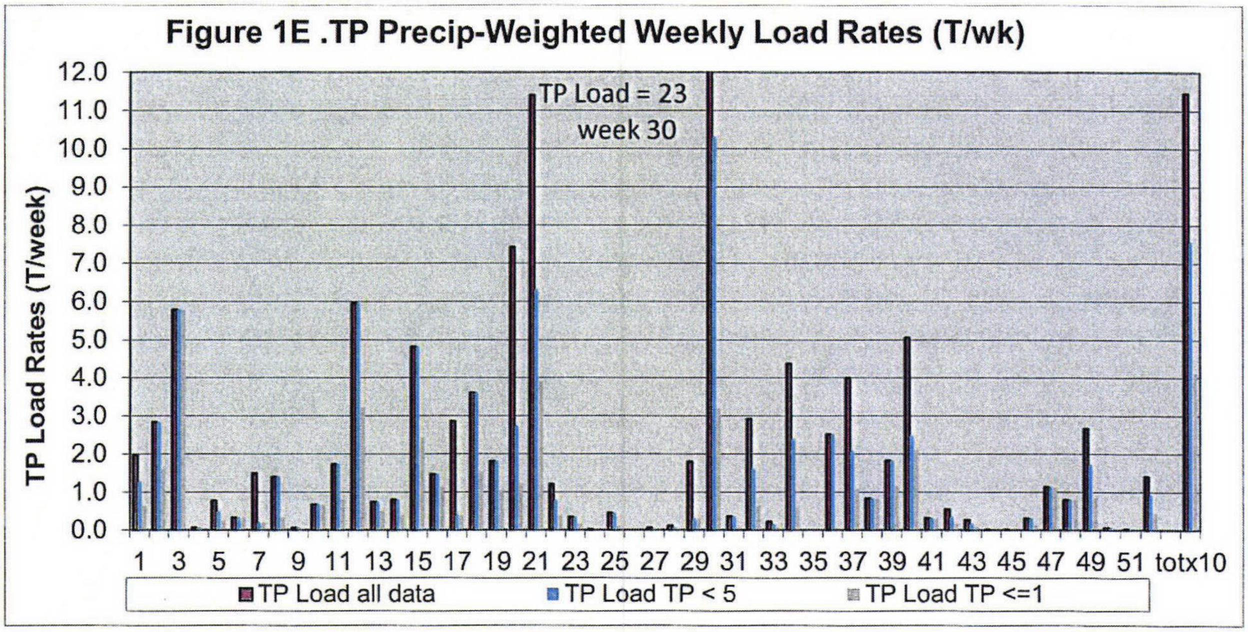


Figure 1E .TP Precip-Weighted Weekly Load Rates (T/wk)
TP Load = 23
week 30
TP Load Rates (T/week)
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 totx10
TP Load all data
TP Load TP < 5
TP Load TP <=1

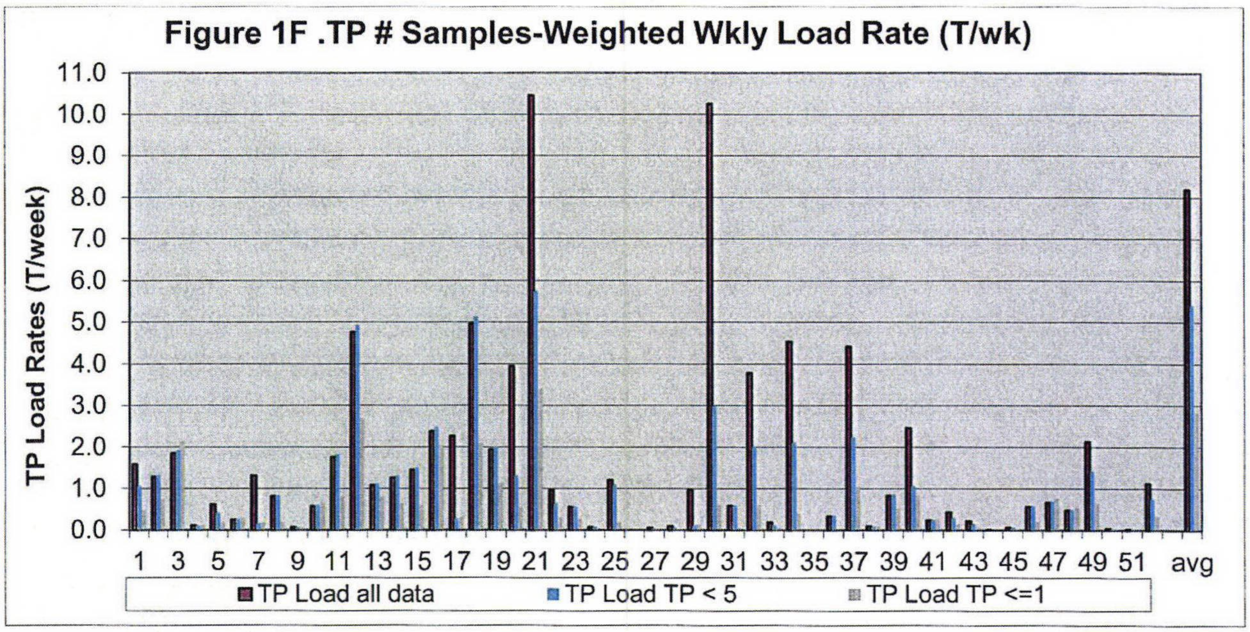


Figure 1F .TP # Samples-Weighted Wkly Load Rate (T/wk)
TP Load Rates (T/week)
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 avg
TP Load all data
TP Load TP < 5
TP Load TP <=1

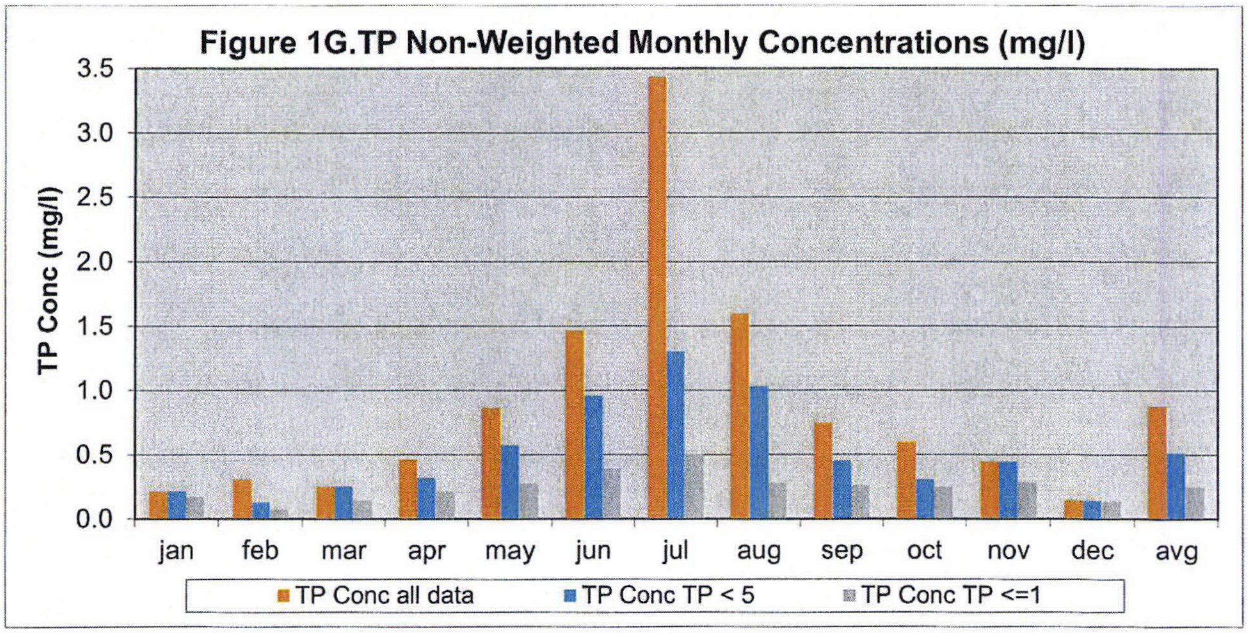


Figure 1G.TP Non-Weighted Monthly Concentrations (mg/l)
TP Conc (mg/l)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
jan
feb
mar
apr
may
jun
jul
aug
sep
oct
nov
dec
avg
TP Conc all data
TP Conc TP < 5
TP Conc TP <=1

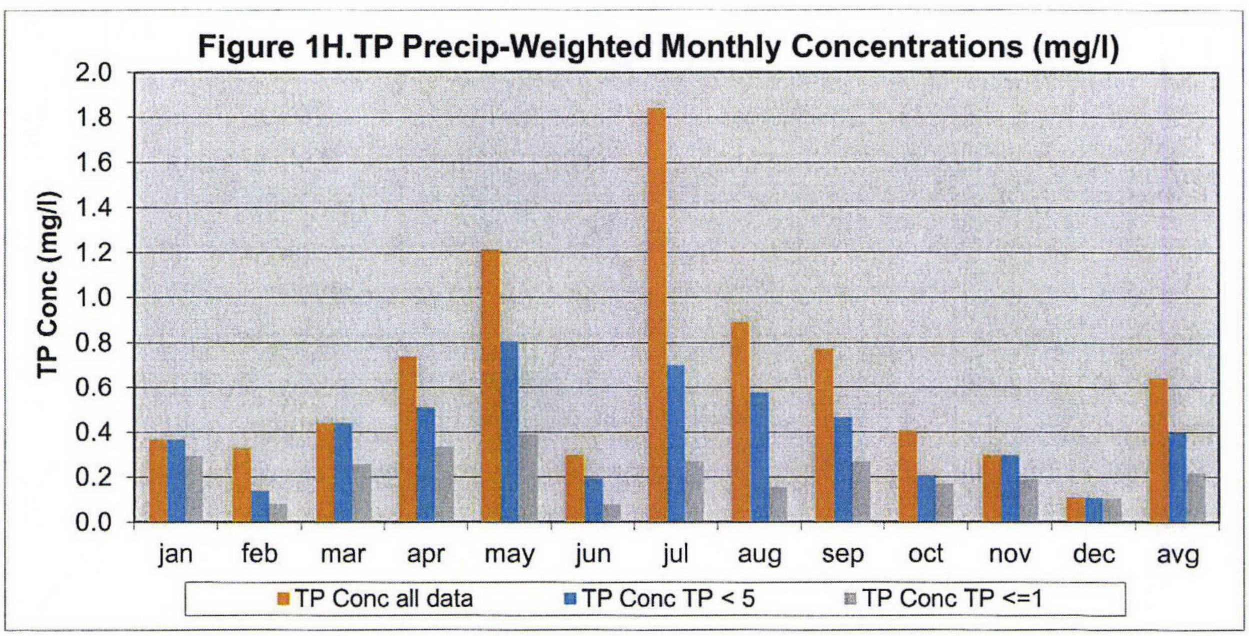


Figure 1H.TP Precip-Weighted Monthly Concentrations (mg/l)
TP Conc (mg/l)
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
jan
feb
mar
apr
may
jun
jul
aug
sep
oct
nov
dec
avg
TP Conc all data
TP Conc TP < 5
TP Conc TP <=1

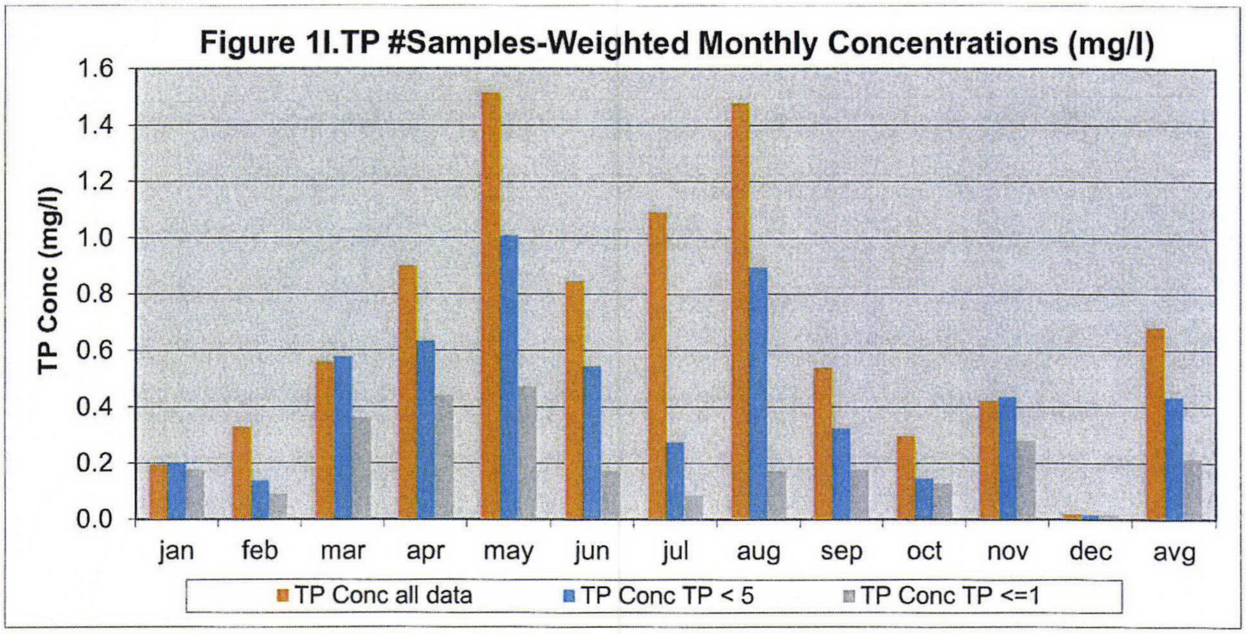


Figure 1I.TP #Samples-Weighted Monthly Concentrations (mg/l)
TP Conc (mg/l)
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
jan
feb
mar
apr
may
jun
jul
aug
sep
oct
nov
dec
avg
TP Conc all data
TP Conc TP < 5
TP Conc TP <=1

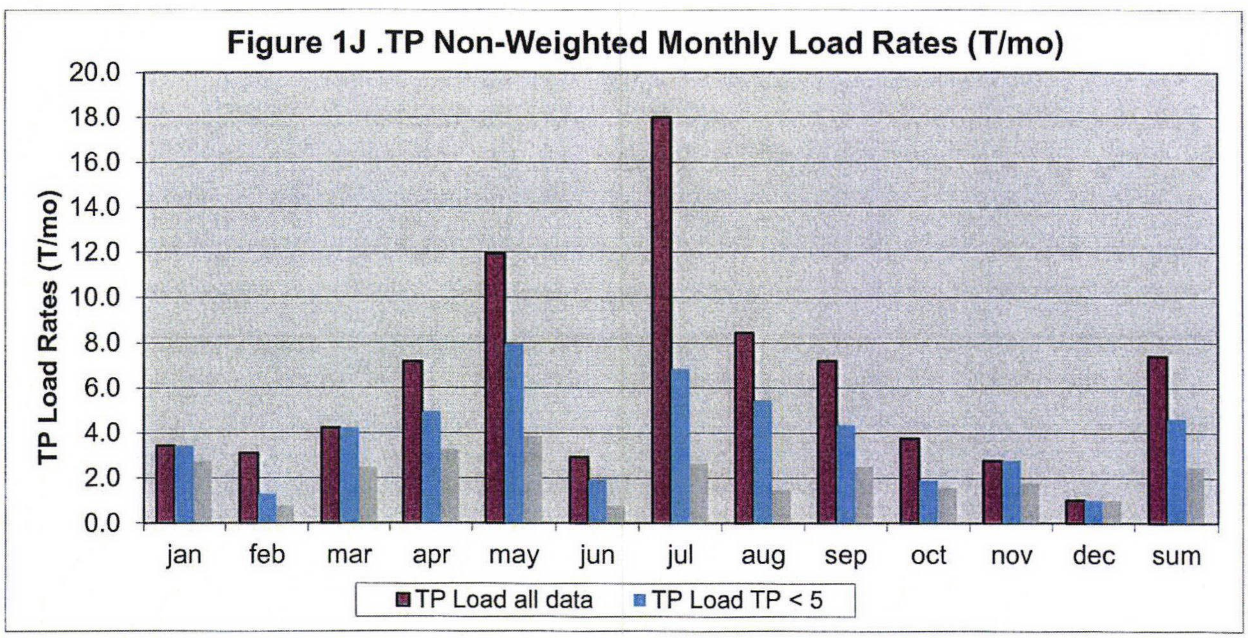


Figure 1J .TP Non-Weighted Monthly Load Rates (T/mo)
TP Load Rates (T/mo)
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
jan
feb
mar
apr
may
jun
jul
aug
sep
oct
nov
dec
sum
TP Load all data
TP Load TP < 5

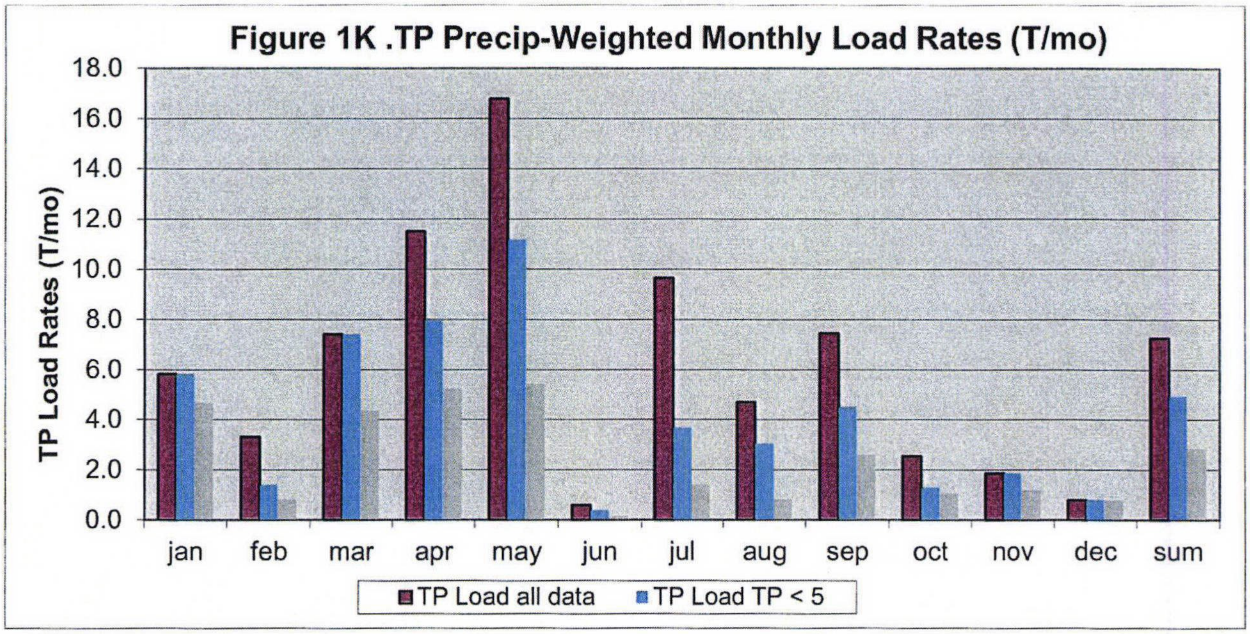


Figure 1K .TP Precip-Weighted Monthly Load Rates (T/mo)
TP Load Rates (T/mo)
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
jan feb mar apr may jun jul aug sep oct nov dec sum
TP Load all data
TP Load TP < 5

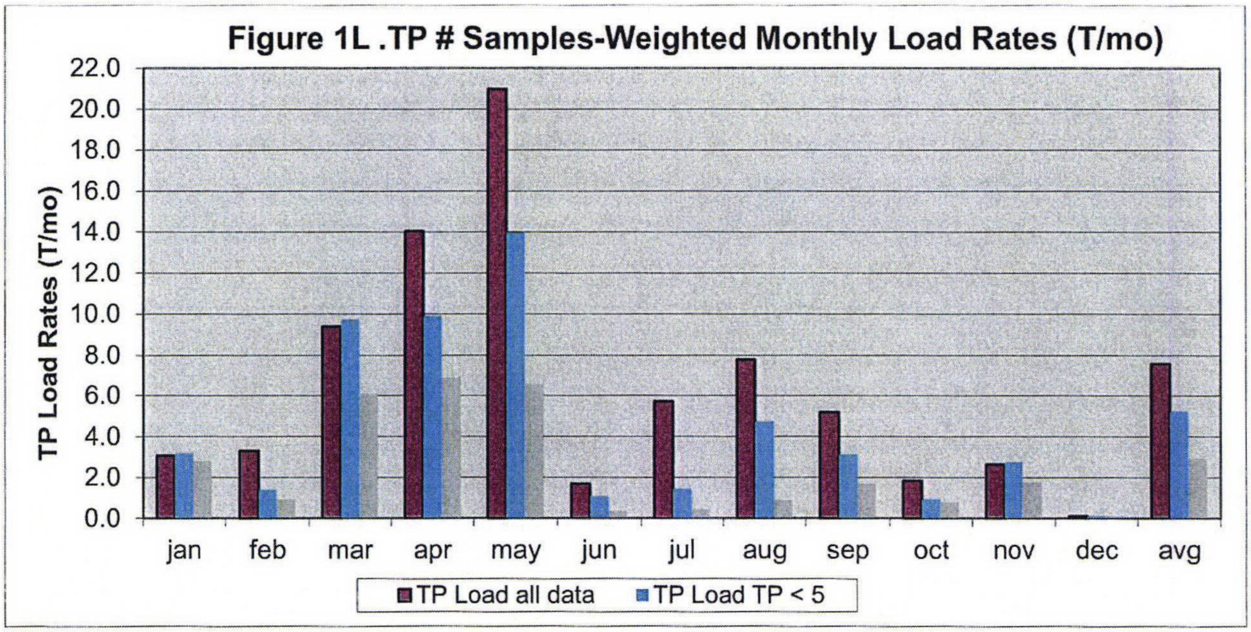


Figure 1L .TP # Samples-Weighted Monthly Load Rates (T/mo)
TP Load Rates (T/mo)
22.0
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
jan feb mar apr may jun jul aug sep oct nov dec avg
TP Load all data
TP Load TP < 5

TN Analysis: I also used Dr. Gay's suggested first method with TN weekly data for each year. First I looked at not weighting. But, there are too many weeks without sampling data. In total, during those 3 years, I sampled 53 weeks. I also sampled 7 weeks in 2016 and 7 weeks in 2020. But the weekly sampling for each year isn't good enough for total annual fluxes each year.

AGAIN, FEEL FREE TO SKIP ALL THIS AND GO TO SUMMARY TABLE 1-TN PAGE 34.

When I combine all 3 years and look at each week, there are only 2 weeks without precip, 50 with precip, over the 3 years. I sampled 39 of the weeks with precip, so there are only 11 weeks without samples over the 3-yr period. There are 39 of the 50 weeks with precip with sampling and therefore TN load rate data. See Table 1J.

The non-weighted TN concentration averages for those 39 weeks are:
all TN data = 3.003 mg/l and TN < 10 mg/l = 2.310 mg/l.
And the total TN load rates for those 39 weeks are (I have the calcs):
all TN data = 283.4 T/yr and TN < 10 mg/l = 211.7 T/yr.

In order to fill in the 11 weeks of missing samples, I substituted in these 39-week averages for the missing weeks. The non-weighted TN concentration average for all 50 weeks with precip are the same (of course, I used the averages), but the TN load rates for the 50 weeks are higher because there are 11 more weeks of load rates. See Table 1K.

The non-weighted TN concentration averages for those 50 weeks are:
all TN data = 3.003 mg/l and TN < 10 mg/l = 2.310 mg/l.
And the total TN load rates for those 50 weeks are:
all TN data = 309.7 T/yr and TN < 10 mg/l = 231.9 T/yr.

Next, I used Dr. Gay's suggested second method which is to determine the precip weighted TN conc for the year or for season/month/week/etc. Again, there are too many weeks without sampling data to apply this method each year. However, again, when I combine all 3 years and look at each week, there are only 11 weeks without samples. So I adjusted the 39 (50 – 11) values of the 3-yr avg actual TN concentrations using the precip weighted method.

The 2017-2019 3-yr average annual precip at Utah Lake is 11.7 inches. The avg weekly precip is 11.7 / 52 = 0.225 inches. I divided each actual weekly precip by this avg weekly of 0.225 to determine the weighting factor. I multiplied the actual weekly TN concentrations by the weighting factors to determine the precip weighted concentrations.

For example, the 3rd week "TN all data" 3-yr avg precip was 0.857 inches and the weighting factor is 0.857 / 0.225 = 3.809. The 3rd week actual TN concentration is 0.876 mg/l and when multiplied by the weighting factor of 3.809, the precip weighted TN conc is 3.34 mg/l and about 4 times higher. This procedure gives 39 of the 50 weeks with precip weighted TN conc values which are used to determine the 39 weekly load rates. See Table 1J.

TABLE 1J

week	all data number samples per week	TN<10 number samples per week	3-yr avg Utah Lake avg precip (in) weekly	3-yr avg monthly lake area (acre) weekly	*not weighted* all data TP conc (mg/l)	*not weighted* TN<10 conc (mg/l)	all data load x1.133E-4 (T/yr)	TN<10 load x1.133E-4 (T/yr)	*precip weighted* all data TP conc (mg/l)	*precip weighted* TN<10 conc (mg/l)	all data load x1.133E-4 (T/yr)	TN<10 load x1.133E-4 (T/yr)
1	1	1	0.243	84290	0.720	0.720	1.671	1.671	0.780	0.780	1.809	1.809
2	10	10	0.467	84290	3.369	3.369	15.026	15.026	7.011	7.011	31.271	31.271
3	8	8	0.857	84290	0.876	0.876	7.170	7.170	3.345	3.345	27.382	27.382
4	8	8	0.093	84290	1.425	1.425	1.266	1.266	0.591	0.591	0.525	0.525
5			0.093	85722			0.000	0.000			0.000	0.000
6	11	11	0.360	85722	1.491	1.491	5.213	5.213	2.392	2.392	8.364	8.364
7	7	7	0.190	85722	2.225	2.225	4.106	4.106	1.884	1.884	3.477	3.477
8	12	11	0.360	85722	3.334	1.419	11.658	4.962	5.349	2.276	18.702	7.960
9	7	7	0.127	86916	2.467	2.467	3.086	3.086	1.396	1.396	1.746	1.746
10	11	11	0.297	86916	1.709	1.709	4.999	4.999	2.262	2.262	6.616	6.616
11	16	16	0.333	86916	1.756	1.756	5.759	5.759	2.606	2.606	8.546	8.546
12	24	24	0.633	86916	1.543	1.543	9.619	9.619	4.353	4.353	27.133	27.133
13	25	25	0.343	86916	1.819	1.819	6.144	6.144	2.780	2.780	9.392	9.392
14	17	17	0.227	88108	2.439	2.439	5.527	5.527	2.467	2.467	5.591	5.591
15	7	7	0.490	88108	1.957	1.957	9.573	9.573	4.273	4.273	20.904	20.904
16	27	27	0.360	88108	2.067	2.067	7.429	7.429	3.316	3.316	11.918	11.918
17	8	8	0.213	88108	2.204	2.204	4.687	4.687	2.092	2.092	4.448	4.448
18	22	22	0.337	89258	2.255	2.255	7.686	7.686	3.386	3.386	11.542	11.542
19	16	16	0.313	89258	1.631	1.631	5.163	5.163	2.275	2.275	7.201	7.201
20	7	7	0.317	89258	3.614	3.614	11.586	11.586	5.105	5.105	16.367	16.367
21	21	20	0.527	89258	2.991	1.543	15.942	8.224	7.024	3.624	37.438	19.313
22			0.140	89258			0.000	0.000			0.000	0.000
23	9	9	0.117	89675	2.444	2.444	2.905	2.905	1.274	1.274	1.515	1.515
24	3	3	0.017	89675	6.457	6.457	1.115	1.115	0.489	0.489	0.084	0.084
25	7	6	0.063	89675	4.709	3.777	3.014	2.418	1.322	1.060	0.846	0.679
26			0.000	89675								
27			0.007	88589			0.000	0.000			0.000	0.000
28			0.013	88589			0.000	0.000			0.000	0.000
29	3	2	0.117	88589	4.703	1.155	5.523	1.356	2.452	0.602	2.880	0.707
30	5	4	0.377	88589	7.348	3.285	27.806	12.431	12.345	5.519	46.715	20.884
31	6	6	0.077	85869	3.700	3.700	2.772	2.772	1.270	1.270	0.951	0.951
32	11	9	0.227	85869	5.464	3.178	12.068	7.019	5.527	3.215	12.207	7.100
33			0.027	85869			0.000	0.000			0.000	0.000
34	11	9	0.223	85869	10.909	4.056	23.669	8.800	10.841	4.031	23.521	8.745
35			0.000	85869								
36	1	1	0.160	84478	6.700	6.700	10.261	10.261	4.777	4.777	7.316	7.316
37	14	14	0.323	84478	1.504	1.504	4.650	4.650	2.165	2.165	6.693	6.693
38	1	1	0.203	84478	1.210	1.210	2.351	2.351	1.095	1.095	2.127	2.127
39	7	7	0.323	84478	2.009	2.009	6.211	6.211	2.892	2.892	8.940	8.940
40	9	6	0.303	83893	7.467	1.483	21.507	4.271	10.082	2.002	29.039	5.767
41	9	9	0.257	83893	1.156	1.156	2.824	2.824	1.324	1.324	3.234	3.234
42			0.067	83893			0.000	0.000			0.000	0.000
43			0.033	83893			0.000	0.000			0.000	0.000
44			0.023	84975			0.000	0.000			0.000	0.000
45	1	1	0.013	84975	3.306	3.306	0.414	0.414	0.192	0.192	0.024	0.024
46	9	9	0.103	84975	2.344	2.344	2.325	2.325	1.076	1.076	1.067	1.067
47	7	7	0.320	84975	2.471	2.471	7.613	7.613	3.524	3.524	10.856	10.856
48	7	7	0.350	84975	0.714	0.714	2.406	2.406	1.114	1.114	3.753	3.753
49			0.323	85476			0.000	0.000			0.000	0.000
50	2	2	0.110	85476	0.625	0.625	0.666	0.666	0.306	0.306	0.326	0.326
51			0.003	85476			0.000	0.000			0.000	0.000
52			0.170	85476			0.000	0.000			0.000	0.000
total/avg	387	375	11.669	86462	3.003	2.310	283.410	211.705	3.301	2.465	422.467	322.275

TABLE 1K

week	all data number samples per week	TN<10 number samples per week	3-yr avg Utah Lake avg precip (in) weekly	3-yr avg monthly lake area (acre) weekly	*not weighted* all data TP conc (mg/l)	TN<10 conc (mg/l)	all data load x1.133E-4 (T/yr)	TN<10 load x1.133E-4 (T/yr)	*precip weighted* all data TP conc (mg/l)	TN<10 conc (mg/l)	all data load x1.133E-4 (T/yr)	TP < 5 load x1.133E-4 (T/yr)
1	1	1	0.243	84290	0.720	0.720	1.671	1.671	0.780	0.780	1.809	1.809
2	10	10	0.467	84290	3.369	3.369	15.026	15.026	7.011	7.011	31.271	31.271
3	8	8	0.857	84290	0.876	0.876	7.170	7.170	3.345	3.345	27.382	27.382
4	8	8	0.093	84290	1.425	1.425	1.266	1.266	0.591	0.591	0.525	0.525
5			0.093	85722	3.003	2.310	2.713	2.087	3.301	2.465	2.982	2.227
6	11	11	0.360	85722	1.491	1.491	5.213	5.213	2.392	2.392	8.364	8.364
7	7	7	0.190	85722	2.225	2.225	4.106	4.106	1.884	1.884	3.477	3.477
8	12	11	0.360	85722	3.334	1.419	11.658	4.962	5.349	2.276	18.702	7.960
9	7	7	0.127	86916	2.467	2.467	3.086	3.086	1.396	1.396	1.746	1.746
10	11	11	0.297	86916	1.709	1.709	4.999	4.999	2.262	2.262	6.616	6.616
11	16	16	0.333	86916	1.756	1.756	5.759	5.759	2.606	2.606	8.546	8.546
12	24	24	0.633	86916	1.543	1.543	9.619	9.619	4.353	4.353	27.133	27.133
13	25	25	0.343	86916	1.819	1.819	6.144	6.144	2.780	2.780	9.392	9.392
14	17	17	0.227	88108	2.439	2.439	5.527	5.527	2.467	2.467	5.591	5.591
15	7	7	0.490	88108	1.957	1.957	9.573	9.573	4.273	4.273	20.904	20.904
16	27	27	0.360	88108	2.067	2.067	7.429	7.429	3.316	3.316	11.918	11.918
17	8	8	0.213	88108	2.204	2.204	4.687	4.687	2.092	2.092	4.448	4.448
18	22	22	0.337	89258	2.255	2.255	7.686	7.686	3.386	3.386	11.542	11.542
19	16	16	0.313	89258	1.631	1.631	5.163	5.163	2.275	2.275	7.201	7.201
20	7	7	0.317	89258	3.614	3.614	11.586	11.586	5.105	5.105	16.367	16.367
21	21	20	0.527	89258	2.991	1.543	15.942	8.224	7.024	3.624	37.438	19.313
22			0.140	89258	3.003	2.310	4.252	3.271	3.301	2.465	4.674	3.490
23	9	9	0.117	89675	2.444	2.444	2.905	2.905	1.274	1.274	1.515	1.515
24	3	3	0.017	89675	6.457	6.457	1.115	1.115	0.489	0.489	0.084	0.084
25	7	6	0.063	89675	4.709	3.777	3.014	2.418	1.322	1.060	0.846	0.679
26			0.000	89675								
27			0.007	88589	3.003	2.310	0.211	0.162	3.301	2.465	0.232	0.173
28			0.013	88589	3.003	2.310	0.392	0.301	3.301	2.465	0.431	0.322
29	3	2	0.117	88589	4.703	1.155	5.523	1.356	2.452	0.602	2.880	0.707
30	5	4	0.377	88589	7.348	3.285	27.806	12.431	12.345	5.519	46.715	20.884
31	6	6	0.077	85869	3.700	3.700	2.772	2.772	1.270	1.270	0.951	0.951
32	11	9	0.227	85869	5.464	3.178	12.068	7.019	5.527	3.215	12.207	7.100
33			0.027	85869	3.003	2.310	0.789	0.607	3.301	2.465	0.867	0.648
34	11	9	0.223	85869	10.909	4.056	23.669	8.800	10.841	4.031	23.521	8.745
35			0.000	85869								
36	1	1	0.160	84478	6.700	6.700	10.261	10.261	4.777	4.777	7.316	7.316
37	14	14	0.323	84478	1.504	1.504	4.650	4.650	2.165	2.165	6.693	6.693
38	1	1	0.203	84478	1.210	1.210	2.351	2.351	1.095	1.095	2.127	2.127
39	7	7	0.323	84478	2.009	2.009	6.211	6.211	2.892	2.892	8.940	8.940
40	9	6	0.303	83893	7.467	1.483	21.507	4.271	10.082	2.002	29.039	5.767
41	9	9	0.257	83893	1.156	1.156	2.824	2.824	1.324	1.324	3.234	3.234
42			0.067	83893	3.003	2.310	1.913	1.471	3.301	2.465	2.102	1.570
43			0.033	83893	3.003	2.310	0.942	0.725	3.301	2.465	1.035	0.773
44			0.023	84975	3.003	2.310	0.665	0.512	3.301	2.465	0.731	0.546
45	1	1	0.013	84975	3.306	3.306	0.414	0.414	0.192	0.192	0.024	0.024
46	9	9	0.103	84975	2.344	2.344	2.325	2.325	1.076	1.076	1.067	1.067
47	7	7	0.320	84975	2.471	2.471	7.613	7.613	3.524	3.524	10.856	10.856
48	7	7	0.350	84975	0.714	0.714	2.406	2.406	1.114	1.114	3.753	3.753
49			0.323	85476	3.003	2.310	9.394	7.226	3.301	2.465	10.326	7.711
50	2	2	0.110	85476	0.625	0.625	0.666	0.666	0.306	0.306	0.326	0.326
51			0.003	85476	3.003	2.310	0.087	0.067	3.301	2.465	0.096	0.072
52			0.170	85476	3.003	2.310	4.944	3.803	3.301	2.465	5.435	4.059
total/avg	387	375	11.669	86462	3.003	2.310	309.712	231.937	3.301	2.465	451.379	343.865

The precip weighted TN concentration for those 39 weeks are:
all TN data = 3.301 mg/l and TN < 10 mg/l = 2.465 mg/l.
And the total TN load rates for those 39 weeks are:
all TN data = 422.5 T/yr and TN < 10 mg/l = 322.3 T/yr.

The precip weighted conc averages are about the same, little higher, as non-weighted, but the load rates are higher, much higher. The precip weighting has increased the load rates when the weekly precip is high and the resulting weighting factor is high. Continuing the example above, the 3rd week non-weighted load rate is 7.17 T/yr and when multiplied by the weighting factor of 3.809, the weighted TN load rate is 27.3 T/yr.

As described above, I substituted in these 39-week averages for the missing 11 weeks. The precip weighted TN concentration average for all 50 weeks with precip are the same, of course, but the precip weighted TN load rates for the 50 weeks are higher because there are 11 more weeks of load rates. See Table 1K.

The precip weighted TN concentration for those 50 weeks are:
all TN data = 3.301 mg/l and TN < 10 mg/l = 2.465 mg/l.
And the total TN load rates for those 50 weeks are:
all TN data = 451.4 T/yr and TN < 10 mg/l = 343.9 T/yr.

Based on Dr. Gay's suggestion to use a weighted average, I applied a "number of samples" weighted avg to the data. As with differences in precip each week, there are significant differences in number of samples each week, and these difference should be taken into account.

Again, there are too many weeks without sampling data to apply this method to each year. However, again, when I combine all 3 years and look at each week, there are only 11 weeks which have precip but without samples. So I adjusted the 39 values of the 3-yr avg actual TN concentrations using the "number of samples" weighted method.

This is different from the precip weighted method. There is only one avg 3-yr annual precip, but there are 3 different numbers of weekly samples. For "TN all data" there are 387 samples, and "TN < 10" has 375. The weekly avg number of samples for "TN all data" is 387 / 39 = 9.923, and the avg for "TN < 10" is 375 / 39 = 9.615.

I divided each weekly number of samples by the appropriate weekly avg to determine the weighting factors. I multiplied the actual weekly TN concentrations by the weighting factors to determine the "number of samples" weighted concentrations.

For example, the 16th week "TN all data" number of samples is 27 and the weighting factor is 27 / 9.923 = 2.721. The 16th week actual TN concentration is 2.067 mg/l and when multiplied by the weighting factor of 2.721, the "number of samples" weighted TN conc is 5.624 mg/l.

This procedure gives 39 of the 50 weeks with "number of samples" weighted TN conc values which are used to determine the 39 weekly load rates. See Table 1L.

The "number of samples" weighted TN concentration for those 39 weeks are:
all TN data = 2.809 mg/l and TN < 10 mg/l = 2.145 mg/l.
And the total TN load rates for those 39 weeks are:
all TN data = 313.7 T/yr and TN < 10 mg/l = 242.2 T/yr.

The "number of samples" weighted conc averages are lower than the non-weighted, but the load rates are about the same. Both the "number of samples" weighted conc averages and load rates are lower than the precip weighted. Continuing the example above, the 16th week non-weighted load rate is 7.429 T/yr and when multiplied by the weighting factor of 2.721, the "number of samples" weighted TN load rate is 20.214 T/yr.

As described above, I substituted in these 39-week "number of samples" weighted TN conc avgs for the 11 missing weeks. The "number of samples" weighted TN concentration average for all 50 weeks with precip are the same, of course, but the precip weighted TN load rates for the 50 weeks are higher because there are 11 more weeks of load rated. See Table 1M.

The "number of samples" weighted TN concentration for those 50 weeks are:
all TN data = 2.809 mg/l and TN < 10 mg/l = 2.145 mg/l.
And the total TN load rates for the 50 weeks are:
all TN data = 344.8 T/yr and TN < 10 mg/l = 265.9 T/yr.

I also used Dr. Gay's suggested first method using TN monthly data for each year. First I looked at not weighting. Again, there are too many months without samples and therefore without load rates. During the 3 years, I sampled during 26 months, albeit multiple times during some months.

However, when I combine all 3 years and look at each month, there are no months without precip. And there are no months that I didn't sample over the 3-yr period. So there are 12 months with precip and with sampling and therefore with load rate data. See Table 1N.

The non-weighted TN conc averages for the 12 months are:
all TN data = 3.082 mg/l and TN < 10 mg/l = 2.052 mg/l.
And the total TN load rates for those 12 months are:
all TN data = 293.3 T/yr and TN < 10 mg/l = 220.8 T/yr.

Next, again, I used Dr. Gay's suggested second method which is to estimate the precip weighted TN conc for the season/month/etc. Again, there are too many months without sampling data to apply this method to each year. However, again, when I combine all 3 years and look at each month, there are no months without samples. So I adjusted the 12 values of the 3-yr avg actual TN concentrations using the precip weighted method.

week	TABLE 1L all data number samples per week	TN<10 number samples per week	3-yr avg Utah Lake avg precip (in) weekly	3-yr avg monthly lake area (acre) weekly	*not weighted* all data TP conc (mg/l)	TN<10 conc (mg/l)	all data load x1.133E-4 (T/yr)	TN<10 load x1.133E-4 (T/yr)	*# samples weighted* all data TP conc (mg/l)	TN<10 conc (mg/l)	all data load x1.133E-4 (T/yr)	TN<10 load x1.133E-4 (T/yr)
1	1	1	0.243	84290	0.720	0.720	1.671	1.671			0.000	0.000
2	10	10	0.467	84290	3.369	3.369	15.026	15.026	3.395	3.504	15.143	15.627
3	8	8	0.857	84290	0.876	0.876	7.170	7.170	0.706	0.729	5.780	5.965
4	8	8	0.093	84290	1.425	1.425	1.266	1.266	1.149	1.186	1.020	1.053
5			0.093	85722			0.000	0.000			0.000	0.000
6	11	11	0.360	85722	1.491	1.491	5.213	5.213	1.653	1.706	5.779	5.964
7	7	7	0.190	85722	2.225	2.225	4.106	4.106	1.570	1.620	2.897	2.989
8	12	11	0.360	85722	3.334	1.419	11.658	4.962	4.032	1.623	14.098	5.676
9	7	7	0.127	86916	2.467	2.467	3.086	3.086	1.740	1.796	2.177	2.246
10	11	11	0.297	86916	1.709	1.709	4.999	4.999	1.894	1.955	5.541	5.718
11	16	16	0.333	86916	1.756	1.756	5.759	5.759	2.831	2.922	9.285	9.582
12	24	24	0.633	86916	1.543	1.543	9.619	9.619	3.732	3.851	23.264	24.009
13	25	25	0.343	86916	1.819	1.819	6.144	6.144	4.583	4.729	15.480	15.976
14	17	17	0.227	88108	2.439	2.439	5.527	5.527	4.178	4.312	9.469	9.772
15	7	7	0.490	88108	1.957	1.957	9.573	9.573	1.381	1.425	6.753	6.969
16	27	27	0.360	88108	2.067	2.067	7.429	7.429	5.624	5.804	20.213	20.860
17	8	8	0.213	88108	2.204	2.204	4.687	4.687	1.777	1.834	3.778	3.899
18	22	22	0.337	89258	2.255	2.255	7.686	7.686	4.999	5.159	17.039	17.585
19	16	16	0.313	89258	1.631	1.631	5.163	5.163	2.630	2.714	8.325	8.591
20	7	7	0.317	89258	3.614	3.614	11.586	11.586	2.549	2.631	8.173	8.435
21	21	20	0.527	89258	2.991	1.543	15.942	8.224	6.330	3.209	33.737	17.106
22			0.140	89258			0.000	0.000			0.000	0.000
23	9	9	0.117	89675	2.444	2.444	2.905	2.905	2.217	2.288	2.635	2.720
24	3	3	0.017	89675	6.457	6.457	1.115	1.115	1.952	2.015	0.337	0.348
25	7	6	0.063	89675	4.709	3.777	3.014	2.418	3.322	2.357	2.126	1.509
26			0.000	89675								
27			0.007	88589			0.000	0.000			0.000	0.000
28			0.013	88589			0.000	0.000			0.000	0.000
29	3	2	0.117	88589	4.703	1.155	5.523	1.356	1.422	0.240	1.670	0.282
30	5	4	0.377	88589	7.348	3.285	27.806	12.431	3.702	1.367	14.011	5.171
31	6	6	0.077	85869	3.700	3.700	2.772	2.772	2.237	2.309	1.676	1.730
32	11	9	0.227	85869	5.464	3.178	12.068	7.019	6.057	2.975	13.377	6.570
33			0.027	85869			0.000	0.000			0.000	0.000
34	11	9	0.223	85869	10.909	4.056	23.669	8.800	12.093	3.796	26.238	8.237
35			0.000	85869								
36	1	1	0.160	84478	6.700	6.700	10.261	10.261	0.675	0.697	1.034	1.067
37	14	14	0.323	84478	1.504	1.504	4.650	4.650	2.122	2.190	6.560	6.770
38	1	1	0.203	84478	1.210	1.210	2.351	2.351	0.122	0.126	0.237	0.245
39	7	7	0.323	84478	2.009	2.009	6.211	6.211	1.417	1.463	4.382	4.522
40	9	6	0.303	83893	7.467	1.483	21.507	4.271	6.772	0.925	19.506	2.665
41	9	9	0.257	83893	1.156	1.156	2.824	2.824	1.048	1.082	2.561	2.643
42			0.067	83893			0.000	0.000			0.000	0.000
43			0.033	83893			0.000	0.000			0.000	0.000
44			0.023	84975			0.000	0.000			0.000	0.000
45	1	1	0.013	84975	3.306	3.306	0.414	0.414	0.333	0.344	0.042	0.043
46	9	9	0.103	84975	2.344	2.344	2.325	2.325	2.126	2.194	2.108	2.176
47	7	7	0.320	84975	2.471	2.471	7.613	7.613	1.743	1.799	5.371	5.542
48	7	7	0.350	84975	0.714	0.714	2.406	2.406	0.504	0.520	1.697	1.752
49			0.323	85476			0.000	0.000			0.000	0.000
50	2	2	0.110	85476	0.625	0.625	0.666	0.666	0.126	0.130	0.134	0.138
51			0.003	85476			0.000	0.000			0.000	0.000
52			0.170	85476			0.000	0.000			0.000	0.000
total/avg	387	375	11.669	86462	3.003	2.310	283.410	211.705	2.809	2.145	313.656	242.154

TABLE 1M

week	all data number samples per week	TN<10 number samples per week	3-yr avg Utah Lake avg precip (in) weekly	3-yr avg monthly lake area (acre) weekly	***not weighted*** all data TP conc (mg/l)	TN<10 conc (mg/l)	all data load x1.133E-4 (T/yr)	TN<10 load x1.133E-4 (T/yr)	***# samples weighted*** all data TP conc (mg/l)	TN<10 conc (mg/l)	all data load x1.133E-4 (T/yr)	TP < 5 load x1.133E-4 (T/yr)
1	1	1	0.243	84290	0.720	0.720	1.671	1.671	2.809	2.145	6.519	4.978
2	10	10	0.467	84290	3.369	3.369	15.026	15.026	3.395	3.504	15.143	15.627
3	8	8	0.857	84290	0.876	0.876	7.170	7.170	0.706	0.729	5.780	5.965
4	8	8	0.093	84290	1.425	1.425	1.266	1.266	1.149	1.186	1.020	1.053
5			0.093	85722	3.003	2.310	2.713	2.087	2.809	2.145	2.537	1.938
6	11	11	0.360	85722	1.491	1.491	5.213	5.213	1.653	1.706	5.779	5.964
7	7	7	0.190	85722	2.225	2.225	4.106	4.106	1.570	1.620	2.897	2.989
8	12	11	0.360	85722	3.334	1.419	11.658	4.962	4.032	1.623	14.098	5.676
9	7	7	0.127	86916	2.467	2.467	3.086	3.086	1.740	1.796	2.177	2.246
10	11	11	0.297	86916	1.709	1.709	4.999	4.999	1.894	1.955	5.541	5.718
11	16	16	0.333	86916	1.756	1.756	5.759	5.759	2.831	2.922	9.285	9.582
12	24	24	0.633	86916	1.543	1.543	9.619	9.619	3.732	3.851	23.264	24.009
13	25	25	0.343	86916	1.819	1.819	6.144	6.144	4.583	4.729	15.480	15.976
14	17	17	0.227	88108	2.439	2.439	5.527	5.527	4.178	4.312	9.469	9.772
15	7	7	0.490	88108	1.957	1.957	9.573	9.573	1.381	1.425	6.753	6.969
16	27	27	0.360	88108	2.067	2.067	7.429	7.429	5.624	5.804	20.213	20.860
17	8	8	0.213	88108	2.204	2.204	4.687	4.687	1.777	1.834	3.778	3.899
18	22	22	0.337	89258	2.255	2.255	7.686	7.686	4.999	5.159	17.039	17.585
19	16	16	0.313	89258	1.631	1.631	5.163	5.163	2.630	2.714	8.325	8.591
20	7	7	0.317	89258	3.614	3.614	11.586	11.586	2.549	2.631	8.173	8.435
21	21	20	0.527	89258	2.991	1.543	15.942	8.224	6.330	3.209	33.737	17.106
22			0.140	89258	3.003	2.310	4.252	3.271	2.809	2.145	3.977	3.037
23	9	9	0.117	89675	2.444	2.444	2.905	2.905	2.217	2.288	2.635	2.720
24	3	3	0.017	89675	6.457	6.457	1.115	1.115	1.952	2.015	0.337	0.348
25	7	6	0.063	89675	4.709	3.777	3.014	2.418	3.322	2.357	2.126	1.509
26			0.000	89675								
27			0.007	88589	3.003	2.310	0.211	0.162	2.809	2.145	0.197	0.151
28			0.013	88589	3.003	2.310	0.392	0.301	2.809	2.145	0.367	0.280
29	3	2	0.117	88589	4.703	1.155	5.523	1.356	1.422	0.240	1.670	0.282
30	5	4	0.377	88589	7.348	3.285	27.806	12.431	3.702	1.367	14.011	5.171
31	6	6	0.077	85869	3.700	3.700	2.772	2.772	2.237	2.309	1.676	1.730
32	11	9	0.227	85869	5.464	3.178	12.068	7.019	6.057	2.975	13.377	6.570
33			0.027	85869	3.003	2.310	0.789	0.607	2.809	2.145	0.738	0.563
34	11	9	0.223	85869	10.909	4.056	23.669	8.800	12.093	3.796	26.238	8.237
35			0.000	85869								
36	1	1	0.160	84478	6.700	6.700	10.261	10.261	0.675	0.697	1.034	1.067
37	14	14	0.323	84478	1.504	1.504	4.650	4.650	2.122	2.190	6.560	6.770
38	1	1	0.203	84478	1.210	1.210	2.351	2.351	0.122	0.126	0.237	0.245
39	7	7	0.323	84478	2.009	2.009	6.211	6.211	1.417	1.463	4.382	4.522
40	9	6	0.303	83893	7.467	1.483	21.507	4.271	6.772	0.925	19.506	2.665
41	9	9	0.257	83893	1.156	1.156	2.824	2.824	1.048	1.082	2.561	2.643
42			0.067	83893	3.003	2.310	1.913	1.471	2.809	2.145	1.789	1.366
43			0.033	83893	3.003	2.310	0.942	0.725	2.809	2.145	0.881	0.673
44			0.023	84975	3.003	2.310	0.665	0.512	2.809	2.145	0.622	0.475
45	1	1	0.013	84975	3.306	3.306	0.414	0.414	0.333	0.344	0.042	0.043
46	9	9	0.103	84975	2.344	2.344	2.325	2.325	2.126	2.194	2.108	2.176
47	7	7	0.320	84975	2.471	2.471	7.613	7.613	1.743	1.799	5.371	5.542
48	7	7	0.350	84975	0.714	0.714	2.406	2.406	0.504	0.520	1.697	1.752
49			0.323	85476	3.003	2.310	9.394	7.226	2.809	2.145	8.787	6.710
50	2	2	0.110	85476	0.625	0.625	0.666	0.666	0.126	0.130	0.134	0.138
51			0.003	85476	3.003	2.310	0.087	0.067	2.809	2.145	0.082	0.062
52			0.170	85476	3.003	2.310	4.944	3.803	2.809	2.145	4.625	3.532
total/avg	387	375	11.669	86462	3.003	2.310	309.712	231.937	2.809	2.145	344.778	265.919

TABLE 1N

month	all TNdata number samples per mo	TN<10 number samples per mo	3-yr avg Utah Lake avg precip (in) monthly	3-yr avg monthly lake area (acre) monthly	*not weighted* all data TP conc (mg/l)	*not weighted* TN<10 conc (mg/l)	all data load x1.133E-4 (T/yr)	TN<10 load x1.133E-4 (T/yr)	**precip weighted** all data TP conc (mg/l)	**precip weighted** TN<10 conc (mg/l)	all data load x1.133E-4 (T/yr)	TN<10 load x1.133E-4 (T/yr)
jan	28	28	1.660	84290	1.918	1.918	30.408	30.408	3.265	3.265	51.763	51.763
feb	37	36	1.043	85722	2.451	1.841	24.830	18.650	2.621	1.969	26.557	19.948
mar	79	79	1.710	86916	1.691	1.691	28.477	28.477	2.965	2.965	49.936	49.936
apr	67	67	1.567	88108	2.093	2.093	32.742	32.742	3.363	3.363	52.614	52.614
may	59	58	1.373	89258	2.631	2.100	36.534	29.160	3.704	2.957	51.438	41.057
jun	19	17	0.197	89675	3.912	2.943	7.831	5.891	0.790	0.595	1.582	1.190
jul	8	6	0.523	88589	6.356	2.575	33.367	13.518	3.409	1.381	17.895	7.250
aug	29	25	0.543	85869	7.207	3.760	38.076	19.865	4.013	2.094	21.202	11.061
sep	22	22	1.010	84478	1.651	1.651	15.961	15.961	1.710	1.710	16.531	16.531
oct	18	15	0.660	83893	4.311	1.287	27.046	8.074	2.918	0.871	18.305	5.465
nov	28	28	0.653	84975	2.140	2.140	13.455	13.455	1.433	1.433	9.010	9.010
dec	2	2	0.763	85476	0.625	0.625	4.619	4.619	0.489	0.489	3.614	3.614
sum/avg	396	383	11.702	86437	3.082	2.052	293.345	220.820	2.557	1.924	320.446	269.437

The 2017-2019 average 3-yr annual precip at Utah Lake is 11.7 inches. The avg monthly precip is 11.7 / 12 = 0.975 inches. I divided each monthly precip by this avg of 0.975 to determine the weighting factor. I multiplied the actual monthly TN concentration values by the weighting factors to determine the precip weighted concentrations.

For example, the Jan 3-yr avg precip was 1.66 inches and the weighting factor is 1.66 / 0.975 = 1.7. The Jan actual TN concentration is 1.918 mg/l and when multiplied by the weighting factor of 1.7, the precip weighted TN conc is 3.26 mg/l. This procedure gives 12 months with precip weighted TN conc values which are used to find the 12 monthly load rates. See Table 1N.

The precip weighted TN concentrations for those 12 months are:
all TN data = 2.557 mg/l and TN < 10 mg/l = 1.924 mg/l.
And the total TN load rates for those 12 months are:
all TN data = 320.4 T/yr and TN < 10 mg/l = 269.4 T/yr.

The precip weighted conc averages are lower than the non-weighted, but the load rates are about the same, little higher. Continuing the example above, the Jan non-weighted load rate is 30.408 T/yr and when multiplied by the weighting factor of 1.7, the weighted TN load rate is 51.7 T/yr.

Based on Dr. Gay's suggestion to use a weighted average, I applied a "number of samples" weighted avg to the monthly data. As with differences in precip each month, there are significant differences in number of samples each month, and these difference should be taken into account.

Again, there are too many months without sampling data to apply this method to each year. However, again, when I combine all 3 years and look at each month, there are no months without precip and without samples. So I adjusted the 12 values of the 3-yr avg actual TN concentrations using the "number of samples" weighted method.

This is different. There is only one avg 3-yr annual precip, but different numbers of monthly samples. For "TN all data" there are 396 samples and "TN < 10" has 383. The <u>average</u> monthly number of samples for "TN all data" is 396 / 12 = 33.00 and for "TN < 10" is 383 / 12 = 31.917.

I divided each monthly number of samples by each avg monthly number of samples to determine the weighting factor. I multiplied the actual monthly TN concentration values by the weighting factors to determine the "number of samples" weighted concentrations.

For example, March "TN all data" number of samples is 79 and the weighting factor is 79 / 33.00 = 2.394. The March actual TN conc is 1.691 mg/l and multiplied by the weighting factor 2.394, the "number of samples" weighted TN conc is 4.048 mg/l. This procedure gives 12 months with "number of samples" weighted TN conc's which are used to determine 12 monthly load rates.

Notice that for "TN < 10," the weighting factor is 79 / 31.917 = 2.475, TN conc is still 1.691 x 2.475 = "no. samples" weighted "TN < 10" conc of 4.186 which is larger than the "TN all data" conc of 4.048, and load rate is larger. The difference in no. of samples causes this. See Table 1O.

TABLE 10

month	all TNdata number samples per mo	TN<10 number samples per mo	3-yr avg Utah Lake avg precip (in) monthly	3-yr avg monthly lake area (acre) monthly	***not weighted*** all data TP conc (mg/l)	TN<10 conc (mg/l)	all data load x1.133E-4 (T/yr)	TN<10 load x1.133E-4 (T/yr)	***# samples weighted*** all data TP conc (mg/l)	TN<10 conc (mg/l)	all data load x1.133E-4 (T/yr)	TN<10 load x1.133E-4 (T/yr)
jan	28	28	1.660	84290	1.918	1.918	30.408	30.408	1.627	1.683	25.801	26.676
feb	37	36	1.043	85722	2.451	1.841	24.830	18.650	2.748	2.077	27.840	21.036
mar	79	79	1.710	86916	1.691	1.691	28.477	28.477	4.048	4.186	68.172	70.486
apr	67	67	1.567	88108	2.093	2.093	32.742	32.742	4.249	4.394	66.477	68.733
may	59	58	1.373	89258	2.631	2.100	36.534	29.160	4.704	3.816	65.318	52.991
jun	19	17	0.197	89675	3.912	2.943	7.831	5.891	2.252	1.568	4.508	3.138
jul	8	6	0.523	88589	6.356	2.575	33.367	13.518	1.541	0.484	8.089	2.541
aug	29	25	0.543	85869	7.207	3.760	38.076	19.865	6.333	2.945	33.460	15.560
sep	22	22	1.010	84478	1.651	1.651	15.961	15.961	1.101	1.138	10.641	11.002
oct	18	15	0.660	83893	4.311	1.287	27.046	8.074	2.351	0.605	14.752	3.795
nov	28	28	0.653	84975	2.140	2.140	13.455	13.455	1.816	1.877	11.416	11.804
dec	2	2	0.763	85476	0.625	0.625	4.619	4.619	0.038	0.039	0.280	0.289
sum/avg	396	383	11.702	86437	3.082	2.052	293.345	220.820	2.734	2.068	336.755	288.052

The "number of samples" weighted TN concentration for those 12 months are:

all TN data = 2.734 mg/l and TN < 10 mg/l = 2.068 mg/l.

And the total TN load rates for those 12 months are:

all TN data = 336.8 T/yr and TN < 10 mg/l = 288.1 T/yr.

The "number of samples" weighted conc averages are lower or about the same as the non-weighted, but the load rates are a little higher. Both the "number of samples" weighted conc averages and load rates are about the same as the precip weighted. Continuing the example above, March non-weighted load rate is 28.477 T/yr and when multiplied by the weighting factor of 2.394, the "number of samples" weighted TN load rate is 68.17 T/yr.

A summary of the above results is given in Table 1-TN below. Also see 4 groups of figures, each with the 3 weightings of non-weighted, precip-weighted, and "number of samples" weighted. The 4 groups are: Figures 1M – 1O for weekly concentrations, Figures 1P – 1R for weekly load rates, Figures 1S – 1U for monthly concentrations, and Figures 1V – 1X for monthly load rates.

Summary Table 1-TN. TN Concentrations (mg/l) / Load Rate (T/yr)			
Weighting	**Week/Month**	**All TN data**	**TN < 10 mg/l**
No	39	3.003 / 283	2.310 / 212
No	50	3.003 / 310	2.310 / 232
Precipitation	39	3.301 / 423	2.465 / 322
Precipitation	50	3.301 / 451	2.465 / 344
Number of Samples	39	2.809 / 314	2.145 / 242
Number of Samples	50	2.809 / 345	2.145 / 266
No	12	3.082 / 293	2.052 / 221
Precipitation	12	2.557 / 320	1.924 / 269
Number of Samples	12	2.734 / 337	2.068 / 288

Here are some observations from the TN table above. "All data" weekly precip-weighted load rates are higher than the other load rates, but not the monthly precip-weighted load rates. High weekly precip's are attenuated in monthly precip's.

There are a few high weekly precip-weighted conc's (with outliers) and precip's (weeks 21, 30 and 34 in Table 1K) that make the weekly load rates so high. The weekly non-weighted load rates are similar to the monthly load rates. But for TN, the "number of samples" weighted load rates are higher than the non-weighted. This is different than the TP results.

"TP < 10" load rates (few outliers) are closer to each other, in the 200's, except precip-weighted, in the 300's. I think we have a good idea of what the range of TN load rates are on Utah Lake.

Observations from the figures: As mentioned above, weekly load rates in weeks 21, 30 and 34 are high (Figures 1P – 1R) because precip and concentrations in those weeks are fairly high (Figures 1M – 1O). In this case, precip-weighted values are only slightly higher than the others.

Monthly results are inconsistent. Non-weighted load rates are fairly constant over the months (Figure 1V) even though concentration values are higher in the summer (Figures 1S), but precip-weighted load rates are higher in winter (Figure 1W) while concentrations are fairly constant over the months (Figure 1T). "Number of sample" weighted load rates are also higher in spring (Figure 1X), but concentrations are higher in August (Figure 1U).

Theron Miller's comment regarding this concern is:

I can see the validity of this calculation for bulk samples or wet dep samples. But a secondary question: what do we do when we may have several weeks without rain, during which we may experience one or more high wind events – with obvious mobilization of dust from the western and southern playas. I think these events may be the source of Wood's high "outlier" values. I strongly agree that we need to align the sampling events with potential high wind events that might have occurred previous to the sample collection.

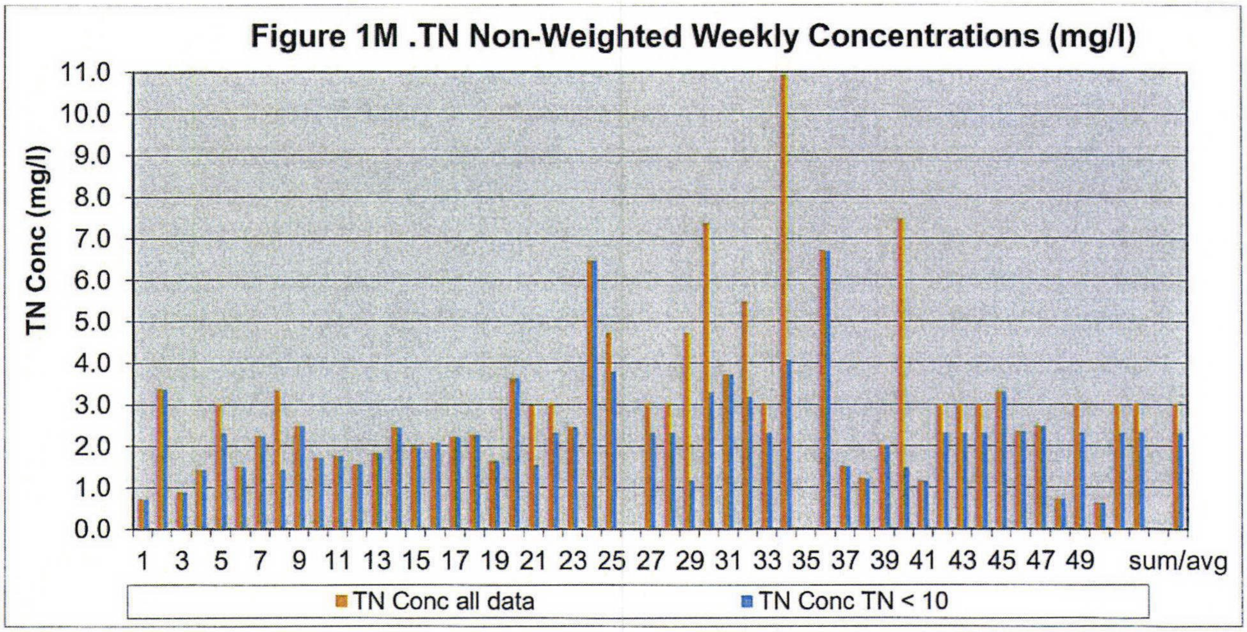


Figure 1M .TN Non-Weighted Weekly Concentrations (mg/l)
TN Conc (mg/l)
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 sum/avg
TN Conc all data
TN Conc TN < 10

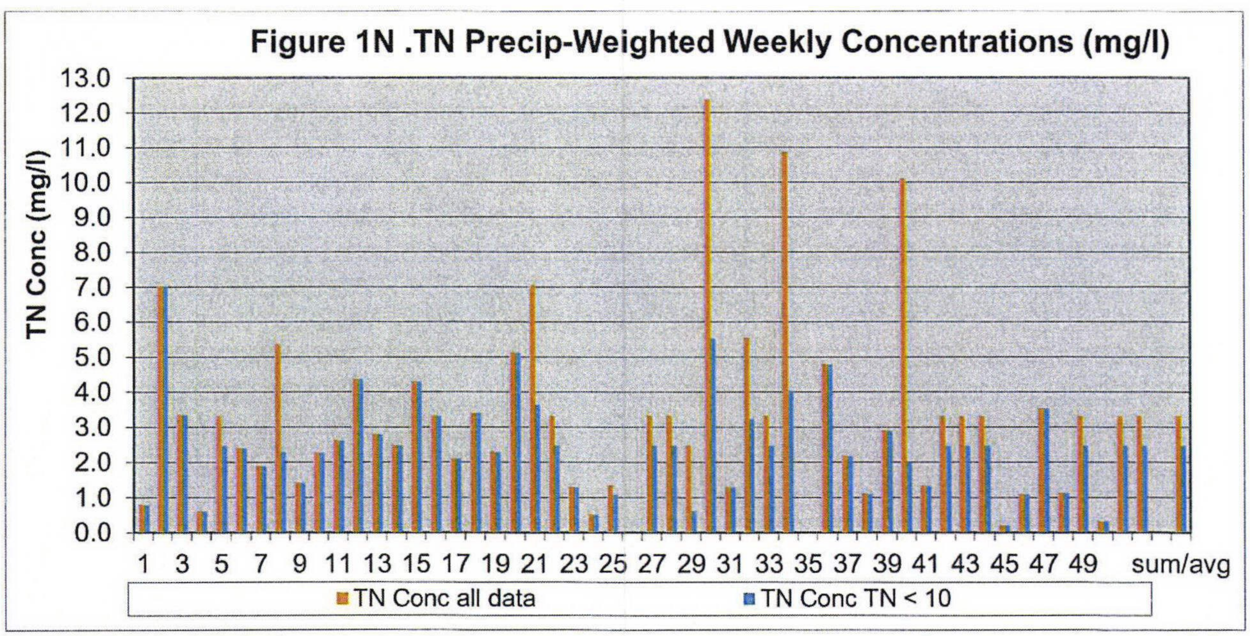


Figure 1N .TN Precip-Weighted Weekly Concentrations (mg/l)
TN Conc (mg/l)
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 sum/avg
TN Conc all data
TN Conc TN < 10

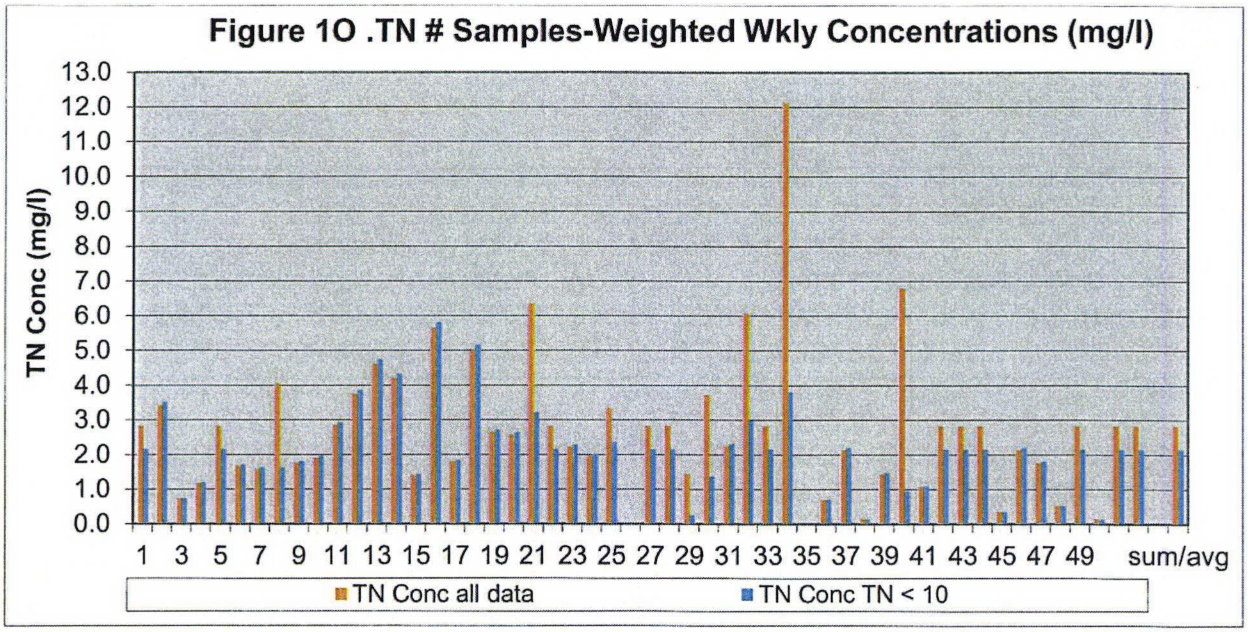


Figure 1O .TN # Samples-Weighted Wkly Concentrations (mg/l)
TN Conc (mg/l)
13.0 12.0 11.0 10.0 9.0 8.0 7.0 6.0 5.0 4.0 3.0 2.0 1.0 0.0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 sum/avg
TN Conc all data
TN Conc TN < 10

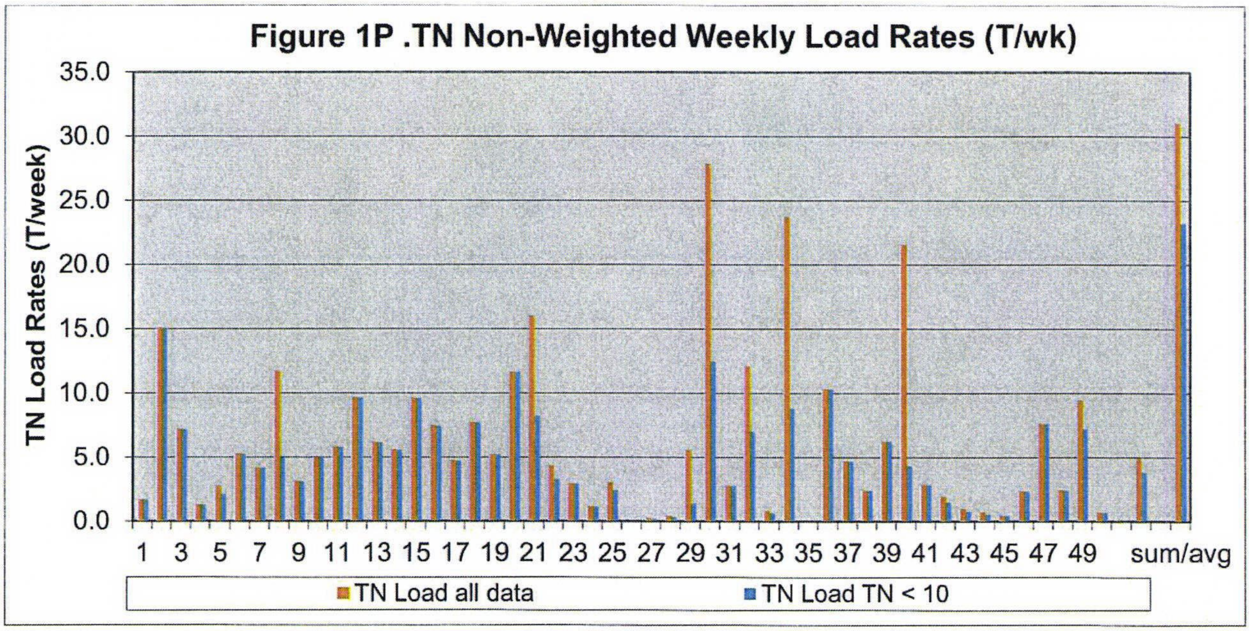


Figure 1P .TN Non-Weighted Weekly Load Rates (T/wk)
TN Load Rates (T/week)
35.0 30.0 25.0 20.0 15.0 10.0 5.0 0.0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 sum/avg
TN Load all data
TN Load TN < 10

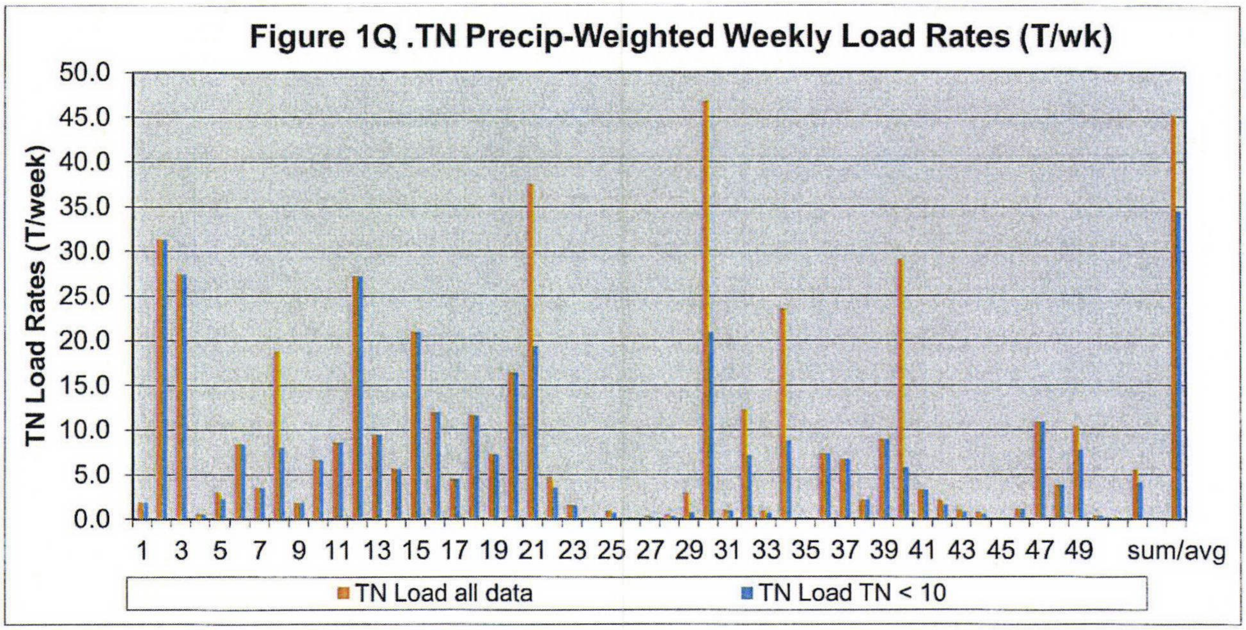


Figure 1Q .TN Precip-Weighted Weekly Load Rates (T/wk)
TN Load Rates (T/week)
50.0
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 sum/avg
TN Load all data
TN Load TN < 10

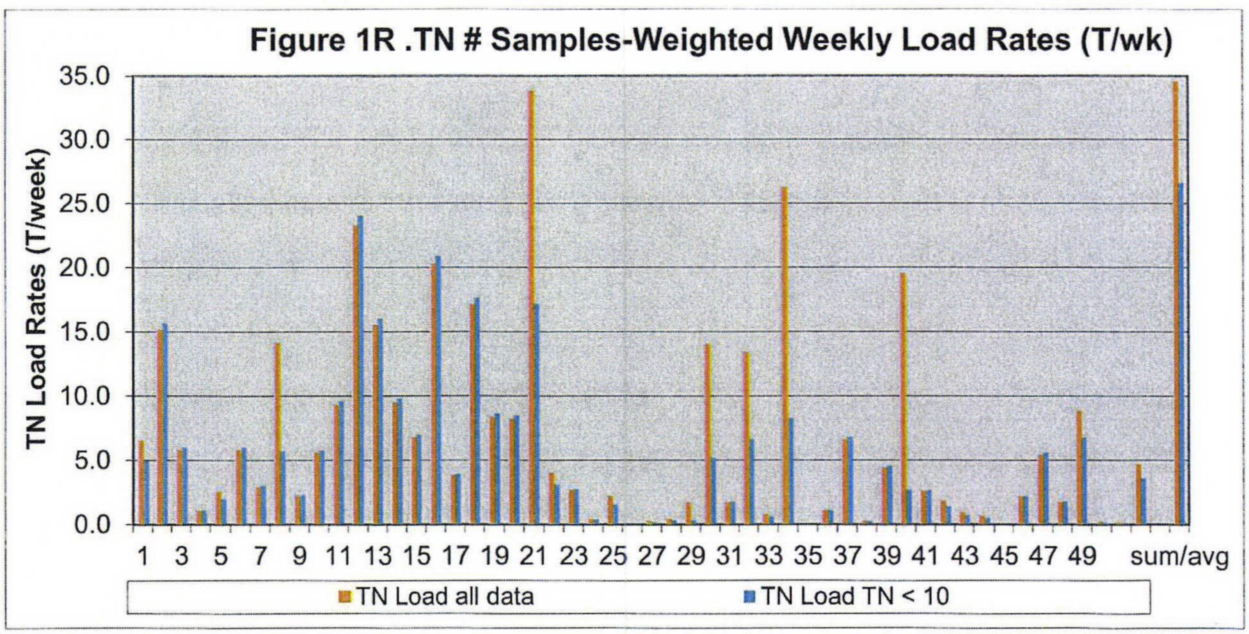


Figure 1R .TN # Samples-Weighted Weekly Load Rates (T/wk)
TN Load Rates (T/week)
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 sum/avg
TN Load all data
TN Load TN < 10

Figure 1S.TN Non-Weighted Monthly Concentrations (mg/l)

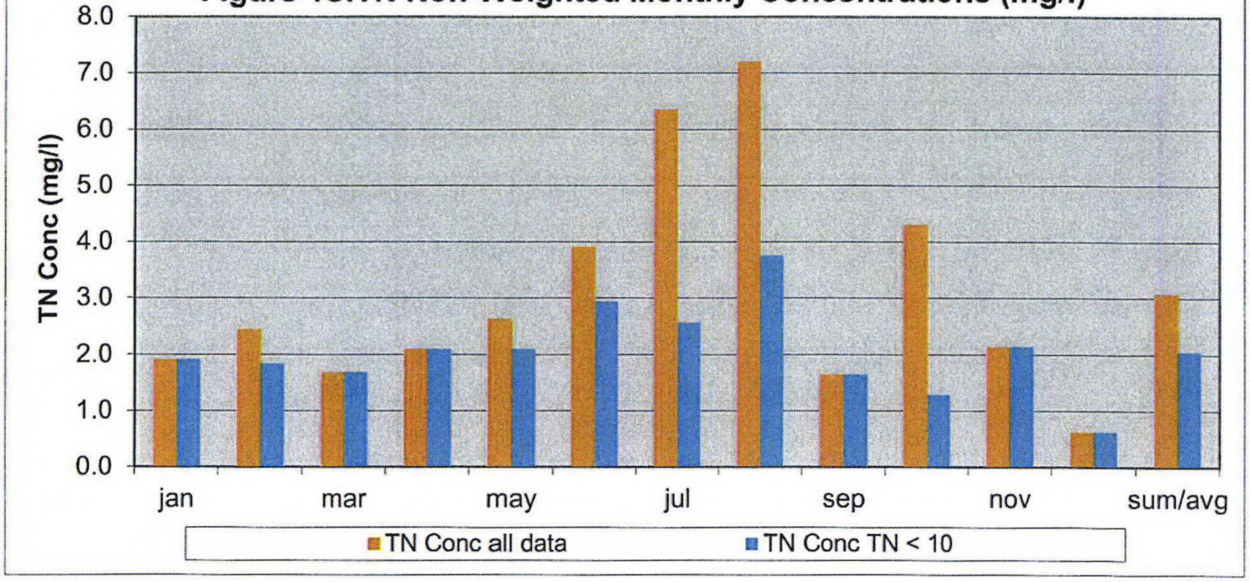
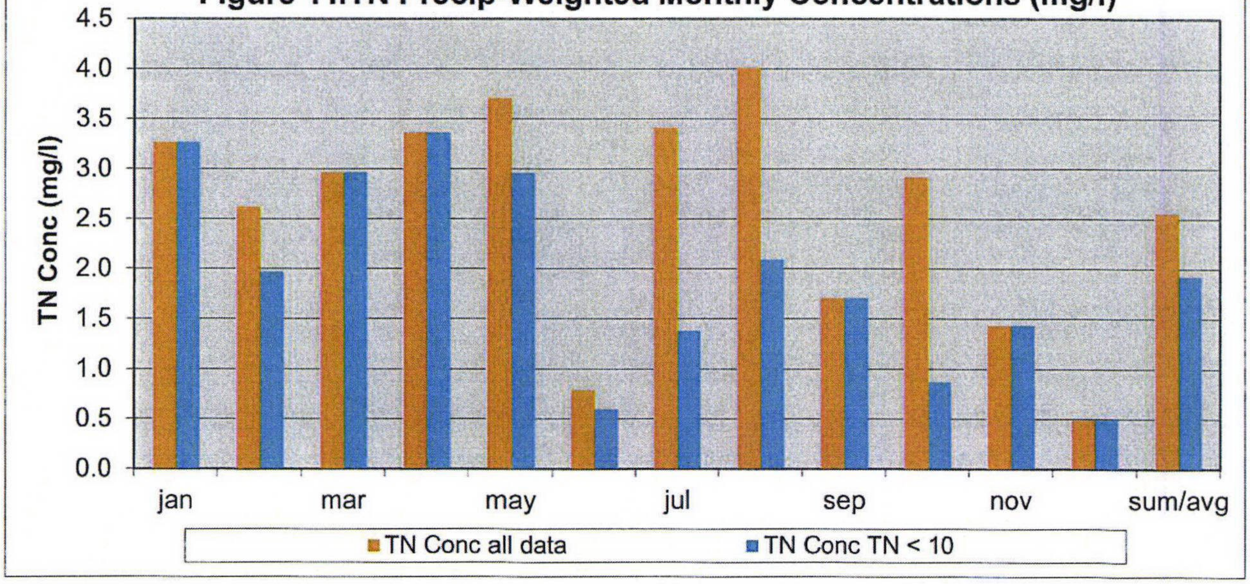


Figure 1T.TN Precip-Weighted Monthly Concentrations (mg/l)



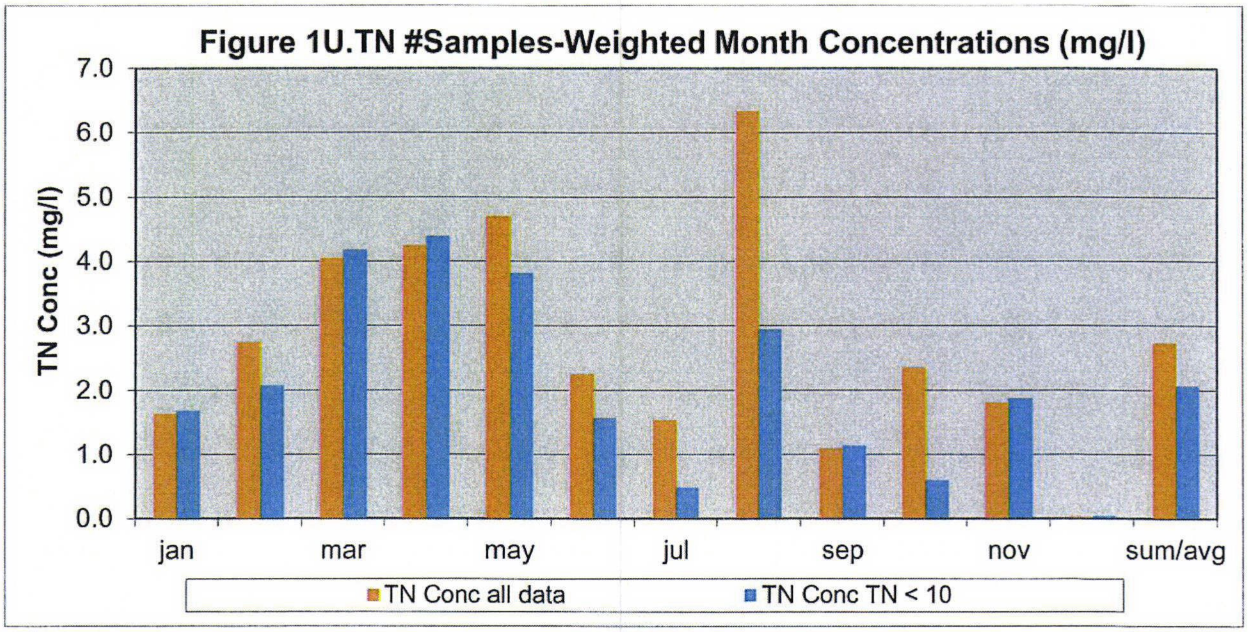


Figure 1U.TN #Samples-Weighted Month Concentrations (mg/l)
TN Conc (mg/l)
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
jan
mar
may
jul
sep
nov
sum/avg
TN Conc all data
TN Conc TN < 10

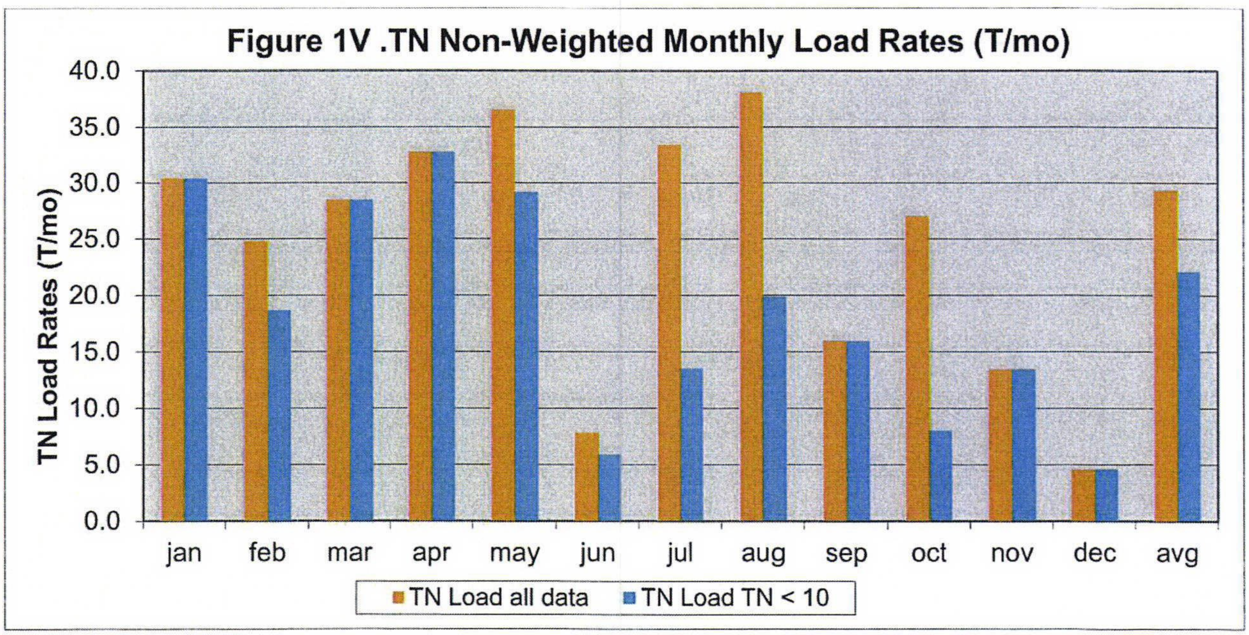


Figure 1V .TN Non-Weighted Monthly Load Rates (T/mo)
TN Load Rates (T/mo)
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
jan
feb
mar
apr
may
jun
jul
aug
sep
oct
nov
dec
avg
TN Load all data
TN Load TN < 10

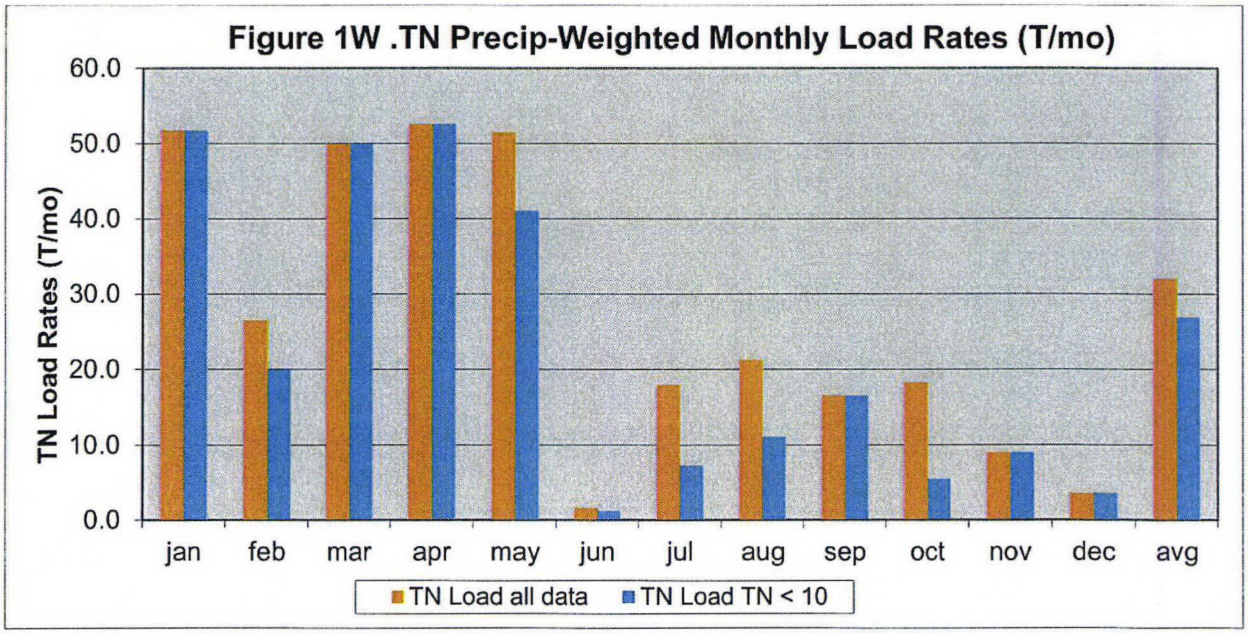


Figure 1W .TN Precip-Weighted Monthly Load Rates (T/mo)
TN Load Rates (T/mo)
60.0
50.0
40.0
30.0
20.0
10.0
0.0
jan feb mar apr may jun jul aug sep oct nov dec avg
TN Load all data
TN Load TN < 10

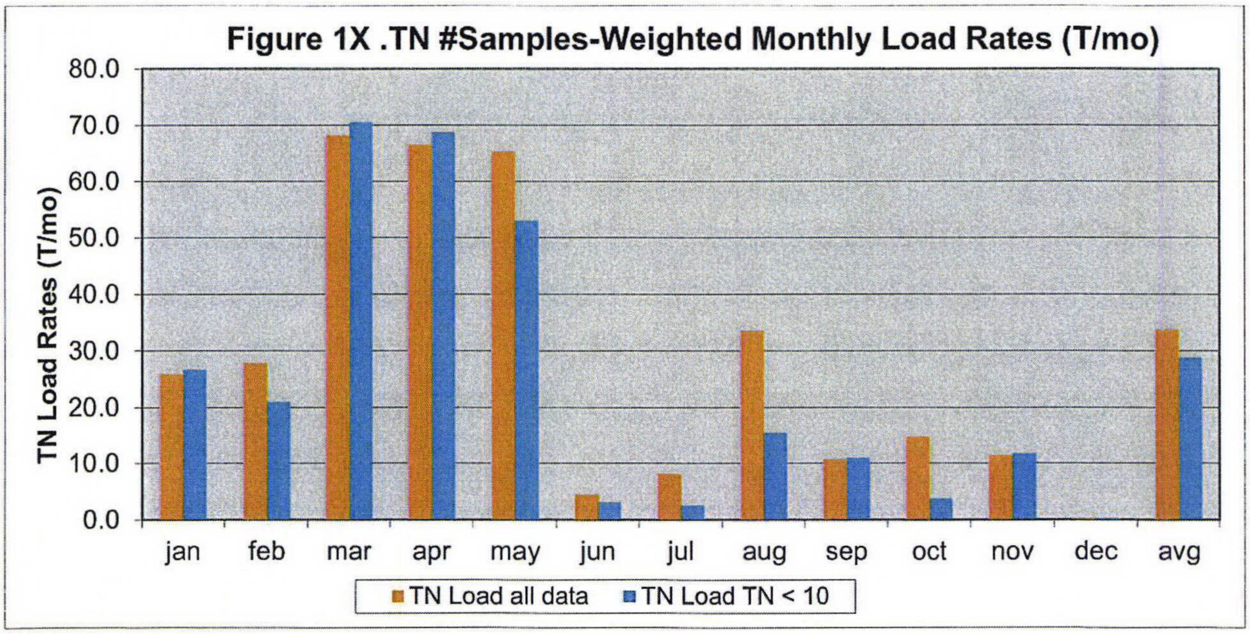


Figure 1X .TN #Samples-Weighted Monthly Load Rates (T/mo)
TN Load Rates (T/mo)
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
jan feb mar apr may jun jul aug sep oct nov dec avg
TN Load all data
TN Load TN < 10

Major Concerns

2. *Average precipitation for the area of 12 inches per year: Using a resource found through the Utah State Climatology Office (Chang, Tsing-Yuan, "A Study of Precipitation Characteristics for Utah" (1969),* Master's Thesis, USU, *https://digitalcommons.usu.edu/etd/2931), it would seem that the average precipitation amount is higher than 12 inches per year, at least for Salt Lake City. However, subtle terrain and elevation differences could be important when compared to Utah Lake. But it is also clear that precipitation amount is skewed towards higher precipitation amounts during the winter months, and particularly high in March through May. Higher precipitation would mean greater deposition to the Lake during the winter and spring. This comment also refers back to #1 above. This assumption of 12 inches is likely to be low, and biases the flux estimates, making them lower. Again, a better estimate may exist and should be used. Second, referring to the annual monthly percentage of precipitation at SLC (graph on the right, with month along the X axis starting in October {left} and ending in September {right}): This significant change in precipitation percentage between winter and summer precipitation and deposition suggests further that a precipitation weighted mean value should be used to estimate deposition. My estimate would be that this would bring the used concentration lower and the deposition would also be lower. Concentrations tend to be higher under light precipitation conditions and this is likely to be in the summer. Further, this point is also confirmed by the arithmetic means of the two season concentrations (Table 1a, 1b, 1c).*

The average annual precipitation on Utah Lake is approximately 12 inches.

The National Weather Service (USWB) map given below shows the mean annual precipitation for 1963-1981 to be 12 inches. See Figure 2A.

The web site https://www.weatherbase.com/weather/weather-summary states that the "average amount of precipitation for the year in Utah Lake is 12.9 inches."

The web site "https://wrcc.dri.edu/cgi-bin/cliMAIN.pl" states that the average annual precipitation at Utah Lake Lehi, which is the best station to represent Utah Lake, is 11.4 inches.

The Desert Research Institute reports the 75-yr (1928-2003) mean annual Utah Lake precipitation to be 11.18 inches.

The Utah Climate Center at Utah State University publication "Utah Climate" lists the following long-term average annual precipitation for the stations near Utah Lake, at approximately the same elevation. Orem TP (on east shore of lake) = 12.6 inches, Fairfield (~15 miles west of lake) = 12.99 inches, Vernon (~35 miles west southwest of lake) = 10.77 inches, and Dugway (~55 miles west of lake) = 8.68.

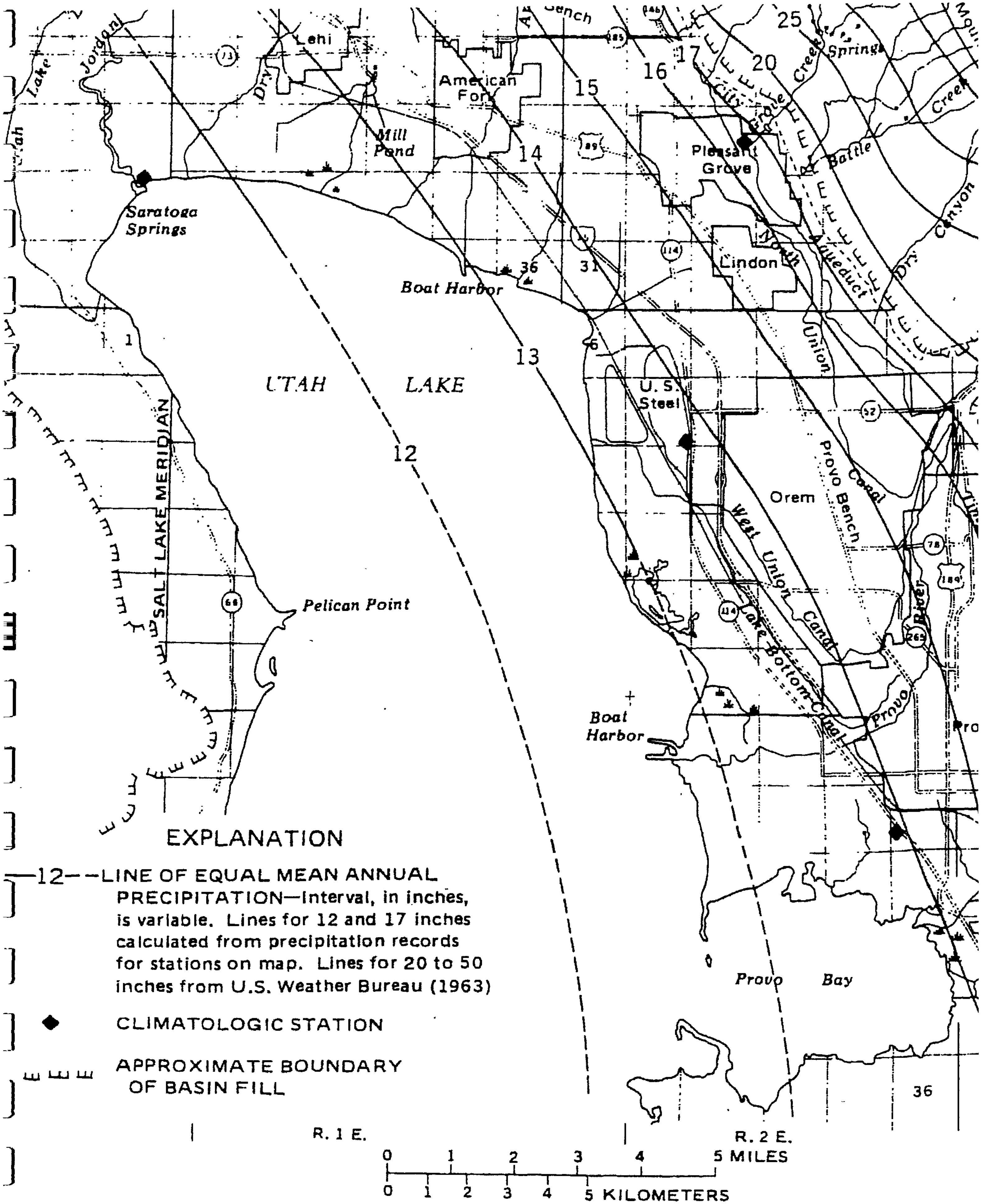


Figure 2A. Mean annual precipitation, 1963-81.

Other long-term average annual precipitation for station east of the lake at higher elevations are: Draper (NE and 100 ft above lake) = 13.74 inches, Santaquin (SE and 671 ft above lake) = 17.11 inches, Pleasant Grove (East and 225 ft above lake) = 17.55 inches, and Provo BYU (East and 100 ft above lake) = 21.11 inches.

Climatological Data reports the following normal annual precipitation values for the Utah Lake Lehi weather station (not sure how normals are different each decade since normal is 30-yr average, but that's what the Climatological Data shows):

1940 = 13.07 inches, 1950 = 12.45", 1960 = 10.12", 1970 = 9.89", 1980 = 10.75", 1990 = 10.66", 2000 = 11.99", 2001-2012 no data, no station, 2013-2014 = 12.41", 2015-2019 = 13.49".

The 3-yr average annual of actual Utah Lake Lehi monthly precipitations for 2017-2019 (the Bulk AD study period) is 11.7".

It seems that estimating 12" as the average annual Utah Lake precipitation is very reasonable. However, in order to determine the weekly and monthly load rates, each weekly and monthly actual measured precipitation was used. The actual monthly lake surface area was also used to determine the load rates. Therefore, it really doesn't matter what the correct long-term average annual Utah Lake precipitation value is.

Major Concerns

3. *Trend lines in figures and in "Table of Trends" (page 3 of report)* (COPIED BELOW)*: Although linear best fit trend lines are standard in reports, I would suggest some changes to this report. For a field campaign, there are a large number of samples available to estimate change over time. However, due to the high variability of precipitation in the American West, a three-year trend line in bulk deposition is a bit short for a robust trend line. Five or more years would be preferable for consistent determination, but this data is not available. I would also suggest that a different trend method be used; specifically, a non-parametric trend method. I would further recommend Mann Kendall Seasonal Test. The method would improve the estimate, particularly because it does not require normality of distribution (precipitation is notorious for this condition), and it is not affected by missing data which is present here. Also, the Seasonal Mann Kendall Test accounts for the seasonal cycles of precipitation chemistry quite nicely. This method has gained prominence in wet deposition and is used extensively by USGS (see here: https://pubs.usgs.gov/sir/2005/5275/). The table on page 3 suggests a lack of consistency across the lake, which could be in part due to the linear trend determination. The MK Seasonal test may remove some of the variability. It works by comparing summer to summer values (or July to July obs.), then winter to winter, etc. and summarizing the entire year's values.*

Table of Trends for TP, OP and TN (from page 3 of interim report)

Location	TP < 5 mg/l	TN < 10 mg/l	Ortho-P
BYU	decreasing	flat	flat
Lincoln Pt.	sl. increasing	decreasing	sl. decreasing
Pelican Pt.	increasing	sl. decreasing	flat
Genola	decreasing	decreasing	sl. decreasing
Elberta	flat	sl. decreasing	str. increasing
Mosida	flat	sl. decreasing	sl. decreasing
Lehi	sl. increasing	sl. decreasing	str. increasing
Orem	flat	decreasing	flat
Spanish Fork	flat	flat	sl. decreasing

I applied the **Mann Kendall Test** to all the nutrient data at each of the 9 locations in order to determine trends which are more appropriate and more accurate than the simple linear best fit trend method. I studied the MK documentation and found that there are several variables developed. They are: **trend**: tells the trend (increasing, decreasing or no trend), **h**: True (if trend is present) or False (if the trend is absence), **p**: p-value of the significance test, **z**: normalized test statistics, **Tau**: Kendall Tau, **s**: Mann-Kendal's score, **var_s**: Variance S, **slope**: Theil-Sen estimator/slope, and **intercept**: intercept of Kendall-Theil Robust Line.

In Table 3A, with all the results, I only show columns with **trend, h, p, slope, and intercept**, along with the location and the analyte (the 6 groups I have used to identify selections of the nutrient data, e.g., TP_lt_5 = TP < 5). This table shows the MK Test results. I have compared these MK Test trends with the simple linear best fit trends. The MK Test shows that most of the data have no trend, at least for each of the 9 relatively small data sets.

There are 54 plots (data sets) for 6 parameters at 9 locations, but only 6 of the data sets show an MK trend, i.e., have a p value of < 0.05. They are: Genola and Orem both decreasing trends for both "TN all data" and "TP < 10," and Lehi increasing trends for "TP < 1" and "Ortho." These plots are shown on Figures 5d, 5e, 9d, 9e, 8c and 8f. Notice that these 6 plots which have MK trends also have relatively steep linear best fit trends.

However, when I combine all the nutrient data for each group / analyte from all 9 locations, the MK Test does show trends. These trends are shown on Table 3B below. Finding MK trends is likely due to having much more data for each analyte. Each of the 9 locations only has about 45 TP and TN values and only about 15 OP values, which, as Dr. Gay noted, is probably too small of a data set for meaningful trends. But with all the data combined, there are 416 TP values, 396 TN values, and even 100 OP values, apparently enough to generate MK trends.

Table 3A

location	analyte	trend	h	p	slope	intercept
Genola	TP_lt_5	no trend	FALSE	0.825775	0	0.1
Genola	TP_All	no trend	FALSE	0.212855	-0.00333	0.328333
Genola	TP_lt_1	no trend	FALSE	0.850083	0	0.1
Genola	Ortho_P	no trend	FALSE	0.206809	0.002679	0.023929
Genola	TN_All	decreasing	TRUE	0.002982	-0.02519	1.654231
Genola	TN_lt_10	decreasing	TRUE	0.004402	-0.02382	1.612055
Sp Fork	TP_lt_5	no trend	FALSE	0.6505	0	0.07
Sp Fork	TP_All	no trend	FALSE	0.6505	0	0.07
Sp Fork	TP_lt_1	no trend	FALSE	0.696344	0	0.06
Sp Fork	Ortho_P	no trend	FALSE	0.900004	0.001	0.0265
Sp Fork	TN_All	no trend	FALSE	0.296476	-0.00615	1.311781
Sp Fork	TN_lt_10	no trend	FALSE	0.296476	-0.00615	1.311781
Pelican Pt	TP_lt_5	no trend	FALSE	0.08344	0.005287	0.074255
Pelican Pt	TP_All	no trend	FALSE	0.055306	0.005714	0.07
Pelican Pt	TP_lt_1	no trend	FALSE	0.219715	0.003333	0.081667
Pelican Pt	Ortho_P	no trend	FALSE	0.752079	0.003333	0.063333
Pelican Pt	TN_All	no trend	FALSE	0.432029	-0.01538	1.923077
Pelican Pt	TN_lt_10	no trend	FALSE	0.207692	-0.02014	1.722708
Lincoln Pt.	TP_lt_5	no trend	FALSE	0.388116	0.001304	0.15
Lincoln Pt.	TP_All	no trend	FALSE	0.660658	0.000833	0.209167
Lincoln Pt.	TP_lt_1	no trend	FALSE	0.416736	0.001333	0.094667
Lincoln Pt.	Ortho_P	no trend	FALSE	0.469648	0.008389	0.042083
Lincoln Pt.	TN_All	no trend	FALSE	0.166534	-0.02381	2.235714
Lincoln Pt.	TN_lt_10	no trend	FALSE	0.332957	-0.01429	1.663571
Orem	TP_lt_5	no trend	FALSE	0.516864	-0.00121	0.206085
Orem	TP_All	no trend	FALSE	0.57597	-0.00107	0.204107
Orem	TP_lt_1	no trend	FALSE	0.632158	-0.00086	0.175857
Orem	Ortho_P	no trend	FALSE	0.387788	0.0025	0.03625
Orem	TN_All	decreasing	TRUE	0.047998	-0.02629	2.378276
Orem	TN_lt_10	decreasing	TRUE	0.027109	-0.02821	2.192308
BYU	TP_lt_5	no trend	FALSE	0.126299	-0.00077	0.073077
BYU	TP_All	no trend	FALSE	0.126299	-0.00077	0.073077
BYU	TP_lt_1	no trend	FALSE	0.126299	-0.00077	0.073077
BYU	TN_All	no trend	FALSE	0.761505	0.00475	1.522875
BYU	TN_lt_10	no trend	FALSE	0.761505	0.00475	1.522875
Lehi	TP_lt_5	no trend	FALSE	0.081586	0.002162	0.082027
Lehi	TP_All	no trend	FALSE	0.197975	0.001467	0.112591
Lehi	TP_lt_1	increasing	TRUE	0.04946	0.002258	0.05371
Lehi	Ortho_P	increasing	TRUE	0.011211	0.03	-0.135
Lehi	TN_All	no trend	FALSE	0.230636	-0.01667	2.53
Lehi	TN_lt_10	no trend	FALSE	0.230636	-0.01667	2.53
Mosida	TP_lt_5	no trend	FALSE	0.216956	0.01	0.23
Mosida	TP_All	no trend	FALSE	0.105136	0.011732	0.206229
Mosida	TP_lt_1	no trend	FALSE	0.440226	0.004018	0.125759

Mosida	Ortho_P	no trend	FALSE	0.937759	0.009	0.365
Mosida	TN_All	no trend	FALSE	0.498074	0.025556	1.744444
Mosida	TN_lt_10	no trend	FALSE	0.573127	-0.01667	2.175
Elberta	TP_lt_5	no trend	FALSE	0.949901	0	0.27
Elberta	TP_All	no trend	FALSE	0.949901	0	0.27
Elberta	TP_lt_1	no trend	FALSE	0.894062	0.000476	0.250952
Elberta	Ortho_P	no trend	FALSE	0.243722	0.014861	0.063264
Elberta	TN_All	no trend	FALSE	0.246575	-0.01861	1.975601
Elberta	TN_lt_10	no trend	FALSE	0.246575	-0.01861	1.975601

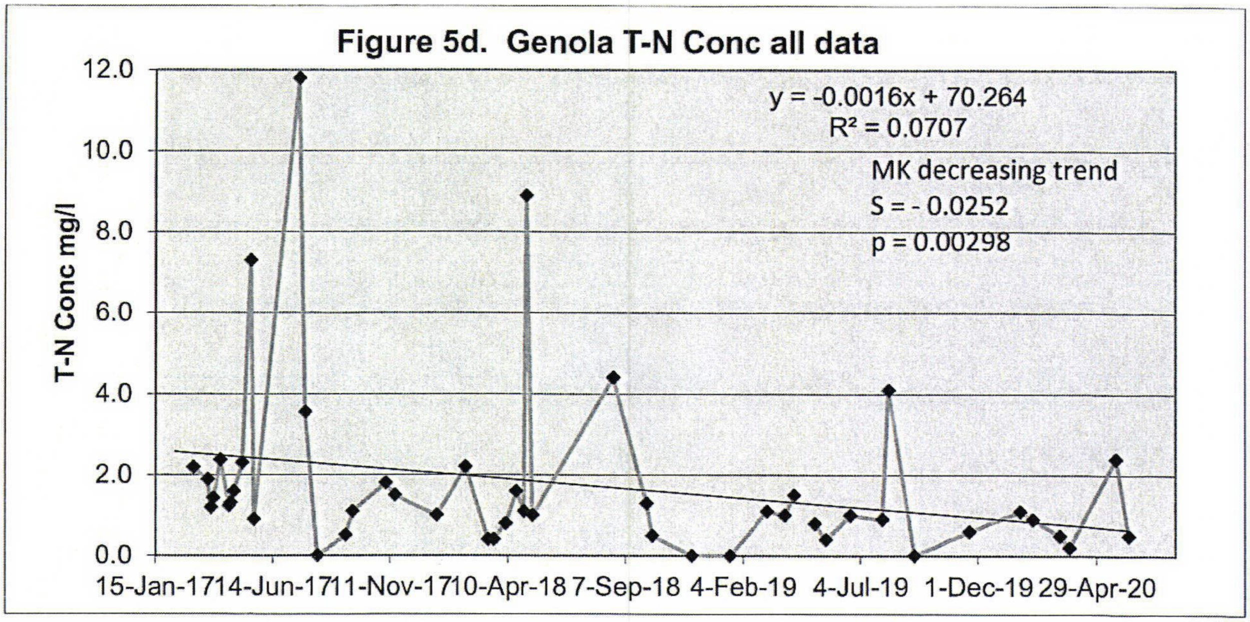


Figure 5d. Genola T-N Conc all data
y = -0.0016x + 70.264
R² = 0.0707
MK decreasing trend
S = - 0.0252
p = 0.00298
T-N Conc mg/l
12.0
10.0
8.0
6.0
4.0
2.0
0.0
15-Jan-17
14-Jun-17
11-Nov-17
10-Apr-18
7-Sep-18
4-Feb-19
4-Jul-19
1-Dec-19
29-Apr-20

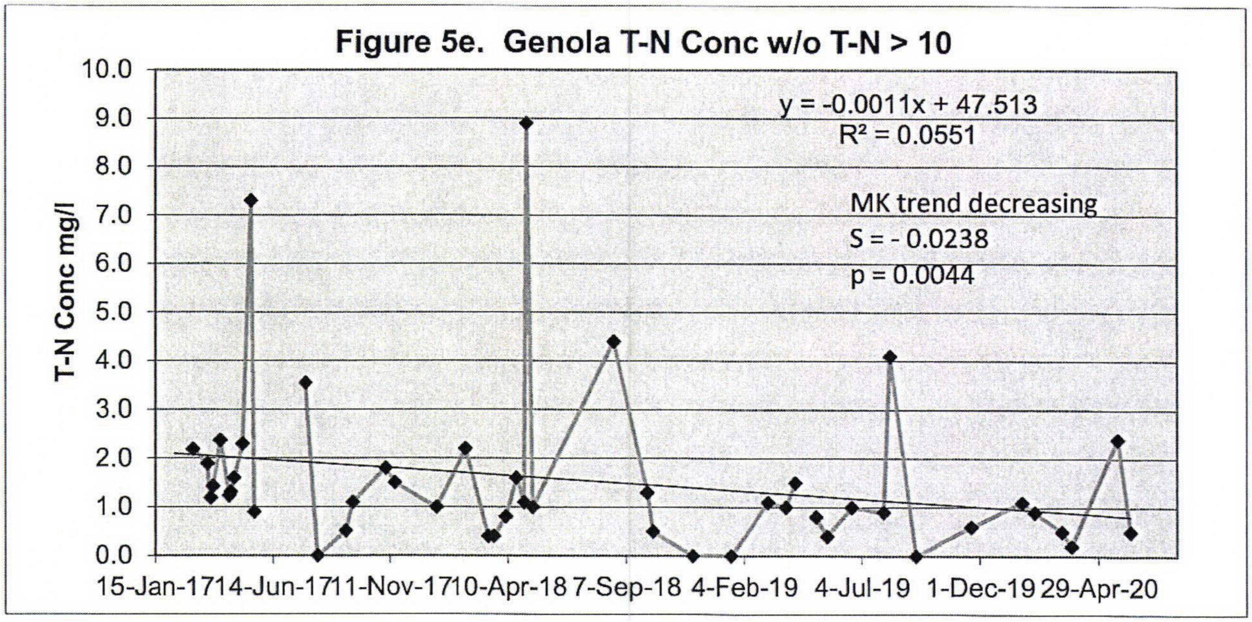


Figure 5e. Genola T-N Conc w/o T-N > 10
y = -0.0011x + 47.513
R² = 0.0551
MK trend decreasing
S = - 0.0238
p = 0.0044
T-N Conc mg/l
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
15-Jan-17
14-Jun-17
11-Nov-17
10-Apr-18
7-Sep-18
4-Feb-19
4-Jul-19
1-Dec-19
29-Apr-20

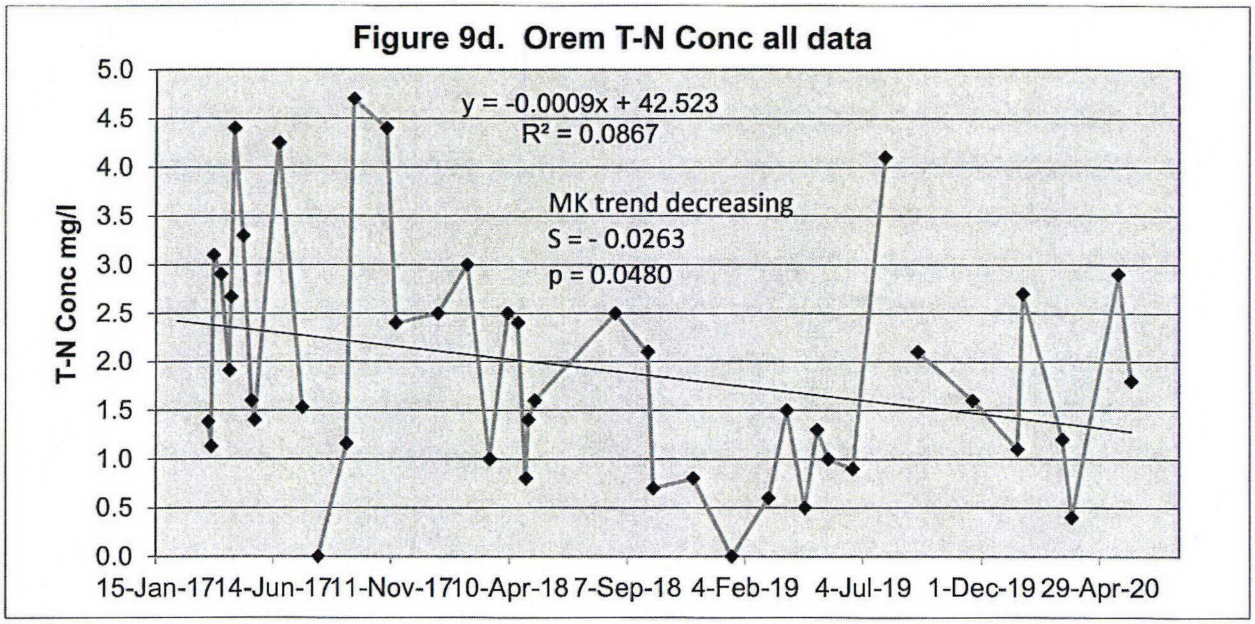


Figure 9d. Orem T-N Conc all data
y = -0.0009x + 42.523
R² = 0.0867
MK trend decreasing
S = - 0.0263
p = 0.0480
T-N Conc mg/l
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
15-Jan-17
14-Jun-17
11-Nov-17
10-Apr-18
7-Sep-18
4-Feb-19
4-Jul-19
1-Dec-19
29-Apr-20

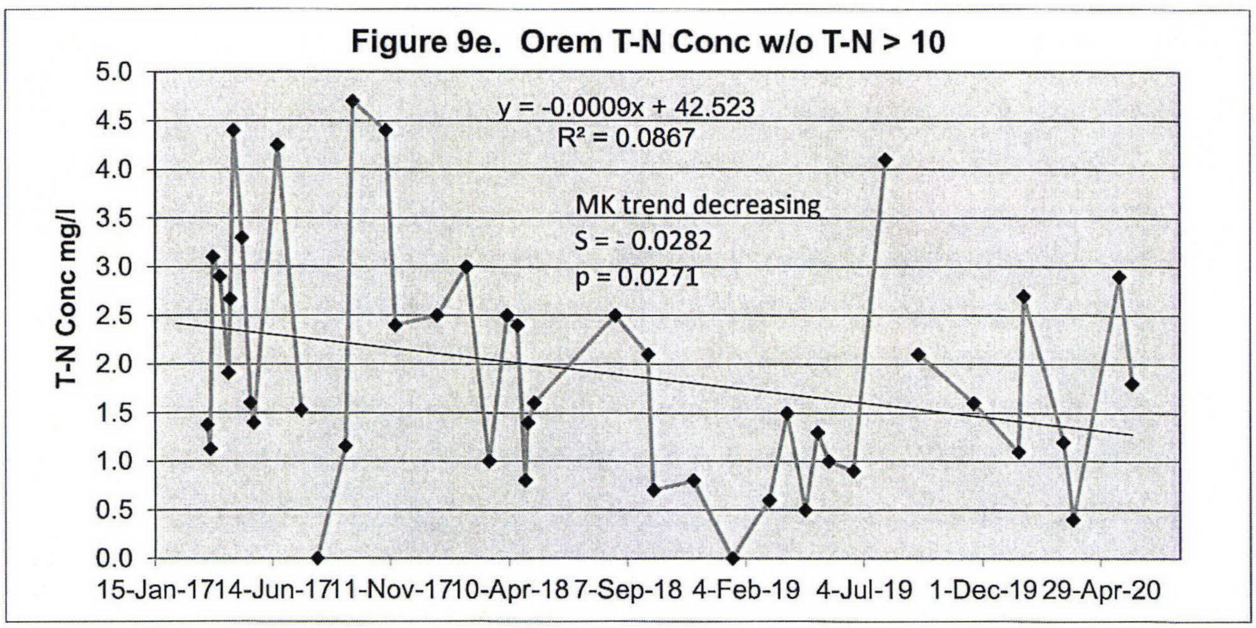


Figure 9e. Orem T-N Conc w/o T-N > 10
y = -0.0009x + 42.523
R² = 0.0867
MK trend decreasing
S = - 0.0282
p = 0.0271
T-N Conc mg/l
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
15-Jan-17
14-Jun-17
11-Nov-17
10-Apr-18
7-Sep-18
4-Feb-19
4-Jul-19
1-Dec-19
29-Apr-20

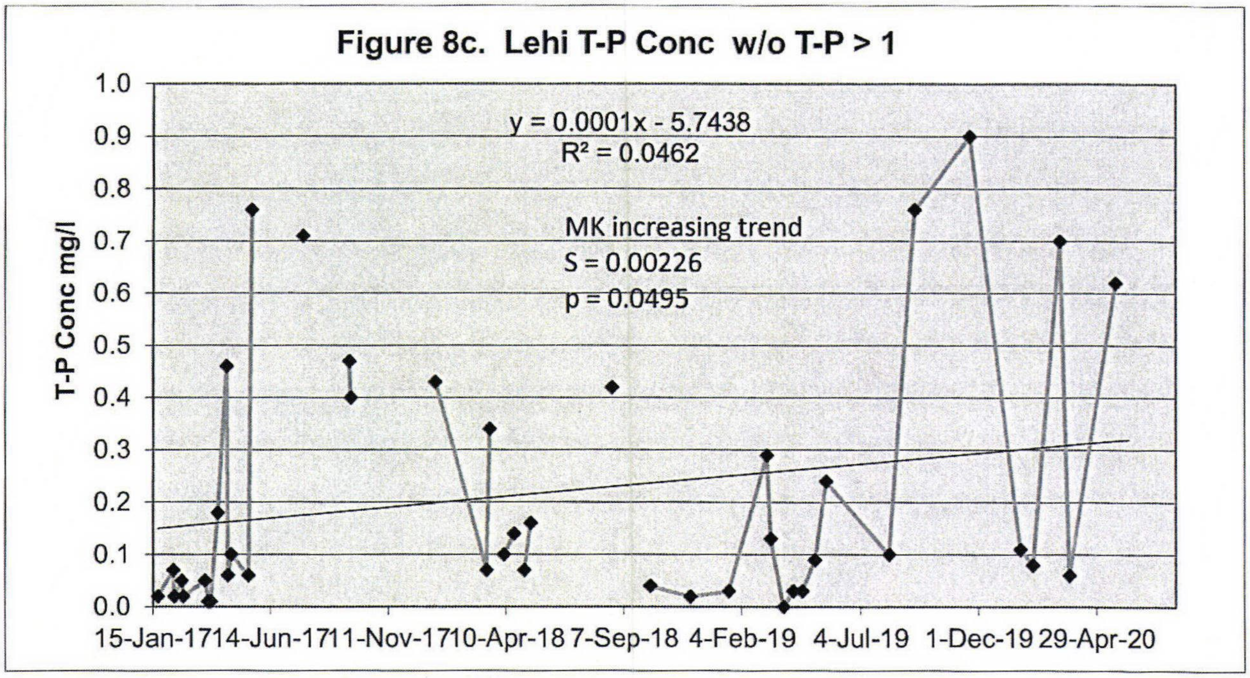


Figure 8c. Lehi T-P Conc w/o T-P > 1
y = 0.0001x - 5.7438
R² = 0.0462
MK increasing trend
S = 0.00226
p = 0.0495
T-P Conc mg/l
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
15-Jan-17
14-Jun-17
11-Nov-17
10-Apr-18
7-Sep-18
4-Feb-19
4-Jul-19
1-Dec-19
29-Apr-20

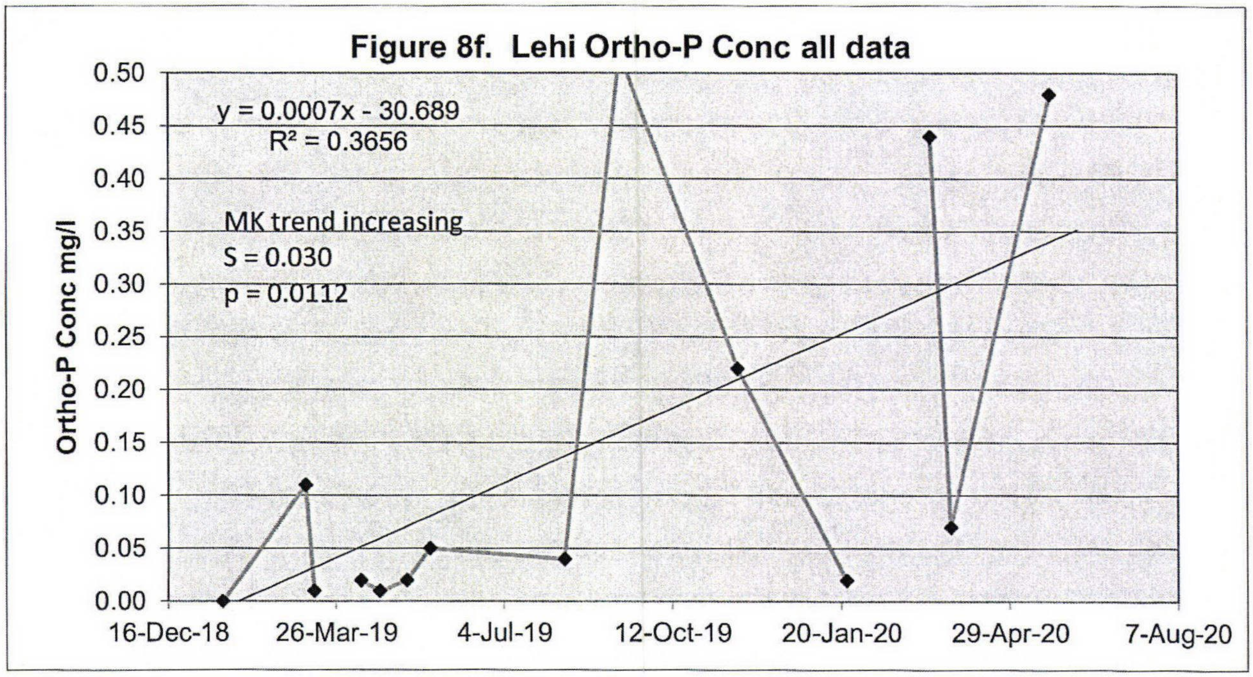


Figure 8f. Lehi Ortho-P Conc all data
y = 0.0007x - 30.689
R² = 0.3656
MK trend increasing
S = 0.030
p = 0.0112
Ortho-P Conc mg/l
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
16-Dec-18
26-Mar-19
4-Jul-19
12-Oct-19
20-Jan-20
29-Apr-20
7-Aug-20

The 3 TP and 1 OP total data sets show increasing trends and the 2 TN total data sets show decreasing trends. In response to Dr. Gay's comment that "*the table on page 3 suggests a lack of consistency across the lake, which could be in part due to the linear trend determination,*" Table 3B with MK Test trends using all the data now shows some consistency across the lake.

Table3B	**analyte**	**trend**	**h**	**p**	**slope**	**intercept**
all data	TP < 5	increasing	TRUE	0.013464	0.000144	0.120848
	TP All	increasing	TRUE	0.02843	0.00013	0.132798
	TP < 1	increasing	TRUE	0.028951	0.00012	0.103679
	Ortho P	increasing	TRUE	0.011852	0.000563	0.041268
	TN All	decreasing	TRUE	0.02088	-0.00107	1.818133
	TN < 10	decreasing	TRUE	0.004904	-0.00128	1.751647

<u>*Other More Minor Comments:*</u>

1. *Unfiltered/Filtered samples: I am assuming that the bulk deposition samples are run for unfiltered samples (including solids suspended in the precipitation samples). However, if they are filtered samples (as NADP samples are run), then the bias for TN and TP will be present towards lower concentration and deposition. For TP in particular, much of TP is expected to be soil particulates washed out of the atmosphere and suspended in solution. Unfiltered samples are preferred in this analysis. Unfiltered samples are likely here, but I am unclear on this point.*

Yes, the bulk deposition samples are run for unfiltered samples. Any bugs or leaves, etc. suspended in the samples are removed, but the samples are not filtered, either in the field or in the Chemtech-Ford lab. Chemtech-Ford is a NELAC-certified laboratory.

2. *I am also assuming that the "tons" references are referring to English tons, but I would be clear so that when comparisons are made, that units are consistent.*

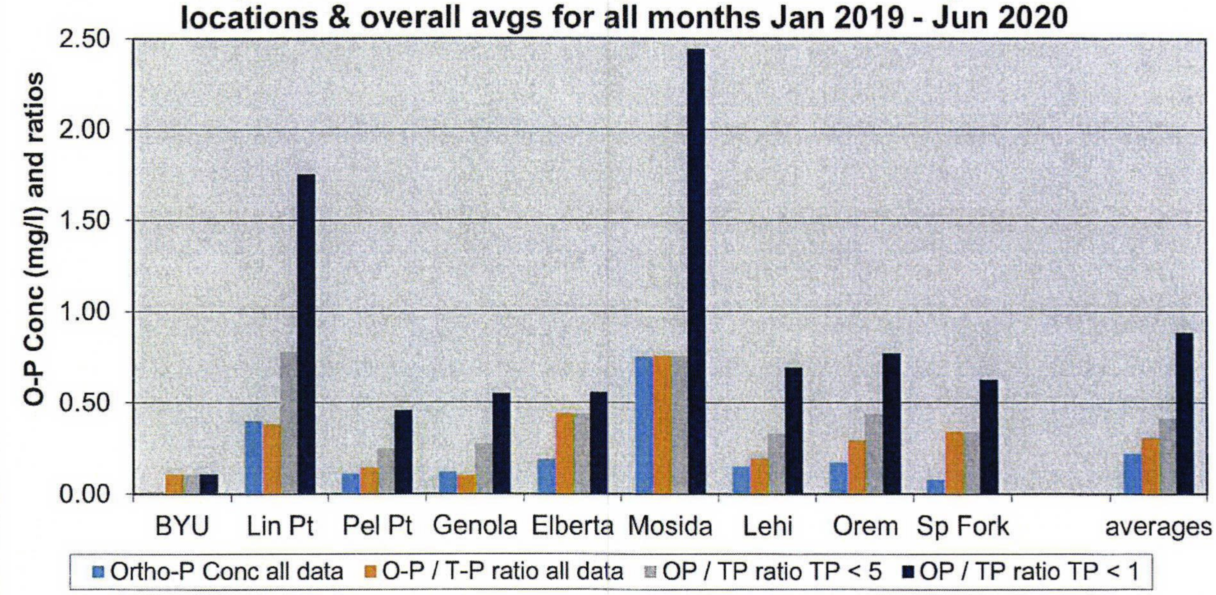
Yes, the "tons" are English tons = 2000 pounds = 907.18 kg.

3. *Table 1b* (COPIED BELOW)*: My initial question was, why is the Mosida OP/TP ratio so high? Why is it so different than the other sites? Then, I noticed that for several observations in the TP<1 block, there are four observations where OP/TP is 175% or higher, which brings in the question of the measurements. I know there are few samples of OP at this point, and that the concentrations are very small, but it brings up the question of the consistency of measurements.*

Table 1b. Averages at all 9 locations for all ortho-phosphorus samples for the whole year and for summer (Apr-Sept) and winter (Oct-Mar).

Location	Ortho-P (mg/l) **all data**	Ortho-P (mg/l) **summer**	Ortho-P (mg/l) **winter**	all Ortho-P samples	OP/TP % **all data**	OP/TP % **summer**	OP/TP % **winter**	OP/TP % **TP < 1**	OP/TP % **summer**	OP/TP % **winter**	OP/TP % **TP < 5**	OP/TP % **summer**	OP/TP % **winter**
BYU	0.01	0.02	0.00	2	10.83	16.57	0.00	10.83	16.57	0.00	10.83	16.57	0.00
Lincoln Pt	0.40	0.68	0.04	16	37.95	41.79	8.01	175.13	190.46	28.26	77.90	86.18	14.68
Pelican Pt	0.11	0.11	0.10	11	14.28	15.00	13.69	45.48	48.81	42.66	24.89	27.25	22.87
Genola	0.12	0.17	0.04	13	10.07	9.02	19.00	54.92	70.92	19.00	27.49	26.62	19.00
Elberta	0.19	0.14	0.26	12	43.87	32.62	59.21	55.61	38.89	81.02	43.87	32.62	59.21
Mosida	0.75	1.09	0.14	11	75.64	74.99	45.51	244.15	280.77	60.90	75.64	74.99	45.51
Lehi	0.15	0.16	0.15	13	19.56	13.96	41.18	69.01	57.38	88.26	33.02	28.30	41.18
Orem	0.17	0.25	0.08	16	29.28	32.87	29.79	76.86	98.49	49.81	43.84	55.45	29.79
Sp Fork	0.08	0.10	0.02	8	33.98	26.68	18.23	62.36	58.01	18.23	33.98	26.68	98.76
averages	0.22	0.30	0.09	102	30.61	29.28	26.07	88.26	95.59	43.13	41.27	41.63	36.78
no.samples	102	58	44	102 plus 25 BDL as of July 1, 2020									
tonsOP/yr at avg area 83,800 ac & 12"/yr rain or 6"/half yr at given avg OP conc.	24.9	17.3	5.2										

Figure 1b. Ortho-P Conc avgs & O-P / T-P ratio avgs at 9 locations & overall avgs for all months Jan 2019 - Jun 2020



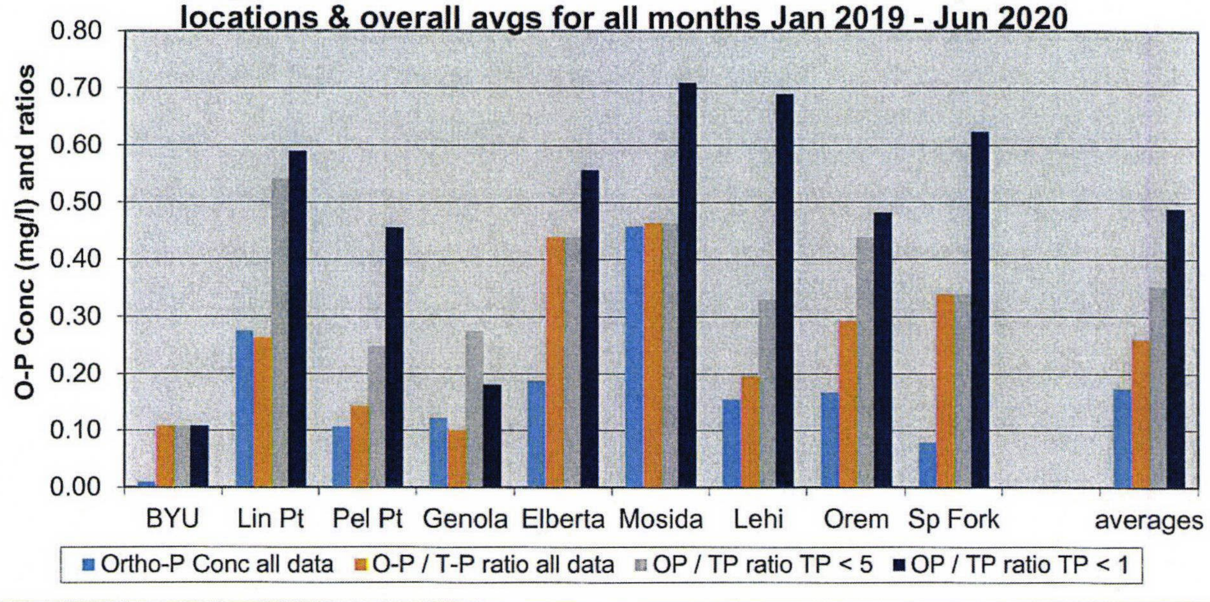
I was able to remedy Dr. Gay's concern in the original Table 1b and original Figure 1b shown above. There are 7 OP samples > 1, and when I calculated the OP/TP ratios, of course, for the samples in the TP < 1 block, the ratios were > 1.0 or > 100%. I eliminated the 7 OP > 1 samples from the 100+ OP samples, but only for the TP < 1 block, not the other 2 blocks.

I also made 3 other minor changes on the original Table 1b. One outlier OP measurement of 2.2 mg/l was deleted from the Lincoln Pt file and two outlier OP measurements of 1.9 and 2.2 mg/l were deleted from the Mosida file. This changed the LP all data avg from 0.40 to 0.275 and summer avg from 0.68 to 0.485. This also changed the Mosida all data avg from 0.75 to 0.458 and summer avg from 1.09 to 0.710. I recalculated the OP and OP/TP ratio values and show them in the new Table 1b* and on the new Figure 1b*.

Table 1b*. Averages at all 9 locations for all ortho-phosphorus samples for the whole year and for summer (Apr-Sept) and winter (Oct-Mar).

Location	Ortho-P (mg/l) all data	Ortho-P (mg/l) OP < 1	Ortho-P (mg/l) summer	Ortho-P (mg/l) OP < 1	Ortho-P (mg/l) winter	Ortho-P (mg/l) OP < 1	all Ortho-P samples	with all OP OP/TP % all data	OP/TP % summer	OP/TP % winter	with only OP < 1 OP/TP % TP < 1	OP/TP % summer	OP/TP % winter	with all OP OP/TP % TP < 5	OP/TP % summer	OP/TP % winter
BYU	0.010	0.010	0.020	0.020	0.000	0.000	2	10.829	16.575	0.000	10.829	16.575	0.000	10.829	16.575	0.000
Lincoln Pt	0.275	0.133	0.485	0.247	0.036	0.036	15	26.410	30.002	8.015	58.910	69.541	28.263	54.213	61.869	14.677
Pelican Pt	0.106	0.106	0.112	0.112	0.102	0.102	11	14.284	14.997	13.695	45.476	48.814	42.657	24.891	27.254	22.872
Genola	0.122	0.040	0.174	0.041	0.038	0.038	13	10.074	9.024	19.000	18.074	16.910	19.000	27.492	26.624	19.000
Elberta	0.188	0.188	0.137	0.137	0.258	0.258	12	43.871	32.622	59.213	55.614	38.894	81.025	43.871	32.622	59.213
Mosida	0.458	0.217	0.710	0.317	0.143	0.143	9	46.336	48.717	45.509	70.945	81.357	60.897	46.336	48.717	45.509
Lehi	0.155	0.155	0.163	0.163	0.145	0.145	13	19.557	13.962	41.183	69.010	57.383	88.261	33.023	28.304	41.183
Orem	0.167	0.105	0.253	0.131	0.081	0.081	16	29.276	32.871	29.786	48.210	51.266	49.808	43.836	55.448	29.786
Sp Fork	0.079	0.079	0.100	0.100	0.015	0.015	8	33.977	26.682	18.232	62.362	58.011	18.232	33.977	26.682	18.232
averages	0.173	0.115	0.239	0.141	0.091	0.091	99	26.068	25.050	26.070	48.826	48.750	43.127	35.385	36.010	27.830
no.samples	99	93	55	49	44	44	99 plus 25 BDL as of July 1, 2020									

Figure 1b.* Ortho-P Conc avgs & O-P / T-P ratio avgs at 9 locations & overall avgs for all months Jan 2019 - Jun 2020



4. *I compared the total bulk deposition of this report for TN (316 tons into the lake) to the NADP's total deposition of N (wet plus dry; nitrate + ammonia + organic), which is approximately 8-9 kg N/hectare. Converting this to tons into the lake, my quick calculation was 317 tons N/lake for a year. I would have to say these compare very favorably. This certainly lends weight to the estimates made in this report using this data (see Schwede, Donna B. and Lear, Gary G., "A novel hybrid approach for estimating total deposition in the United States" (2014). U.S. Environmental Protection Agency Papers. 219. http://digitalcommons.unl.edu/usepapapers/219 for more information).*

Sounds good. Also see my new weighted weekly and monthly TN results shown in Table 1N and 1O. Still quite close to the new calculations for TN load rates.

Theron Miller's comment regarding this concern is:

Notably, this relationship is also true for our wet and dry samplers. I tried to point this out to the SP, but no one seemed very interested. They only wanted to focus on how high our P estimates were in relation to the regional P estimates in the white paper.

5. *Bulk measurements versus "dry deposition measurements" are likely low compared to true dry deposition rates. As stated previously, bulk deposition is not likely to capture all of the dry deposition, and therefore, bulk concentrations are likely lower than a full dry deposition measurement.*

Sounds good. We look forward to comparing bulk results with dry results in the near future.

6. *Contamination between samples: I cannot confirm that the samplers are washed well between samples week to week. If any of the compounds of interest stick to the sides of the sampling container, then cross contamination between samples could be a problem. But again, I do appreciate using the samples of opportunity with the gages.*

I asked the NWS observers if they clean out their samplers. They said they do, now and then. But they say they don't think there's much contamination from day to day, between sampling. The Spanish Fork and BYU samples usually have the lowest concentrations of TP or OP or TN. I also clean out my collection tubes and funnels quite well each time I take a sample.

7. *Contamination by birds in the NWS open gages is likely to be a problem, at least at some point and various sites over the years. NADP samples are screened for this with the worry that phosphorus contamination is added from bird feces. I do not know if the samples were screened for this occurrence (samples may have operator comments like sample cloudy, etc.).*

The day after a storm, I obtain water samples from the NWS stations at BYU, Spanish Fork and Lehi. Therefore, there is essentially no evaporation from their samples, and the same is true for my samples, negligible evaporations. The NWS observers save the water for me in a clean bottle, and I think they take anything extraneous out. I checked with the observers and they don't have screens, but they say they haven't noticed any bird feces in their rain gages, and I haven't ever noticed the water to be cloudy or otherwise dirty (contaminated). But it's possible that anything could get into the rain gages. The gages are located ~ 4 ft above the ground.

Theron Miller's comment regarding this concern is:

While this is certainly possible, to my knowledge we haven't ever seen this. We do look for cloudy water, droppings in the tables, etc.

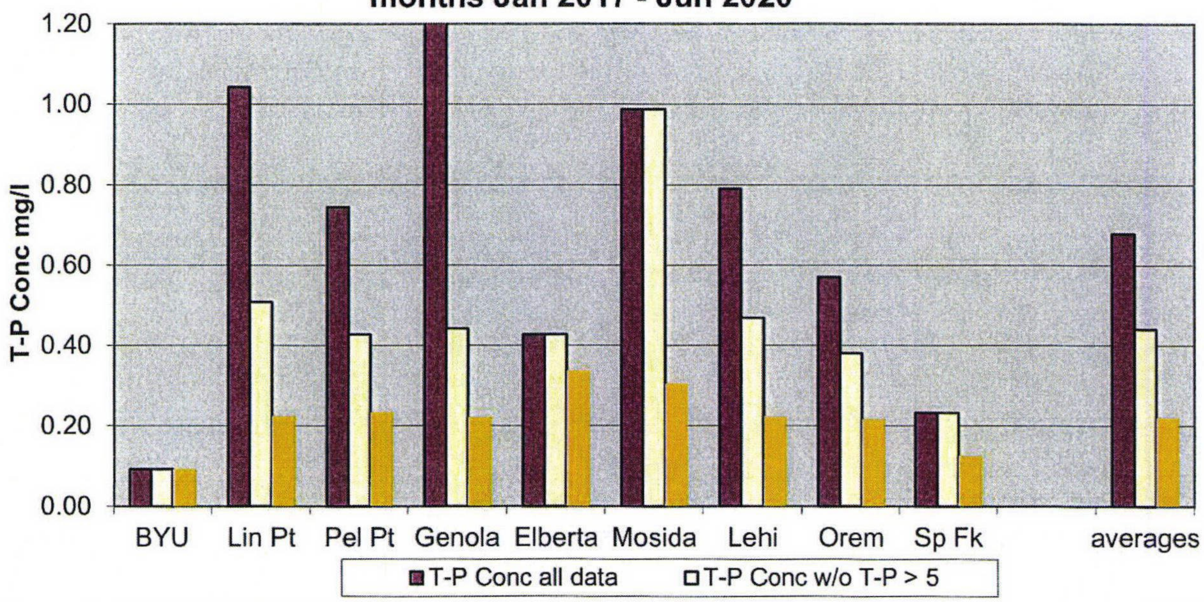
8. *Looking at the graphics and at the variability in average concentrations, it would certainly seem that local sources (or perhaps local conditions) are driving some of these measurements. For example, TP for Genola as compared to Elberta, and the three-fold increase between the two sites.*

Dr. Gay's comment is referring to Table 1a and Figure 1a in the original interim report, which are shown again below for reference. The main reason for the large differences is a few outliers. For the TP < 1 mg/l block, there are not significant differences (all in 0.2's and low 0.3's) among locations (except for low BYU and SF). For "all data" and "TP < 5" blocks, there are differences among some locations. When the largest of the outliers are deleted, the concentration averages for each location are much closer to each other, similar to TP < 1. Which outliers could be deleted? I suggest the following:

Table 1a. Averages at all 9 locations for all phosphorus samples for the whole year and for summer (Apr-Sept) and winter (Oct-

Location	Total Phos (mg/l) **all data**	Total Phos (mg/l) **summer**	Total Phos (mg/l) **winter**	Total Phos (mg/l) **TP < 1**	Total Phos (mg/l) **summer**	Total Phos (mg/l) **winter**	Total Phos (mg/l) **TP < 5**	Total Phos (mg/l) **summer**	Total Phos (mg/l) **winter**	all TP samples	TP outliers >1 mg/l	>5 mg/l
BYU	0.09	0.12	0.08	0.09	0.12	0.08	0.09	0.12	0.08	47	0	0
Lincoln Pt	1.04	1.62	0.45	0.23	0.35	0.13	0.51	0.78	0.24	51	12	4
Pelican Pt	0.74	0.75	0.74	0.23	0.23	0.24	0.43	0.41	0.44	43	7	2
Genola	1.21	1.93	0.20	0.22	0.25	0.20	0.44	0.65	0.20	48	10	5
Elberta	0.43	0.42	0.44	0.34	0.35	0.32	0.43	0.42	0.44	46	4	0
Mosida	0.99	1.46	0.31	0.31	0.39	0.23	0.99	1.46	0.31	39	11	0
Lehi	0.79	1.17	0.35	0.22	0.28	0.16	0.47	0.58	0.35	52	10	2
Orem	0.57	0.77	0.27	0.22	0.26	0.16	0.38	0.46	0.27	45	7	1
Sp Fork	0.23	0.37	0.08	0.13	0.17	0.08	0.23	0.37	0.08	45	2	0
averages	0.68	0.96	0.32	0.22	0.27	0.18	0.44	0.58	0.27	416	63	14
no.samples	416	217	199	353	168	185	402	205	197	416 plus 14 BDL as of July 1, 2020		
tonsTP/yr at avg area 83,800 ac & 12"/yr rain or 6"/half yr at given avg TP conc.	77.1	54.4	18.5	25.1	15.2	10.2	50.2	33.2	15.3			

Figure 1a. T-P Conc avgs at 9 locations & overall avgs all months Jan 2017 - Jun 2020



Mosida: The only location with very large differences in the "all data" and "TP < 5" blocks (which have the same averages since all are < 5) is Mosida. When only the 2 highest values, 4.9 and 4.6 mg/l, are deleted from all the data, the concentration average for "all data" changes from 0.99 to 0.785, and for summer, changes from 1.46 to 1.144. Now, the "all data" avg is quite close to the other locations' averages, but the summer avg is still higher than the others (1).

For the "TP < 5" data, the changes are the same. But, both the "all data" and summer averages are still higher than the other locations' averages (2). See bolded numbers in Table 1a* below.

Lehi: When only the highest sample is deleted, 11.0 mg/l, so TP < 10, the average for "all data" changes from 0.79 to 0.59, & for summer, changes from 1.17 to 0.802, similar to other locations.

Genola: With only the 2 highest values deleted, 10.0 and 9.8 mg/l, so TP < 9, the "all data" and summer averages change from 1.21 to 0.828 and from 1.93 to 1.312, respectively. The "all data" avg is quite close to the others, but the summer avg is still higher than the others (1).

Lincoln Pt: With only the 2 highest values deleted, 8.9 and 8.8 mg/l, so TP < 8, the "all data" and summer averages change from 1.04 to 0.724 and from 1.62 to 1.014, respectively. The "all data" avg is close, but again, the summer avg is still higher than the others (1).

Pelican Pt: When only the highest sample is deleted, 7.8 mg/l, so TP < 7, the averages for "all data," summer, and winter change from 0.74 to 0.577, from 0.75 to 0.411 and from 0.74 to 0.742, respectively. The "all data" and summer averages are close to the other locations, but the winter average is still ~ the same and higher than the others (1).

With these 8 outliers removed from the data (of 400+ samples) in Table 1a and Figure 1a, new Table 1a* and new Figure 1a* are generated. In Table 1a*, there are only 6 averages **(bolded)** that are significantly different than the others, 4 in "all data" block and 2 in "TP < 5" block.

In the "all data" block, 3 locations remaining with high summer avg TP are Lincoln Pt, Genola and Mosida, and the 1 location with high winter avg TP is Pelican Pt. In the "TP < 5" block, Mosida is the only location remaining with a high all year and a high summer value.

A reason these 6 averages are higher than others is that these 4 locations have many relatively high concentrations. In summer, Lincoln Pt has 6 samples between 1 & 3, Genola has 5 samples between 1 & 3, and Mosida has 6 samples between 1 & 3. In winter, Pelican Pt has 2 samples between 2 & 3.

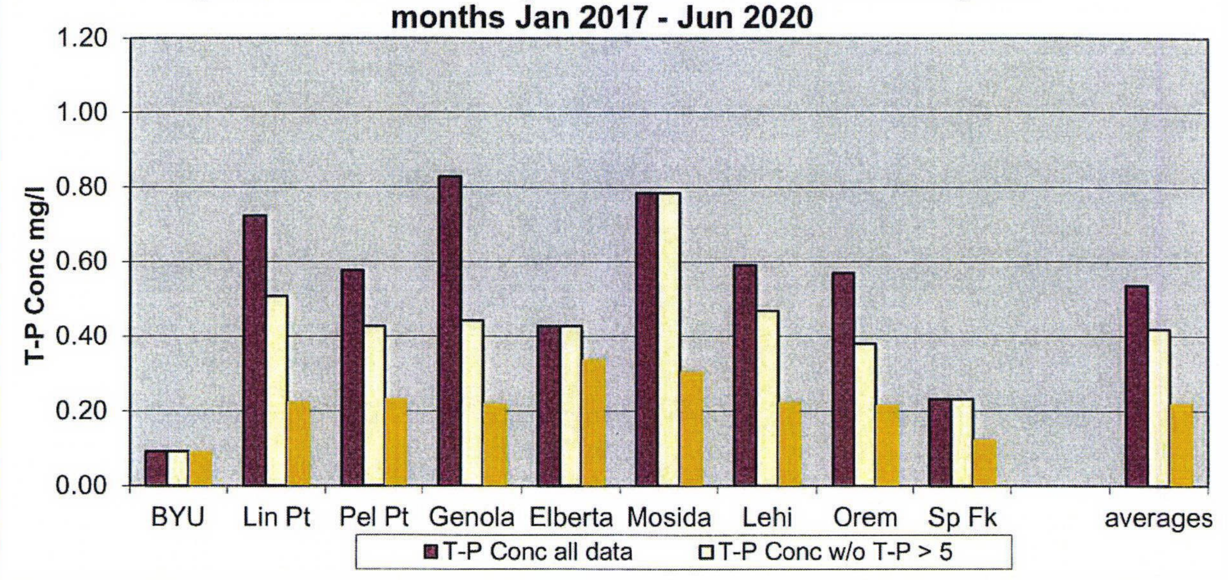
Theron Miller's comment regarding this concern is:

This does seem peculiar. A couple of notes: Although not at the exact same location, the Councils sampler at Mosida is the one that is so notorious for collecting insects. But this only occurs for a 2-4 weeks during April-May. Moreover, these are not midges as the SP refuses to acknowledge. Rather, they are high numbers of a single species of wasp that likely hatches at that time. Notably, the winter seasonal data is actually slightly below the average. We know that these bugs can number in the 2-3 hundred range in some samples – significantly adding to the P and N results – occurring on the same seasonal basis. Has Wood ever noticed this wasp contamination in his late spring samples. Secondly, the Genola-Lincoln Point samples are high and quite similar to Mosida for the summer season, but clearly back off during winter. I agree with Dr. Gay that we need further seasonal/monthly resolution to help us sort out possible sources of variability. Finally, it is notable that all sites except Elberta have this dramatic shift between summer and winter – likely associated with the colder temperatures and increased soil moisture helping to secure soil particles during winter.

Table 1a*. Averages at all 9 locations for all phosphorus samples for the whole year and for summer (Apr-Sept) and winter (Oct-Ma

Location	Total Phos (mg/l) **all data**	Total Phos (mg/l) **summer**	Total Phos (mg/l) **winter**	Total Phos (mg/l) **TP < 1**	Total Phos (mg/l) **summer**	Total Phos (mg/l) **winter**	Total Phos (mg/l) **TP < 5**	Total Phos (mg/l) **summer**	Total Phos (mg/l) **winter**	all TP samples	TP outliers >1 mg/l	>5 mg/l
BYU	0.092	0.121	0.079	0.092	0.121	0.079	0.092	0.121	0.079	47	0	0
Lincoln Pt	0.724	**1.014**	0.446	0.226	0.355	0.126	0.508	0.784	0.243	49	12	4
Pelican Pt	0.577	0.411	**0.742**	0.234	0.229	0.238	0.427	0.411	0.445	42	7	2
Genola	0.828	**1.312**	0.200	0.221	0.245	0.200	0.442	0.653	0.200	46	10	5
Elberta	0.427	0.420	0.436	0.337	0.353	0.318	0.427	0.420	0.436	46	4	0
Mosida	0.785	**1.144**	0.313	0.306	0.389	0.234	**0.785**	**1.144**	0.313	37	11	2
Lehi	0.590	0.802	0.352	0.224	0.284	0.164	0.468	0.575	0.352	51	10	2
Orem	0.570	0.768	0.273	0.217	0.256	0.163	0.381	0.455	0.273	45	7	1
Sp Fork	0.232	0.375	0.082	0.126	0.172	0.082	0.232	0.375	0.082	45	2	0
averages	0.536	0.707	0.325	0.220	0.267	0.178	0.418	0.549	0.269	408	63	16
no.sample	408	209	199	345	168	185	392	203	197	408 plus 14 BDL as of July 1, 2020		

Figure 1a*. T-P Conc avgs at 9 locations & overall avgs all months Jan 2017 - Jun 2020



9. *Following from these observations, I would recommend keeping a site map in the report from year to year to aid the readers' understanding. It also might be valuable to organize the X-axis into groups of western lake sites, southern lake sites, and eastern side/urban site groupings.*

In the follow-up report I submitted after the Interim Report that Dr. Gay reviewed, I added several figures, including a site map, a picture of the Pelican Pt sampling station, and a typical Utah Lake wind-rose. I have included these 3 figures in this report, Figures 9A, 9B & 9C.

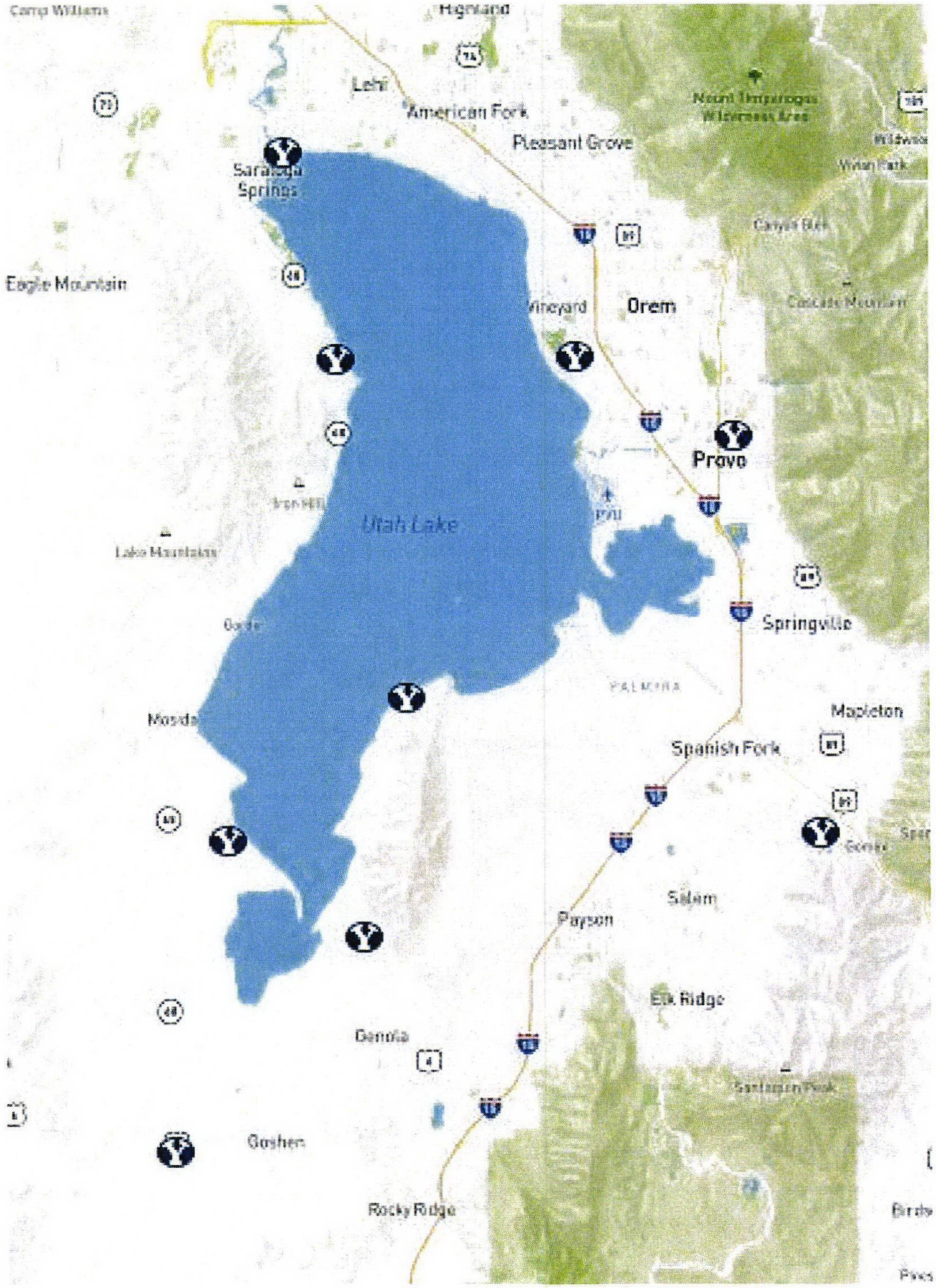


Figure 9A. Map of the 9 Bulk Atmospheric Deposition Measuring Stations

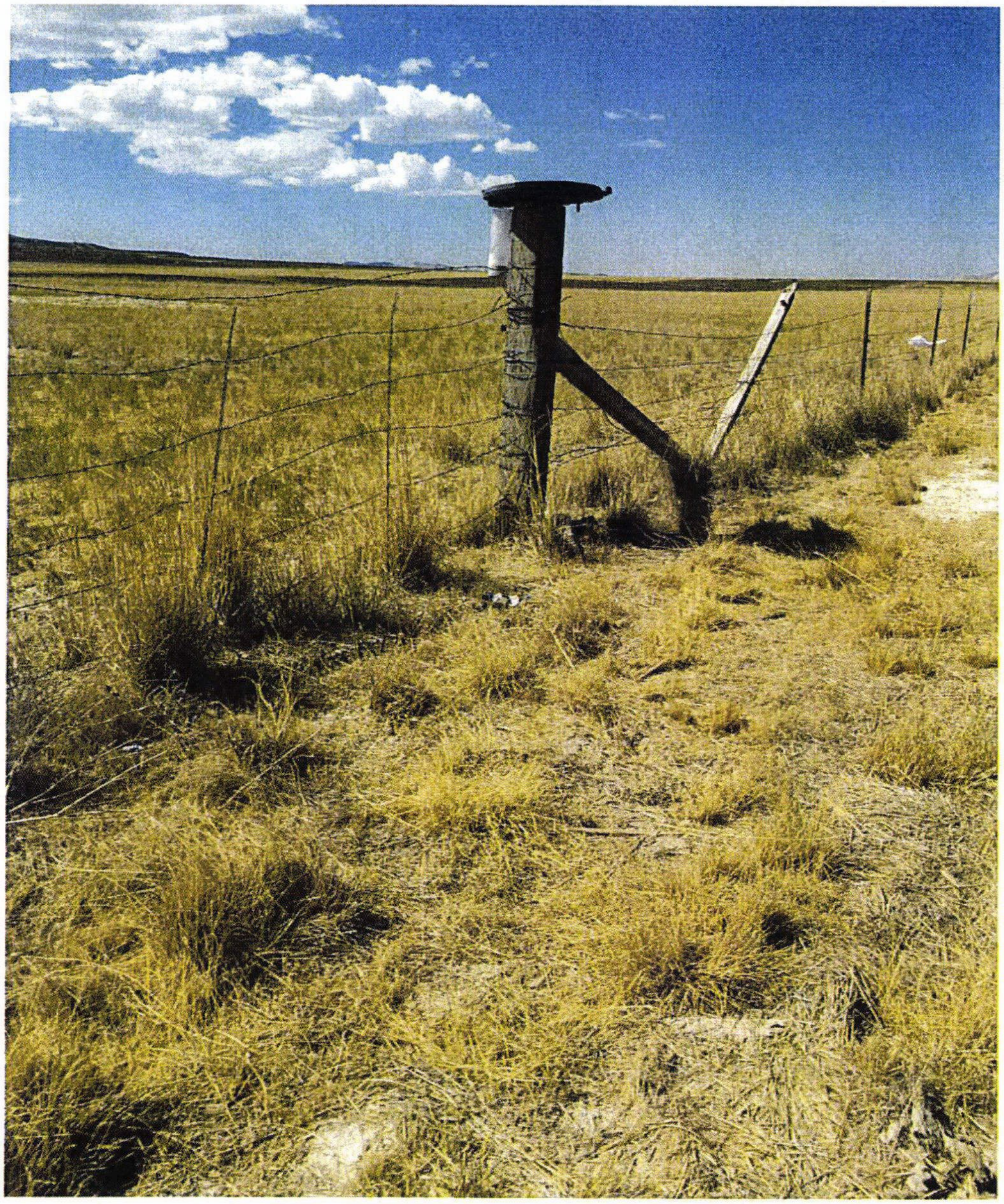


Figure 9B. Pelican Point Bulk Atmospheric Deposition Measuring Station

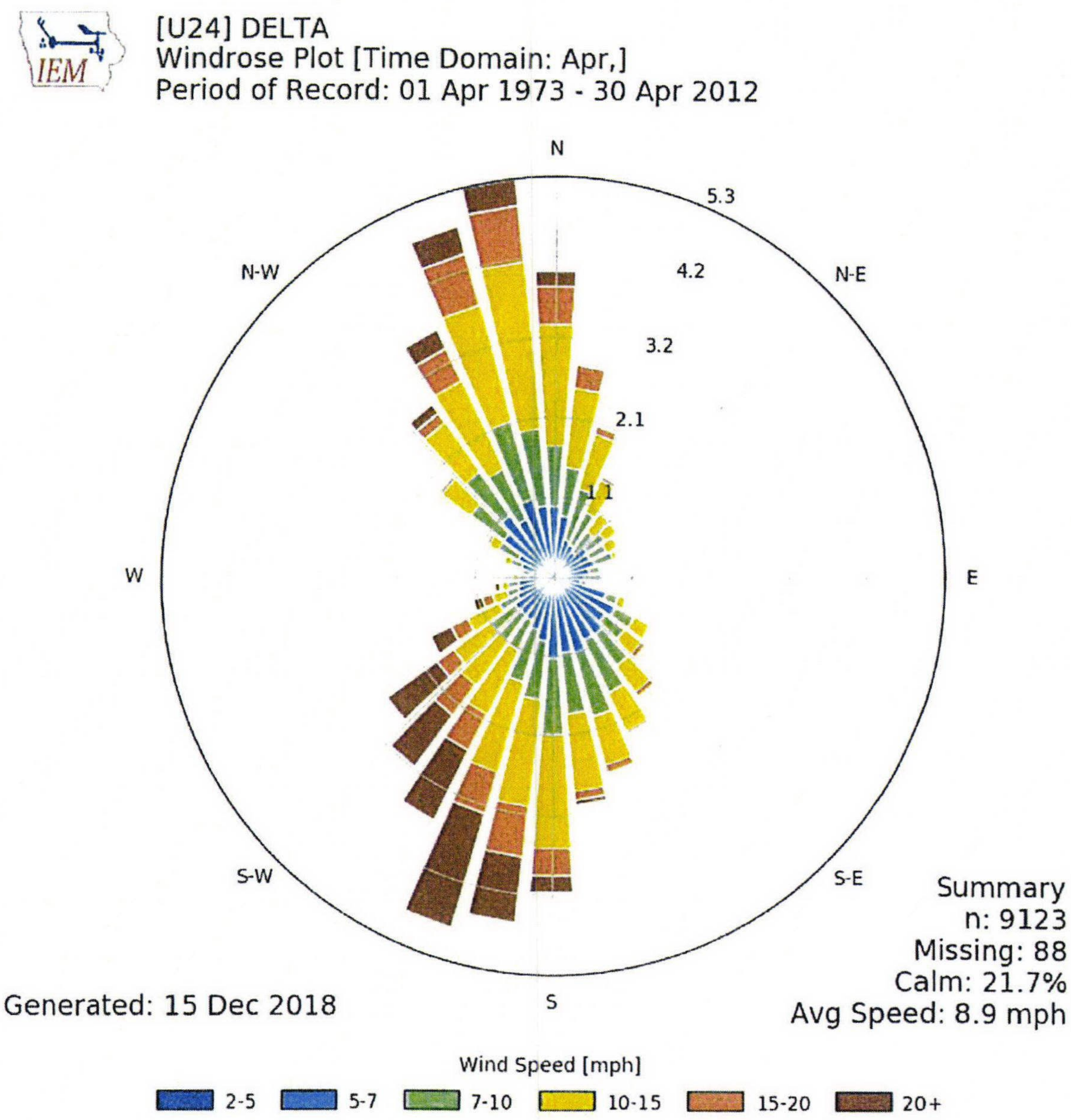


Figure 3 - Windrose from the Provo Airport

Figure 9C. Windrose for Utah Lake Region

Dr. Gay's second suggestion in comment #9 above is to arrange the 9 stations in Tables 1a*, 1b*, and 1c* into 3 groups: West = Lehi and Pelican Pt, South = Mosida, Elberta, Genola and Lincoln Pt, and East = Orem, BYU and Spanish Fork. I have rearranged the locations and show below the new Tables 1a** and 1b** along with corresponding new Figures 1a** and 1b**, not 1c** yet.

Tables 1c* & 1c** (pp. 67 & 68) and Figures 1c* (same as Figure 1g*, p. 66) & 1c** (p. 68), which show all the TN data, are given later with the discussion on TN outliers, after concern #10.

10. As I look at the change between concentrations of TP (Figure 1a SHOWN ABOVE*), LP, PP, and G sites, they have significant and influential outlier data. These are all western sites or southern sites, but the same condition does not show up with the Mosida site as I would expect. It would seem that further investigation into this contrast is needed, since I would expect all sites to have a heavy impact from southwestern dust storms. It suggests that there is another source at the three sites (or a moderator for Mosida) having a significant influence. Similarly, looking at Figure 1g, h, Mosida has a very distinctive outlier influence for TN, as does LP, whereas all of the other sites do not seem to have significantly influential TN outliers. I would conclude from both of these that something is distinctly different at the Mosida site. Further investigation of this record seems warranted.*

Many of the comments and changes made above for concern #8 are applicable to concern #10.

The significant differences between "all data" and "TP < 5" on Figure 1a for the 5 sampling stations listed below are reduced as shown on Figure 1a*. The main reason for large differences is a few outliers. When the 8 largest of the outliers are deleted, Table 1a* and Figure 1a* show the concentration averages for the 5 locations are much closer to each other, similar to TP < 1.

As stated before, in Table 1a*, there are only 6 averages (**bolded**) that are significantly different from the others, 4 in "all data" block and 2 in "TP < 5" block. In the "all data" block, Lin Pt, Genola and Mosida still have high summer avg TP's and Pel Pt has a high winter avg TP. In the "TP < 5" block, Mosida still has a high all year and a high summer TP value.

A reason these 6 averages are higher than others is that these 4 locations have many relatively high concentrations. In summer, Lincoln Pt has 6 samples between 1 & 3. Genola has 5 samples between 1 & 3. Mosida has 6 samples between 1 & 3. In winter, Pelican Pt has 2 samples between 2 & 3.

Listed here are the changes from Figure 1a and Table 1a to Figure 1a* and Table 1a* at these 4 locations. Lincoln Pt: TP conc for all data was reduced from 1.04 to 0.724 mg/l. Pelican Pt: TP conc for all data was reduced from 0.74 to 0.577 mg/l. Genola: TP conc for all data was reduced from 1.21 to 0.828. Mosida: TP conc for all data (and TP > 5) was reduced from 0.99 to 0.785.

Table 1a**. Averages at all 9 locations for all phosphorus samples for the whole year and for summer (Apr-Sept) and winter (Oct-Ma

Location	Total Phos (mg/l) all data	Total Phos (mg/l) summer	Total Phos (mg/l) winter	Total Phos (mg/l) TP < 1	Total Phos (mg/l) summer	Total Phos (mg/l) winter	Total Phos (mg/l) TP < 5	Total Phos (mg/l) summer	Total Phos (mg/l) winter	all TP samples	TP outliers >1 mg/l	>5 mg/l
Lehi	0.590	0.802	0.352	0.224	0.284	0.164	0.468	0.575	0.352	51	10	2
PelicanPt	0.577	0.411	0.742	0.234	0.229	0.238	0.427	0.411	0.445	42	7	2
Mosida	0.785	1.144	0.313	0.306	0.389	0.234	0.785	1.144	0.313	37	11	2
Elberta	0.427	0.420	0.436	0.337	0.353	0.318	0.427	0.420	0.436	46	4	0
Genola	0.828	1.312	0.200	0.221	0.245	0.200	0.442	0.653	0.200	46	10	5
LincolnPt	0.724	1.014	0.446	0.226	0.355	0.126	0.508	0.784	0.243	49	12	4
Orem	0.570	0.768	0.273	0.217	0.256	0.163	0.381	0.455	0.273	45	7	1
BYU	0.092	0.121	0.079	0.092	0.121	0.079	0.092	0.121	0.079	47	0	0
Sp Fork	0.232	0.375	0.082	0.126	0.172	0.082	0.232	0.375	0.082	45	2	0
averages	0.536	0.707	0.325	0.220	0.267	0.178	0.418	0.549	0.269	408	63	16
no.sample	408	209	199	345	168	185	392	203	197	408 plus 14 BDL as of July 1, 2020		

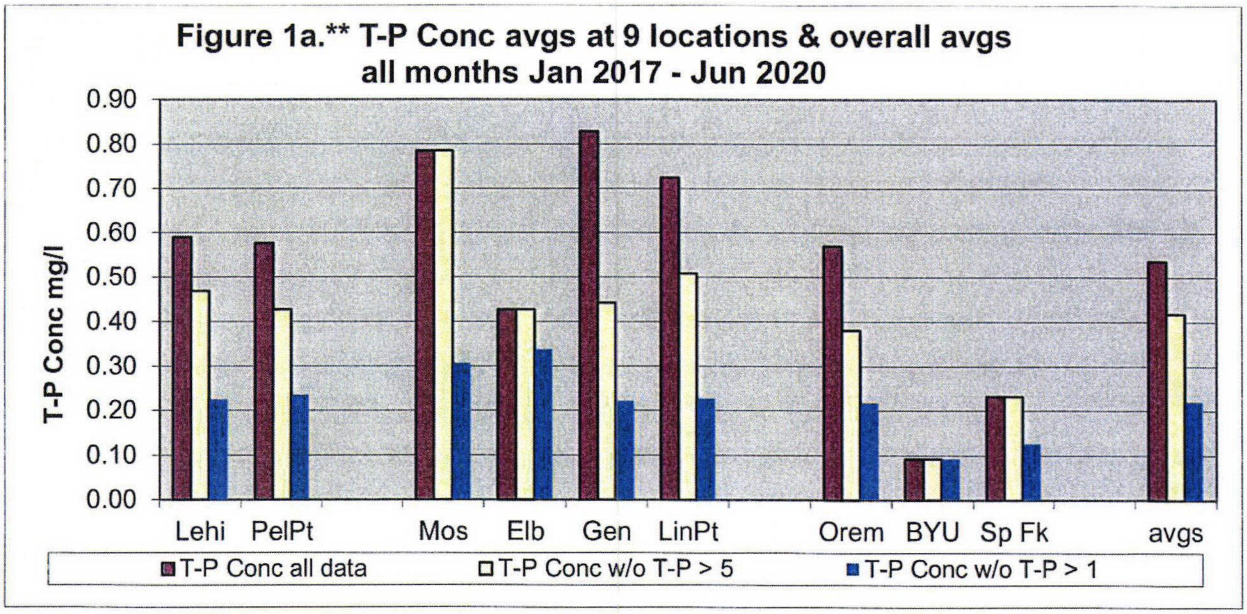
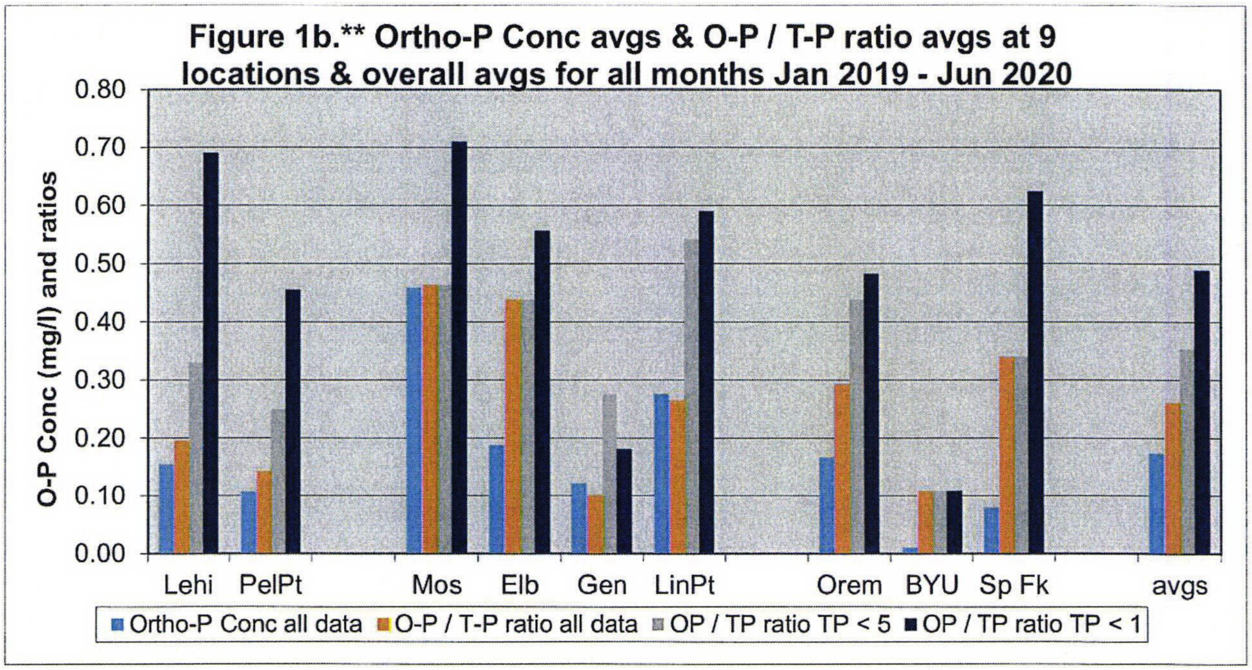


Table 1b**. Averages at all 9 locations for all ortho-phosphorus samples for the whole year and for summer (Apr-Sept) and winter (Oct-Mar).

Location	Ortho-P (mg/l) all data	Ortho-P (mg/l) OP < 1	Ortho-P (mg/l) summer	Ortho-P (mg/l) OP < 1	Ortho-P (mg/l) winter	Ortho-P (mg/l) OP < 1	all Ortho-P samples	with all OP: OP/TP % all data	OP/TP % summer	OP/TP % winter	with only OP < 1: OP/TP % TP < 1	OP/TP % summer	OP/TP % winter	with all OP: OP/TP % TP < 5	OP/TP % summer	OP/TP % winter
Lehi	0.155	0.155	0.163	0.163	0.145	0.145	13	19.557	13.962	41.183	69.010	57.383	88.261	33.023	28.304	41.183
PelicanPt	0.106	0.106	0.112	0.112	0.102	0.102	11	14.284	14.997	13.695	45.476	48.814	42.657	24.891	27.254	22.872
Mosida	0.458	0.217	0.710	0.317	0.143	0.143	9	46.336	48.717	45.509	70.945	81.357	60.897	46.336	48.717	45.509
Elberta	0.188	0.188	0.137	0.137	0.258	0.258	12	43.871	32.622	59.213	55.614	38.894	81.025	43.871	32.622	59.213
Genola	0.122	0.040	0.174	0.041	0.038	0.038	13	10.074	9.024	19.000	18.074	16.910	19.000	27.492	26.624	19.000
LincolnPt	0.275	0.133	0.485	0.247	0.036	0.036	15	26.410	30.002	8.015	58.910	69.541	28.263	54.213	61.869	14.677
Orem	0.167	0.105	0.253	0.131	0.081	0.081	16	29.276	32.871	29.786	48.210	51.266	49.808	43.836	55.448	29.786
BYU	0.010	0.010	0.020	0.020	0.000	0.000	2	10.829	16.575	0.000	10.829	16.575	0.000	10.829	16.575	0.000
Sp Fork	0.079	0.079	0.100	0.100	0.015	0.015	8	33.977	26.682	18.232	62.362	58.011	18.232	33.977	26.682	18.232
averages	0.173	0.115	0.239	0.141	0.091	0.091	99	26.068	25.050	26.070	48.826	48.750	43.127	35.385	36.010	27.830

99 plus 25 BDL
as of July 1, 2020



Furthermore, with regard to Dr. Gay's comments in concern #10 above about TN at Lincoln Pt and Mosida, namely "*Similarly, looking at Figure 1g, h, Mosida has a very distinctive outlier influence for TN, as does LP,*" the following explanation and analysis are given here. Figures 1g, 1h and 1i are shown again below.

As with TP, the large Lincoln Pt and Mosida TN concentrations are due to a few high TN outliers. When the LP 4 largest (out of 53 samples) TN concentrations, namely 24.4, 23.0, 21.4 and 34.2 mg/l, are deleted, the overall averages change from 4.728 to 2.711 mg/l (all months), 5.605 to 3.006 (summer) and 3.481 to 2.318 (winter).

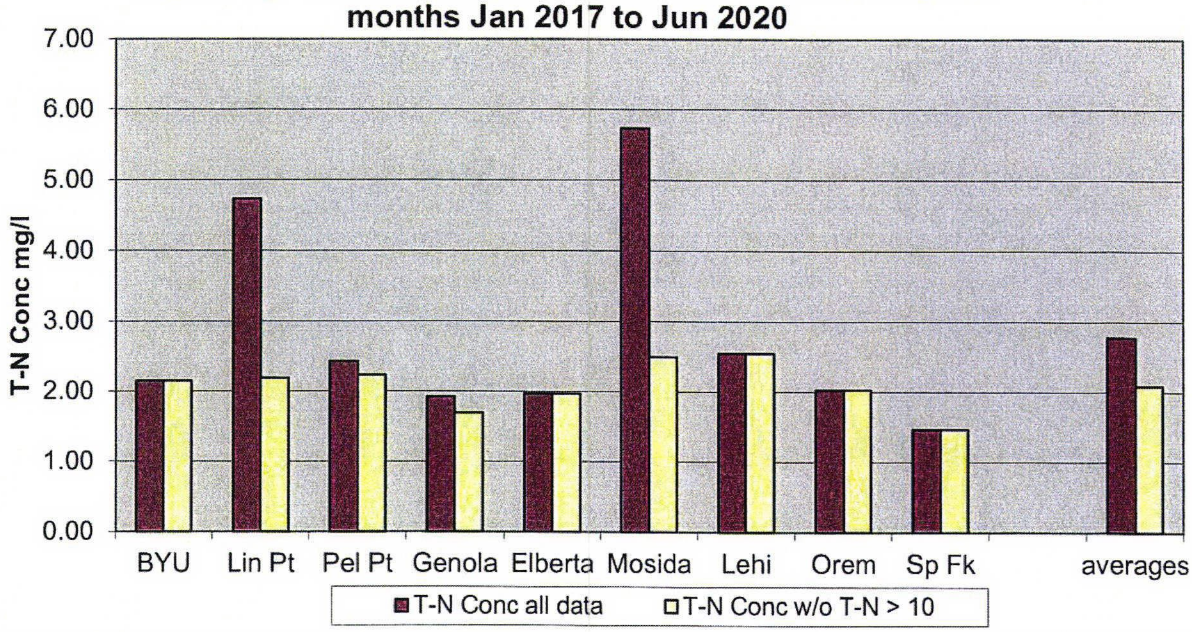
And when the Mosida 3 largest (out of 41 samples) TN concentrations, 49.3, 35.7 and 33.4 mg/l, are deleted, the averages change from 5.732 to 2.920 (all months), 6.674 to 3.371 (summer) and 4.376 to 2.287 (winter).

These are large reductions, about 50%, with few deletions. The new results are plotted on new Figures 1g* (same as Figure 1c*), 1h* and 1i*, and they look much more reasonable for LP and Mosida, consistent with all the other sampling locations.

As to why apparently only Lincoln Pt and Mosida have these high TN outliers, it's not clear.??? Lincoln Pt and Mosida are across the lake from each other a little south of mid-lake. Mosida is in a wide open area and Lincoln Pt is closer to some trees.

Figure 1g shows that Elberta, Lehi, Sp Fk, and BYU all have 0 TN's > 10. Pelican Pt, Genola and Orem each have 1 TN > 10. Lincoln Pt has 6 TN's > 10 of which 4 were deleted to produce Figure 1g* and Mosida has 5 TN's > 10 of which 3 were deleted to give Figure 1g*.

Figure 1g. T-N Conc avgs at 9 locations & overall avgs all months Jan 2017 to Jun 2020



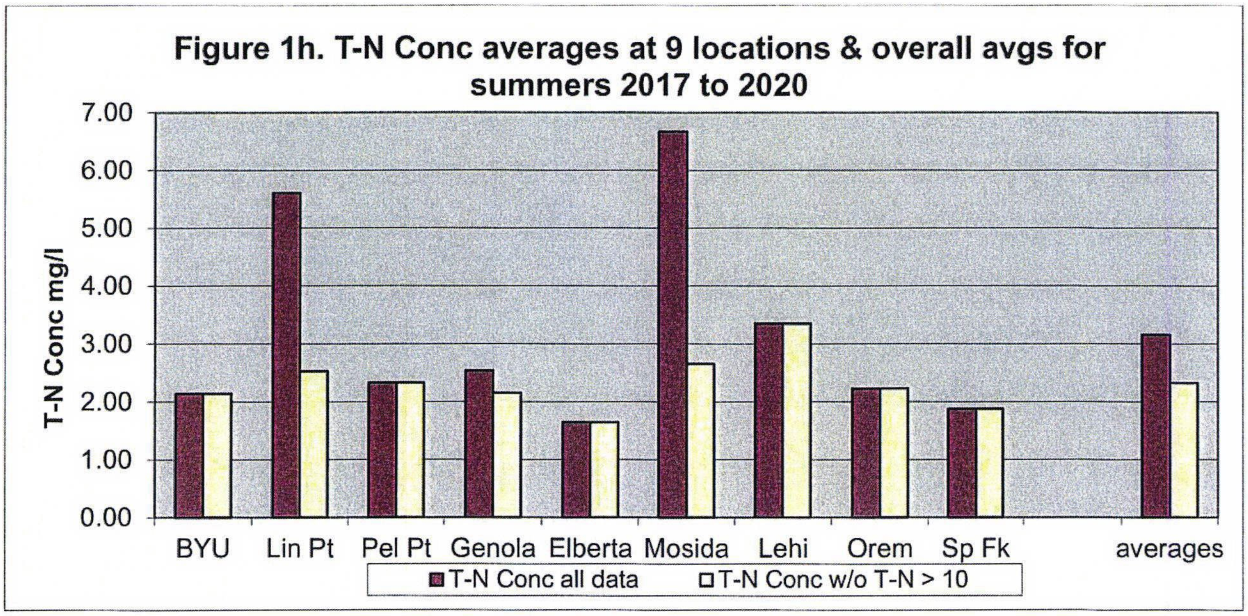


Figure 1h. T-N Conc averages at 9 locations & overall avgs for summers 2017 to 2020
T-N Conc mg/l
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
BYU
Lin Pt
Pel Pt
Genola
Elberta
Mosida
Lehi
Orem
Sp Fk
averages
T-N Conc all data
T-N Conc w/o T-N > 10

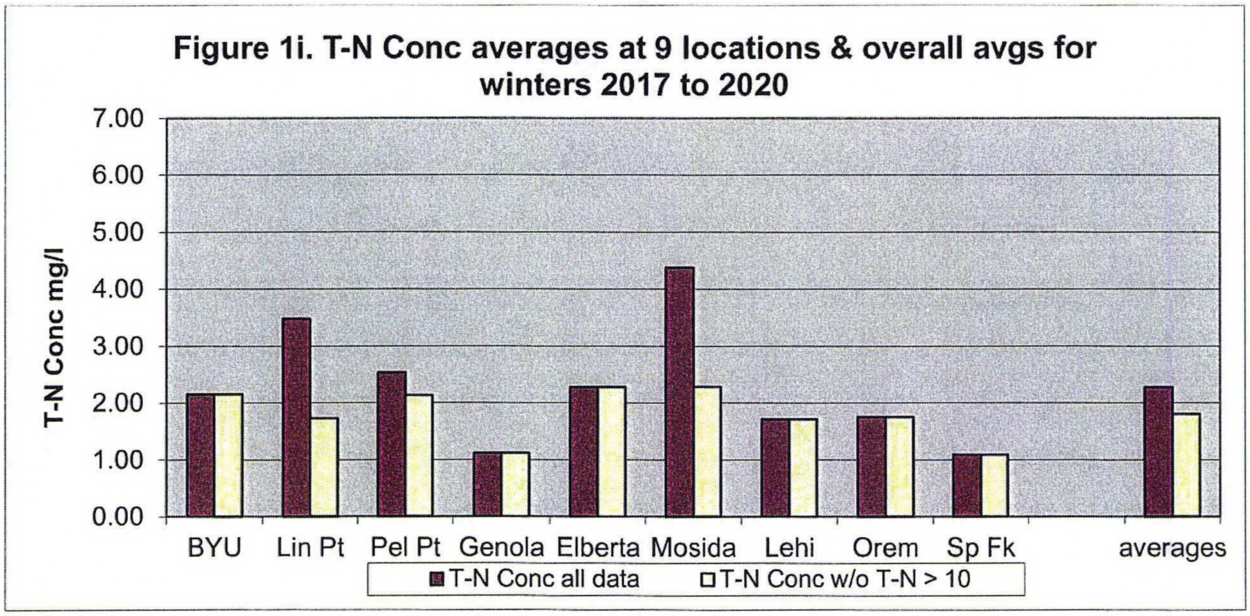


Figure 1i. T-N Conc averages at 9 locations & overall avgs for winters 2017 to 2020
T-N Conc mg/l
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
BYU
Lin Pt
Pel Pt
Genola
Elberta
Mosida
Lehi
Orem
Sp Fk
averages
T-N Conc all data
T-N Conc w/o T-N > 10

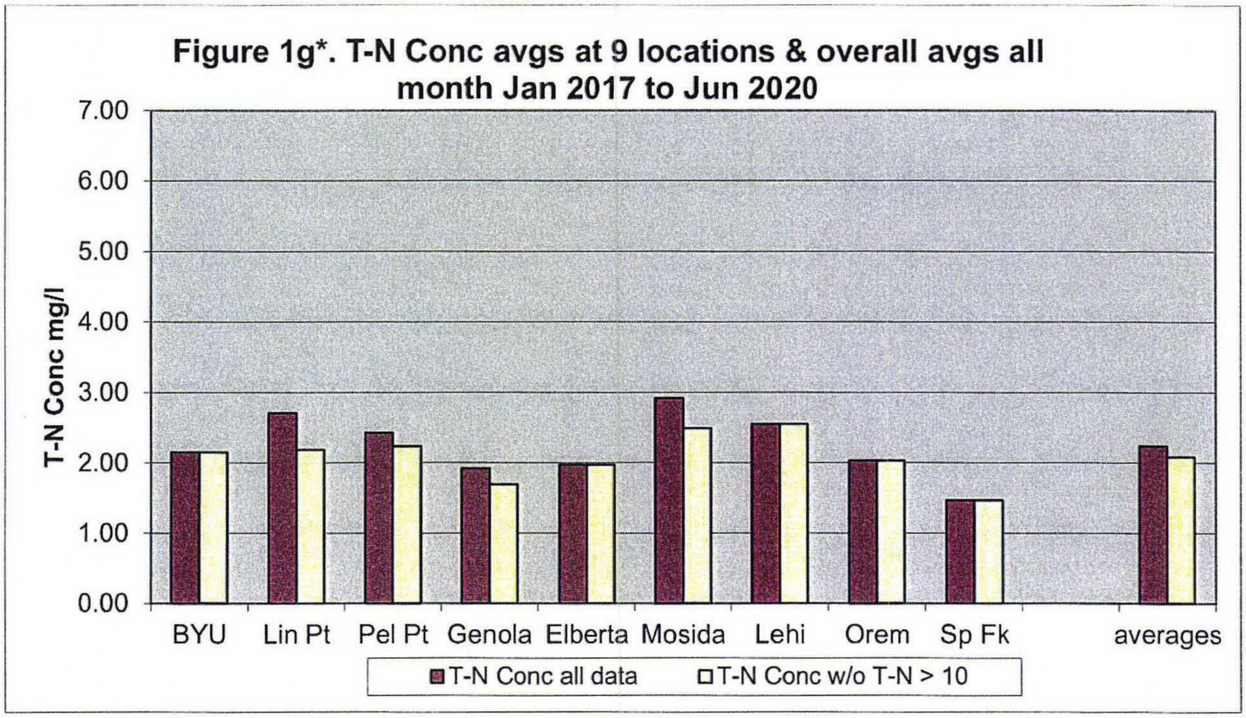


Figure 1g*. T-N Conc avgs at 9 locations & overall avgs all month Jan 2017 to Jun 2020
T-N Conc mg/l
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
BYU
Lin Pt
Pel Pt
Genola
Elberta
Mosida
Lehi
Orem
Sp Fk
averages
T-N Conc all data
T-N Conc w/o T-N > 10

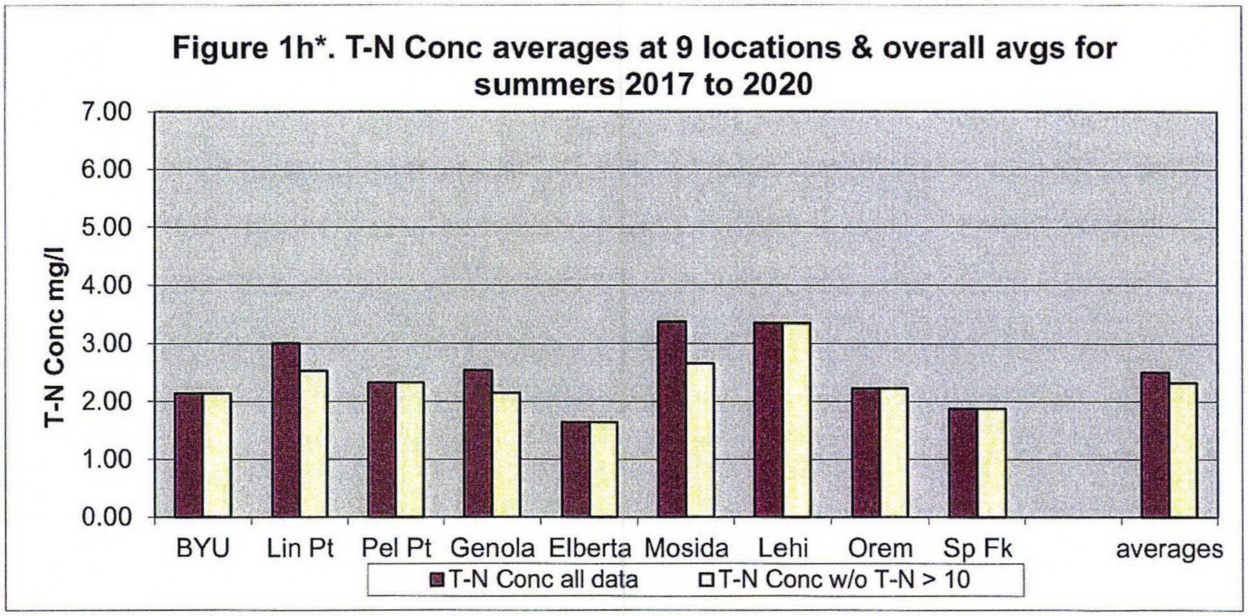


Figure 1h*. T-N Conc averages at 9 locations & overall avgs for summers 2017 to 2020
T-N Conc mg/l
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
BYU
Lin Pt
Pel Pt
Genola
Elberta
Mosida
Lehi
Orem
Sp Fk
averages
T-N Conc all data
T-N Conc w/o T-N > 10

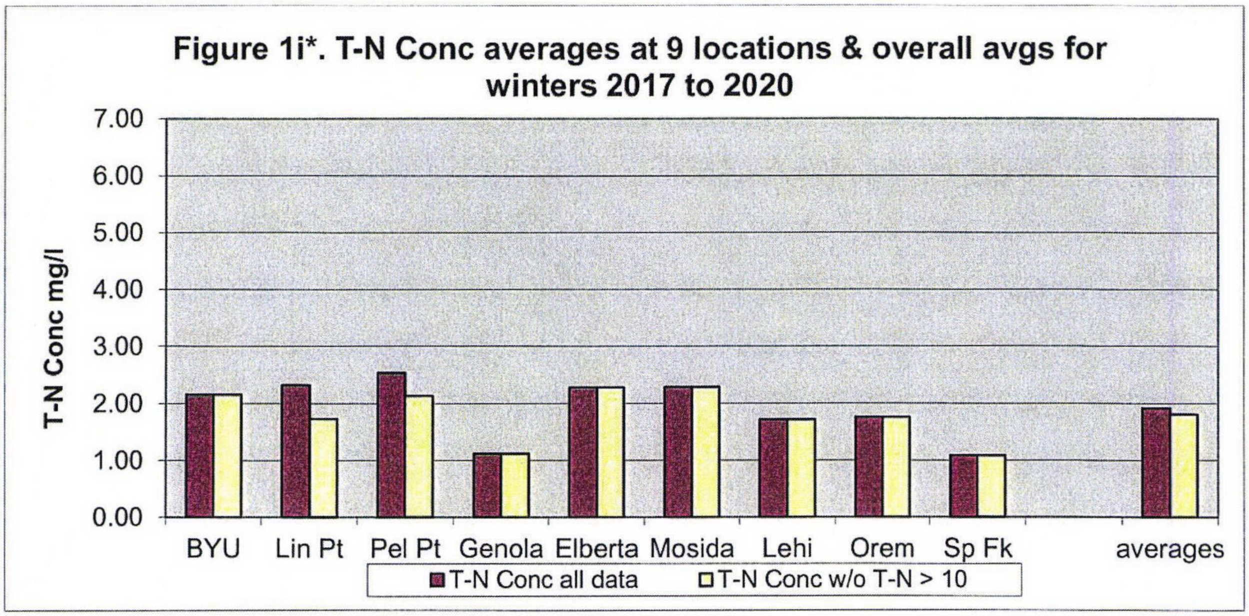


Table 1c with the original TN averages was shown on page 2. Figure 1c (not shown) is the same as Figure 1g given above on page 64. Figure 1c* (not shown) is the same as Figure 1g* given above on page 66. Figure 1g* shows the data given in Table 1c* below. Table 1c** and Figure 1c** are the rearrangements of Table 1c* and Figure 1g* (would be Figure 1c*).

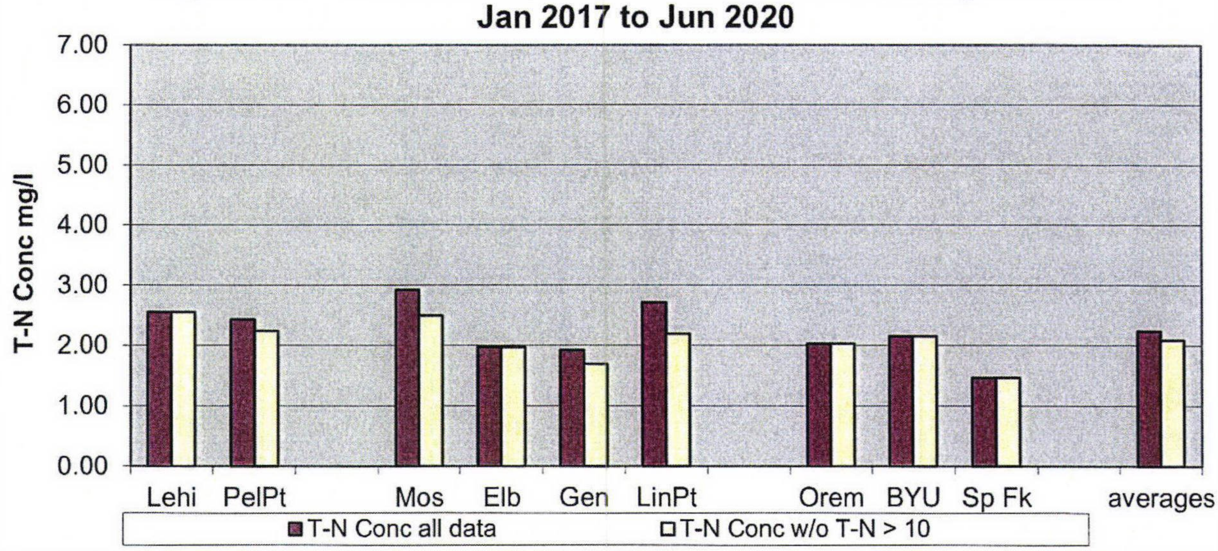
Table 1c*. Averages at 9 locations for nitrogen samples for whole year and for summer and winter.

Location	Total Nitro (mg/l) all data	Total Nitro (mg/l) summer	Total Nitro (mg/l) winter	Total Nitro (mg/l) TN <10	Total Nitro (mg/l) summer	Total Nitro (mg/l) winter	all TN samples	TN outliers >10 mg/l
BYU	2.149	2.137	2.155	2.149	2.137	2.155	43	0
Lincoln Pt	2.711	3.006	2.318	2.187	2.528	1.725	42	6
Pelican Pt	2.428	2.326	2.535	2.234	2.326	2.132	41	1
Genola	1.922	2.535	1.116	1.693	2.149	1.116	44	1
Elberta	1.969	1.643	2.279	1.969	1.643	2.279	39	0
Mosida	2.920	3.371	2.287	2.491	2.653	2.287	36	5
Lehi	2.548	3.348	1.715	2.548	3.348	1.715	49	0
Orem	2.029	2.225	1.756	2.029	2.225	1.756	43	0
Sp Fork	1.466	1.877	1.086	1.466	1.877	1.086	52	0
averages	2.238	2.496	1.916	2.085	2.321	1.806	389	13
no.samples	396	205	191	383	196	187	389 plus 32 BDL as of July 1, 2020	

Table 1c. Averages at 9 locations for nitrogen samples for whole year and for summer and winter.**

Location	Total Nitro (mg/l) **all data**	Total Nitro (mg/l) **summer**	Total Nitro (mg/l) **winter**	Total Nitro (mg/l) **TN <10**	Total Nitro (mg/l) **summer**	Total Nitro (mg/l) **winter**	all TN samples	TN outliers >10 mg/l
Lehi	2.548	3.348	1.715	2.548	3.348	1.715	49	0
PelPt	2.428	2.326	2.535	2.234	2.326	2.132	41	1
Mos	2.920	3.371	2.287	2.491	2.653	2.287	36	5
Elb	1.969	1.643	2.279	1.969	1.643	2.279	39	0
Gen	1.922	2.535	1.116	1.693	2.149	1.116	44	1
LinPt	2.711	3.006	2.318	2.187	2.528	1.725	42	6
Orem	2.029	2.225	1.756	2.029	2.225	1.756	43	0
BYU	2.149	2.137	2.155	2.149	2.137	2.155	43	0
Sp Fk	1.466	1.877	1.086	1.466	1.877	1.086	52	0
averages	2.238	2.496	1.916	2.085	2.321	1.806	389	13

Figure 1c. T-N Conc avgs at 9 locations & overall avgs months Jan 2017 to Jun 2020**



Theron Miller's comment regarding this concern is:

As I suggest above, I think it is possible that the outlier data is actually usable data. During this prolonged drought, there are extended rainless periods but that also experience very high winds – up to 65 mph. This might lead to additional accumulation of dusts during the long dry intervals.

11. *I suggest that the high TP and TN concentration samples be compared to an independent record of the southwest dust storms. If this can be done, and the comparison is favorable, this would provide credence to the entire sampling program and deposition estimates. This could potentially be done with wind direction, wind speed, and rainfall records at the nearest airport/monitoring station to the west.*

I have obtained wind data (mph), wind speed and direction, from three Bureau of Land Management (the old BLM) stations to the west of Utah Lake. The Mud Spring - Eureka station to the southwest is ~ 14 miles from the lake shore and ~ 20 miles from the middle of the lake. The Vernon station to the west is ~ 30 miles from the lake. The Tickville - Eagle Mtn station to the northwest is ~ 13 miles from the middle of the lake.

TOTAL PHOSPHORUS. I determined that all TP >= 1 mg/l samples were collected on 36 different dates. These dates and sample concentrations are shown on Table 11A. Lincoln Pt has TP samples > 1 on 14 dates, Pelican Pt has TP samples > 1 on 11 dates, Genola on 9 dates, Mosida on 13 dates, Lehi on 10 dates, and Orem on 7 dates. There are 6 samples >> 12 mg/l to which I assigned the value of 12.

I tabulated the wind data from the 3 BLM stations corresponding on these 36 dates. The wind data which I used are: avg wind the day before the sample, 10-day avg of avg wind day before the sample, max wind the day before the sample, and the 10-day avg of max wind the day before the sample. These data are listed in Table 11B and plotted on Figures 11A, 11B and 11C.

I have attempted to find reasonable, meaningful, and useful ways to determine if there is a correlation between the wind data and the TP data.

I AM VERY OPEN AND ANXIOUS TO FIND OTHER WAYS TO COMPARE TP & WIND

Method 1: First I plotted all the TP > 1 data for 6 of my sampling locations along with the wind data (mph) from Eureka and Vernon. These bar graphs are shown on Figures 11D – 11F (pages 75 - 77) for Eureka, and Figures 11G – 11I (pages 78 - 80) for Vernon.

Each figure is on one page, has 4 bar graphs, and 2 bar graphs for each sampling station. For example, Figure 11D shows Lincoln Pt and Pelican Pt TP outliers along with Eureka 1) max wind the day before the sample, 2) 10-day avg max wind the day before the sample, and 3) 10-day avg avg wind the day before the sample.

The first of the 2 bar graphs for each station shows all the dates. But as noted above, Lincoln Pt has only 14 of the 36 dates, and Pelican Pt has only 11 of the 36, with TP > 1 data. So the second of the 2 bar graphs for each station shows only those 14, and only those 11 comparisons. Each of the 6 figures with 4 sets of bar graphs has the same configuration.

The next set of graphs shows the same data plotted as line graphs. This is still another way of illustrating the wind and TP comparisons. These plots are shown on Figure 11J for Eureka wind data and Figure 11K for Vernon data (pages 81 and 83). Only the "all dates" bar graphs are shown on the figures.

Table 11A TP Outliers (TP > 1 mg/l): Concentrations and Locations

values > 12 are assigned values of 12

	date	LincolnPt	PelicanPt	Genola	Elberta	Mosida	Lehi	Orem	Sp Fork	BYU
1	22-Feb-17	1.96								
2	8-Apr-17					1.66				
3	25-Apr-17			10						
4	6-May-17			2.1		4.0				
5	17-May-17	8.9		2.6						
6	21-May-17	1.4		9.8		2.6				
7	13-Jun-17	12.0	12.0		1.2				2.7	
8	20-Jun-17		1.0				11.0	1.1		
9	17-Jul-17									
10	25-Jul-17	8.8		5.3		4.6	6.7	2.0		
11	10-Aug-17	12.0	12.0				1.5			
12	15-Sep-17						1.3			
13	24-Sep-17							1.3		
14	5-Nov-17	1.1						1.1		
15	17-Nov-17				1.8		2.3			
16	9-Jan-18					1.5				
17	15-Feb-18		6.7							
18	16-Mar-18				1.3					
19	23-Mar-18		2.5				1.6			
20	7-Apr-18	1.6								
21	20-Apr-18		1.8							
22	30-Apr-18						1.3			
23	3-May-18			2.7						
24	11-May-18		1.4	1.8						
25	22-Aug-18	6.3	1.3	6.0		4.9	2.1			
26	3-Oct-18	5.3	12.0			12.0	1.1			
27	29-Mar-19							1.2		
28	10-Apr-19					1.8				
29	21-Jun-19	2.2				3.1				
30	1-Aug-19	3.7				2.0		1.8		
31	9-Aug-19	1.4		1.4		2.5		8.9		
32	28-Aug-19								2.3	
33	11-Sep-19	1.7	7.8			1.3				
34	13-Mar-20		2.1							
35	23-May-20				1.2	11				
36	8-Jun-20						2.8			
Total		14	11	9	4	13	10	7	2	

Table 11B Wind Data (daily avg and max on day before storm and prior 10 day avg of daily avgs and maxs)

	date	Eureka avg (mph)	previous 10 day avg of avgs	Eureka max (mph)	previous 10 day avg of maxs	Eureka angle (deg)	Vernon avg (mph)	previous 10 day avg of avgs	Vernon max (mph)	previous 10 day avg of maxs	Vernon angle (deg)	Tickville avg (mph)	previous 10 day avg of avgs	Tickville max (mph)	previous 10 day avg of maxs	Tickville angle (deg)
1	22-Feb-17	20	10	42	29		5	9	48	27		4	6	42	22	
2	8-Apr-17	18	12	52	32		12	11	48	32		11	9	45	28	
3	25-Apr-17	10	8	37	31		8	7	41	28		7	7	33	25	
4	6-May-17	8	9	55	28	213	11	8	51	28	146	8	8	38	25	42
5	17-May-17	10	10	46	34	234	8	8	40	31	242	9	9	37	26	352
6	21-May-17	9	10	24	33	345	6	8	25	30	32	5	8	17	25	347
7	13-Jun-17	18	13	49	38	214	15	11	48	33	226	14	10	48	32	214
8	20-Jun-17	8	10	51	32	292	6	8	44	29	214	6	8	25	26	16
9	17-Jul-17	7	7	40	29		6	0.6	30	26		6	6	31	23	
10	25-Jul-17	8	7	30	27	225	6	6	36	29	209	6	6	28	24	60
11	10-Aug-17	7	7	55	33	329	5	6	39	31	200	5	6	41	23	350
12	15-Sep-17	8	7	45	29		7	7	42	29		6	7	30	24	
13	24-Sep-17	6	9	23	27		5	8	34	28		5	8	25	25	
14	5-Nov-17	14	10	41	26	240	12	7	45	25	197	8	6	31	21	185
15	17-Nov-17	17	9	42	25	273	20	8	44	24	196	11	7	42	21	182
16	9-Jan-18	6	6	28	18		11	5	38	16		4	4	24	14	
17	15-Feb-18	10	8	33	26		7	6	27	22		7	7	31	21	
18	16-Mar-18	7	6	49	22		11	6	38	22		7	6	31	21	
19	23-Mar-18	9	8	52	31		8	9	48	33		8	7	41	28	
20	7-Apr-18	7	7	39	29		5	6	38	26		4	7	29	22	
21	20-Apr-18	5	11	29	28		8	10	30	36		6	10	25	29	
22	30-Apr-18	6	9	41	28		8	7	41	27		11	8	39	25	
23	3-May-18	4	8	24	25		6	7	24	26		6	8	21	23	
24	11-May-18	10	7	27	22	332	8	6	29	22	67	10	7	32	22	4
25	22-Aug-18	11	8	36	33	200	10	7	36	29	168	6	6	24	23	120
26	3-Oct-18	8	9	37	28	204	10	8	40	28	186	6	7	28	23	136
27	29-Mar-19	8	7	38	28		6	7	33	24		8	7	38	23	
28	10-Apr-19	10	8	41	27		11	8	36	24		12	7	40	23	
29	21-Jun-19	13	7	47	31	312	11	7	38	27	355	12	7	39	24	312
30	1-Aug-19	8	7	30	27	210	9	6	37	26	194	5	6	26	22	352
31	9-Aug-19	7	7	51	29	273	6	6	47	27	213	6	5	31	23	344
32	28-Aug-19	8	8	37	29		6	7	22	23		7	8	32	25	
33	11-Sep-19	13	8	41	30	209	12	7	52	28	205	9	7	45	25	320
34	13-Mar-20	11	7	28	25	251	6	6	28	24	163	5	6	28	21	140
35	23-May-20	6	11	47	33	230	6	9	58	34	290	5	9	46	30	312
36	8-Jun-20	11	9	32	37	323	8	10	45	40	322	8	8	37	30	343
avgs																
avgs	averages	9.0	8.3	39.0	28.7		8.5	7.1	38.3	27.5		7.3	7.2	32.7	24.0	

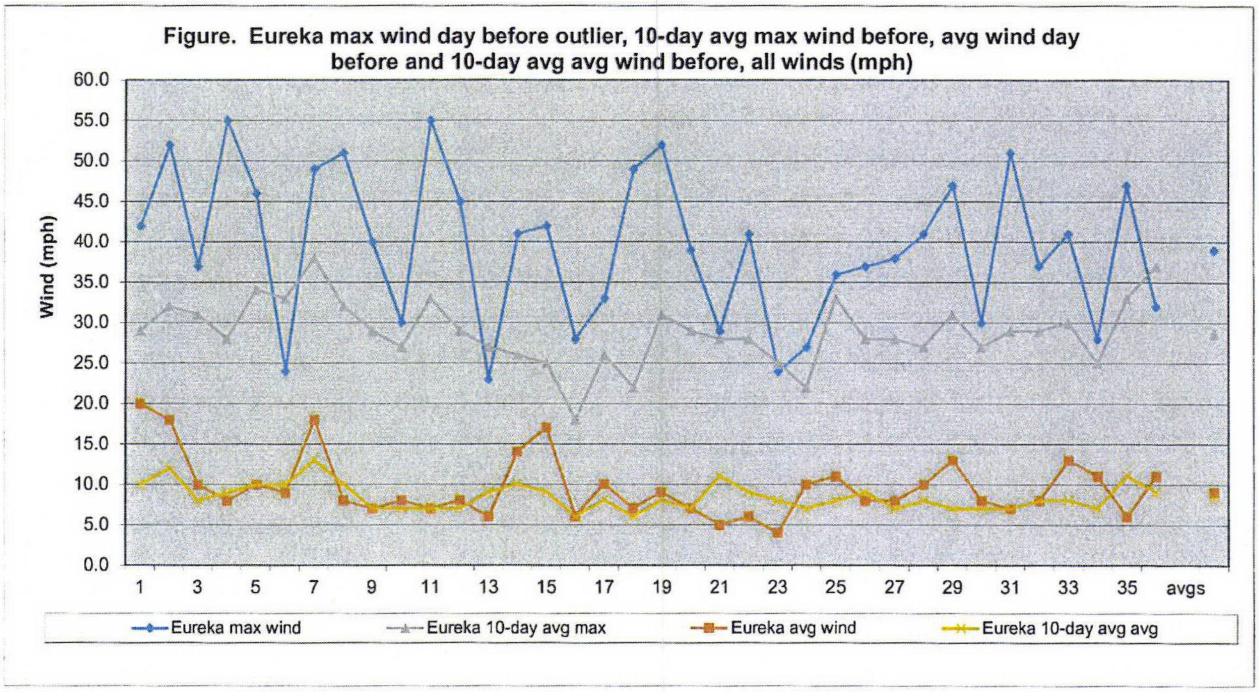


Figure. Eureka max wind day before outlier, 10-day avg max wind before, avg wind day before and 10-day avg avg wind before, all winds (mph)
Wind (mph)
avgs
Eureka max wind
Eureka 10-day avg max
Eureka avg wind
Eureka 10-day avg avg

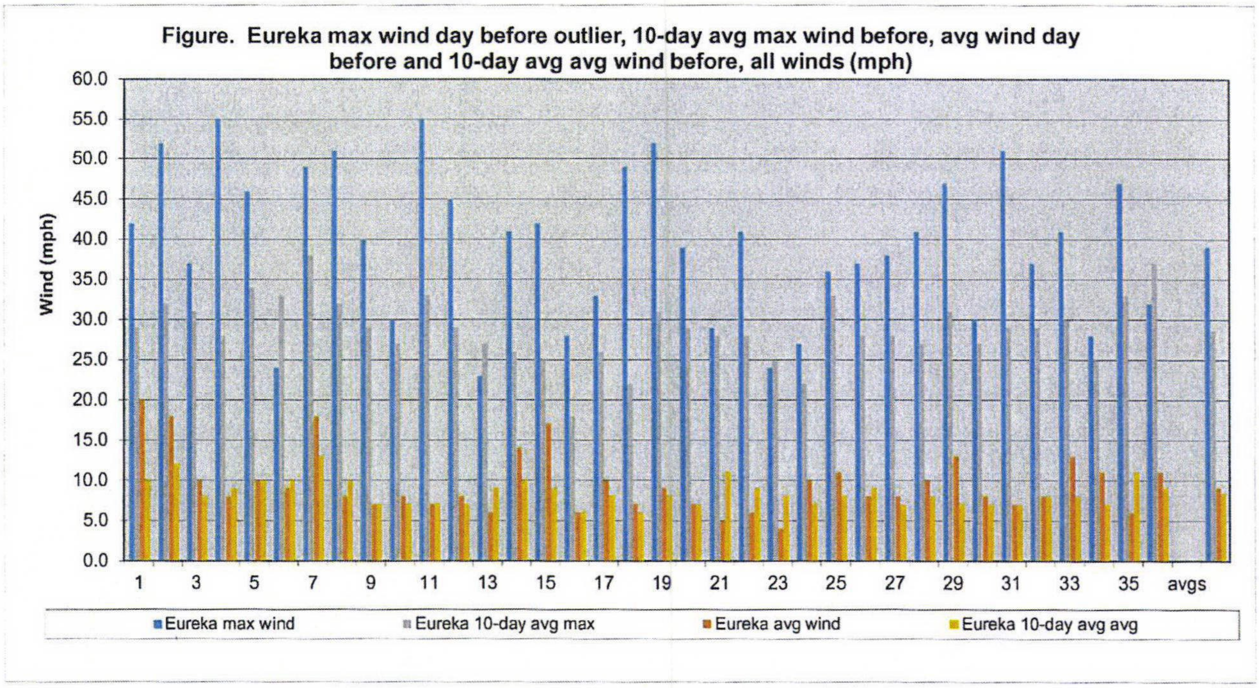


Figure. Eureka max wind day before outlier, 10-day avg max wind before, avg wind day before and 10-day avg avg wind before, all winds (mph)
Wind (mph)
avgs
Eureka max wind
Eureka 10-day avg max
Eureka avg wind
Eureka 10-day avg avg

Figure 11A

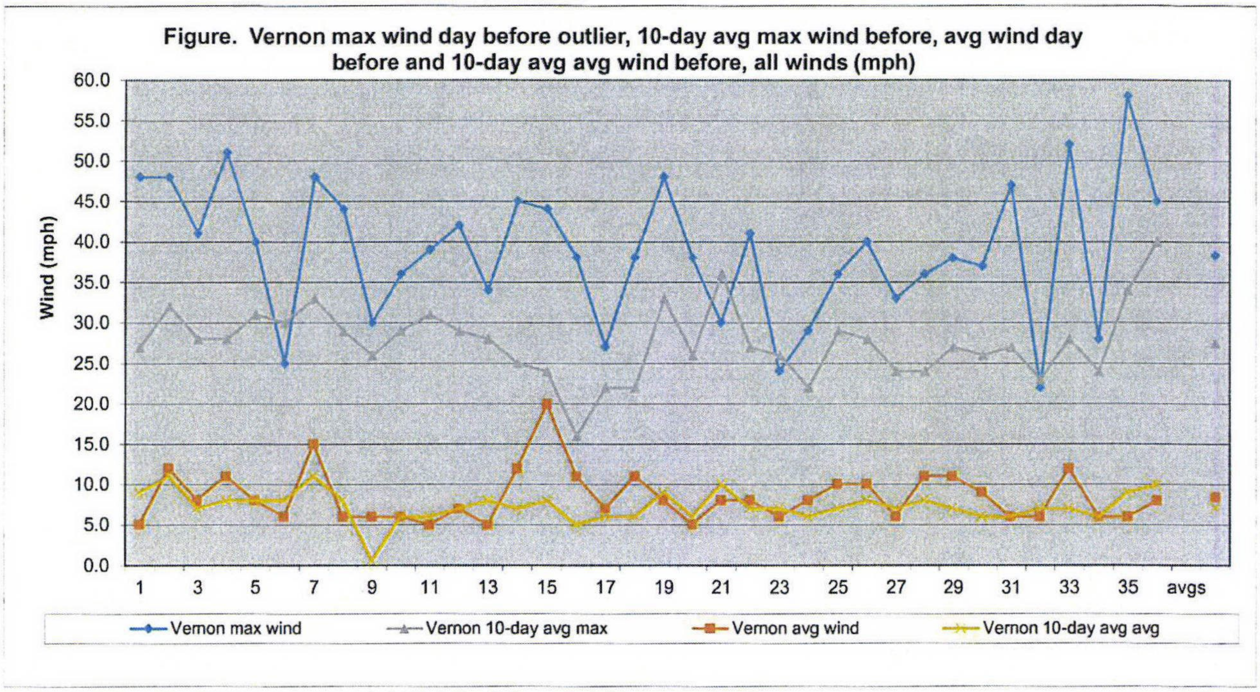


Figure. Vernon max wind day before outlier, 10-day avg max wind before, avg wind day before and 10-day avg avg wind before, all winds (mph)
Wind (mph)
60.0
55.0
50.0
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 avgs
Vernon max wind
Vernon 10-day avg max
Vernon avg wind
Vernon 10-day avg avg

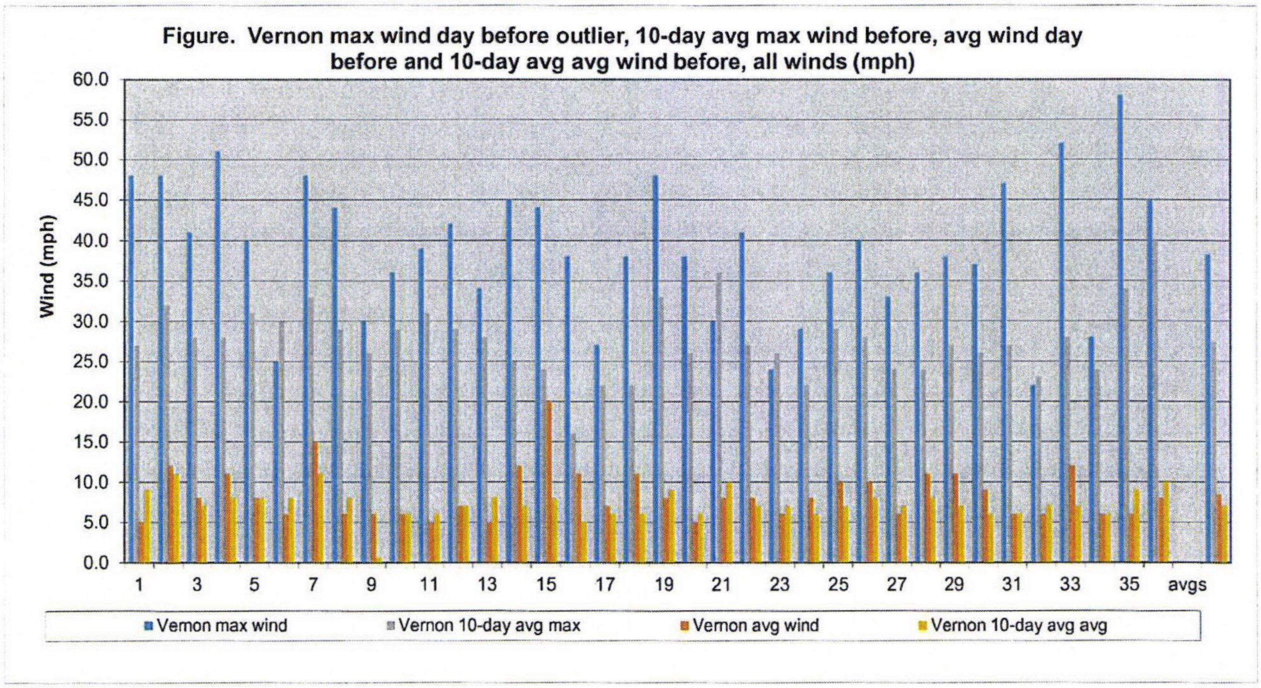


Figure. Vernon max wind day before outlier, 10-day avg max wind before, avg wind day before and 10-day avg avg wind before, all winds (mph)
Wind (mph)
60.0
55.0
50.0
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 avgs
Vernon max wind
Vernon 10-day avg max
Vernon avg wind
Vernon 10-day avg avg

Figure 11B

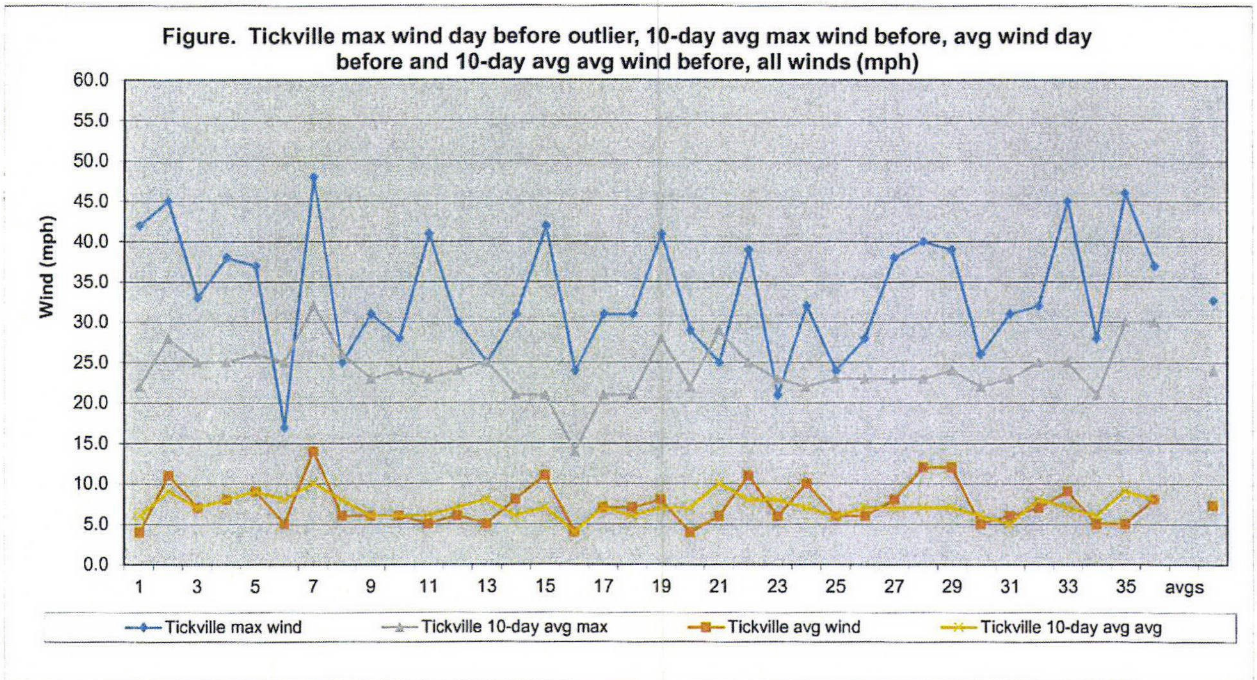


Figure. Tickville max wind day before outlier, 10-day avg max wind before, avg wind day before and 10-day avg avg wind before, all winds (mph)
Wind (mph)
60.0
55.0
50.0
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 avgs
Tickville max wind
Tickville 10-day avg max
Tickville avg wind
Tickville 10-day avg avg

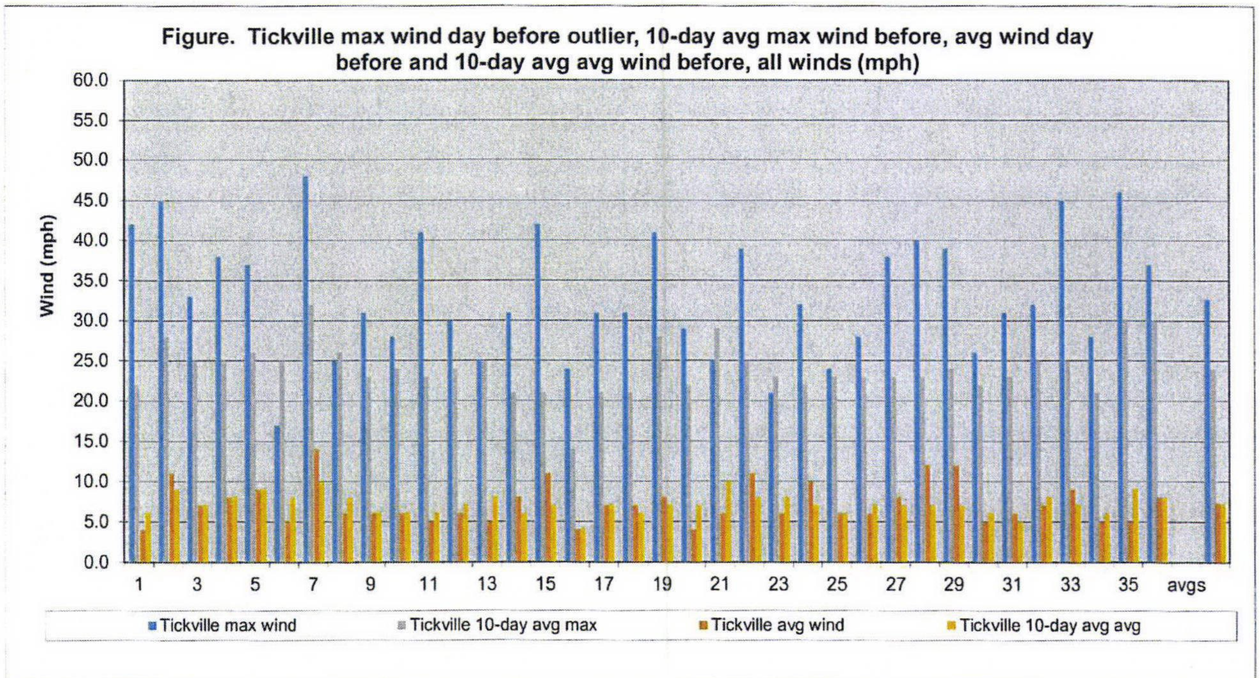


Figure. Tickville max wind day before outlier, 10-day avg max wind before, avg wind day before and 10-day avg avg wind before, all winds (mph)
Wind (mph)
60.0
55.0
50.0
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 avgs
Tickville max wind
Tickville 10-day avg max
Tickville avg wind
Tickville 10-day avg avg

Figure 11C

Figure .TP > 1 mg/l outliers at Lincoln Pt vs. Eureka max wind day before outlier, 10-day avg max wind before & 10-day avg avg wind before, all winds (mph) x 10
ALL TP > 1 DATA AND ALL WIND DATA

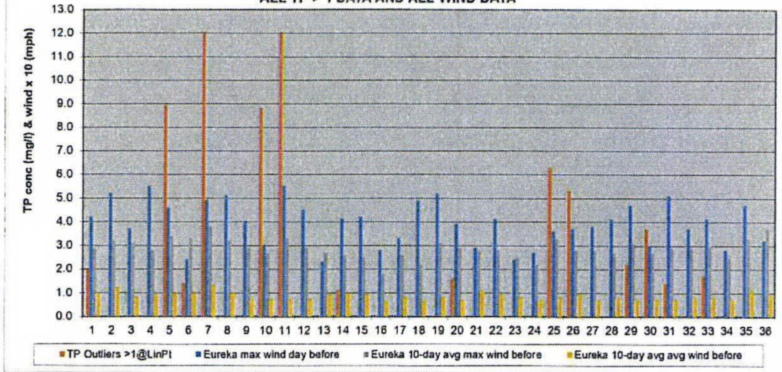


Figure .TP > 1 mg/l outliers at Lincoln Pt vs. Eureka max wind day before outlier, 10-day avg max wind before & 10-day avg avg wind before, all winds (mph) x 10
ALL TP > 1 DATA AND CORRESPONDING WIND DATA

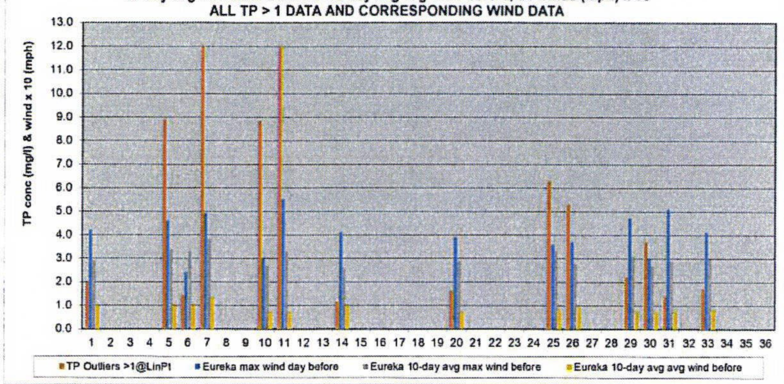


Figure .TP > 1 mg/l outliers at Pelican Pt vs. Eureka max wind day before outlier, 10-day avg max wind before & 10-day avg avg wind before, all winds (mph) x 10
ALL TP > 1 DATA AND ALL WIND DATA

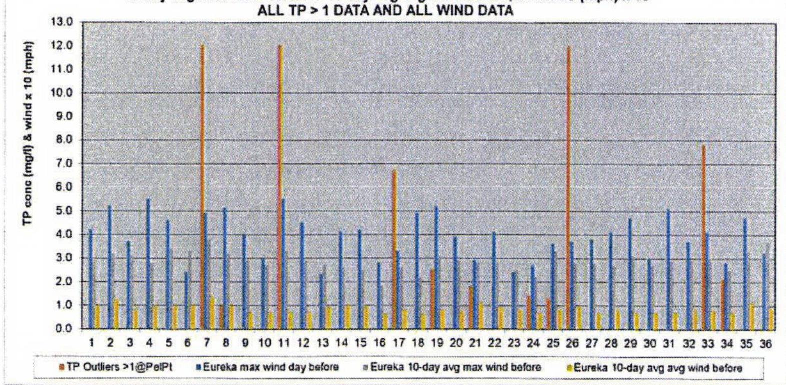


Figure .TP > 1 mg/l outliers at Pelican Pt vs. Eureka max wind day before outlier, 10-day avg max wind before & 10-day avg avg wind before, all winds (mph) x 10
ALL TP > 1 DATA AND CORRESPONDING WIND DATA

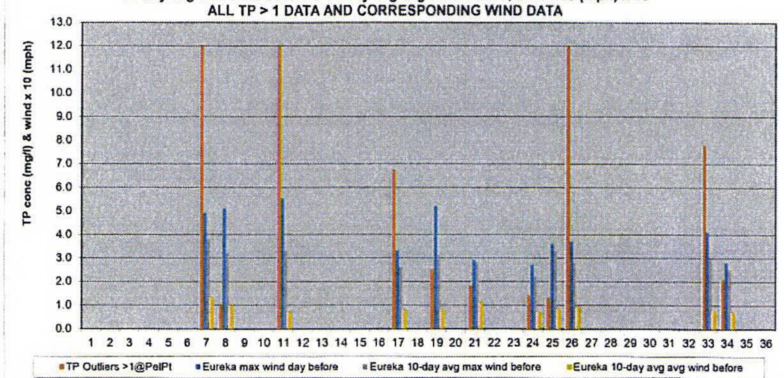


Figure 11D

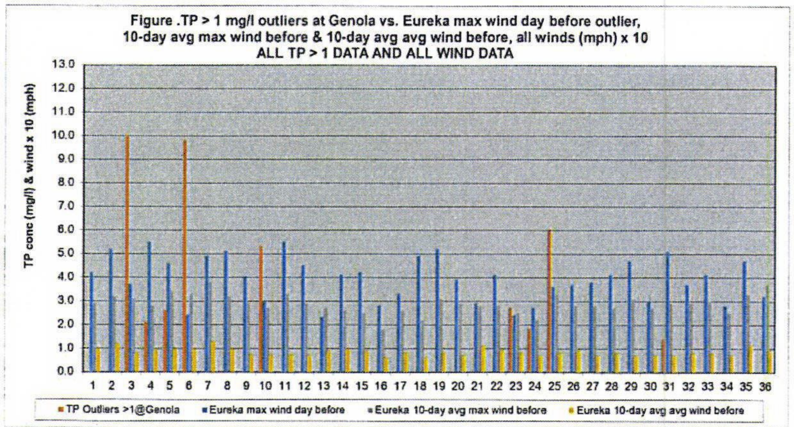


Figure .TP > 1 mg/l outliers at Genola vs. Eureka max wind day before outlier, 10-day avg max wind before & 10-day avg avg wind before, all winds (mph) x 10
ALL TP > 1 DATA AND ALL WIND DATA
TP conc (mg/l) & wind x 10 (mph)
TP Outliers >1@Genola
Eureka max wind day before
Eureka 10-day avg max wind before
Eureka 10-day avg avg wind before

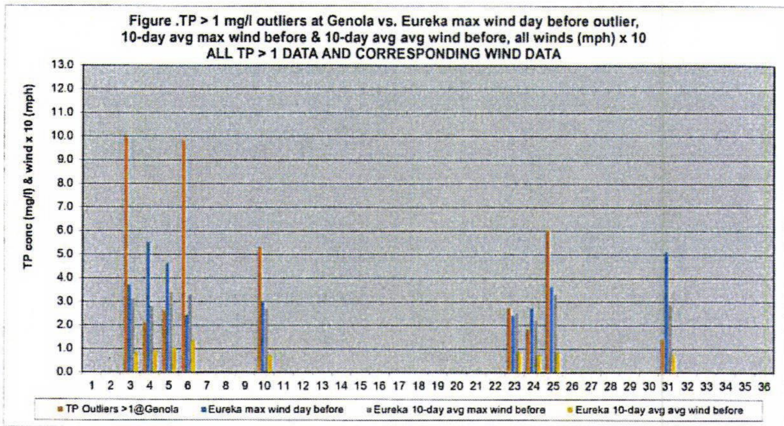


Figure .TP > 1 mg/l outliers at Genola vs. Eureka max wind day before outlier, 10-day avg max wind before & 10-day avg avg wind before, all winds (mph) x 10
ALL TP > 1 DATA AND CORRESPONDING WIND DATA
TP conc (mg/l) & wind x 10 (mph)
TP Outliers >1@Genola
Eureka max wind day before
Eureka 10-day avg max wind before
Eureka 10-day avg avg wind before

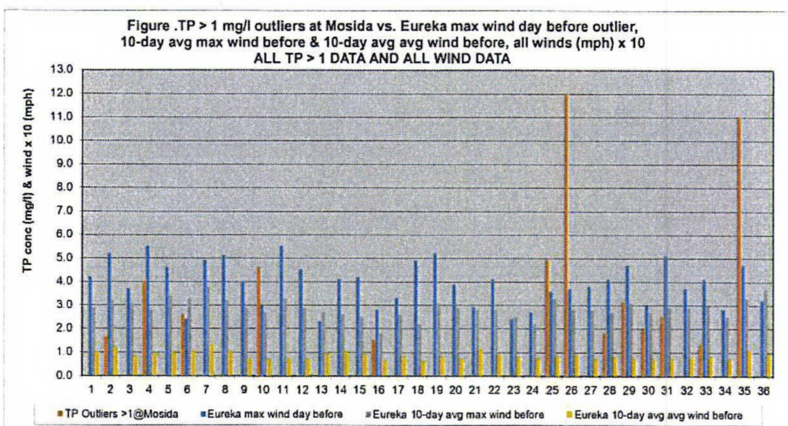


Figure .TP > 1 mg/l outliers at Mosida vs. Eureka max wind day before outlier, 10-day avg max wind before & 10-day avg avg wind before, all winds (mph) x 10
ALL TP > 1 DATA AND ALL WIND DATA
TP conc (mg/l) & wind x 10 (mph)
TP Outliers >1@Mosida
Eureka max wind day before
Eureka 10-day avg max wind before
Eureka 10-day avg avg wind before

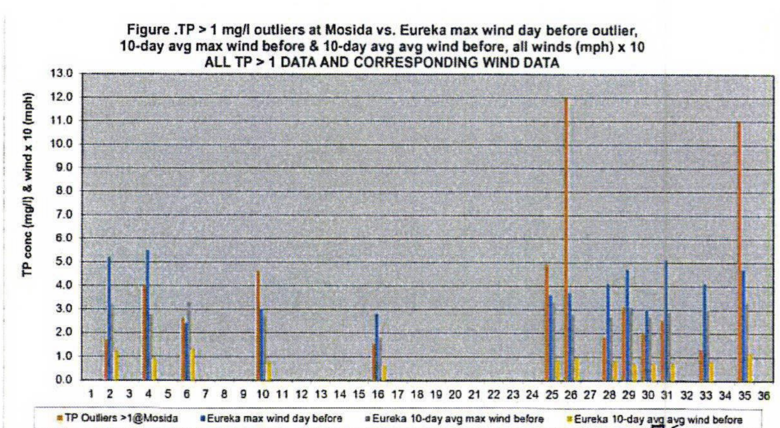


Figure .TP > 1 mg/l outliers at Mosida vs. Eureka max wind day before outlier, 10-day avg max wind before & 10-day avg avg wind before, all winds (mph) x 10
ALL TP > 1 DATA AND CORRESPONDING WIND DATA
TP conc (mg/l) & wind x 10 (mph)
TP Outliers >1@Mosida
Eureka max wind day before
Eureka 10-day avg max wind before
Eureka 10-day avg avg wind before

Figure 11E

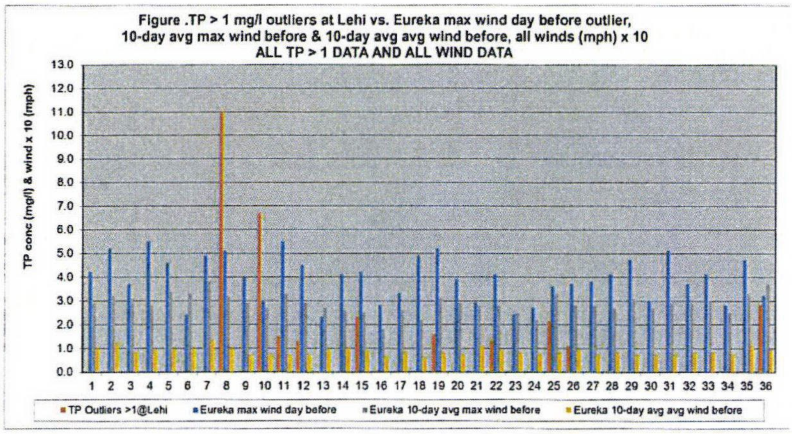


Figure .TP > 1 mg/l outliers at Lehi vs. Eureka max wind day before outlier, 10-day avg max wind before & 10-day avg avg wind before, all winds (mph) x 10
ALL TP > 1 DATA AND ALL WIND DATA
TP conc (mg/l) & wind x 10 (mph)
TP Outliers >1@Lehi
Eureka max wind day before
Eureka 10-day avg max wind before
Eureka 10-day avg avg wind before

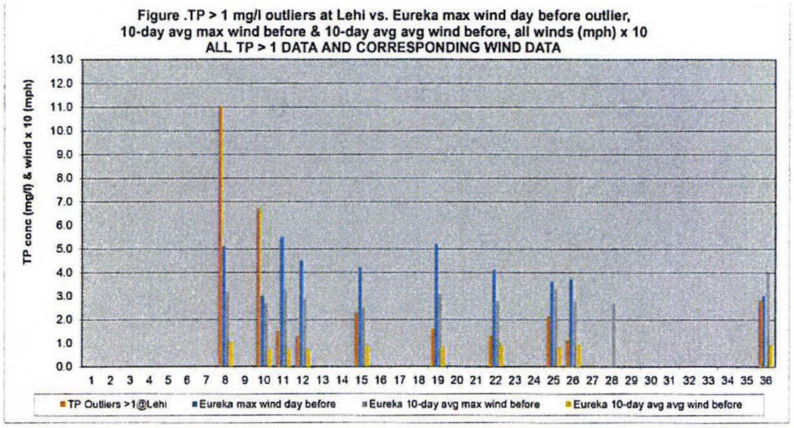


Figure .TP > 1 mg/l outliers at Lehi vs. Eureka max wind day before outlier, 10-day avg max wind before & 10-day avg avg wind before, all winds (mph) x 10
ALL TP > 1 DATA AND CORRESPONDING WIND DATA
TP conc (mg/l) & wind x 10 (mph)
TP Outliers >1@Lehi
Eureka max wind day before
Eureka 10-day avg max wind before
Eureka 10-day avg avg wind before

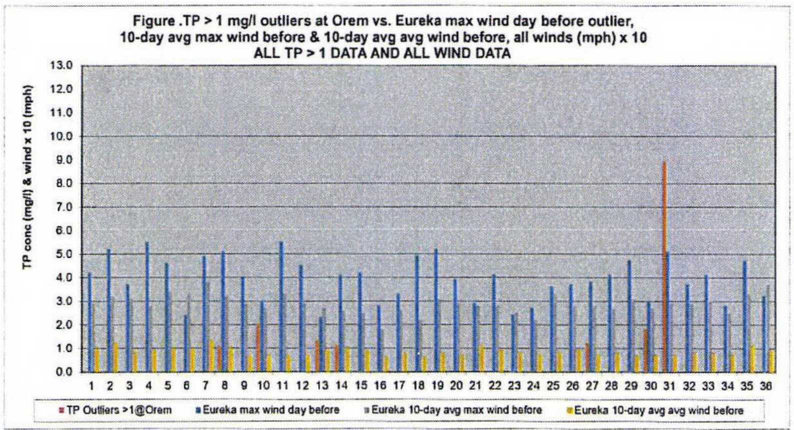


Figure .TP > 1 mg/l outliers at Orem vs. Eureka max wind day before outlier, 10-day avg max wind before & 10-day avg avg wind before, all winds (mph) x 10
ALL TP > 1 DATA AND ALL WIND DATA
TP conc (mg/l) & wind x 10 (mph)
TP Outliers >1@Orem
Eureka max wind day before
Eureka 10-day avg max wind before
Eureka 10-day avg avg wind before

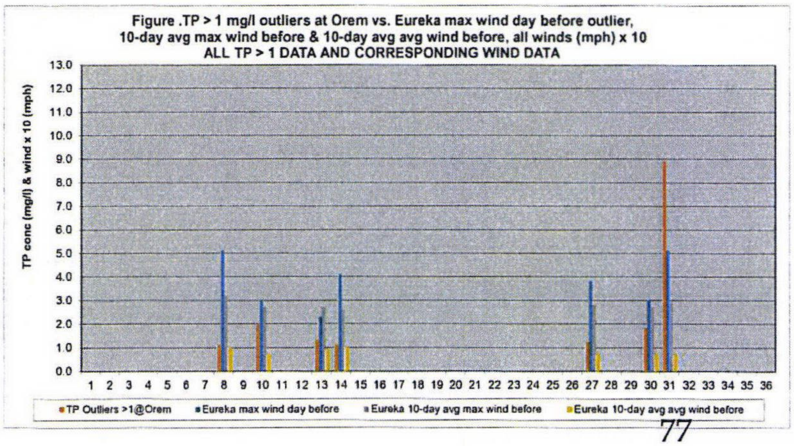


Figure .TP > 1 mg/l outliers at Orem vs. Eureka max wind day before outlier, 10-day avg max wind before & 10-day avg avg wind before, all winds (mph) x 10
ALL TP > 1 DATA AND CORRESPONDING WIND DATA
TP conc (mg/l) & wind x 10 (mph)
TP Outliers >1@Orem
Eureka max wind day before
Eureka 10-day avg max wind before
Eureka 10-day avg avg wind before

Figure 11F

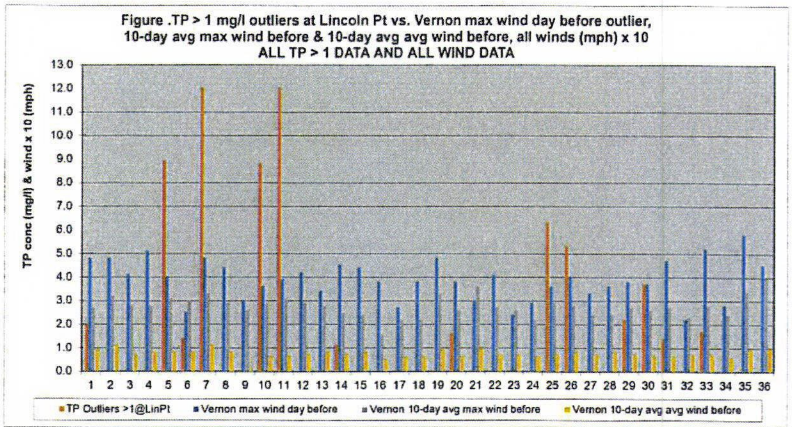


Figure .TP > 1 mg/l outliers at Lincoln Pt vs. Vernon max wind day before outlier, 10-day avg max wind before & 10-day avg avg wind before, all winds (mph) x 10
ALL TP > 1 DATA AND ALL WIND DATA
TP conc (mg/l) & wind x 10 (mph)
TP Outliers >1@LinPt
Vernon max wind day before
Vernon 10-day avg max wind before
Vernon 10-day avg avg wind before

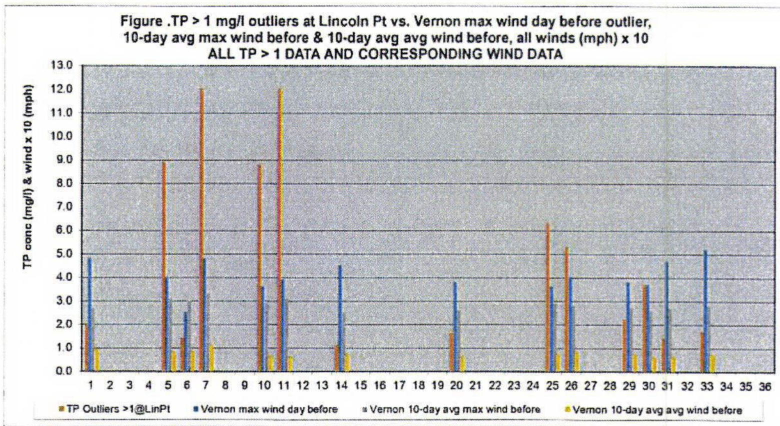


Figure .TP > 1 mg/l outliers at Lincoln Pt vs. Vernon max wind day before outlier, 10-day avg max wind before & 10-day avg avg wind before, all winds (mph) x 10
ALL TP > 1 DATA AND CORRESPONDING WIND DATA
TP conc (mg/l) & wind x 10 (mph)
TP Outliers >1@LinPt
Vernon max wind day before
Vernon 10-day avg max wind before
Vernon 10-day avg avg wind before

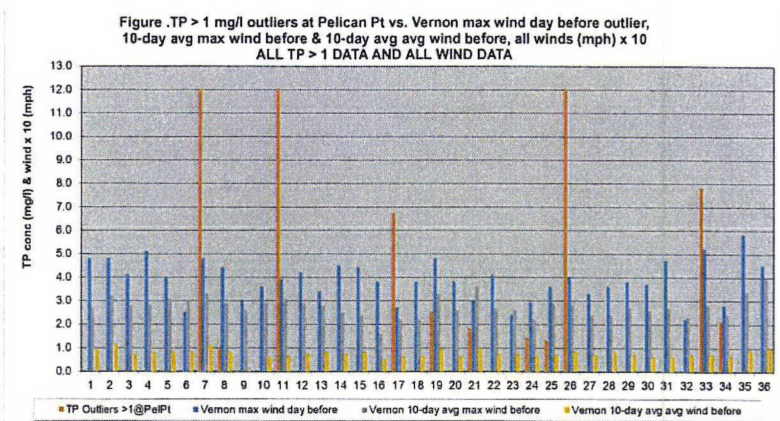


Figure .TP > 1 mg/l outliers at Pelican Pt vs. Vernon max wind day before outlier, 10-day avg max wind before & 10-day avg avg wind before, all winds (mph) x 10
ALL TP > 1 DATA AND ALL WIND DATA
TP conc (mg/l) & wind x 10 (mph)
TP Outliers >1@PelPt
Vernon max wind day before
Vernon 10-day avg max wind before
Vernon 10-day avg avg wind before

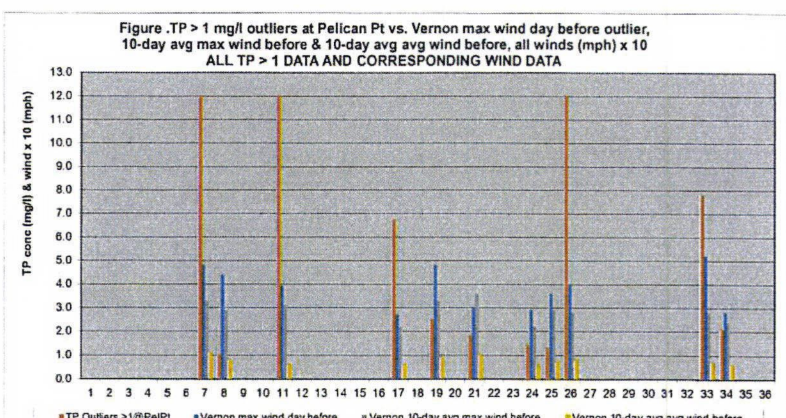


Figure .TP > 1 mg/l outliers at Pelican Pt vs. Vernon max wind day before outlier, 10-day avg max wind before & 10-day avg avg wind before, all winds (mph) x 10
ALL TP > 1 DATA AND CORRESPONDING WIND DATA
TP conc (mg/l) & wind x 10 (mph)
TP Outliers >1@PelPt
Vernon max wind day before
Vernon 10-day avg max wind before
Vernon 10-day avg avg wind before

Figure 11G

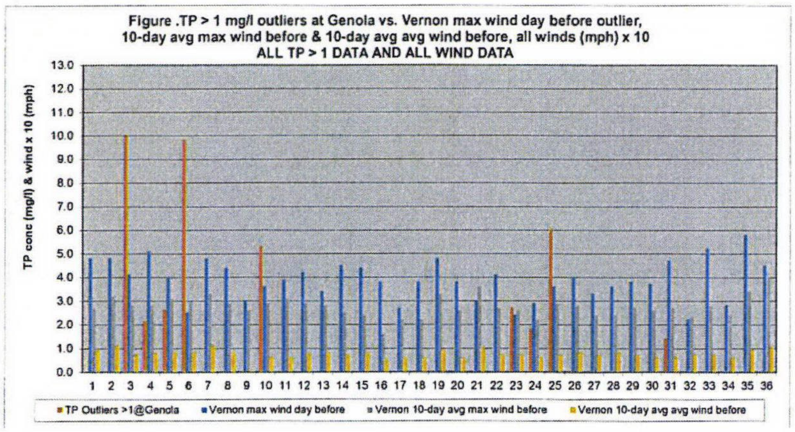


Figure .TP > 1 mg/l outliers at Genola vs. Vernon max wind day before outlier, 10-day avg max wind before & 10-day avg avg wind before, all winds (mph) x 10
ALL TP > 1 DATA AND ALL WIND DATA
TP conc (mg/l) & wind x 10 (mph)
TP Outliers >1@Genola
Vernon max wind day before
Vernon 10-day avg max wind before
Vernon 10-day avg avg wind before

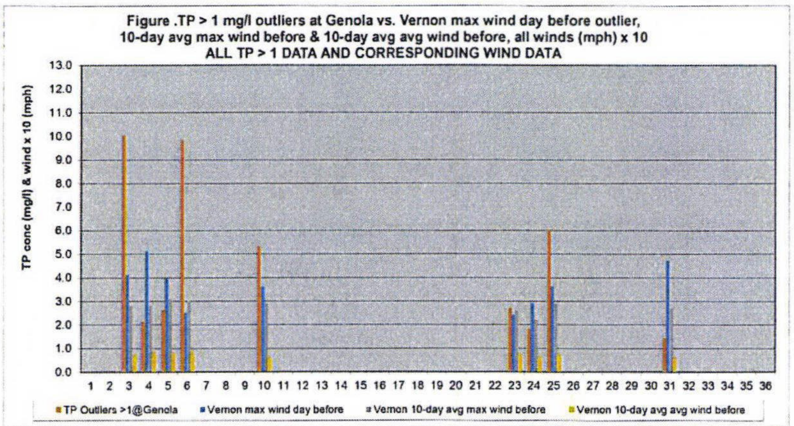


Figure .TP > 1 mg/l outliers at Genola vs. Vernon max wind day before outlier, 10-day avg max wind before & 10-day avg avg wind before, all winds (mph) x 10
ALL TP > 1 DATA AND CORRESPONDING WIND DATA
TP conc (mg/l) & wind x 10 (mph)
TP Outliers >1@Genola
Vernon max wind day before
Vernon 10-day avg max wind before
Vernon 10-day avg avg wind before

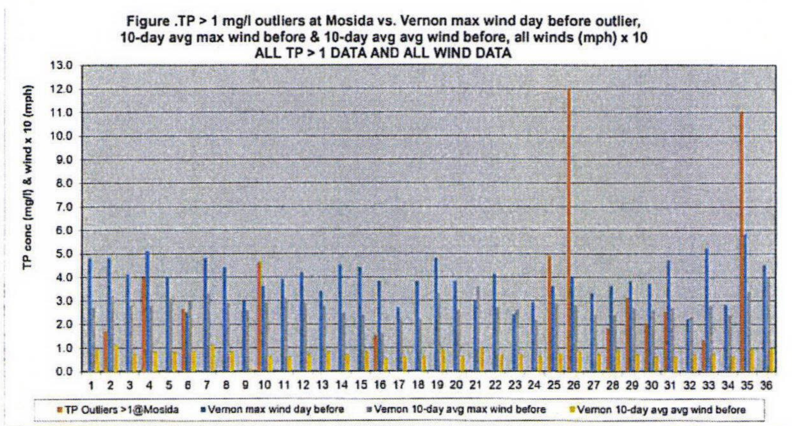


Figure .TP > 1 mg/l outliers at Mosida vs. Vernon max wind day before outlier, 10-day avg max wind before & 10-day avg avg wind before, all winds (mph) x 10
ALL TP > 1 DATA AND ALL WIND DATA
TP conc (mg/l) & wind x 10 (mph)
TP Outliers >1@Mosida
Vernon max wind day before
Vernon 10-day avg max wind before
Vernon 10-day avg avg wind before

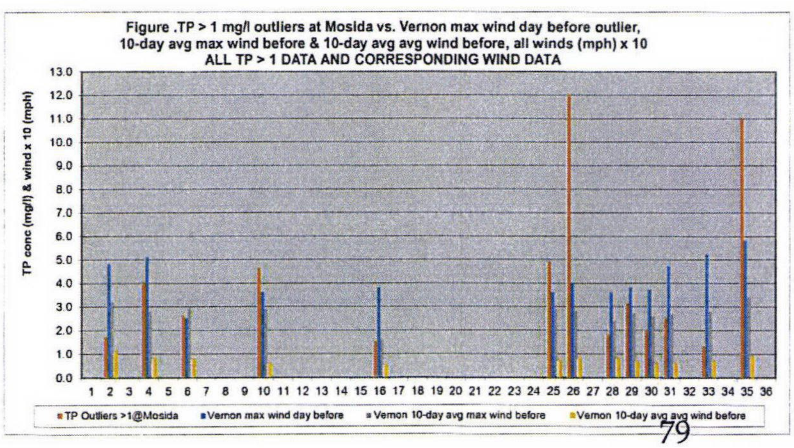


Figure .TP > 1 mg/l outliers at Mosida vs. Vernon max wind day before outlier, 10-day avg max wind before & 10-day avg avg wind before, all winds (mph) x 10
ALL TP > 1 DATA AND CORRESPONDING WIND DATA
TP conc (mg/l) & wind x 10 (mph)
TP Outliers >1@Mosida
Vernon max wind day before
Vernon 10-day avg max wind before
Vernon 10-day avg avg wind before

Figure 11H

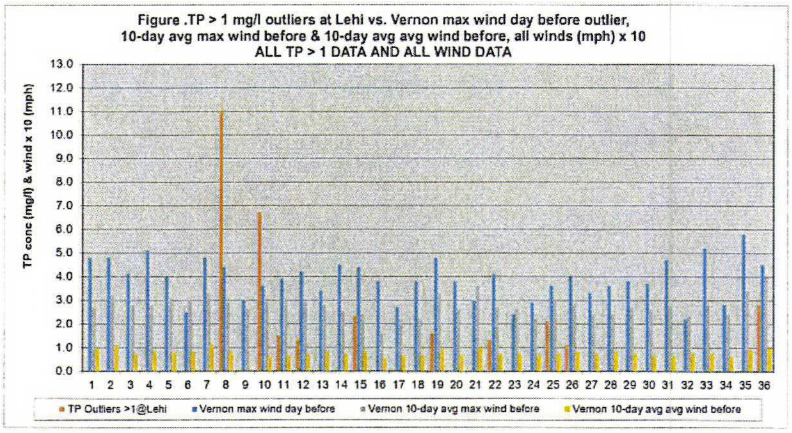


Figure .TP > 1 mg/l outliers at Lehi vs. Vernon max wind day before outlier, 10-day avg max wind before & 10-day avg avg wind before, all winds (mph) x 10
ALL TP > 1 DATA AND ALL WIND DATA
TP conc (mg/l) & wind x 10 (mph)
TP Outliers >1@Lehi
Vernon max wind day before
Vernon 10-day avg max wind before
Vernon 10-day avg avg wind before

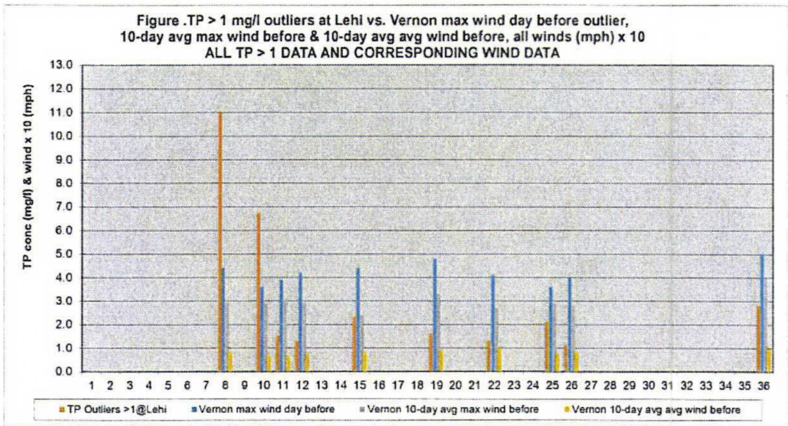


Figure .TP > 1 mg/l outliers at Lehi vs. Vernon max wind day before outlier, 10-day avg max wind before & 10-day avg avg wind before, all winds (mph) x 10
ALL TP > 1 DATA AND CORRESPONDING WIND DATA
TP conc (mg/l) & wind x 10 (mph)
TP Outliers >1@Lehi
Vernon max wind day before
Vernon 10-day avg max wind before
Vernon 10-day avg avg wind before

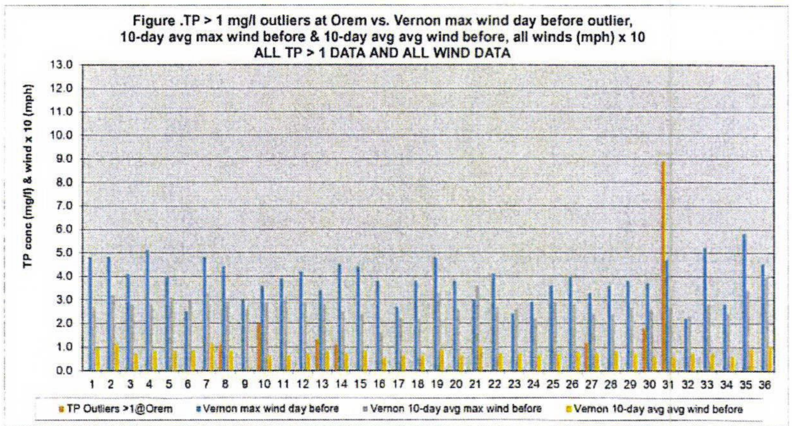


Figure .TP > 1 mg/l outliers at Orem vs. Vernon max wind day before outlier, 10-day avg max wind before & 10-day avg avg wind before, all winds (mph) x 10
ALL TP > 1 DATA AND ALL WIND DATA
TP conc (mg/l) & wind x 10 (mph)
TP Outliers >1@Orem
Vernon max wind day before
Vernon 10-day avg max wind before
Vernon 10-day avg avg wind before

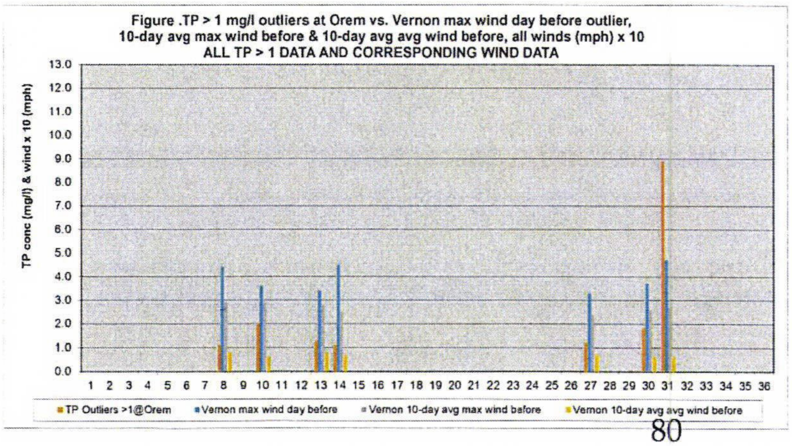


Figure .TP > 1 mg/l outliers at Orem vs. Vernon max wind day before outlier, 10-day avg max wind before & 10-day avg avg wind before, all winds (mph) x 10
ALL TP > 1 DATA AND CORRESPONDING WIND DATA
TP conc (mg/l) & wind x 10 (mph)
TP Outliers >1@Orem
Vernon max wind day before
Vernon 10-day avg max wind before
Vernon 10-day avg avg wind before

Figure 11 I

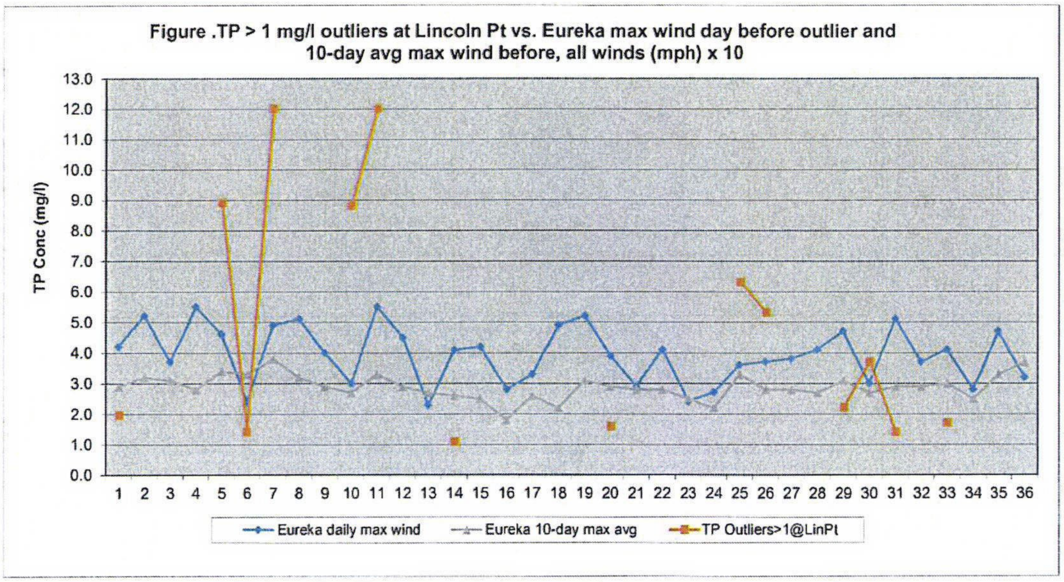


Figure .TP > 1 mg/l outliers at Lincoln Pt vs. Eureka max wind day before outlier and 10-day avg max wind before, all winds (mph) x 10
TP Conc (mg/l)
Eureka daily max wind
Eureka 10-day max avg
TP Outliers>1@LinPt

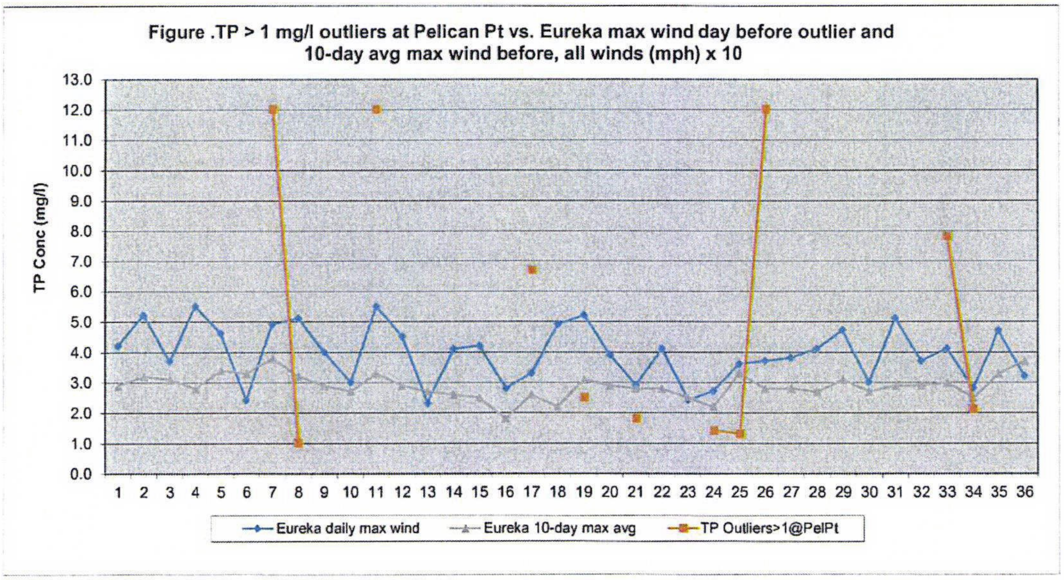


Figure .TP > 1 mg/l outliers at Pelican Pt vs. Eureka max wind day before outlier and 10-day avg max wind before, all winds (mph) x 10
TP Conc (mg/l)
Eureka daily max wind
Eureka 10-day max avg
TP Outliers>1@PelPt

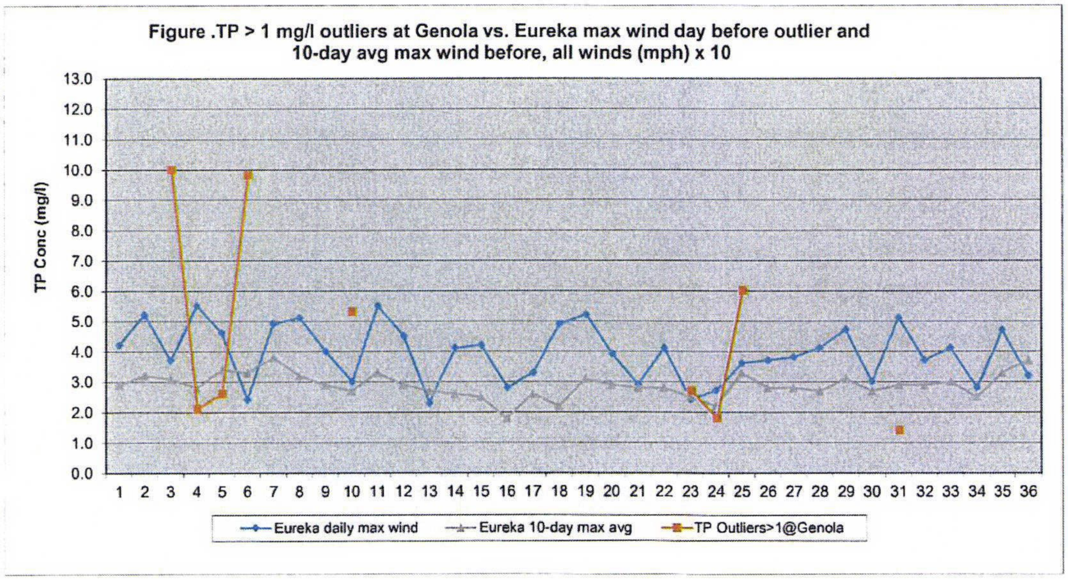


Figure .TP > 1 mg/l outliers at Genola vs. Eureka max wind day before outlier and 10-day avg max wind before, all winds (mph) x 10
TP Conc (mg/l)
Eureka daily max wind
Eureka 10-day max avg
TP Outliers>1@Genola

Figure 11J(a)

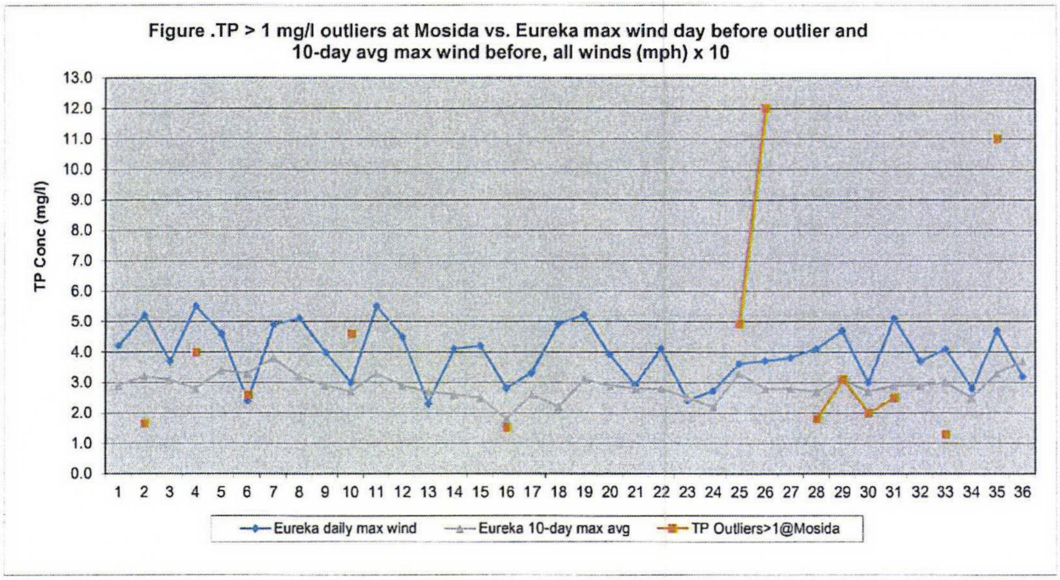


Figure .TP > 1 mg/l outliers at Mosida vs. Eureka max wind day before outlier and 10-day avg max wind before, all winds (mph) x 10
TP Conc (mg/l)
Eureka daily max wind
Eureka 10-day max avg
TP Outliers>1@Mosida

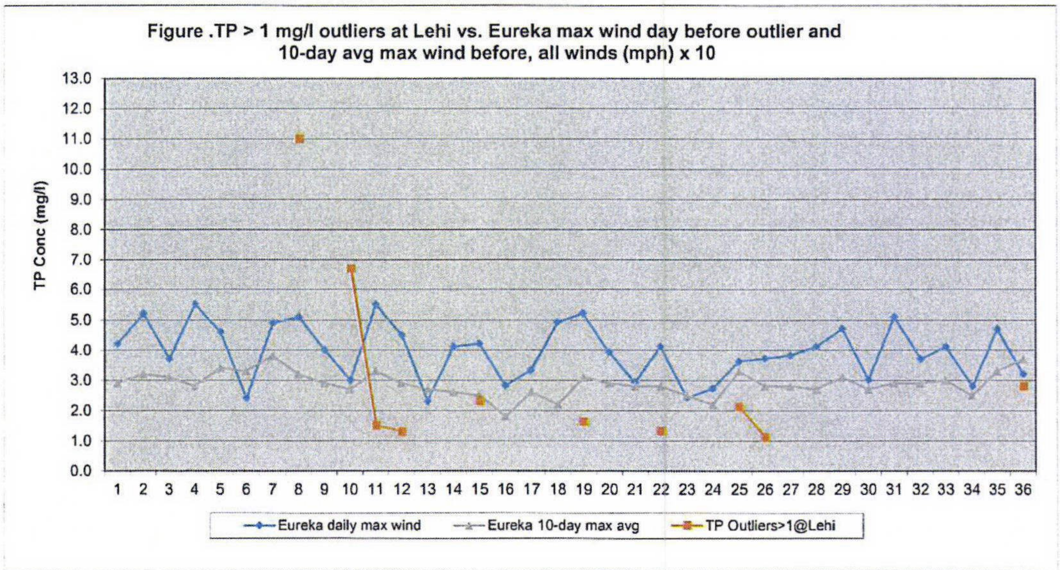


Figure .TP > 1 mg/l outliers at Lehi vs. Eureka max wind day before outlier and 10-day avg max wind before, all winds (mph) x 10
TP Conc (mg/l)
Eureka daily max wind
Eureka 10-day max avg
TP Outliers>1@Lehi

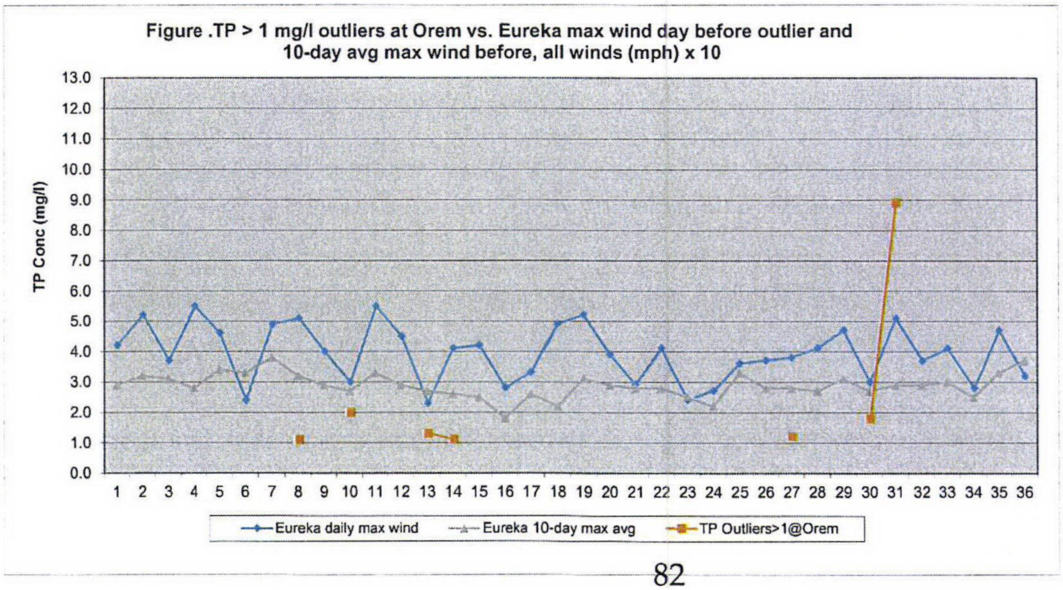


Figure .TP > 1 mg/l outliers at Orem vs. Eureka max wind day before outlier and 10-day avg max wind before, all winds (mph) x 10
TP Conc (mg/l)
Eureka daily max wind
Eureka 10-day max avg
TP Outliers>1@Orem

Figure 11J(b)

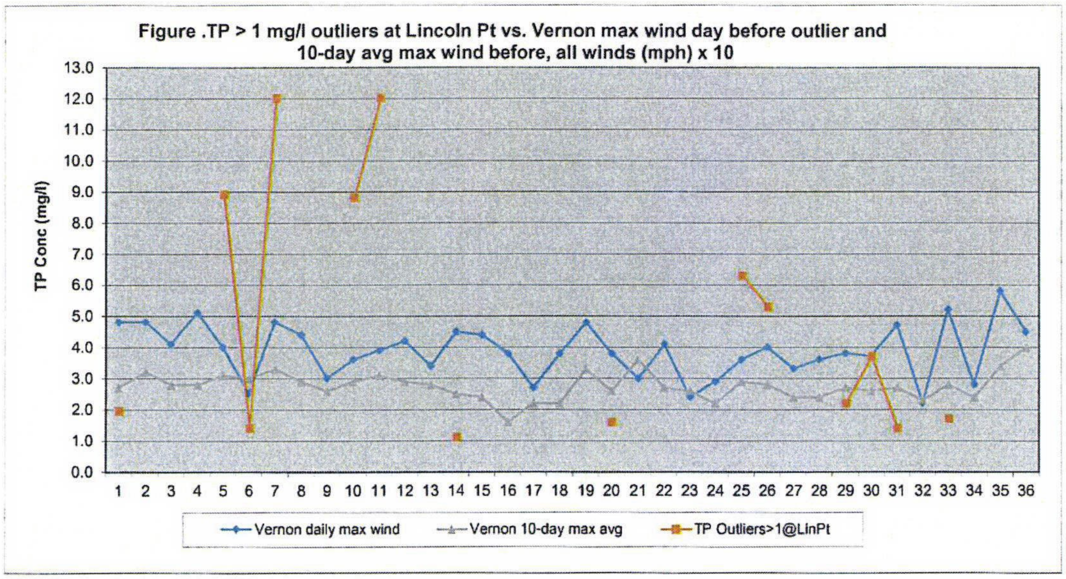


Figure .TP > 1 mg/l outliers at Lincoln Pt vs. Vernon max wind day before outlier and 10-day avg max wind before, all winds (mph) x 10
TP Conc (mg/l)
Vernon daily max wind
Vernon 10-day max avg
TP Outliers>1@LinPt

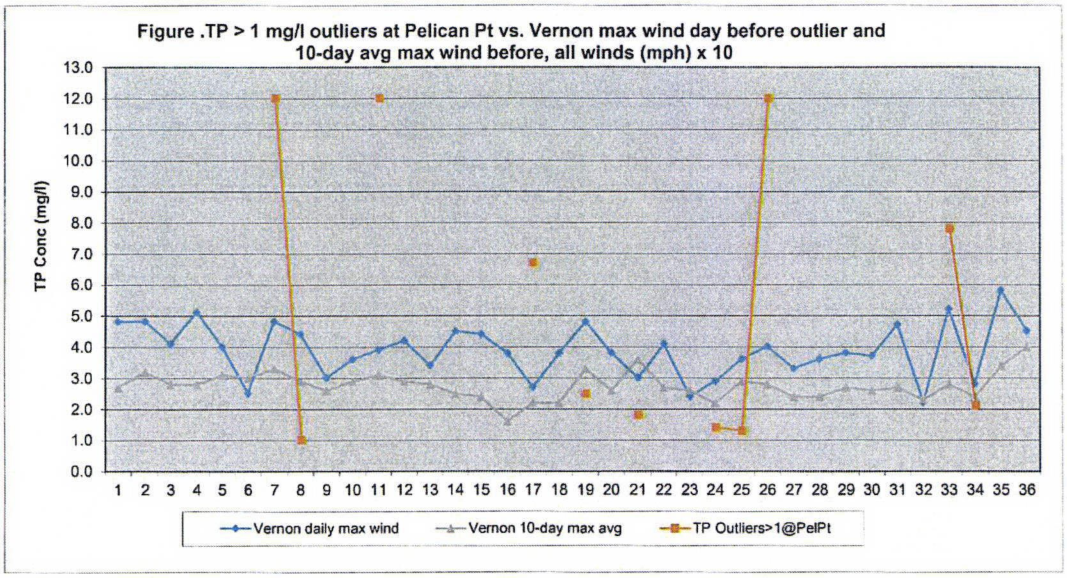


Figure .TP > 1 mg/l outliers at Pelican Pt vs. Vernon max wind day before outlier and 10-day avg max wind before, all winds (mph) x 10
TP Conc (mg/l)
Vernon daily max wind
Vernon 10-day max avg
TP Outliers>1@PelPt

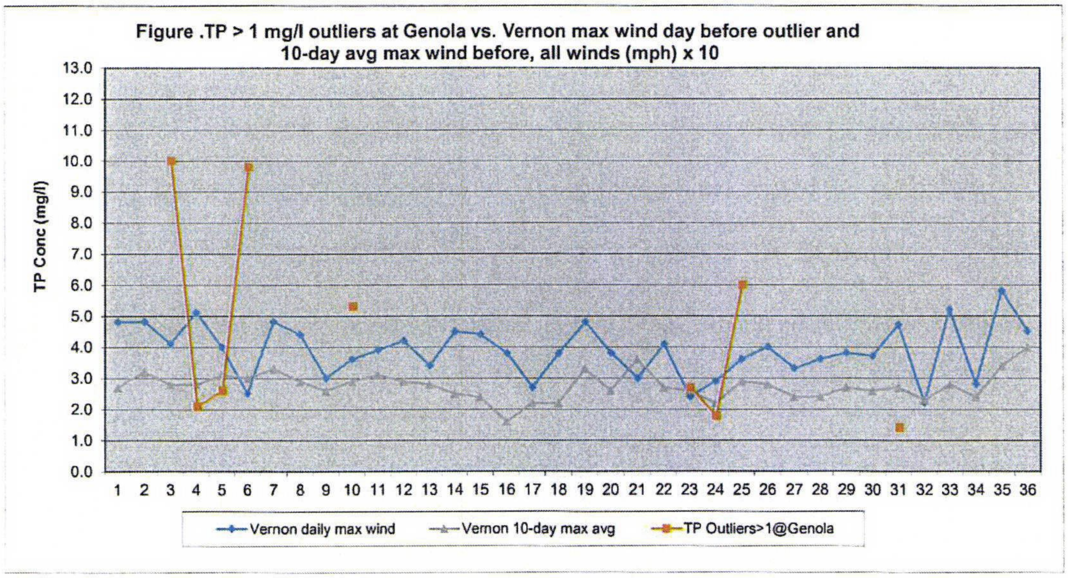


Figure .TP > 1 mg/l outliers at Genola vs. Vernon max wind day before outlier and 10-day avg max wind before, all winds (mph) x 10
TP Conc (mg/l)
Vernon daily max wind
Vernon 10-day max avg
TP Outliers>1@Genola

Figure 11Ka

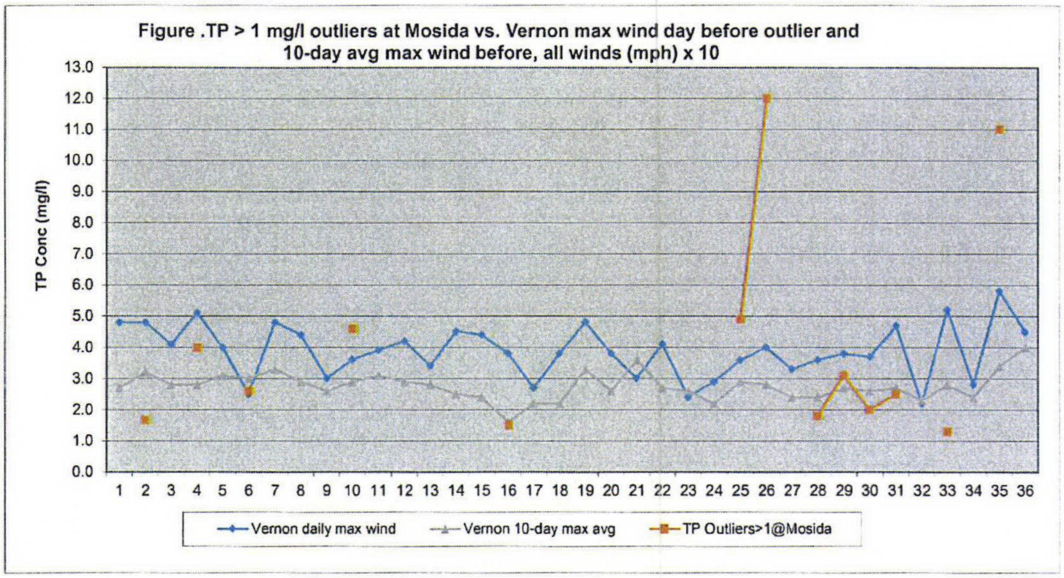


Figure .TP > 1 mg/l outliers at Mosida vs. Vernon max wind day before outlier and 10-day avg max wind before, all winds (mph) x 10
TP Conc (mg/l)
Vernon daily max wind
Vernon 10-day max avg
TP Outliers>1@Mosida

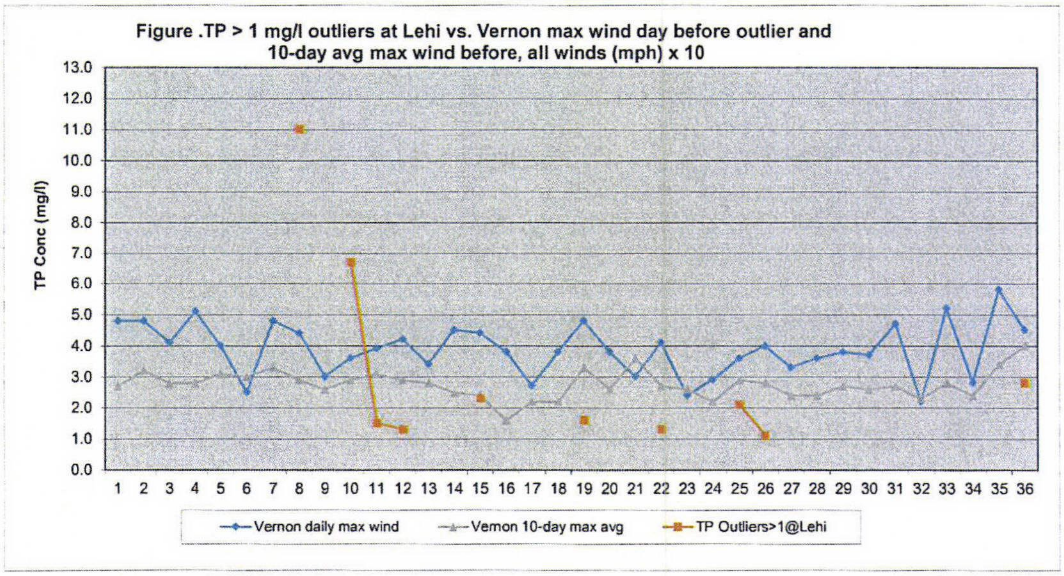


Figure .TP > 1 mg/l outliers at Lehi vs. Vernon max wind day before outlier and 10-day avg max wind before, all winds (mph) x 10
TP Conc (mg/l)
Vernon daily max wind
Vernon 10-day max avg
TP Outliers>1@Lehi

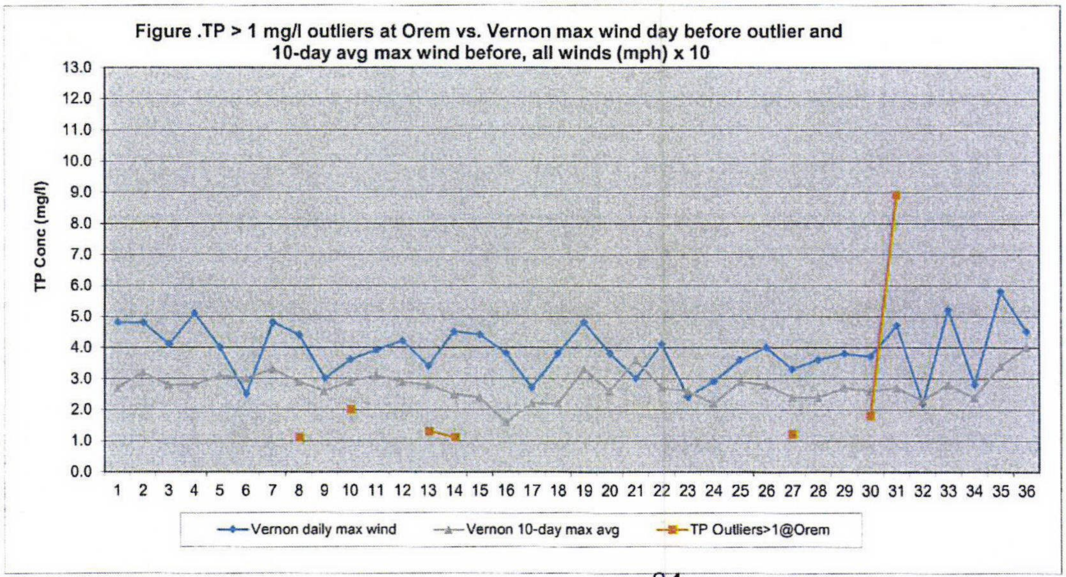


Figure .TP > 1 mg/l outliers at Orem vs. Vernon max wind day before outlier and 10-day avg max wind before, all winds (mph) x 10
TP Conc (mg/l)
Vernon daily max wind
Vernon 10-day max avg
TP Outliers>1@Orem

Figure 11Kb

These paragraphs relate to Method 1 for TP vs. wind discussed above, starting on page 69. One observation or conclusion that can be made from these figures, Figures 11D – 11K above, is that, in general, when there is a high TP concentration outlier, there is usually a high wind, but when there is a high wind, there is not always a high TP concentration.

**You might choose to go directly to the summary table below and skip these details.

Consider 1 of the 6 figures, each of which has 4 graphs. Figure 11D (page 75, first bar graph) shows that for Lincoln Pt TP (14 dates TP > 1) and Eureka wind, there are 6 dates with day before max wind > 50 mph, but only 2 of those dates have TP > 1. There are 19 dates with max wind > 40 mph, and 8 of those dates have TP > 1. And there are 29 dates, of the 36 total dates, with max wind > 30 mph, of which 13, of the 14, have TP > 1.

Consider another example of the 6 figures. Figure 11H (page 79, third bar graph) shows that for Mosida TP (13 dates TP > 1) and Vernon wind, there are 3 dates with > 50 mph day before max wind, and all 3 have TP > 1. There are 17 dates with max wind > 40 mph, and 6 of those dates have TP > 1. And there are 30 dates with max wind > 30 mph, of which 12 have TP > 1.

NOW LOOK AT ALL STATIONS AND DATES WITH TP > 1 AND WIND > 50, 40 & 30.

In the TP data set, there are 36 dates which have at least 1 TP > 1 sample (Table 11A and 11B). The winds on these 36 dates are plotted on the bar graphs. I used 6 of my 8 sampling stations. That gives 216 (6 x 36) total bars on the 6 figures at each of the 2 wind stations (Figures 11D – 11F for Eureka and Figures 11G – 11I for Vernon). Also, for the 6 stations, there are 64 samples with TP > 1 (Table 11A) distributed over the 36 dates. Therefore, 30 % (64/216) of all the wind bars have accompanying TP > 1 bars, and comparisons. The comparisons are described below.

There are 6 dates with Eureka max wind > 50 mph, and for 6 sampling stations (bar graphs), that's 36 "high wind comparisons." Of those 36, there are 15 with TP > 1, or 42 %.

There are 19 dates with Eureka max wind > 40 mph, and for 6 stations gives 114 high wind comparisons. Of those 114, there are 31 with TP > 1, or 27 %.

There are 29 dates with Eureka max wind > 30 mph, and for 6 stations gives 174 comparisons. Of those 174, there are 54 with TP > 1, or 31 %.

There are 3 dates with Vernon max wind > 50 mph, and for 6 stations, that's 18 high wind comparisons. Of those 18, there are only 6 with TP > 1, or 33 %.

There are 17 dates with Vernon max wind > 40 mph, and for 6 stations gives 102 comparisons. Of those 102, there are 32 with TP > 1, or 31 %.

There are 30 dates with Vernon max wind > 30 mph, and for 6 stations gives 180 comparisons. Of those 180, there are 56 with TP > 1, or 31 %.

About 33% of all the "high wind comparisons" have relatively high TP's, TP> 1. The Eureka and Vernon BLM wind station data are similar in high and low wind trends, if not absolute values. Method 1 Summary Table below gives the numbers of dates and other information stated above.

Method 1 Summary Table. No. of Dates of Winds, Comparisons, & TP > 1 vs. Max Wind				
Station & > wind speed	**Number of Wind Dates**	**Number of Comparisons**	**Number of TP > 1 Dates**	**% TP > 1 of Comparisons**
Eureka: > 50	6	x 6 stations = 36	15	42%
> 40	19	114	31	27%
> 30	29	174	54	31%
Average				33%
Vernon: > 50	3	x 6 stations = 18	6	33%
> 40	17	102	32	31%
> 30	30	180	56	31%
Average				32%
Sum: > 50	9	54	21	39%
> 40	36	216	63	29%
> 30	59	354	110	31%
Average				33%

Method 2: Another way to determine if there is any correlation between wind and TP outliers is to plot max wind the day before the sample/storm vs. the TP > 1 outliers. The graphs are shown on Figure 11L for Eureka wind data, Figure 11M for Vernon, and Figure 11N for Tickville.

I realize Dr. Gay is concerned with simple linear best fit trends, and prefers MK trends, but I think comparing these simple trend lines is a useful and convincing way to interpret these plots.

Figure 11L shows the trends for TP > 1 outliers vs. 2 sets of Eureka wind data, max wind and 10-day avg max wind. For max wind, there are 4 positive (increasing) trends (higher wind, higher TP), 1 flat trend (slope < 0.020), and 1 negative (decreasing) trend at Genola. For 10-day avg max wind, all 6 have positive trends, albeit some slightly positive.

**You might choose to go directly to the summary table below and skip these details.

Figure 11M shows the trends for TP > 1 outliers vs. Vernon wind. For max wind, there are 3 positive trends, 2 flat trends (slope < 0.020), and 1 negative trend at Genola. For 10-day avg max wind, there are 5 positive trends and 1 negative trend at Lehi.

Figure 11N shows the trends for TP > 1 outliers vs. Tickville wind. For max wind, there are 3 positive trends, 1 flat trend, and 2 negative trends including Genola and Lehi. For 10-day avg max wind, there are 5 positive trends and 1 negative trend at Orem.

In total, for the 6 sample locations, 3 wind stations, and 2 max wind types (daily max and 10-day avg of daily max's), there are 36 comparisons between TP > 1 outliers and max wind. Of the 36 simple linear best fit trend lines, 26 (72 %) are positive, 4 flat trends (11 %), and 6 (17 %) are negative. That means 72 % of the trends show that there appears to be a positive correlation for TP > 1 outliers and max wind; higher max wind, higher TP > 1 concentrations.

Figure 11La

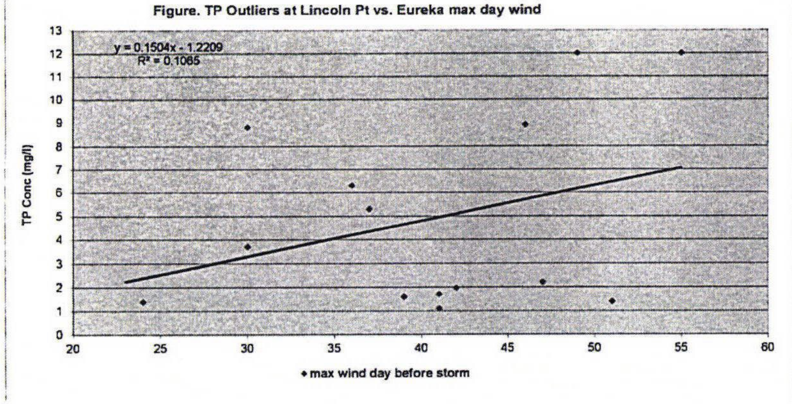


Figure. TP Outliers at Lincoln Pt vs. Eureka max day wind

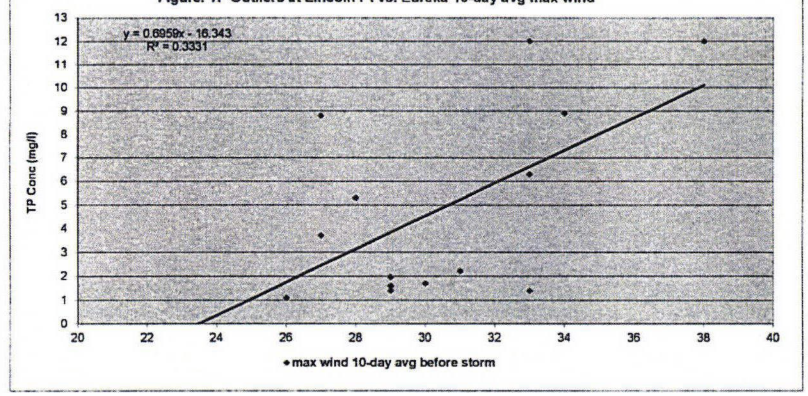


Figure. TP Outliers at Lincoln Pt vs. Eureka 10-day avg max wind

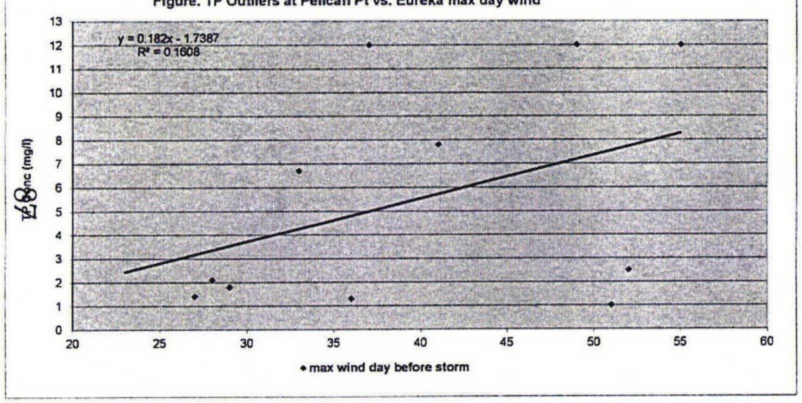


Figure. TP Outliers at Pelican Pt vs. Eureka max day wind

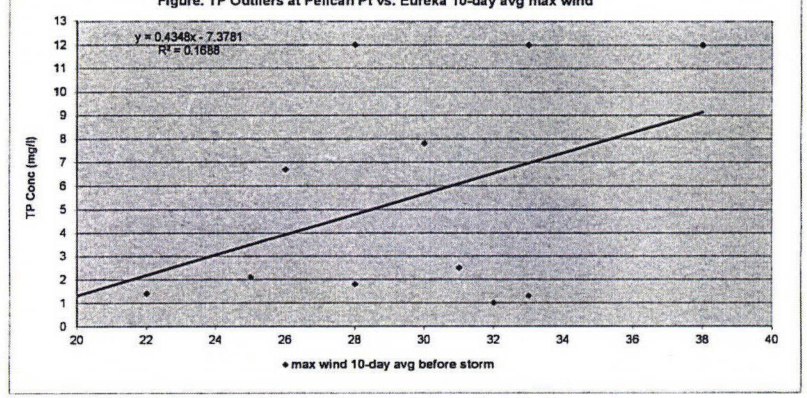


Figure. TP Outliers at Pelican Pt vs. Eureka 10-day avg max wind

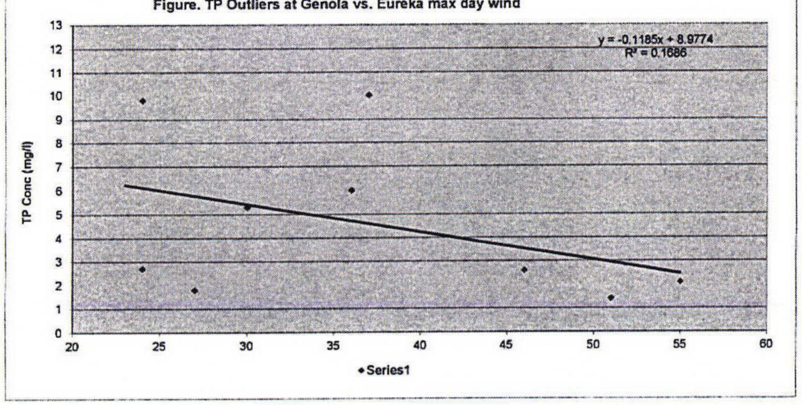


Figure. TP Outliers at Genola vs. Eureka max day wind

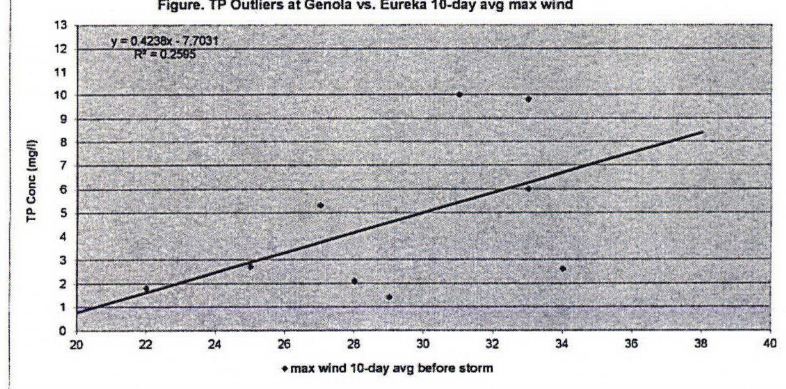


Figure. TP Outliers at Genola vs. Eureka 10-day avg max wind

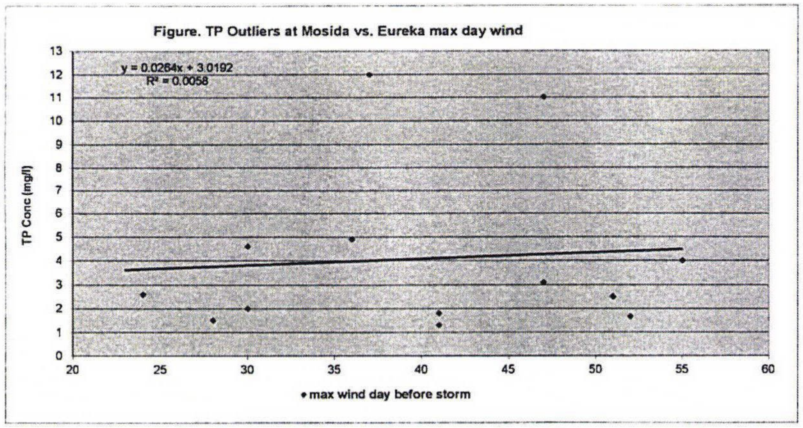


Figure. TP Outliers at Mosida vs. Eureka max day wind
y = 0.0264x + 3.0192
R² = 0.0058
TP Conc (mg/l)
max wind day before storm

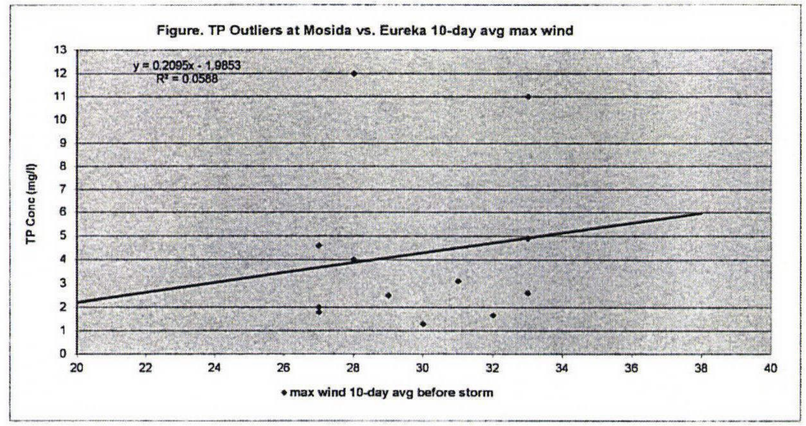


Figure. TP Outliers at Mosida vs. Eureka 10-day avg max wind
y = 0.2095x - 1.9853
R² = 0.0588
TP Conc (mg/l)
max wind 10-day avg before storm

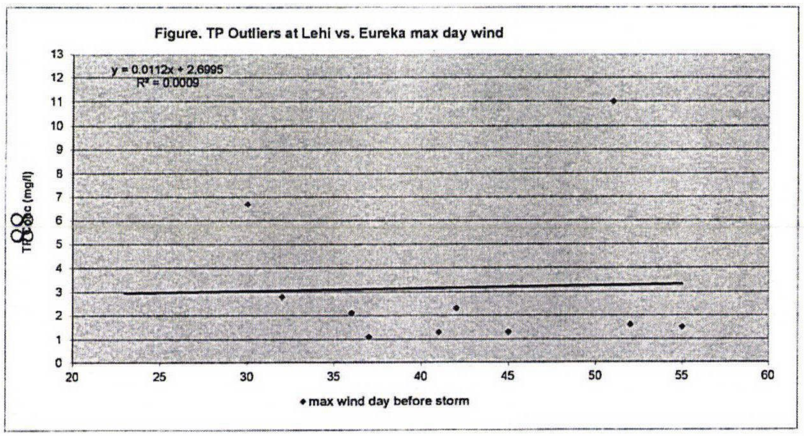


Figure. TP Outliers at Lehi vs. Eureka max day wind
y = 0.0112x + 2.6995
R² = 0.0009
TP Conc (mg/l)
max wind day before storm

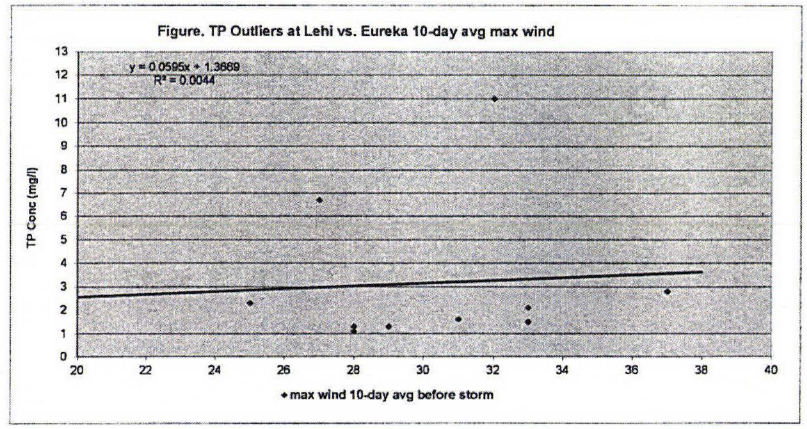


Figure. TP Outliers at Lehi vs. Eureka 10-day avg max wind
y = 0.0595x + 1.3669
R² = 0.0044
TP Conc (mg/l)
max wind 10-day avg before storm

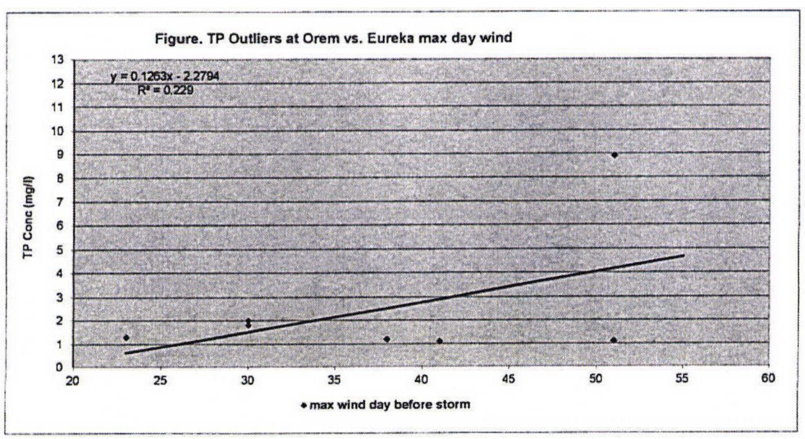


Figure. TP Outliers at Orem vs. Eureka max day wind
y = 0.1263x - 2.2794
R² = 0.229
TP Conc (mg/l)
max wind day before storm

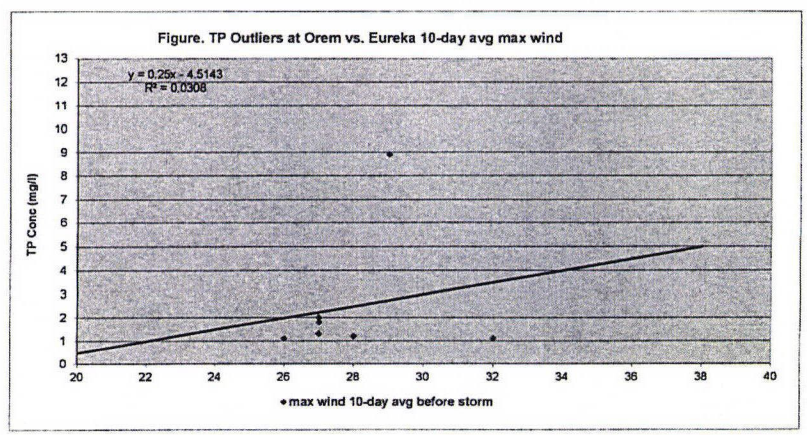


Figure. TP Outliers at Orem vs. Eureka 10-day avg max wind
y = 0.25x - 4.5143
R² = 0.0308
TP Conc (mg/l)
max wind 10-day avg before storm

Figure 11Lb

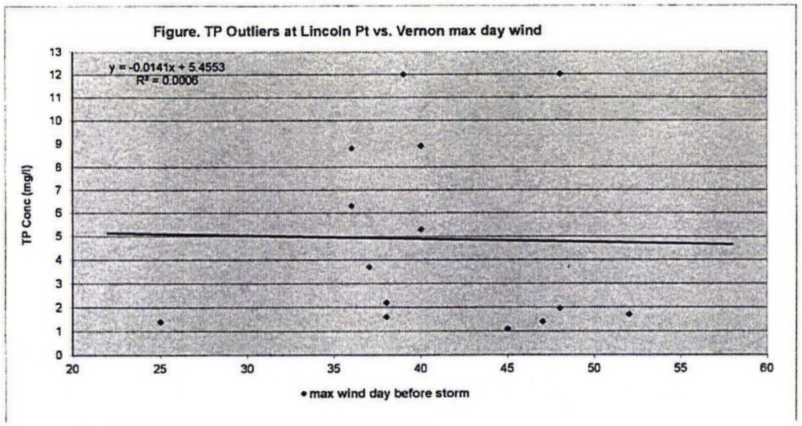


Figure. TP Outliers at Lincoln Pt vs. Vernon max day wind
y = -0.0141x + 5.4553
R² = 0.0006
TP Conc (mg/l)
max wind day before storm

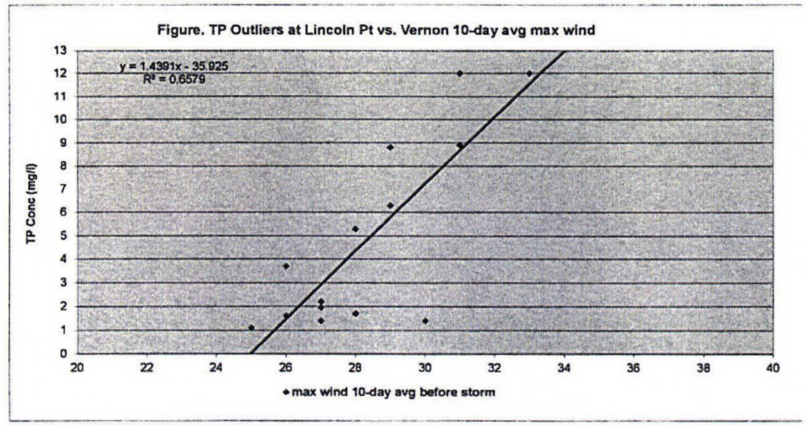


Figure. TP Outliers at Lincoln Pt vs. Vernon 10-day avg max wind
y = 1.4391x - 35.925
R² = 0.6579
TP Conc (mg/l)
max wind 10-day avg before storm

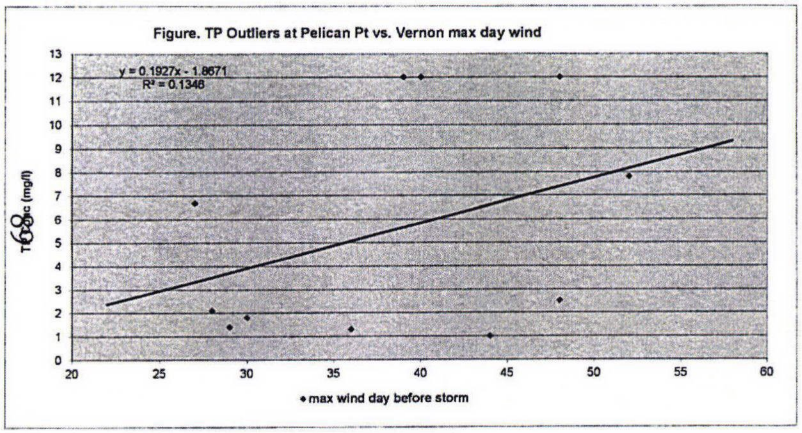


Figure. TP Outliers at Pelican Pt vs. Vernon max day wind
y = 0.1927x - 1.8671
R² = 0.1346
TP Conc (mg/l)
max wind day before storm

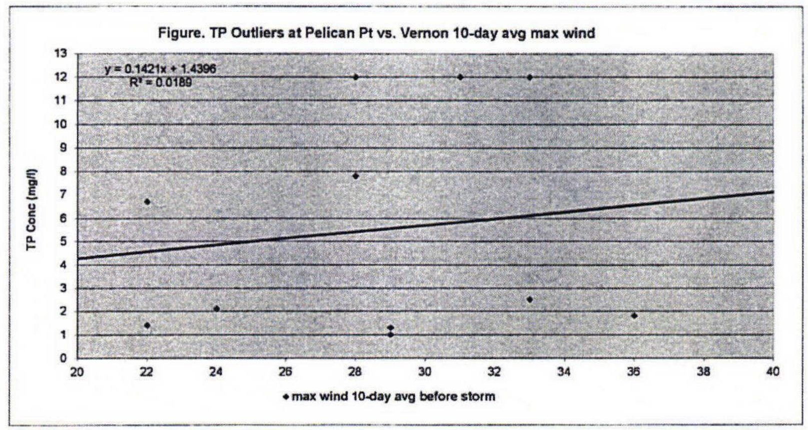


Figure. TP Outliers at Pelican Pt vs. Vernon 10-day avg max wind
y = 0.1421x + 1.4396
R² = 0.0189
TP Conc (mg/l)
max wind 10-day avg before storm

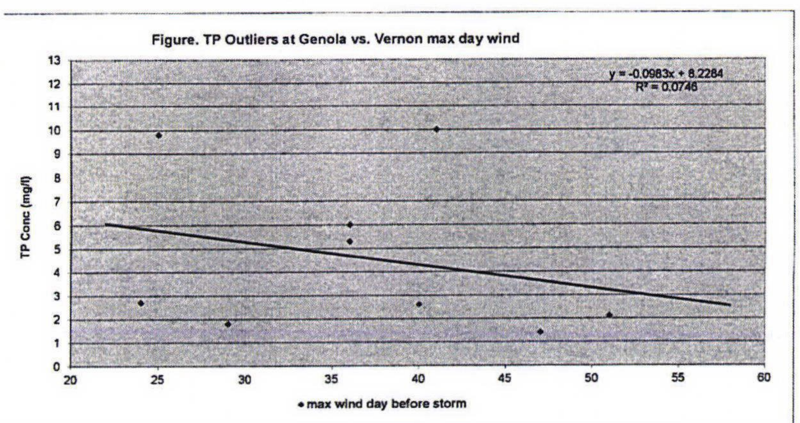


Figure. TP Outliers at Genola vs. Vernon max day wind
y = -0.0983x + 8.2284
R² = 0.0746
TP Conc (mg/l)
max wind day before storm

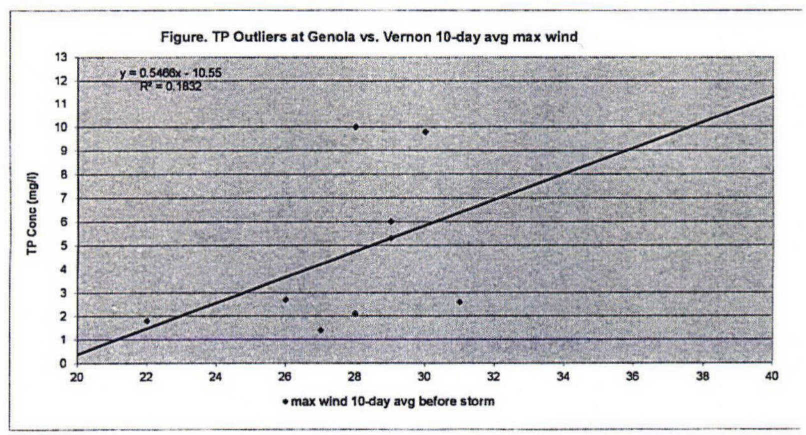


Figure. TP Outliers at Genola vs. Vernon 10-day avg max wind
y = 0.5466x - 10.55
R² = 0.1832
TP Conc (mg/l)
max wind 10-day avg before storm

Figure 11M a

Figure 11M b

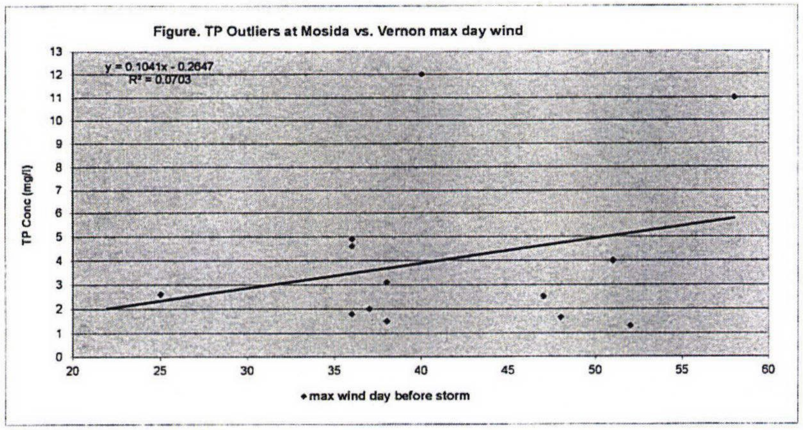


Figure. TP Outliers at Mosida vs. Vernon max day wind

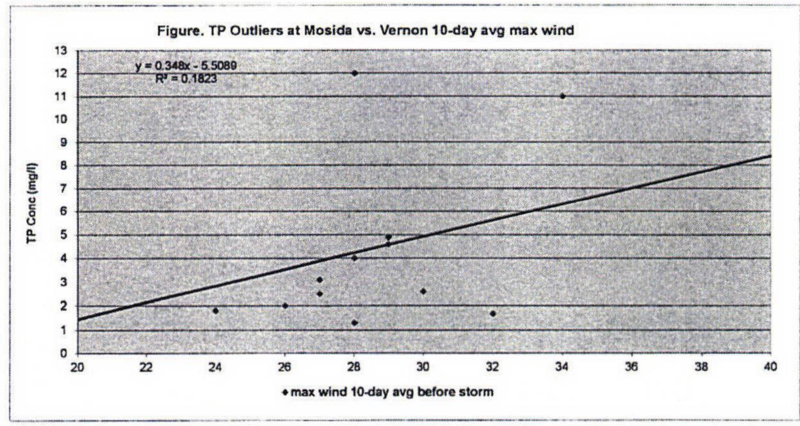


Figure. TP Outliers at Mosida vs. Vernon 10-day avg max wind

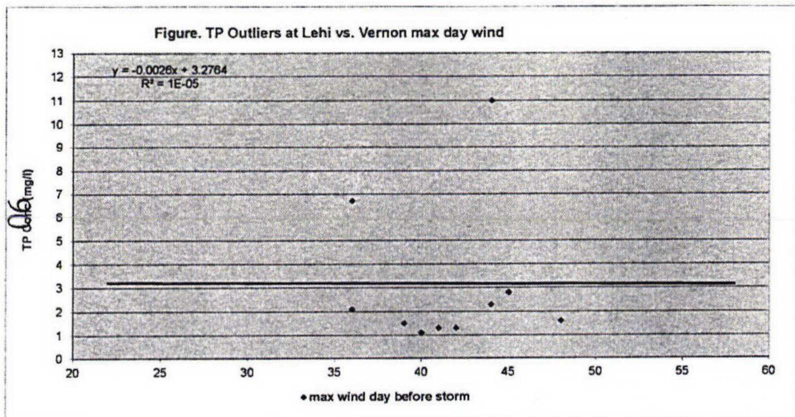


Figure. TP Outliers at Lehi vs. Vernon max day wind

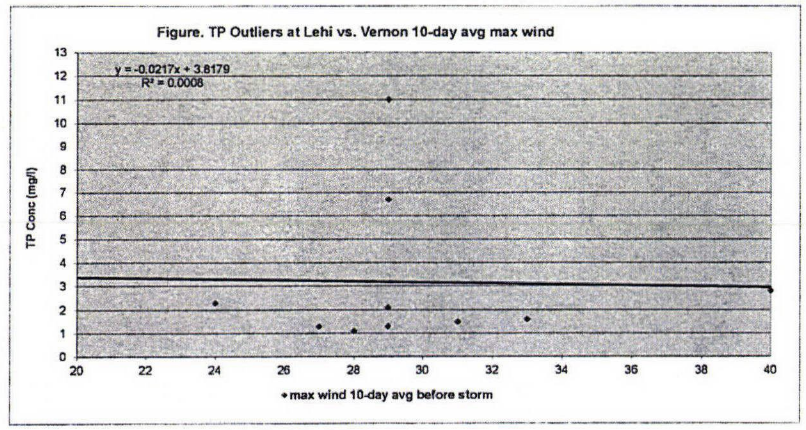


Figure. TP Outliers at Lehi vs. Vernon 10-day avg max wind

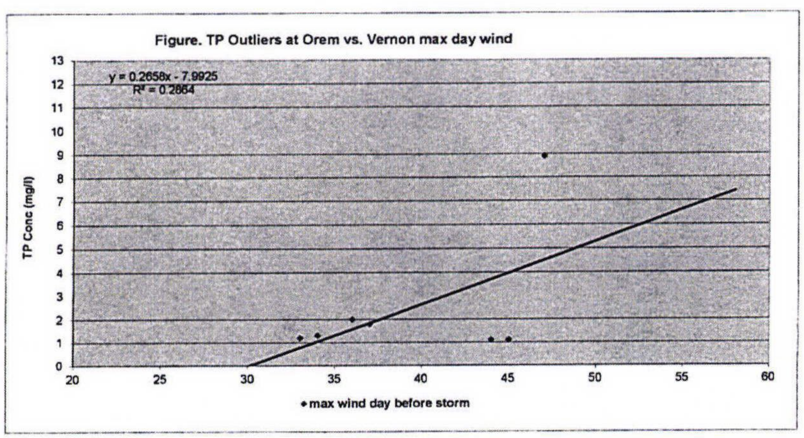


Figure. TP Outliers at Orem vs. Vernon max day wind

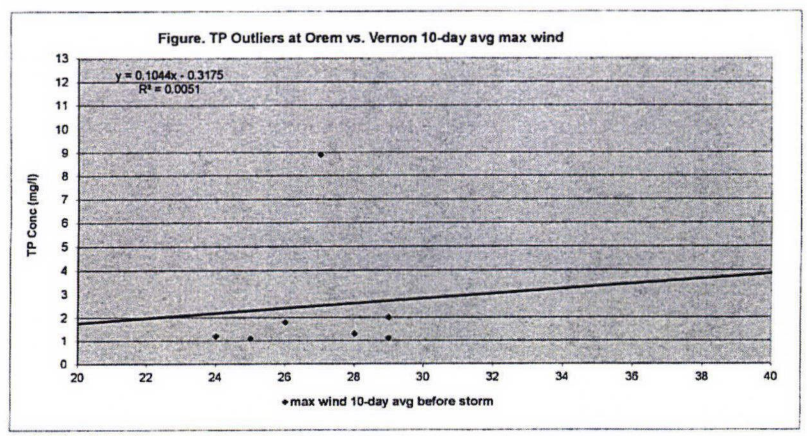


Figure. TP Outliers at Orem vs. Vernon 10-day avg max wind

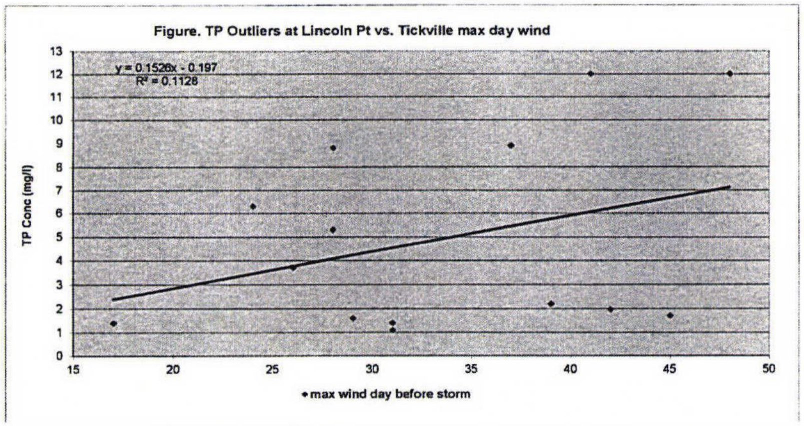


Figure. TP Outliers at Lincoln Pt vs. Tickville max day wind
y = 0.1526x - 0.197
R² = 0.1128
TP Conc (mg/l)
max wind day before storm

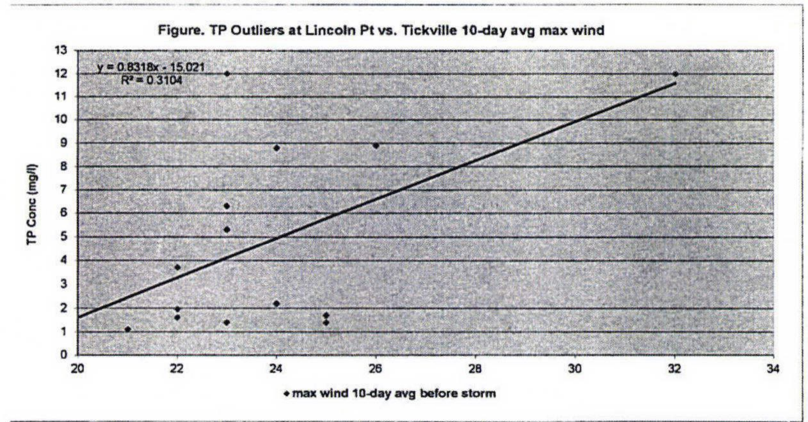


Figure. TP Outliers at Lincoln Pt vs. Tickville 10-day avg max wind
y = 0.8318x - 15.021
R² = 0.3104
TP Conc (mg/l)
max wind 10-day avg before storm

Figure11Na

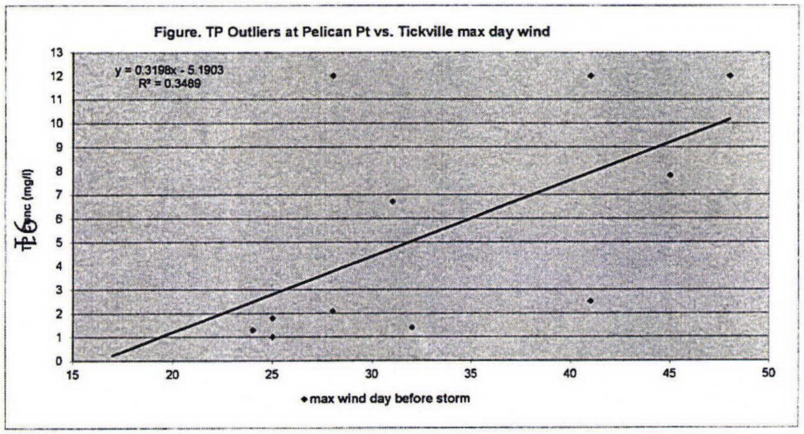


Figure. TP Outliers at Pelican Pt vs. Tickville max day wind
y = 0.3198x - 5.1903
R² = 0.3489
TP Conc (mg/l)
max wind day before storm

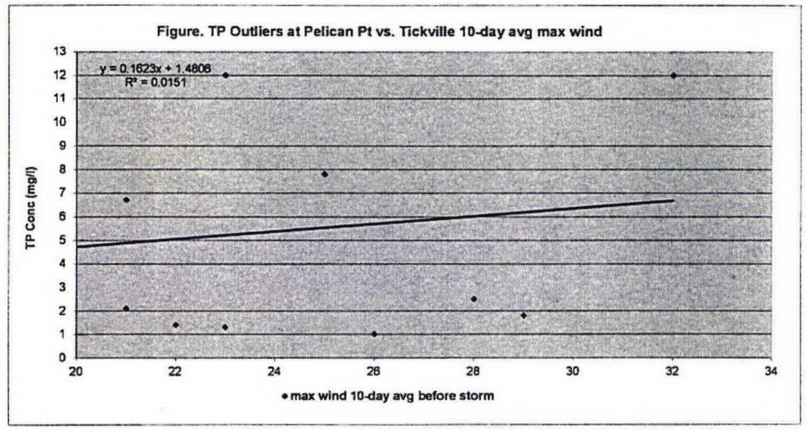


Figure. TP Outliers at Pelican Pt vs. Tickville 10-day avg max wind
y = 0.1623x + 1.4806
R² = 0.0151
TP Conc (mg/l)
max wind 10-day avg before storm

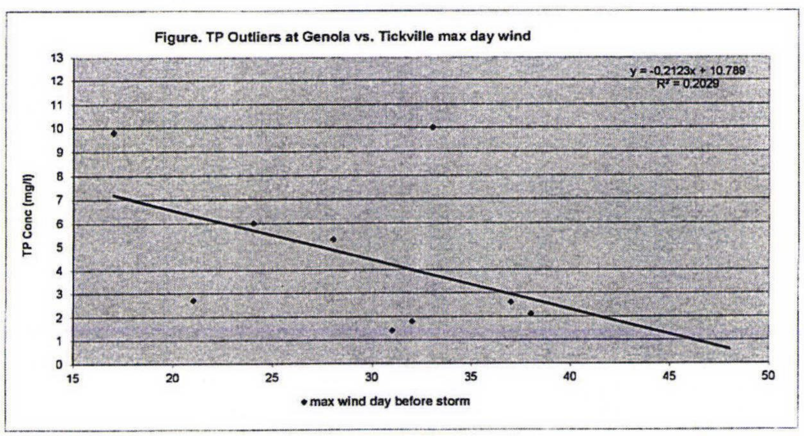


Figure. TP Outliers at Genola vs. Tickville max day wind
y = -0.2123x + 10.789
R² = 0.2029
TP Conc (mg/l)
max wind day before storm

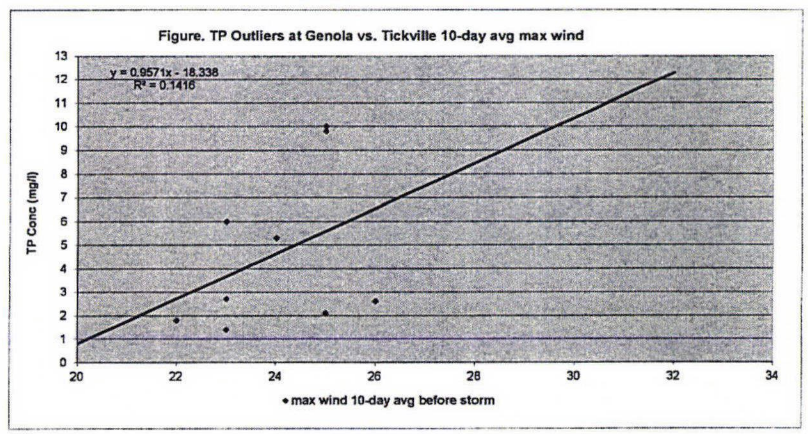


Figure. TP Outliers at Genola vs. Tickville 10-day avg max wind
y = 0.9571x - 18.338
R² = 0.1416
TP Conc (mg/l)
max wind 10-day avg before storm

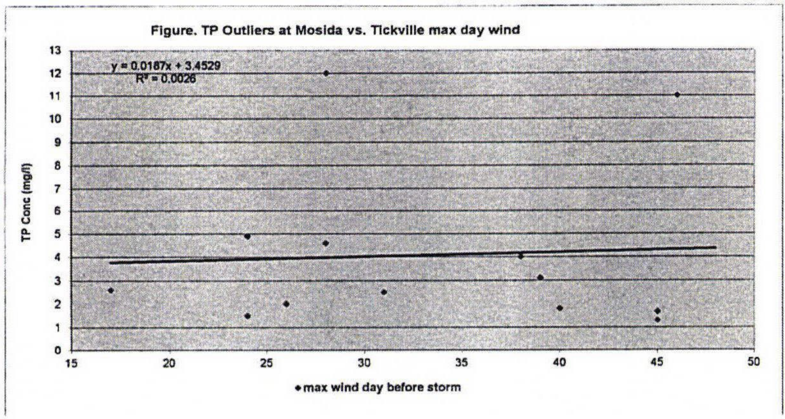


Figure. TP Outliers at Mosida vs. Tickville max day wind
y = 0.0187x + 3.4529
R² = 0.0026
TP Conc (mg/l)
♦max wind day before storm

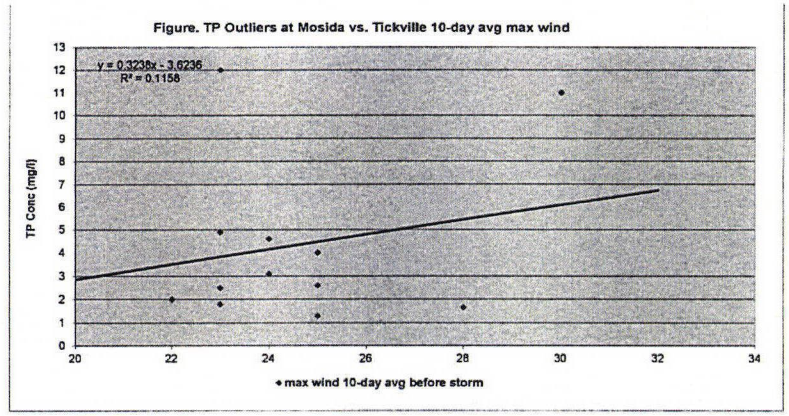


Figure. TP Outliers at Mosida vs. Tickville 10-day avg max wind
y = 0.3238x - 3.6236
R² = 0.1158
TP Conc (mg/l)
♦max wind 10-day avg before storm

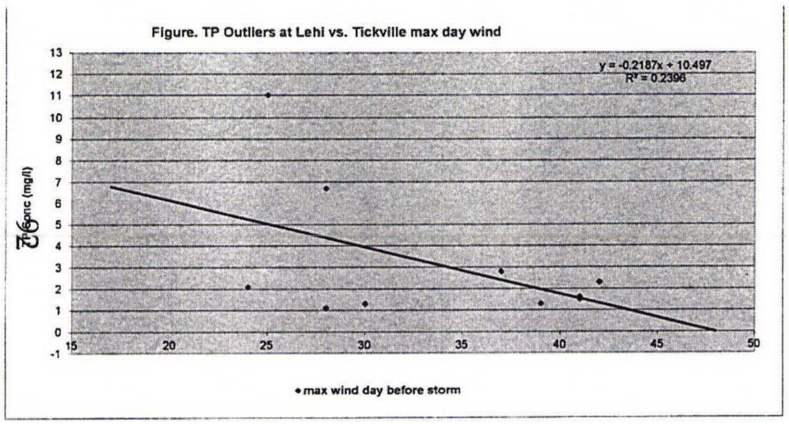


Figure. TP Outliers at Lehi vs. Tickville max day wind
y = -0.2187x + 10.497
R² = 0.2396
TP Conc (mg/l)
♦max wind day before storm

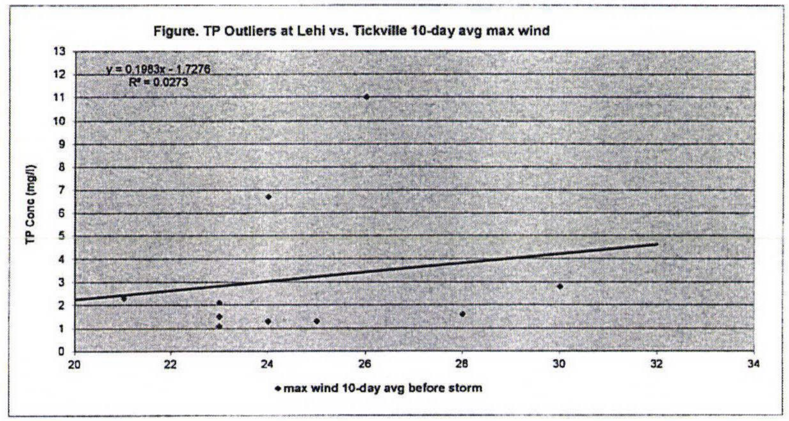


Figure. TP Outliers at Lehi vs. Tickville 10-day avg max wind
y = 0.1983x - 1.7276
R² = 0.0273
TP Conc (mg/l)
♦max wind 10-day avg before storm

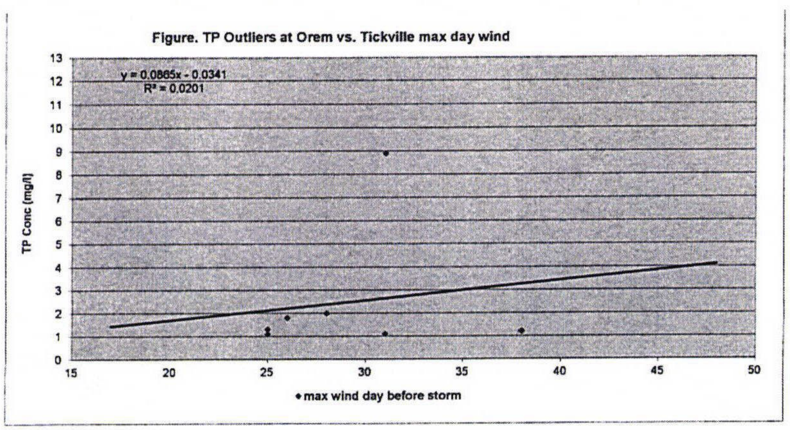


Figure. TP Outliers at Orem vs. Tickville max day wind
y = 0.0865x - 0.0341
R² = 0.0201
TP Conc (mg/l)
♦max wind day before storm

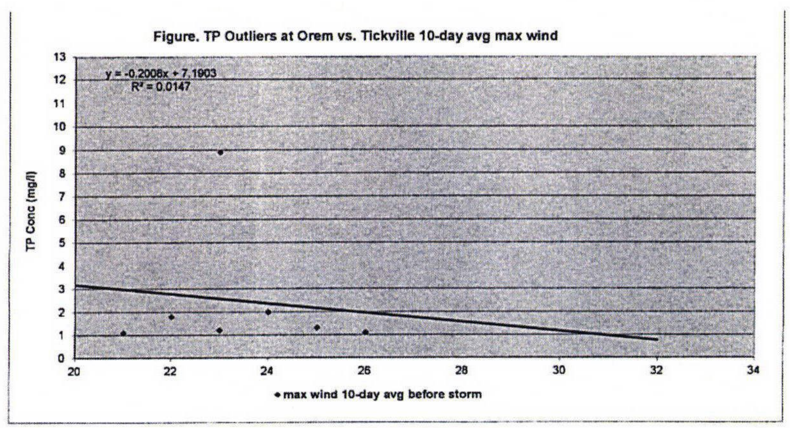


Figure. TP Outliers at Orem vs. Tickville 10-day avg max wind
y = -0.2006x + 7.1903
R² = 0.0147
TP Conc (mg/l)
♦max wind 10-day avg before storm

Figure 11Nb

Regarding the figures and discussion above, and the table below, of the 6 negative trends, 3 are for Genola, all 3 are with max day wind, and with each of the 3 wind stations. Of the other 3 negative trends, 2 are for Lehi, 1 with Tickville max day wind and the other with Vernon 10-day avg max wind. The other negative trend is for Orem with Tickville 10-day avg max wind. Four max day wind and two 10-day avg max wind.

Why Genola neg ??? and why all max day???

Of the 4 flat trends, 2 are for Lehi with Eureka and Vernon max wind, 1 is for Lincoln Pt with Vernon max wind, and the other is for Mosida with Tickville max wind. Note that all 4 flat trends are with day max wind.

Method 2 Summary Table. No. of Trends on Plots of TP > 1 vs. Max Wind (mph)				
Station - trend	**Max Day Wind**	**10-day Avg Max**	**Totals**	**Percentages**
Eureka – positive	4	6	10	10/12 = 84%
flat	1	0	1	1/12 = 8%
negative	1(Gen)	0	1	1/12 = 8%
Vernon – positive	3	5	8	8/12 = 66%
flat	2	0	2	2/12 = 17%
negative	1(Gen)	1(Lehi)	2	2/12 = 17%
Tickville – positive	3	5	8	8/12 = 67%
flat	1	0	1	1/12 = 8%
negative	2(Gen,Lehi)	1(Orem)	3	3/12 = 25%
Totals – positive	10	16	26	26/36 = 72%
flat	4	0	4	4/36 = 11%
negative	4	2	6	6/36 = 17%

Method 3: My next attempt at comparing the TP outliers and the wind is to consider the number of days between the samples / storms, i.e., the number of days from one TP measurement to the previous measurement / storm. The time between storms / samples is somewhat related to the wind which transports air-born nutrients to the sampler and to the lake.

I have the data for "number of days between storms" which are shown on Table 11C. I plotted the "number of days between storms" vs. TP outliers at 6 of my sampling stations and the graphs are shown on Figure 11O.

There are 5 positive (increasing) trends and 1 negative (decreasing) trend at Orem. More time between samples / storms likely means more time for windblown dust, including nutrients, and other dry atmospheric deposition to accumulate on the funnels and in the samplers, and, of course, on the lake. One may tentatively conclude that the graphs show that the more time between samples / storms, the higher the TP concentrations.

Any more conclusions and observations???

Table 11C TP Outliers (TP > 1 mg/l): Concentrations and Locations

days since precip: values > 12 are assigned values of 12

	date	LincolnPt	# days	PelicanPt	# days	Genola	# days	Elberta	# days	Mosida	# days	Lehi	# days	Orem	# days
1	22-Feb-17	1.96	12												
2	8-Apr-17		9							1.66	9				
3	25-Apr-17		4			10	17								
4	6-May-17		11			2.1	11			4.0	11				
5	17-May-17	8.9	11			2.6	11								
6	21-May-17	1.4	4			9.8	4			2.6	4				
7	13-Jun-17	12.0	23	12.0	23			1.2	23						
8	20-Jun-17		7	1.0	7							11.0	30	1.1	30
9	17-Jul-17														
10	25-Jul-17	8.8	42			5.3	8			4.6	65	6.7	35	2.0	35
11	10-Aug-17	12.0	16	12.0	51							1.5	16		
12	15-Sep-17		30									1.3	30		
13	24-Sep-17		9											1.3	9
14	5-Nov-17	1.1	42											1.1	42
15	17-Nov-17		12					1.8	12			2.3	12		
16	9-Jan-18		20							1.5	37				
17	15-Feb-18		37	6.7	37										
18	16-Mar-18		29					1.3	29						
19	23-Mar-18		7	2.5	7							1.6	7		
20	7-Apr-18	1.6	15												
21	20-Apr-18		13	1.8	13										
22	30-Apr-18		10									1.3	10		
23	3-May-18		3			2.7	3								
24	11-May-18		8	1.4	8	1.8	8								
25	22-Aug-18	6.3	72	1.3	72	6.0	72			4.9	72	2.1	71		
26	3-Oct-18	5.3	42	12.0	42					12.0	42	1.1	42		
27	29-Mar-19		23											1.2	12
28	10-Apr-19		12							1.8	12				
29	21-Jun-19	2.2	31							3.1	31				
30	1-Aug-19	3.7	40							2.0	40			1.8	40
31	9-Aug-19	1.4	8			1.4	8			2.5	8			8.9	8
32	28-Aug-19		19												
33	11-Sep-19	1.7	33	7.8	33					1.3	33				
34	13-Mar-20		33	2.1	34										
35	23-May-20		59					1.2	59	11	59				
36	8-Jun-20		13									2.8	16		
Total		14	35	11	11	9	9	4	4	13	13	10	10	7	7

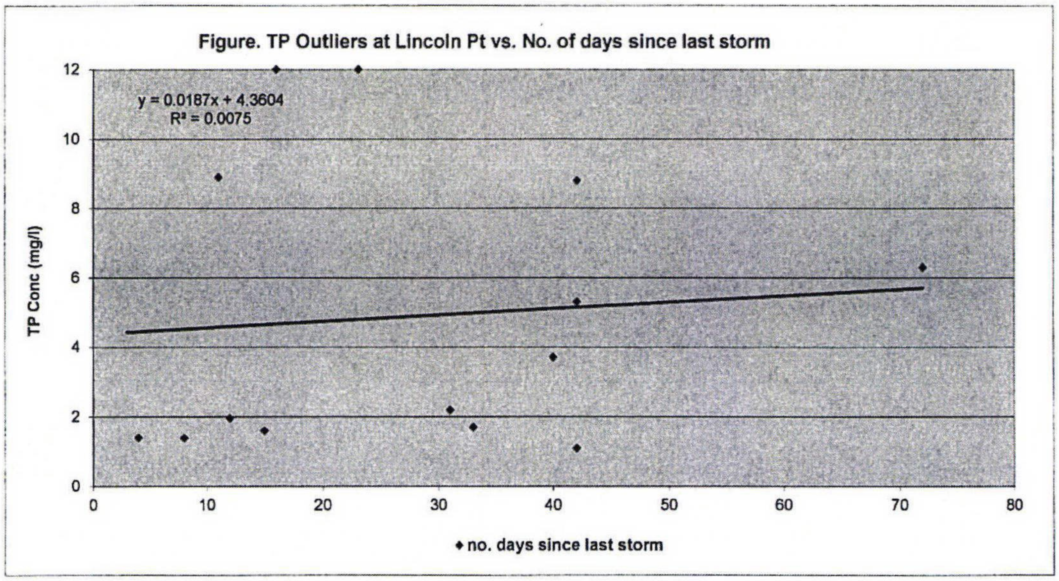


Figure. TP Outliers at Lincoln Pt vs. No. of days since last storm
y = 0.0187x + 4.3604
R² = 0.0075
TP Conc (mg/l)
◆ no. days since last storm

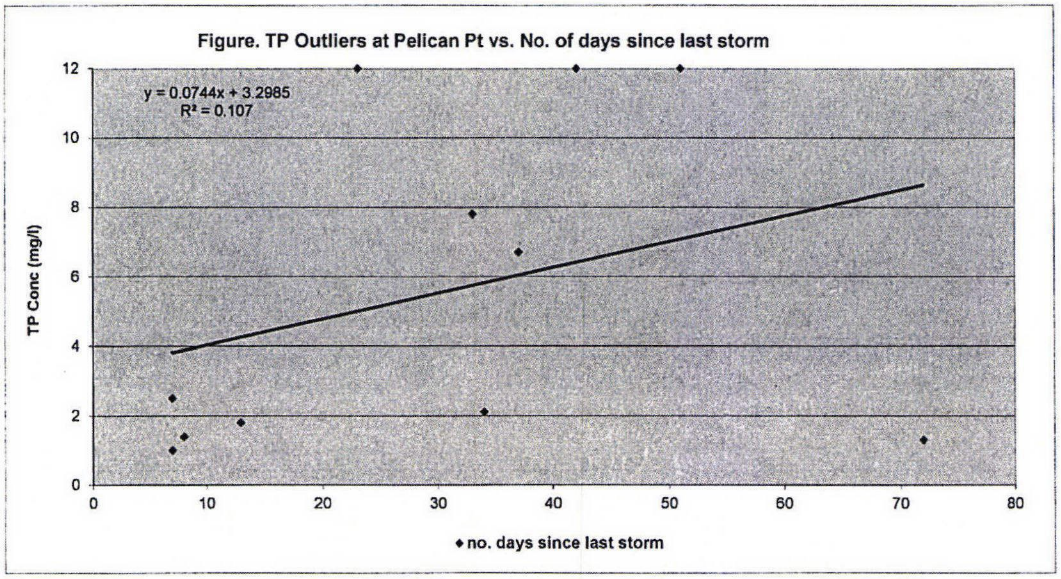


Figure. TP Outliers at Pelican Pt vs. No. of days since last storm
y = 0.0744x + 3.2985
R² = 0.107
TP Conc (mg/l)
◆ no. days since last storm

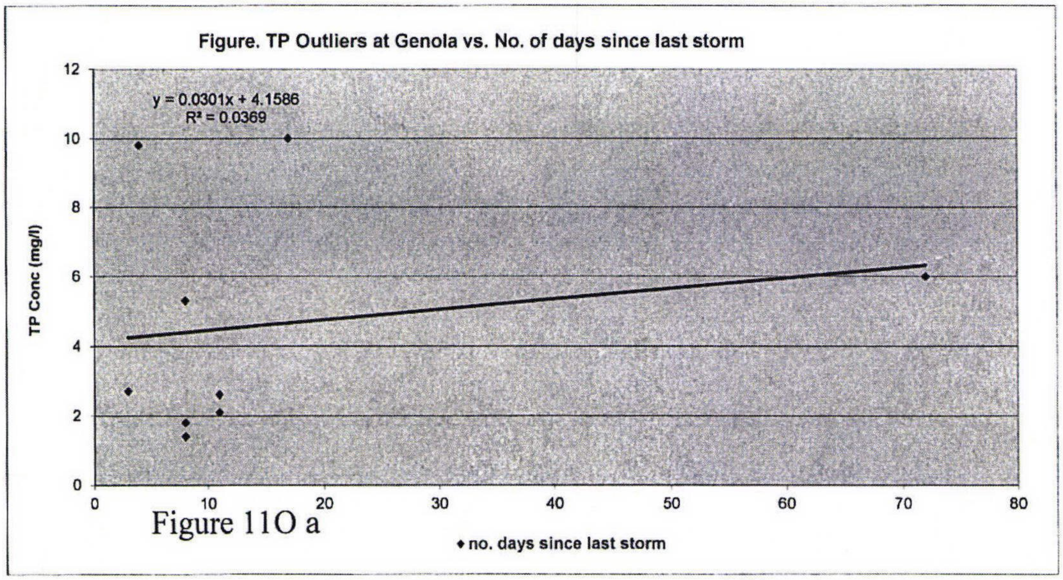


Figure. TP Outliers at Genola vs. No. of days since last storm
y = 0.0301x + 4.1586
R² = 0.0369
TP Conc (mg/l)
◆ no. days since last storm

Figure 11O a

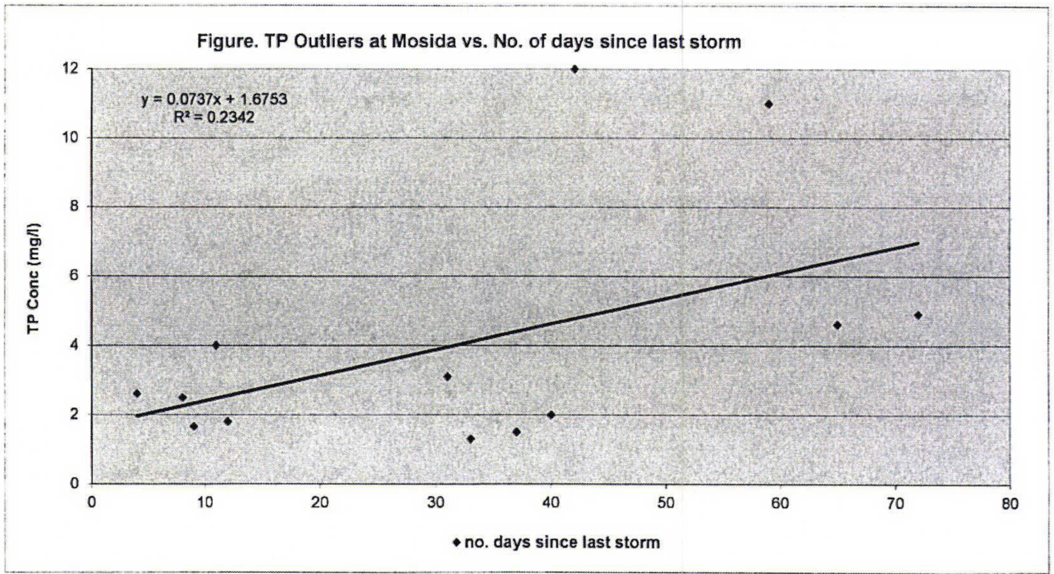


Figure. TP Outliers at Mosida vs. No. of days since last storm
y = 0.0737x + 1.6753
R² = 0.2342
TP Conc (mg/l)
0
2
4
6
8
10
12
0
10
20
30
40
50
60
70
80
◆ no. days since last storm

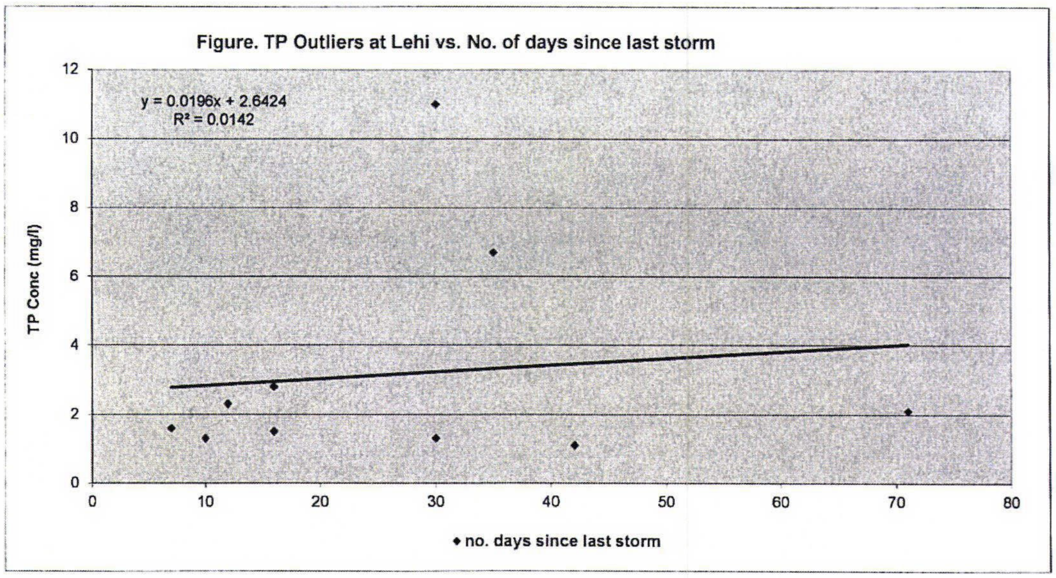


Figure. TP Outliers at Lehi vs. No. of days since last storm
y = 0.0196x + 2.6424
R² = 0.0142
TP Conc (mg/l)
0
2
4
6
8
10
12
0
10
20
30
40
50
60
70
80
◆ no. days since last storm

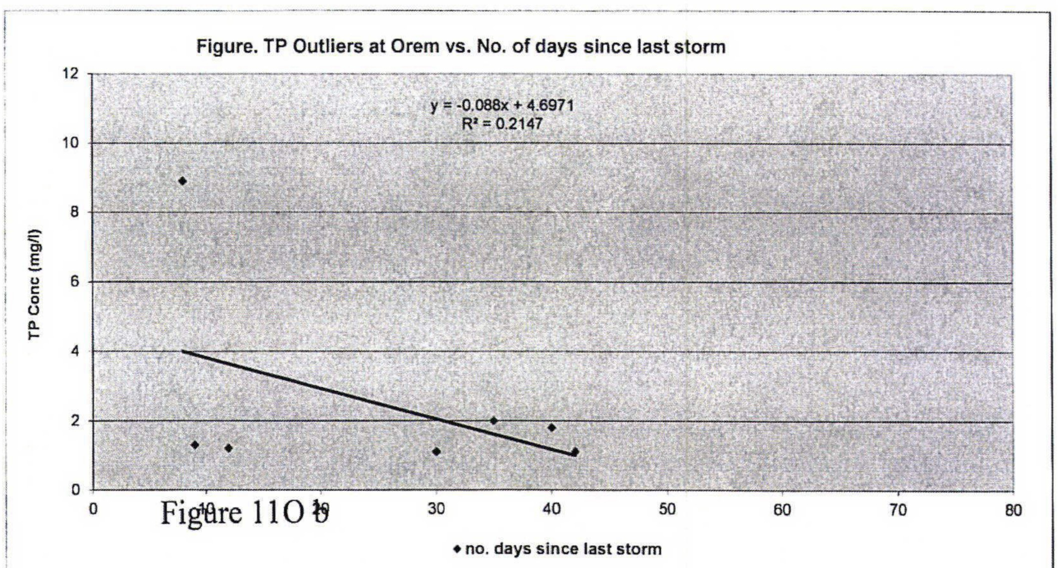


Figure. TP Outliers at Orem vs. No. of days since last storm
y = -0.088x + 4.6971
R² = 0.2147
TP Conc (mg/l)
0
2
4
6
8
10
12
0
30
40
50
60
70
80
◆ no. days since last storm

Figure 11O b

Method 4: Yet another way to compare wind to TP high values is to plot all the 3½ years of daily max wind (mph) from the Eureka station (that's lots of data, ~ 3½ x 365 = 1300 pts) including the max wind the day before the sample and the 36 dates with TP > 1 outliers. I marked the 36 high TP dates on the daily max wind plots. These are shown on Figure 11P for each year.

In 2017, there were ~ 11 of the 15 dates with samples of TP > 1 which were in fact on dates when the max daily wind was quite high, some of the highest winds during that year. Other high wind days may have been when there were dry cold fronts creating windy conditions, or when I didn't get a sample.

In 2018, there were ~ 8 of the 11 dates with samples of TP > 1 which were on several dates when the max daily wind was quite high, but not on all the highest wind days. Maybe lots of dry cold fronts and lots of TP measurements not > 1.

In 2019, there were ~ 5 of the 7 dates with TP > 1 which were on dates when the daily max wind was high, some of the highest that year. There were lots of TP samples taken in 2019, but apparently not many high TP sample measurements.

In 2020, so far, there are 2 of 3 dates with TP > 1 which were on a date with high daily max winds. There were in fact lots of dry windy fronts that passed thru this year. We'll see what happens the rest of the year?

In summary, over the past 3½ years, there have been ~ 26 of the 36 dates with TP > 1 which were dates when the Eureka daily max winds were relatively high, some of the highest those years. That's ~ 72 % of the time.

There is good reason to believe also that the results shown above with Eureka wind on these 36 dates would be essentially the same with Vernon and Tickville wind. Figures 11A, 11B and 11C show that the wind data at Vernon and Tickville are about the same as the wind data at Eureka in terms of wind trends, lows and highs. Eureka and Vernon wind magnitudes are about the same, while Tickville wind magnitudes are somewhat lower.

Therefore, the results shown on Figure 11P would likely be similar for Vernon and Tickville. (Maybe someday I'll plot those also?)

I think this method of comparisons and these plots are a good way of showing / suggesting that there is a positive relationship / correlation between high winds and high TP concentrations.

Something else here???

Theron Miller's comment regarding this concern is:

And to our wet and dry samples. We have now added three data recording weather stations at three of our sites, including the two that have the NADP samplers.

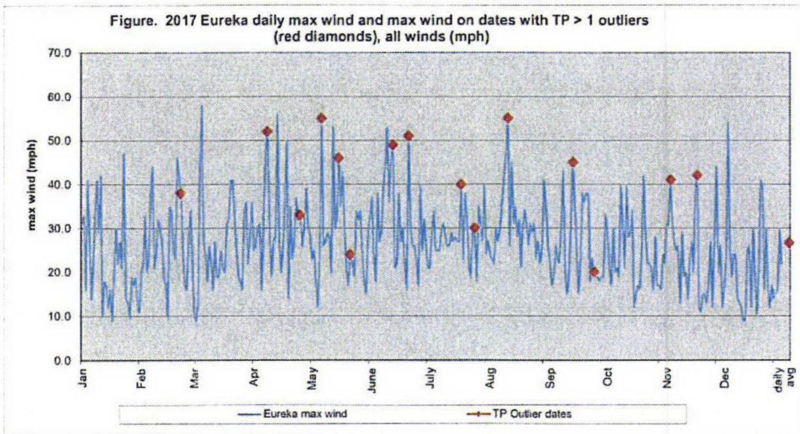


Figure. 2017 Eureka daily max wind and max wind on dates with TP > 1 outliers (red diamonds), all winds (mph)

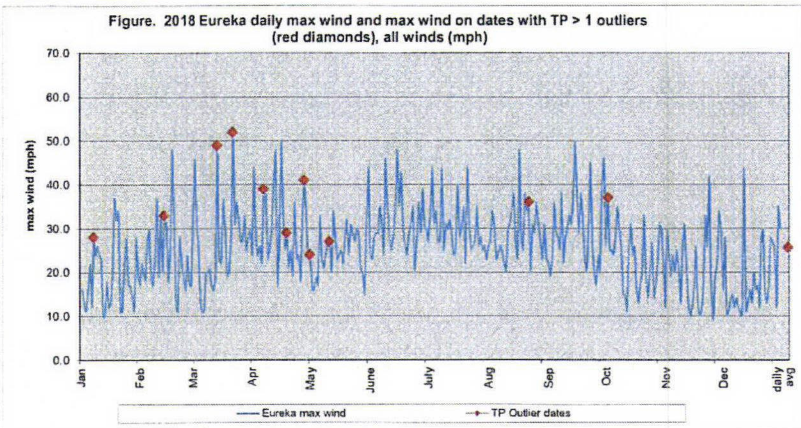


Figure. 2018 Eureka daily max wind and max wind on dates with TP > 1 outliers (red diamonds), all winds (mph)

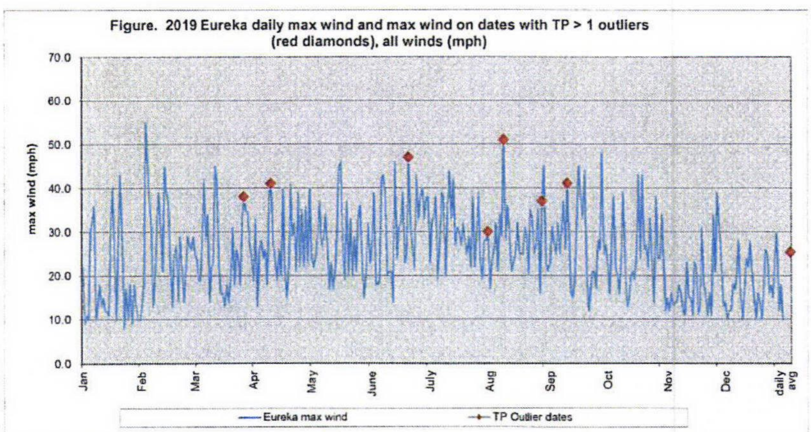


Figure. 2019 Eureka daily max wind and max wind on dates with TP > 1 outliers (red diamonds), all winds (mph)

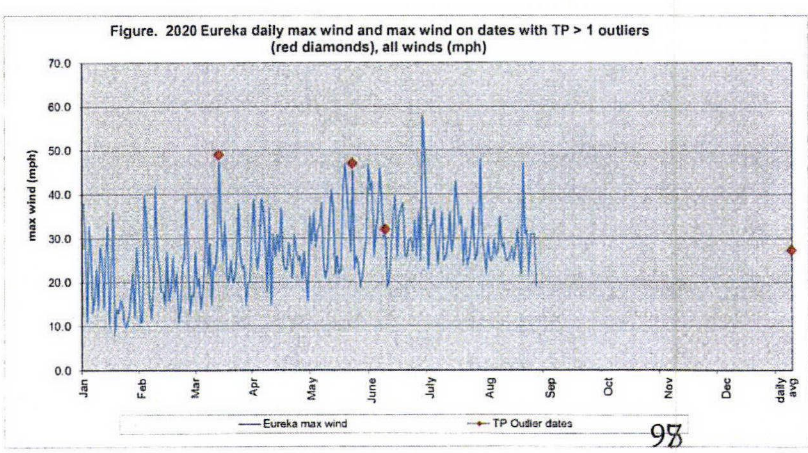


Figure. 2020 Eureka daily max wind and max wind on dates with TP > 1 outliers (red diamonds), all winds (mph)

Figure 11P

The preceding discussion (pages 69 – 98) has been my response to Dr. Gay's suggestions in Comments #11 (copied again below) on high TP concentrations compared to wind speed. The following discussion is a similar evaluation for high TN concentrations and wind speed. Much of this text is repetitious, but with the data, plots and tables, results, and conclusions for TN.

> *11. I suggest that the high TP and TN concentration samples be compared to an independent record of the southwest dust storms. If this can be done, and the comparison is favorable, this would provide credence to the entire sampling program and deposition estimates. This could potentially be done with wind direction, wind speed, and rainfall records at the nearest airport/monitoring station to the west.*

Like I said before, I obtained wind data (mph) from three Bureau of Land Management stations to the west of Utah Lake. The Eureka station to the southwest is ~ 14 miles from the lake shore and ~ 20 miles from the middle of the lake. The Vernon station to the west is ~ 30 miles from the lake. The Tickville station to the northwest is ~ 13 miles from the middle of the lake.

<u>TOTAL NITROGEN</u>. For the purposes of this analysis, I identified all TN concentrations > 5 mg/l as TN outliers. I found that all TN > 5 samples were collected on 28 different dates. These dates and sample concentrations are shown on Table 11D. Lincoln Pt has TN samples > 5 on 10 dates, Pelican Pt has TN samples > 5 on 5 dates, Genola on 3 dates, Mosida on 9 dates, Lehi on 5 dates, and BYU on 5 dates. I have not considered Elberta, Orem and Sp Fork due to their low numbers of TN samples > 5. There are 6 samples >> 15 mg/l to which I assigned the value of 15.

I tabulated the wind data from the 3 BLM stations corresponding on these 28 dates. The wind data which I used are: avg wind the day before the sample, 10-day avg of avg wind day before the sample, max wind the day before the sample, and the 10-day avg of max wind the day before the sample. These data are listed in Table 11E (also see Figures 11A, 11B and 11C, same data).

<u>Method 1</u>: First I plotted all the TN > 5 data for 6 of my sampling locations along with the wind data (mph) from Eureka and Vernon. These bar graphs are shown on Figures 11Q – 11S (pages 102 - 104) for Eureka, and Figures 11T – 11V (pages 105 - 107) for Vernon.

Like I said before, each figure is on one page, has 4 bar graphs, and 2 bar graphs for each sampling station. For example, Figure 11Q shows Lincoln Pt and Pelican Pt TN outliers along with Eureka 1) max wind the day before the sample, 2) 10-day avg max wind the day before the sample, and 3) 10-day avg avg wind the day before the sample.

The first of the 2 bar graphs for each station shows all the dates. But as noted above, Lincoln Pt has only 10 of the 28 dates, and Pelican Pt has only 5 of the 28, with TN > 5 data. The second of the 2 bar graphs for each station shows only those 10, and only those 5 comparisons. Each of the 6 figures with 4 sets of bar graphs has the same configuration.

The next set of graphs shows the same data plotted as line graphs. This is still another way of illustrating the wind and TP comparisons. These plots are shown on Figure 11W for Eureka wind data and Figure 11X for Vernon data. Only the "all dates" bar graphs are shown on these figures.

Table 11D TN Outliers (TN > 5 mg/l): Concentrations and Locations

values > 15 are assigned values of 15 (7 values out of ~ 400)

	date	LincolnPt	PelicanPt	Genola	Elberta	Mosida	Lehi	Orem	Sp Fork	BYU
1	8-Jan-17									9.59
2	22-Feb-17	15								
3	27-Feb-17	5.31			6.26					
4	30-Mar-17						5.33			
5	8-Apr-17					7.24	8.05			
6	21-Apr-17	5.03								
7	17-May-17	6.9		7.3						
8	13-Jun-17	14								
9	20-Jun-17		9.91							
10	17-Jul-17			11.8						
11	25-Jul-17	15								
12	10-Aug-17	15					7.11			
13	5-Nov-17									6.3
14	17-Nov-17				6.9					
15	9-Jan-18					7.2				5.6
16	16-Mar-18				8.5					
17	23-Mar-18		6.3							
18	20-Apr-18		7.8							
19	30-Apr-18						5			
20	3-May-18			8.9						
21	22-Aug-18	15	5.7			15	5.7			5.8
22	3-Oct-18	12.4	10.2			15				
23	10-Oct-18					5				
24	21-Jun-19					10.3				
25	1-Aug-19	9.6				6.4				
26	9-Aug-19					10.1				
27	20-Nov-19									5.1
28	23-May-20					15				
	total	10	5	3	3	9	5	0	0	5

Table 11E Wind Data (daily avg and max on day before storm and prior 10 day avg of daily avgs and maxs)

	date	Eureka avg (mph)	previous 10 day avg of avgs	Eureka max (mph)	previous 10 day avg of maxs	Eureka angle (deg)	Vernon avg (mph)	previous 10 day avg of avgs	Vernon max (mph)	previous 10 day avg of maxs	Vernon angle (deg)	Tickville avg (mph)	previous 10 day avg of avgs	Tickville max (mph)	previous 10 day avg of maxs	Tickvill angle (deg)
1	8-Jan-17	7	9	34	27		9	7	41	27		4	4	15	13	
2	22-Feb-17	20	10	42	29		5	9	48	27		4	6	42	22	
3	27-Feb-17	9	10	34	29		9	9	37	29		6	6	22	21	
4	30-Mar-17	8	9	36	27		5	7	31	24		7	7	29	24	
5	8-Apr-17	18	12	52	32		12	11	48	32		11	9	45	28	
6	21-Apr-17	8	9	35	32		7	8	31	28		7	8	27	24	
7	17-May-17	10	10	46	34	234	8	8	40	31	242	9	9	37	26	352
8	13-Jun-17	18	13	49	38	214	15	11	48	33	226	14	10	48	32	214
9	20-Jun-17	8	10	51	32	292	6	8	44	29	214	6	8	25	26	16
10	17-Jul-17	7	7	40	29		6	6	30	26		6	6	31	23	
11	25-Jul-17	8	7	30	27	225	6	6	36	29	209	6	6	28	24	60
12	10-Aug-17	7	7	55	33	329	5	6	39	31	200	5	6	41	23	350
13	5-Nov-17	14	10	41	26	240	12	7	45	25	197	8	6	31	21	185
14	17-Nov-17	17	9	42	25	273	20	8	44	24	196	11	7	42	21	182
15	9-Jan-18	6	6	28	18		11	5	38	16		4	4	24	14	
16	16-Mar-18	7	6	49	22		11	6	38	22		7	6	31	21	
17	23-Mar-18	9	8	52	31		8	9	48	33		8	7	41	28	
18	20-Apr-18	5	11	29	28		8	10	30	36		6	10	25	29	
19	30-Apr-18	6	9	41	28		8	7	41	27		11	8	39	25	
20	3-May-18	4	8	24	25		6	7	24	26		6	8	21	23	
21	22-Aug-18	11	8	36	33	200	10	7	36	29	168	6	6	24	23	120
22	3-Oct-18	8	9	37	28	204	10	8	40	28	186	6	7	28	23	136
23	10-Oct-18	7	8	30	27		7	8	28	29		6	8	30	24	
24	21-Jun-19	13	7	47	31	312	11	7	38	27	355	12	7	39	24	312
25	1-Aug-19	8	7	30	27	210	9	6	37	26	194	5	6	26	22	352
26	9-Aug-19	7	7	51	29	273	6	6	47	27	213	6	5	31	23	344
27	20-Nov-19	5	6	31	18		8	6	35	17		5	7	22	16	
28	23-May-20	6	11	47	33	230	6	9	58	34	290	5	9	46	30	312
	averages	9.3	8.7	40.0	28.5		8.7	7.6	39.3	27.6		7.0	7.0	31.8	23.3	

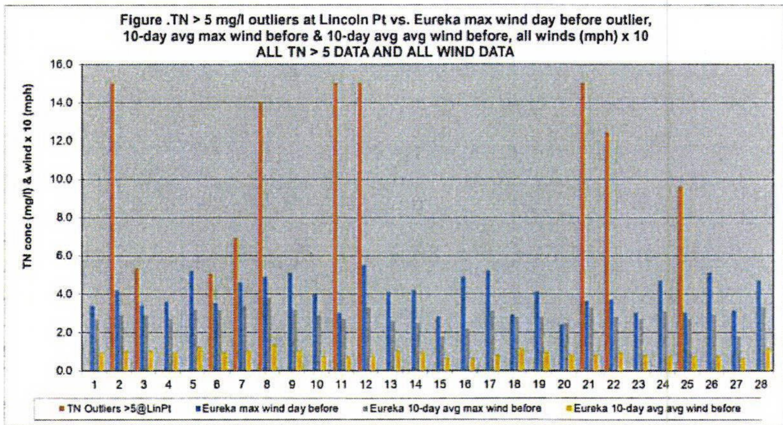


Figure .TN > 5 mg/l outliers at Lincoln Pt vs. Eureka max wind day before outlier, 10-day avg max wind before & 10-day avg avg wind before, all winds (mph) x 10
ALL TN > 5 DATA AND ALL WIND DATA
TN conc (mg/l) & wind x 10 (mph)
TN Outliers >5@LinPt
Eureka max wind day before
Eureka 10-day avg max wind before
Eureka 10-day avg avg wind before

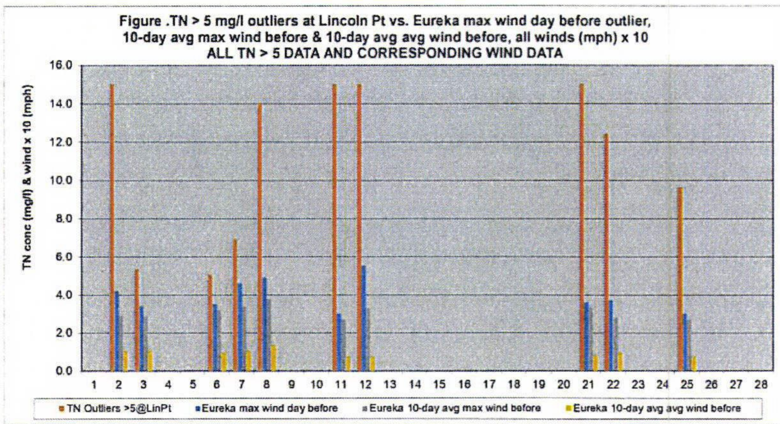


Figure .TN > 5 mg/l outliers at Lincoln Pt vs. Eureka max wind day before outlier, 10-day avg max wind before & 10-day avg avg wind before, all winds (mph) x 10
ALL TN > 5 DATA AND CORRESPONDING WIND DATA
TN conc (mg/l) & wind x 10 (mph)
TN Outliers >5@LinPt
Eureka max wind day before
Eureka 10-day avg max wind before
Eureka 10-day avg avg wind before

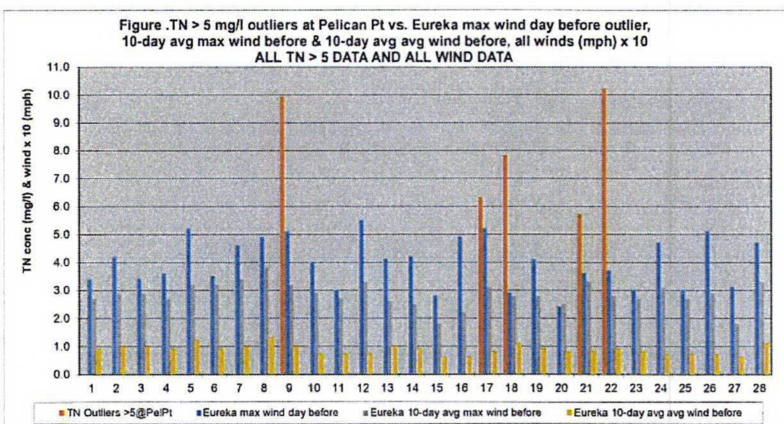


Figure .TN > 5 mg/l outliers at Pelican Pt vs. Eureka max wind day before outlier, 10-day avg max wind before & 10-day avg avg wind before, all winds (mph) x 10
ALL TN > 5 DATA AND ALL WIND DATA
TN conc (mg/l) & wind x 10 (mph)
TN Outliers >5@PelPt
Eureka max wind day before
Eureka 10-day avg max wind before
Eureka 10-day avg avg wind before

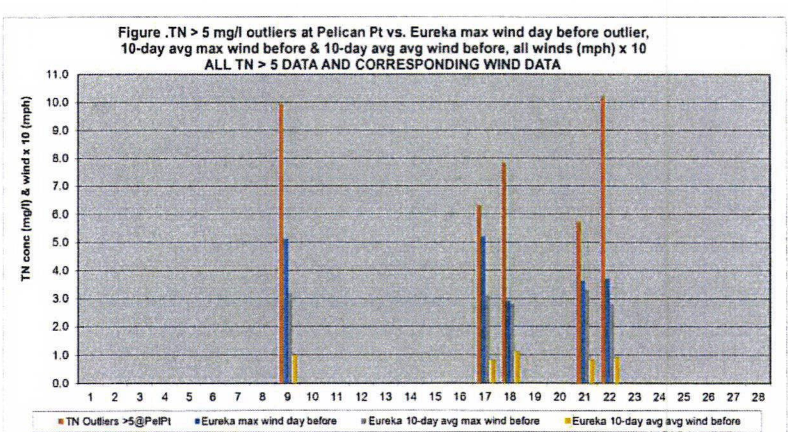


Figure .TN > 5 mg/l outliers at Pelican Pt vs. Eureka max wind day before outlier, 10-day avg max wind before & 10-day avg avg wind before, all winds (mph) x 10
ALL TN > 5 DATA AND CORRESPONDING WIND DATA
TN conc (mg/l) & wind x 10 (mph)
TN Outliers >5@PelPt
Eureka max wind day before
Eureka 10-day avg max wind before
Eureka 10-day avg avg wind before

Figure 11Q

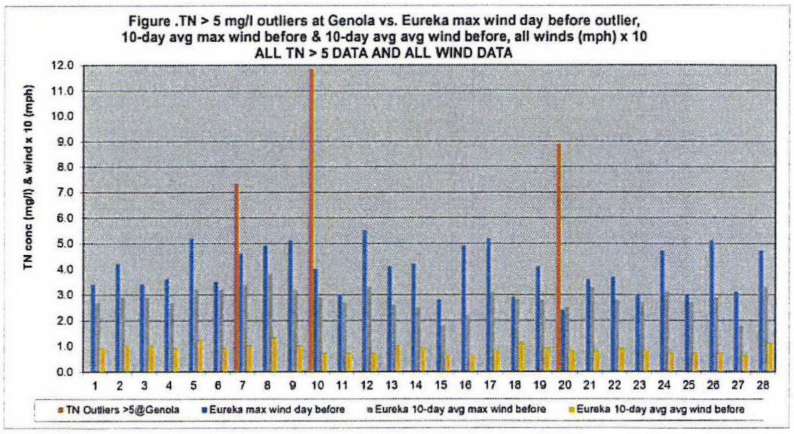


Figure .TN > 5 mg/l outliers at Genola vs. Eureka max wind day before outlier, 10-day avg max wind before & 10-day avg avg wind before, all winds (mph) x 10
ALL TN > 5 DATA AND ALL WIND DATA
TN conc (mg/l) & wind x 10 (mph)
TN Outliers >5@Genola
Eureka max wind day before
Eureka 10-day avg max wind before
Eureka 10-day avg avg wind before

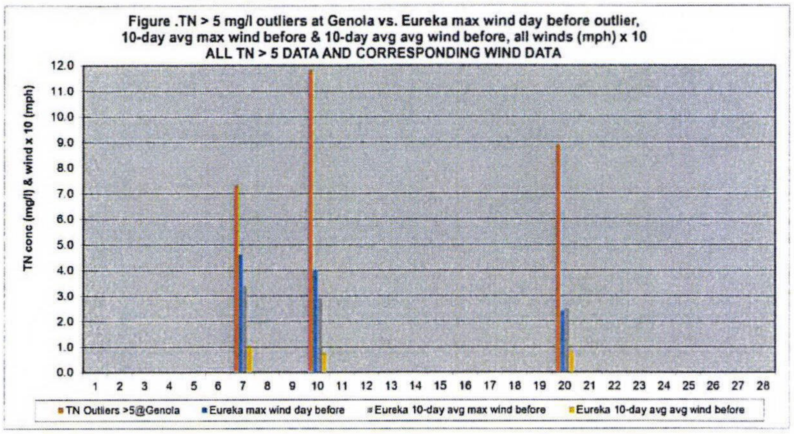


Figure .TN > 5 mg/l outliers at Genola vs. Eureka max wind day before outlier, 10-day avg max wind before & 10-day avg avg wind before, all winds (mph) x 10
ALL TN > 5 DATA AND CORRESPONDING WIND DATA
TN conc (mg/l) & wind x 10 (mph)
TN Outliers >5@Genola
Eureka max wind day before
Eureka 10-day avg max wind before
Eureka 10-day avg avg wind before

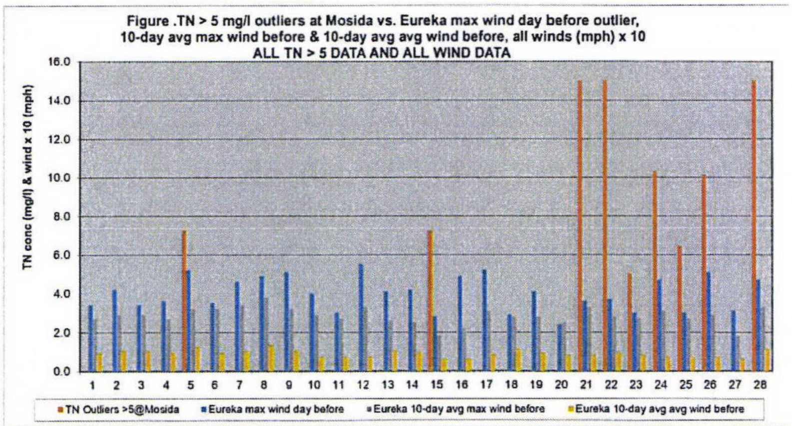


Figure .TN > 5 mg/l outliers at Mosida vs. Eureka max wind day before outlier, 10-day avg max wind before & 10-day avg avg wind before, all winds (mph) x 10
ALL TN > 5 DATA AND ALL WIND DATA
TN conc (mg/l) & wind x 10 (mph)
TN Outliers >5@Mosida
Eureka max wind day before
Eureka 10-day avg max wind before
Eureka 10-day avg avg wind before

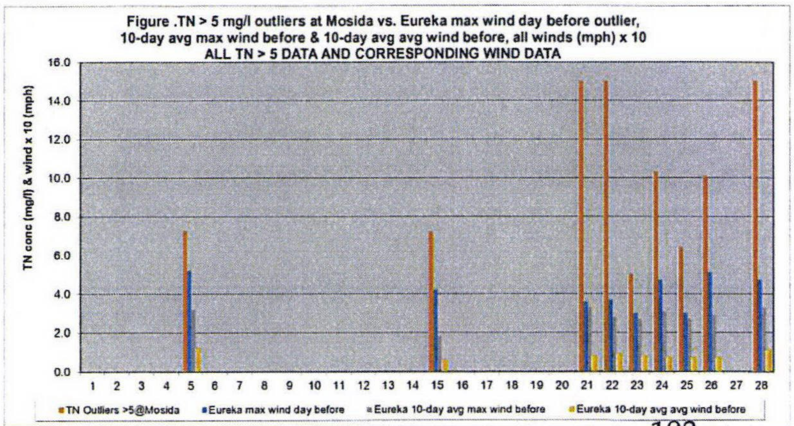


Figure .TN > 5 mg/l outliers at Mosida vs. Eureka max wind day before outlier, 10-day avg max wind before & 10-day avg avg wind before, all winds (mph) x 10
ALL TN > 5 DATA AND CORRESPONDING WIND DATA
TN conc (mg/l) & wind x 10 (mph)
TN Outliers >5@Mosida
Eureka max wind day before
Eureka 10-day avg max wind before
Eureka 10-day avg avg wind before

Figure 11R

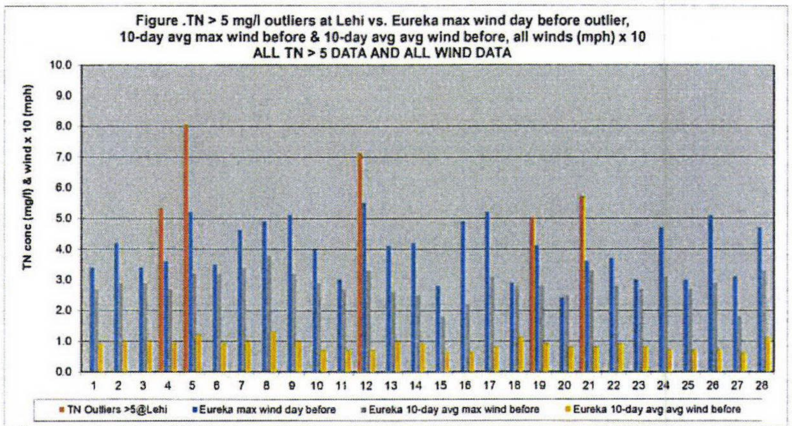


Figure .TN > 5 mg/l outliers at Lehi vs. Eureka max wind day before outlier, 10-day avg max wind before & 10-day avg avg wind before, all winds (mph) x 10
ALL TN > 5 DATA AND ALL WIND DATA
TN conc (mg/l) & wind x 10 (mph)
TN Outliers >5@Lehi
Eureka max wind day before
Eureka 10-day avg max wind before
Eureka 10-day avg avg wind before

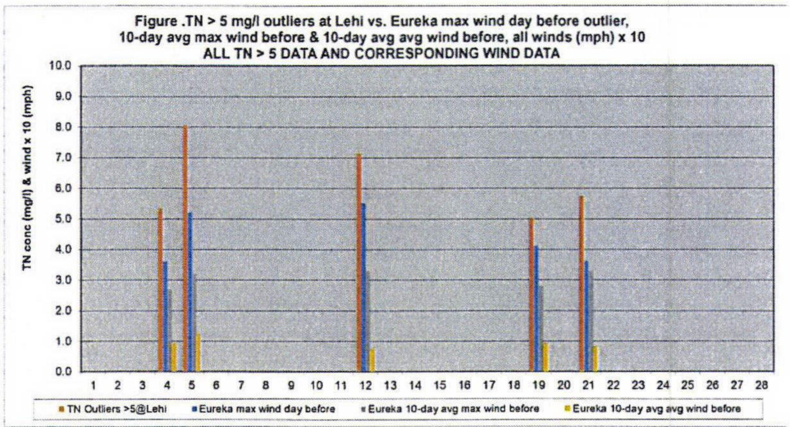


Figure .TN > 5 mg/l outliers at Lehi vs. Eureka max wind day before outlier, 10-day avg max wind before & 10-day avg avg wind before, all winds (mph) x 10
ALL TN > 5 DATA AND CORRESPONDING WIND DATA
TN conc (mg/l) & wind x 10 (mph)
TN Outliers >5@Lehi
Eureka max wind day before
Eureka 10-day avg max wind before
Eureka 10-day avg avg wind before

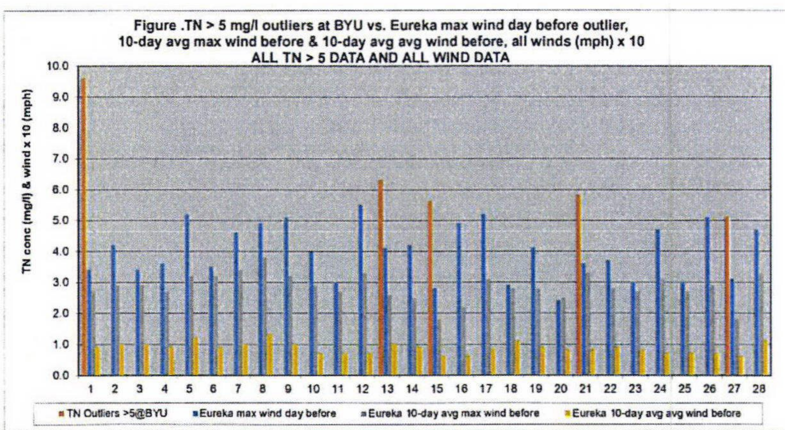


Figure .TN > 5 mg/l outliers at BYU vs. Eureka max wind day before outlier, 10-day avg max wind before & 10-day avg avg wind before, all winds (mph) x 10
ALL TN > 5 DATA AND ALL WIND DATA
TN conc (mg/l) & wind x 10 (mph)
TN Outliers >5@BYU
Eureka max wind day before
Eureka 10-day avg max wind before
Eureka 10-day avg avg wind before

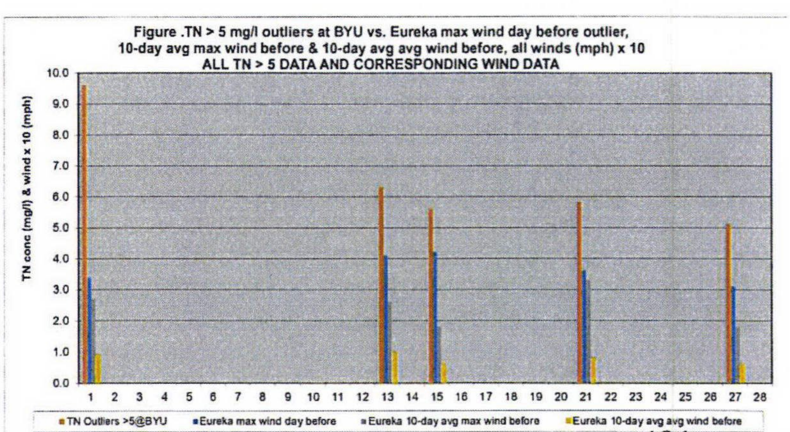


Figure .TN > 5 mg/l outliers at BYU vs. Eureka max wind day before outlier, 10-day avg max wind before & 10-day avg avg wind before, all winds (mph) x 10
ALL TN > 5 DATA AND CORRESPONDING WIND DATA
TN conc (mg/l) & wind x 10 (mph)
TN Outliers >5@BYU
Eureka max wind day before
Eureka 10-day avg max wind before
Eureka 10-day avg avg wind before

Figure 11S

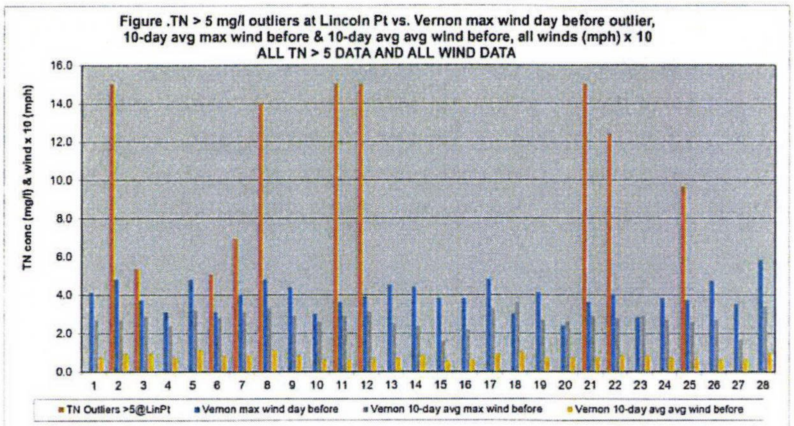


Figure .TN > 5 mg/l outliers at Lincoln Pt vs. Vernon max wind day before outlier, 10-day avg max wind before & 10-day avg avg wind before, all winds (mph) x 10
ALL TN > 5 DATA AND ALL WIND DATA
TN conc (mg/l) & wind x 10 (mph)
TN Outliers >5@LinPt
Vernon max wind day before
Vernon 10-day avg max wind before
Vernon 10-day avg avg wind before

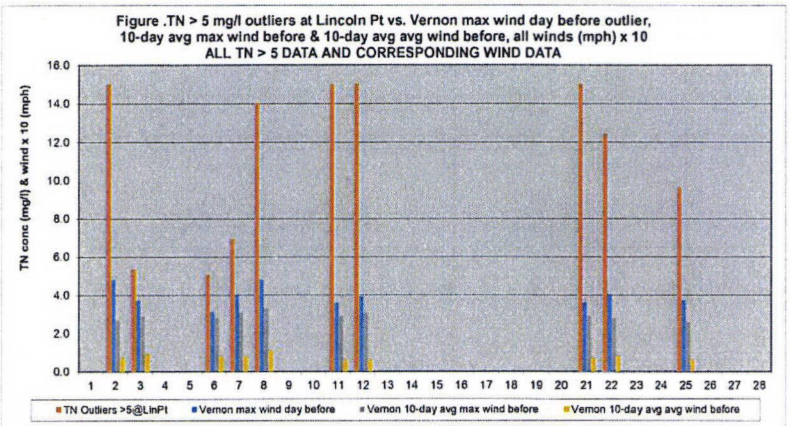


Figure .TN > 5 mg/l outliers at Lincoln Pt vs. Vernon max wind day before outlier, 10-day avg max wind before & 10-day avg avg wind before, all winds (mph) x 10
ALL TN > 5 DATA AND CORRESPONDING WIND DATA
TN conc (mg/l) & wind x 10 (mph)
TN Outliers >5@LinPt
Vernon max wind day before
Vernon 10-day avg max wind before
Vernon 10-day avg avg wind before

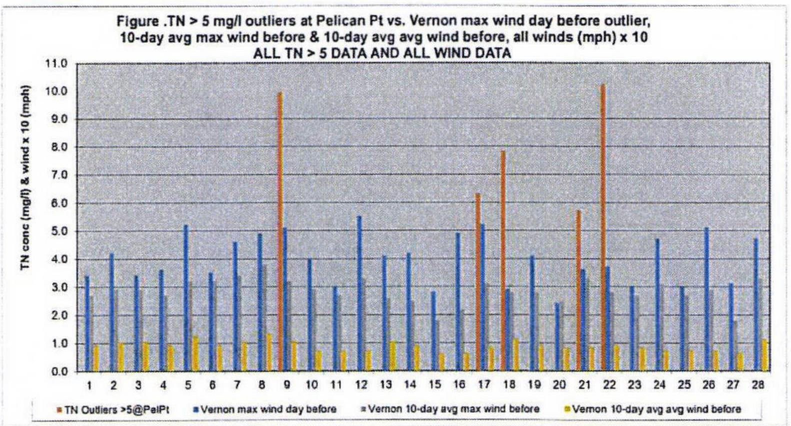


Figure .TN > 5 mg/l outliers at Pelican Pt vs. Vernon max wind day before outlier, 10-day avg max wind before & 10-day avg avg wind before, all winds (mph) x 10
ALL TN > 5 DATA AND ALL WIND DATA
TN conc (mg/l) & wind x 10 (mph)
TN Outliers >5@PelPt
Vernon max wind day before
Vernon 10-day avg max wind before
Vernon 10-day avg avg wind before

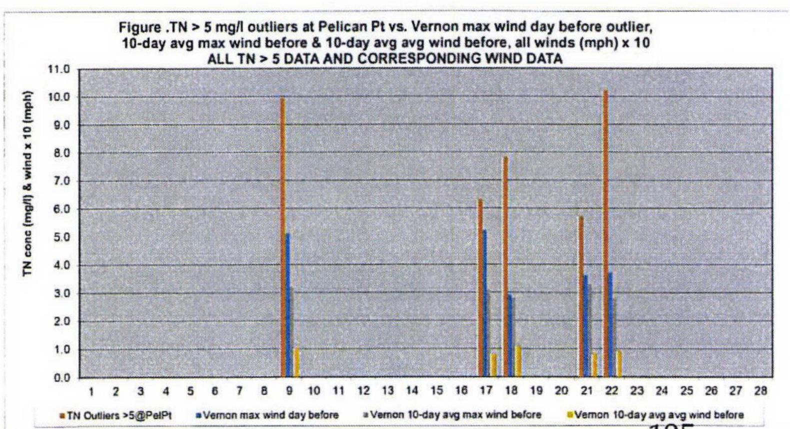


Figure .TN > 5 mg/l outliers at Pelican Pt vs. Vernon max wind day before outlier, 10-day avg max wind before & 10-day avg avg wind before, all winds (mph) x 10
ALL TN > 5 DATA AND CORRESPONDING WIND DATA
TN conc (mg/l) & wind x 10 (mph)
TN Outliers >5@PelPt
Vernon max wind day before
Vernon 10-day avg max wind before
Vernon 10-day avg avg wind before

Figure 11T

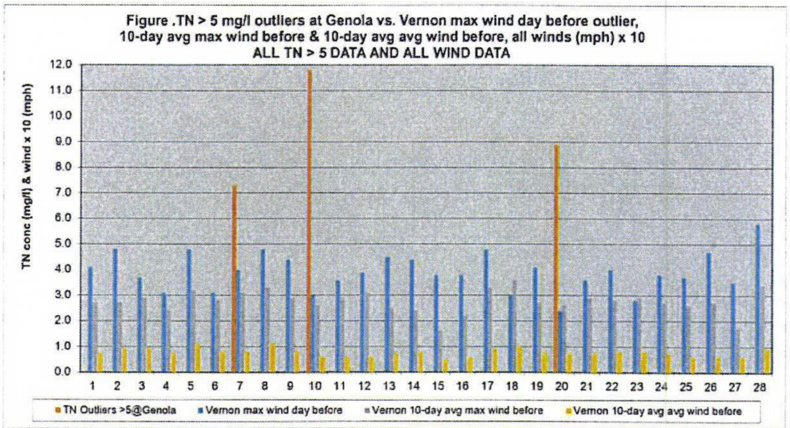


Figure .TN > 5 mg/l outliers at Genola vs. Vernon max wind day before outlier,
10-day avg max wind before & 10-day avg avg wind before, all winds (mph) x 10
ALL TN > 5 DATA AND ALL WIND DATA
TN conc (mg/l) & wind x 10 (mph)
TN Outliers >5@Genola
Vernon max wind day before
Vernon 10-day avg max wind before
Vernon 10-day avg avg wind before

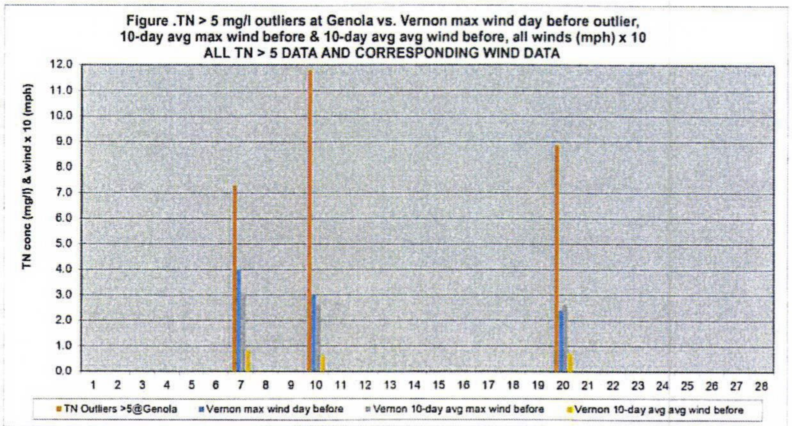


Figure .TN > 5 mg/l outliers at Genola vs. Vernon max wind day before outlier,
10-day avg max wind before & 10-day avg avg wind before, all winds (mph) x 10
ALL TN > 5 DATA AND CORRESPONDING WIND DATA
TN conc (mg/l) & wind x 10 (mph)
TN Outliers >5@Genola
Vernon max wind day before
Vernon 10-day avg max wind before
Vernon 10-day avg avg wind before

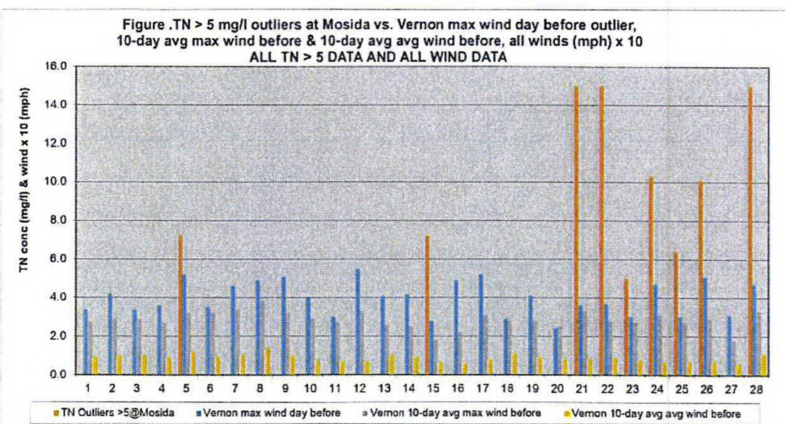


Figure .TN > 5 mg/l outliers at Mosida vs. Vernon max wind day before outlier,
10-day avg max wind before & 10-day avg avg wind before, all winds (mph) x 10
ALL TN > 5 DATA AND ALL WIND DATA
TN conc (mg/l) & wind x 10 (mph)
TN Outliers >5@Mosida
Vernon max wind day before
Vernon 10-day avg max wind before
Vernon 10-day avg avg wind before

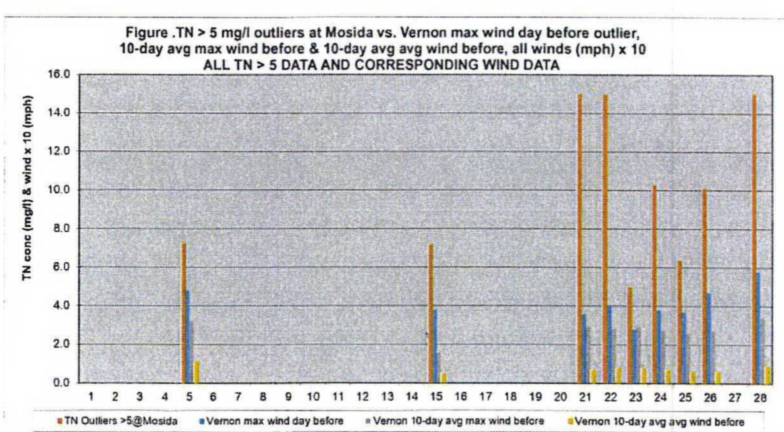


Figure .TN > 5 mg/l outliers at Mosida vs. Vernon max wind day before outlier,
10-day avg max wind before & 10-day avg avg wind before, all winds (mph) x 10
ALL TN > 5 DATA AND CORRESPONDING WIND DATA
TN conc (mg/l) & wind x 10 (mph)
TN Outliers >5@Mosida
Vernon max wind day before
Vernon 10-day avg max wind before
Vernon 10-day avg avg wind before

Figure 11U

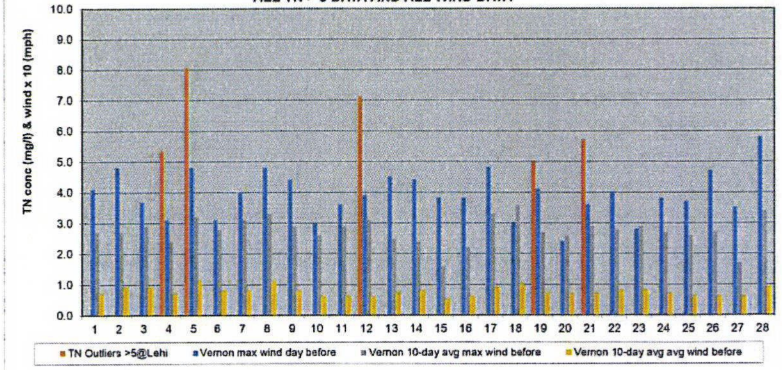


Figure .TN > 5 mg/l outliers at Lehi vs. Vernon max wind day before outlier, 10-day avg max wind before & 10-day avg avg wind before, all winds (mph) x 10
ALL TN > 5 DATA AND ALL WIND DATA

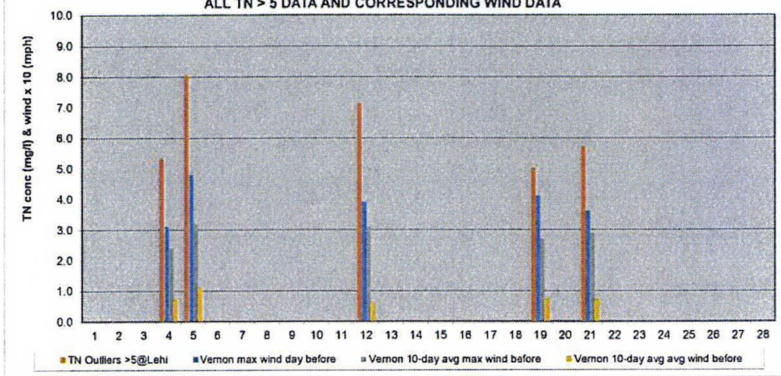


Figure .TN > 5 mg/l outliers at Lehi vs. Vernon max wind day before outlier, 10-day avg max wind before & 10-day avg avg wind before, all winds (mph) x 10
ALL TN > 5 DATA AND CORRESPONDING WIND DATA

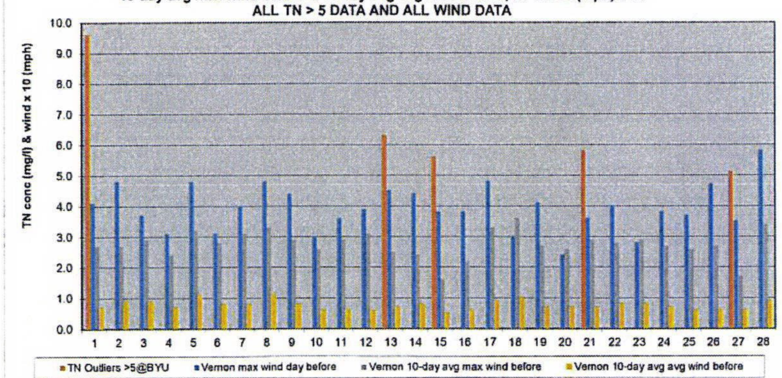


Figure .TN > 5 mg/l outliers at BYU vs. Vernon max wind day before outlier, 10-day avg max wind before & 10-day avg avg wind before, all winds (mph) x 10
ALL TN > 5 DATA AND ALL WIND DATA

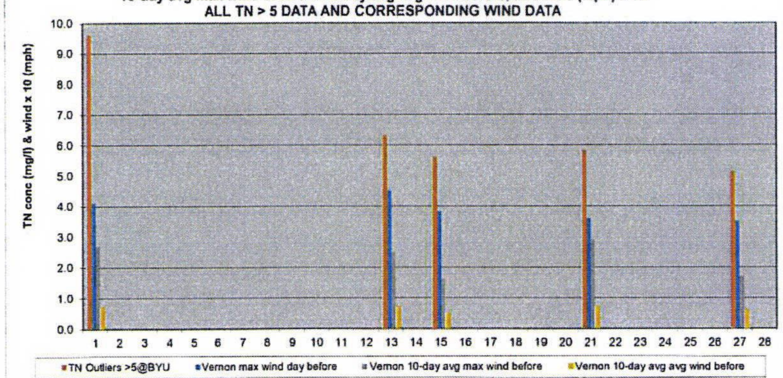


Figure .TN > 5 mg/l outliers at BYU vs. Vernon max wind day before outlier, 10-day avg max wind before & 10-day avg avg wind before, all winds (mph) x 10
ALL TN > 5 DATA AND CORRESPONDING WIND DATA

Figure 11V

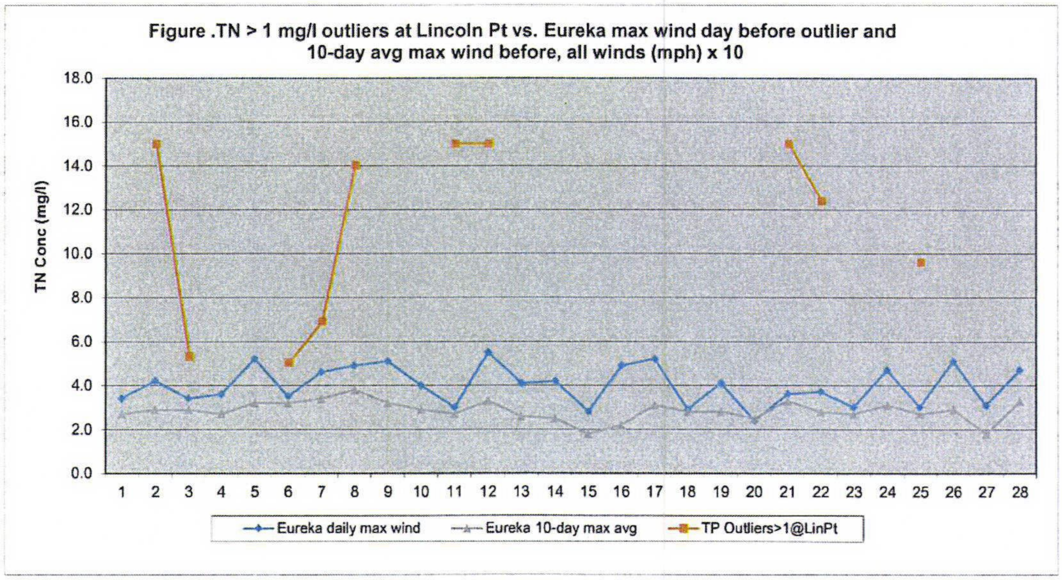


Figure .TN > 1 mg/l outliers at Lincoln Pt vs. Eureka max wind day before outlier and 10-day avg max wind before, all winds (mph) x 10
TN Conc (mg/l)
Eureka daily max wind
Eureka 10-day max avg
TP Outliers>1@LinPt

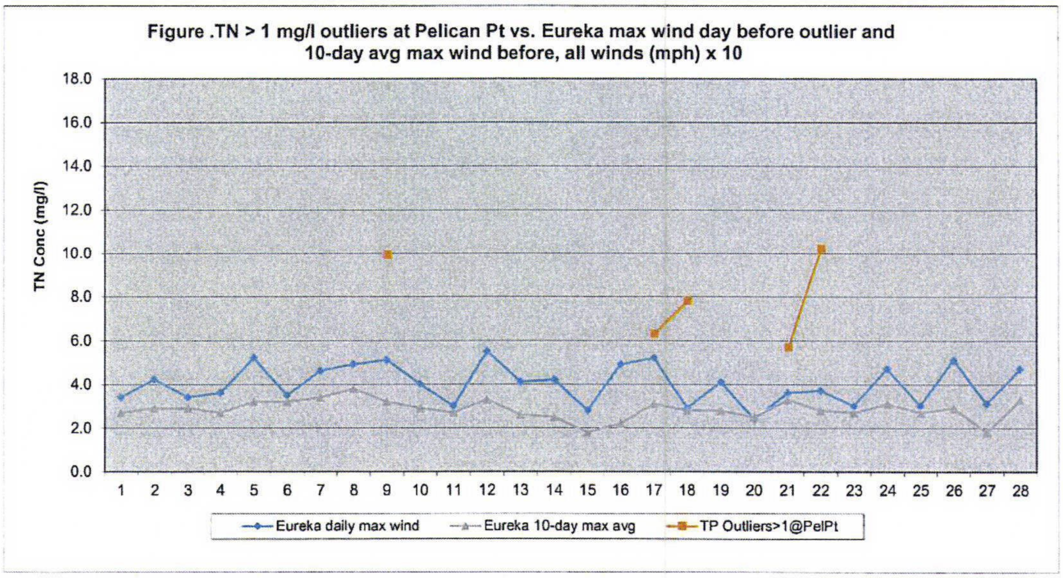


Figure .TN > 1 mg/l outliers at Pelican Pt vs. Eureka max wind day before outlier and 10-day avg max wind before, all winds (mph) x 10
TN Conc (mg/l)
Eureka daily max wind
Eureka 10-day max avg
TP Outliers>1@PelPt

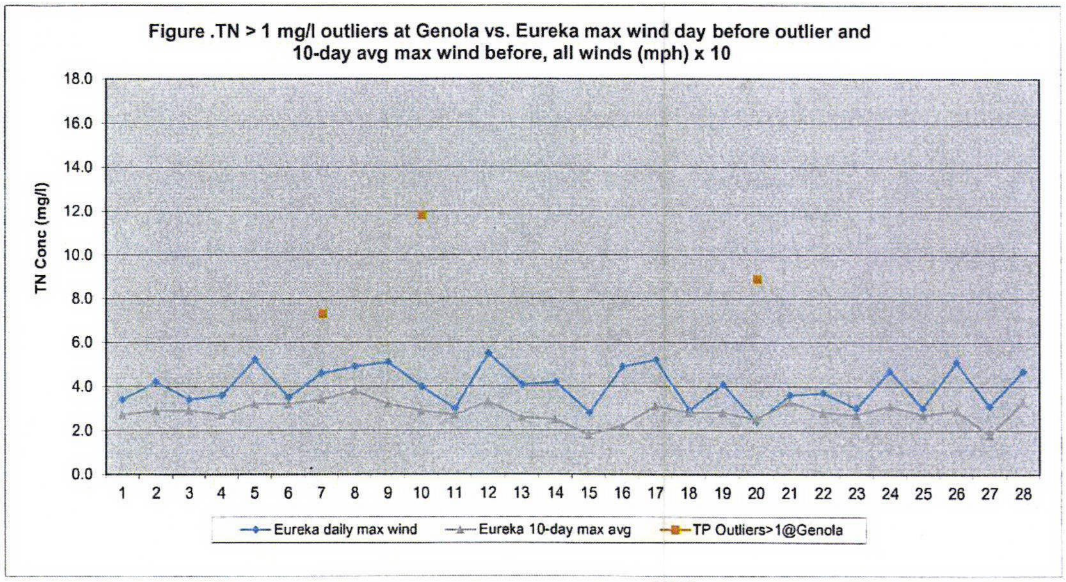


Figure .TN > 1 mg/l outliers at Genola vs. Eureka max wind day before outlier and 10-day avg max wind before, all winds (mph) x 10
TN Conc (mg/l)
Eureka daily max wind
Eureka 10-day max avg
TP Outliers>1@Genola

Figure 11Wa

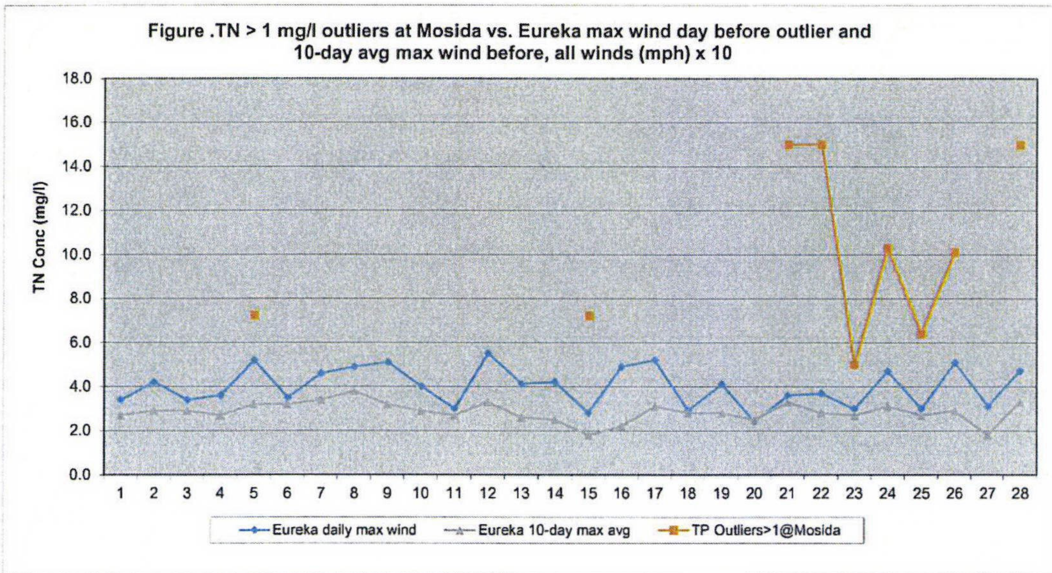


Figure .TN > 1 mg/l outliers at Mosida vs. Eureka max wind day before outlier and 10-day avg max wind before, all winds (mph) x 10
TN Conc (mg/l)
Eureka daily max wind
Eureka 10-day max avg
TP Outliers>1@Mosida

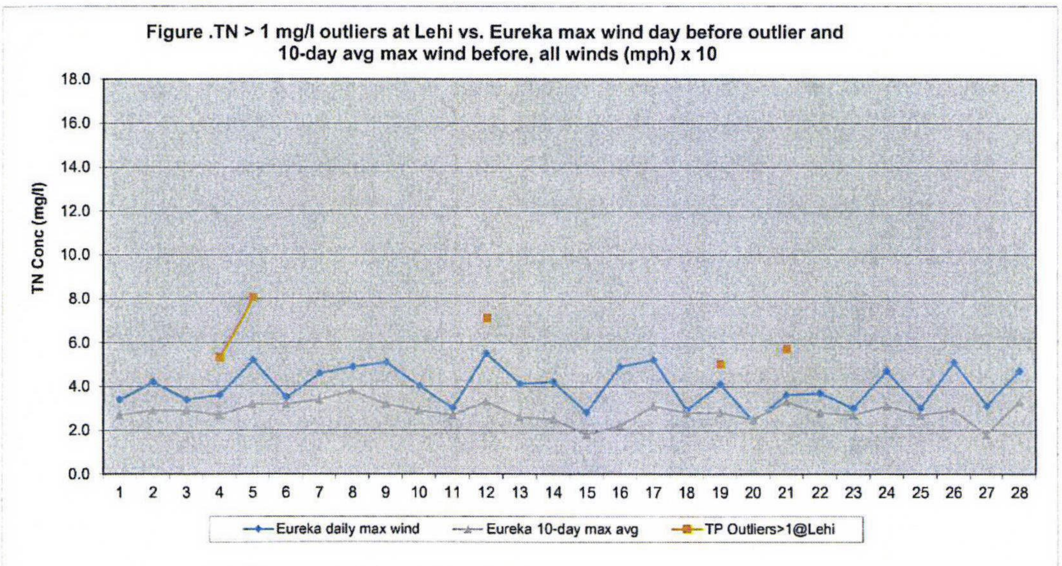


Figure .TN > 1 mg/l outliers at Lehi vs. Eureka max wind day before outlier and 10-day avg max wind before, all winds (mph) x 10
TN Conc (mg/l)
Eureka daily max wind
Eureka 10-day max avg
TP Outliers>1@Lehi

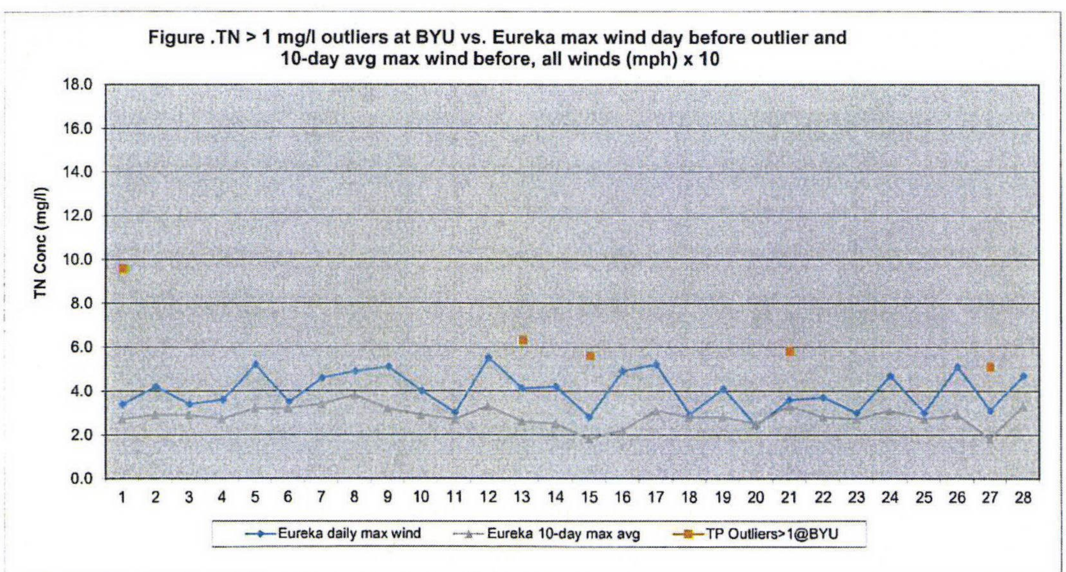


Figure .TN > 1 mg/l outliers at BYU vs. Eureka max wind day before outlier and 10-day avg max wind before, all winds (mph) x 10
TN Conc (mg/l)
Eureka daily max wind
Eureka 10-day max avg
TP Outliers>1@BYU

Figure 11Wb

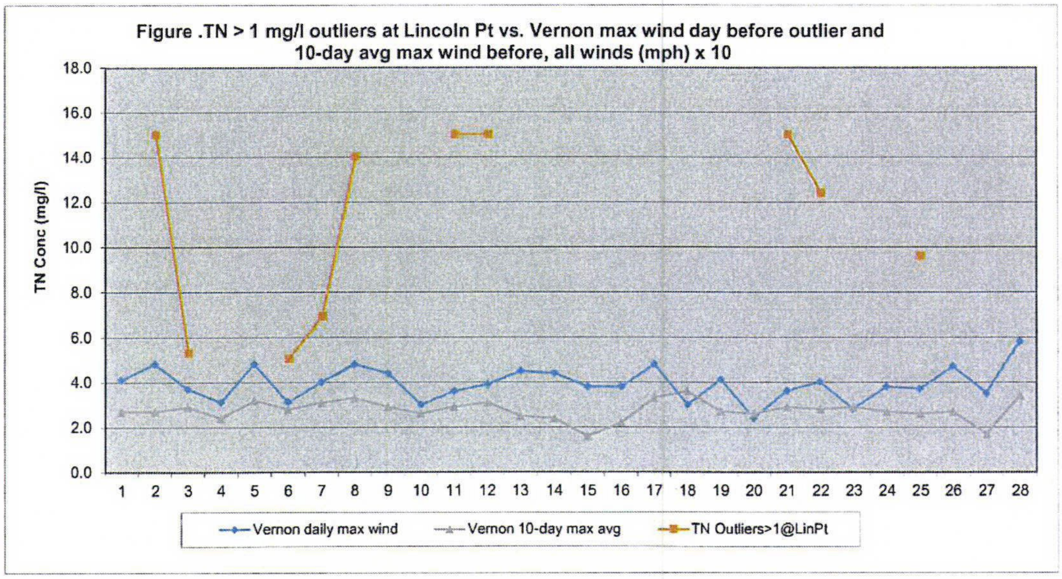


Figure .TN > 1 mg/l outliers at Lincoln Pt vs. Vernon max wind day before outlier and 10-day avg max wind before, all winds (mph) x 10
TN Conc (mg/l)
Vernon daily max wind
Vernon 10-day max avg
TN Outliers>1@LinPt

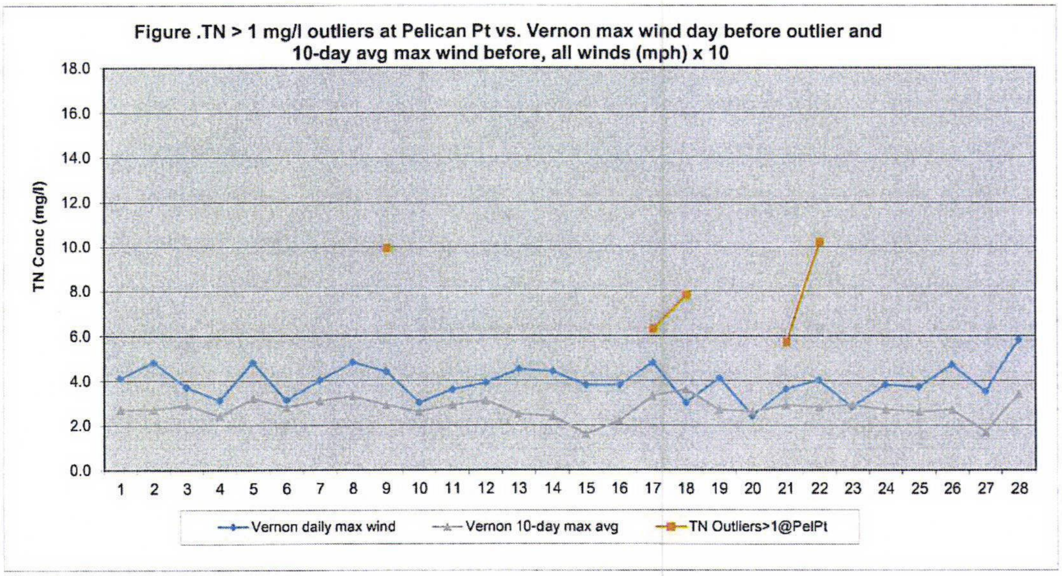


Figure .TN > 1 mg/l outliers at Pelican Pt vs. Vernon max wind day before outlier and 10-day avg max wind before, all winds (mph) x 10
TN Conc (mg/l)
Vernon daily max wind
Vernon 10-day max avg
TN Outliers>1@PelPt

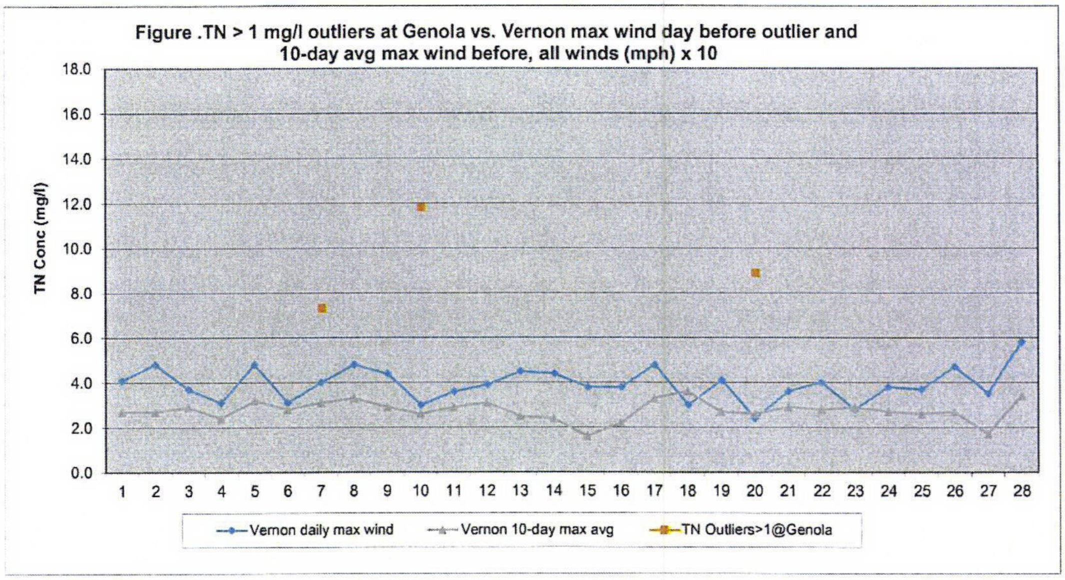


Figure .TN > 1 mg/l outliers at Genola vs. Vernon max wind day before outlier and 10-day avg max wind before, all winds (mph) x 10
TN Conc (mg/l)
Vernon daily max wind
Vernon 10-day max avg
TN Outliers>1@Genola

Figure 11Xa

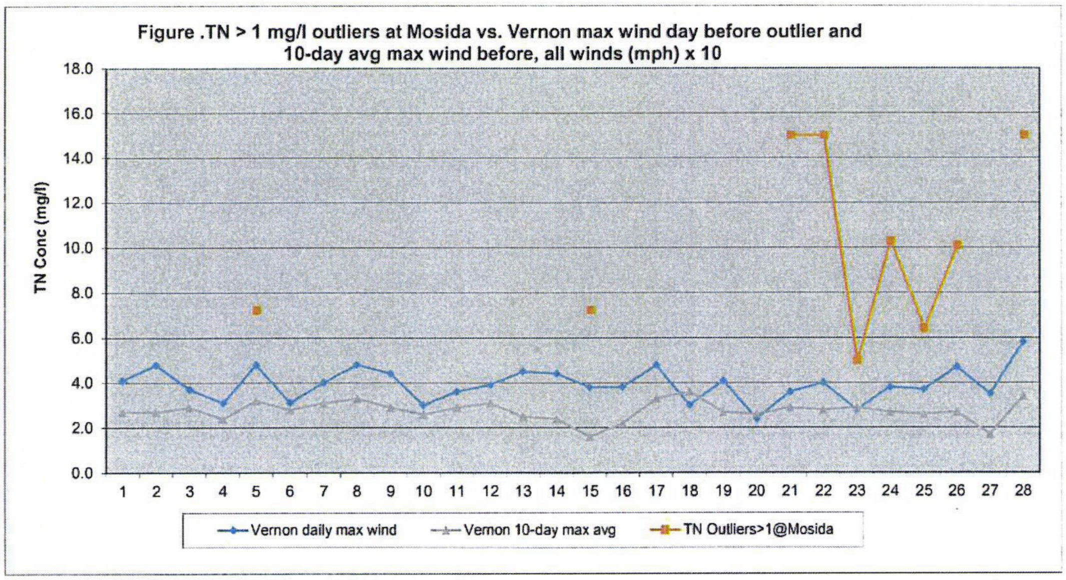


Figure .TN > 1 mg/l outliers at Mosida vs. Vernon max wind day before outlier and 10-day avg max wind before, all winds (mph) x 10
TN Conc (mg/l)
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28
Vernon daily max wind
Vernon 10-day max avg
TN Outliers>1@Mosida

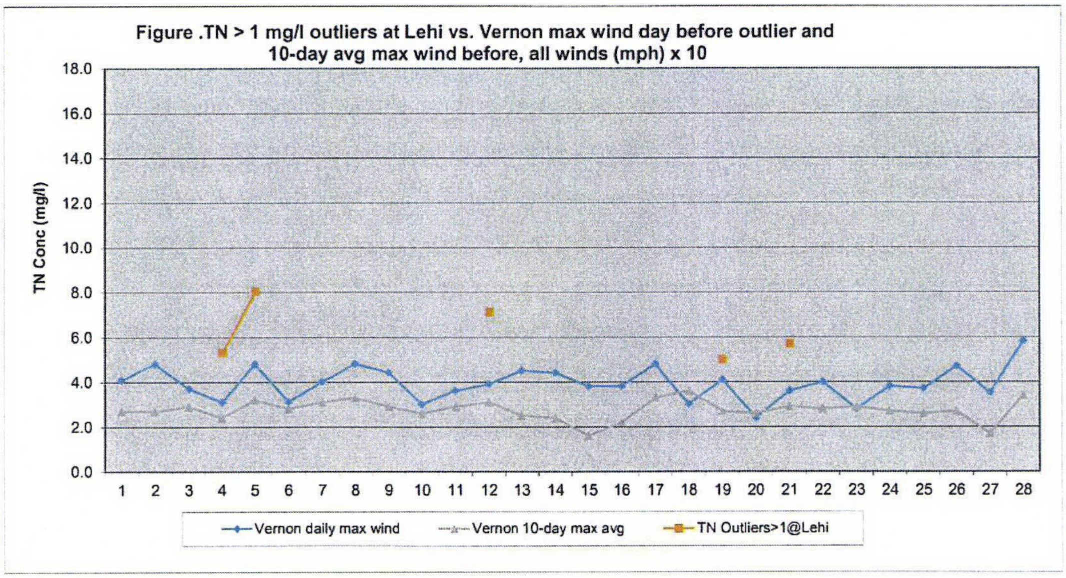


Figure .TN > 1 mg/l outliers at Lehi vs. Vernon max wind day before outlier and 10-day avg max wind before, all winds (mph) x 10
TN Conc (mg/l)
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28
Vernon daily max wind
Vernon 10-day max avg
TN Outliers>1@Lehi

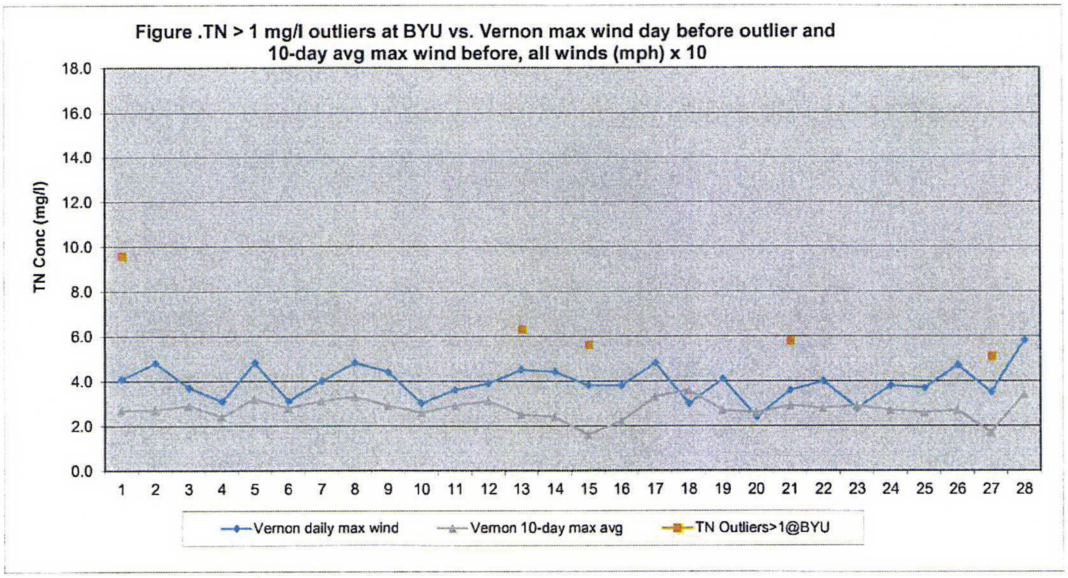


Figure .TN > 1 mg/l outliers at BYU vs. Vernon max wind day before outlier and 10-day avg max wind before, all winds (mph) x 10
TN Conc (mg/l)
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28
Vernon daily max wind
Vernon 10-day max avg
TN Outliers>1@BYU

Figure 11Xb

These paragraphs relate to Method 1 for TN vs. wind discussed above, starting on page 99. One observation that can be made from these figures, Figures 11Q – 11X above, is that, in general, when there is a high TN concentration outlier, there is usually a high wind, but when there is a high wind, there is not always a high TN conc. This was more apparent for TP than for TN.

**You might choose to go directly to the summary table below and skip these details.

Consider 1 of the 6 figures, each of which has 4 graphs. Figure 11Q (page 102, first bar graph) shows that for Lincoln Pt TN (10 dates with TN > 5) and Eureka wind, there are 5 dates with day before max wind > 50 mph, but only 1 of those dates has TN > 5. There are 15 dates with max wind > 40 mph, and only 4 of those dates have TN > 5. And there are 25 dates, of the 28, with max wind > 30 mph, of which all 10 have TN > 5.

Consider another example of the 6 figures. Figure 11U (page 106, third bar graph) shows that for Mosida TN (9 dates TN > 1) and Vernon wind, there is 1 date with > 50 mph day before max wind, and that 1 has TN > 5. There are 13 dates with max wind > 40 mph, and 4 of those dates have TN > 5. And there are 26 dates with max wind > 30 mph, of which 8, of the 9, have TN > 5.

In the TN data set, there are 28 dates which have at least 1 TN > 5 sample (Table 11D and 11E). The winds on these 28 dates are plotted on the bar graphs. I used 6 of my 8 sampling stations. That gives 168 (6 x 28) total bars on the 6 figures at each of the 2 wind stations (Figures 11Q – 11S for Eureka and Figures 11T – 11V for Vernon). Also, for the 6 stations, there are 37 samples with TN > 5 (Table 11D) distributed over the 28 dates. Therefore, 22 % (37 / 168) of all the wind bars have accompanying TP > 1 bars, and comparisons. The comparisons are described below.

There are 5 dates with Eureka max wind > 50 mph, and for 6 sampling stations (bar graphs), that's 30 "high wind comparisons." Of those 30, there are 7 with TN > 5, or 23 %.

There are 15 dates with Eureka max wind > 40 mph, and for 6 stations gives 90 high wind comparisons. Of those 90, there are 16 with TN > 5, or 18 %.

There are 25 dates with Eureka max wind > 30 mph, and for 6 stations gives 150 comparisons. Of those 150, there are 33 with TN > 5, or 22 %.

There is 1 date with Vernon max wind > 50 mph, and for 6 stations, gives 6 high wind comparisons. Of those 6, there is only 1 with TP > 1, or 17 %.

There are 13 dates with Vernon max wind > 40 mph, and for 6 stations, gives 78 comparisons. Of those 78, there are 16 with TP > 1, or 21 %.

There are 26 dates with Vernon max wind > 30 mph, and for 6 stations gives 156 comparisons. Of those 156, there are 35 with TP > 1, or 22 %.

These percentages above for TN are somewhat lower than the percentages for TP (pages 85-86). About 21 % of all the "high wind comparisons" have relatively high TN's, TN > 5 mg/l. The Eureka and Vernon BLM wind station data are very similar in high and low wind trends. Method 1 Summary Table below summarizes the numbers of dates and other information stated above.

Method 1 Summary Table. No. of Dates of Winds, Comparisons, & TN > 5 vs. Max Wind				
Station & > wind speed	**Number of Wind Dates**	**Number of Comparisons**	**Number of TN > 5 Dates**	**% TN > 5 of Comparisons**
Eureka: > 50	5	x 6 stations = 30	7	23%
> 40	15	90	16	18%
> 30	25	150	33	22%
Average				21%
Vernon: > 50	1	x 6 stations = 6	1	17%
> 40	13	78	16	21%
> 30	26	156	35	22%
Average				20%
Sum: > 50	6	36	8	22%
> 40	28	168	32	19%
> 30	51	306	68	22%
Average				21%

Method 2: Another way to determine if there is any correlation between wind and TN outliers is to plot max wind the day before the sample/storm vs. the TN > 5 mg/l outlier. These graphs are shown on Figure 11Y for Eureka wind, Figure 11Z for Vernon, and Figure 11AA for Tickville.

I realize Dr. Gay is concerned with simple linear best fit trends, and prefers MK trends, but I think comparing these simple trend lines is a useful and convincing way to interpret these plots.

Figure 11Y shows the trends for TN > 5 outliers vs. 2 sets of Eureka wind data, max wind and 10-day avg max wind. For max wind, there are 4 positive (increasing) trends (higher wind, higher TN), 1 flat trend (slope < 0.020), and 1 negative (decreasing) trend at Genola. For 10-day avg max wind, there are 4 positive trends and 2 negative trends at Genola and Pelican Pt.

Figure 11Z shows the trends for TN > 5 outliers vs. Vernon wind. For max wind, there are 5 positive trends and 1 negative trend at Genola. For 10-day avg max wind, there are 4 positive trends and 2 negative trends, again at Genola and Pelican Pt.

Figure 11AA shows the trends for TN > 5 outliers vs. Tickville wind. For max wind, there are 3 positive trends and 3 negative trends including Genola, Pel Pt and BYU. For 10-day avg max wind, there are also 3 positive trends and 3 negative trend, again at Genola, Pel Pt and BYU.

In total, for the 6 sample locations, 3 wind stations, and 2 max wind types (daily max and 10-day avg of daily max's), there are 36 correlations between TN > 5 outliers and max wind. Of these 36 simple linear best fit trend lines, 23 (64 %) are positive, 1 flat trend (3 %), and 12 (33 %) are negative. That means 64 % of the trends show that there appears to be a positive correlation for TN > 5 outliers and max wind; higher max wind, higher TN > 5 concentrations. However, these TN results (64 % positive) are lower than the TP results (72 % positive).

Figure 11Ya

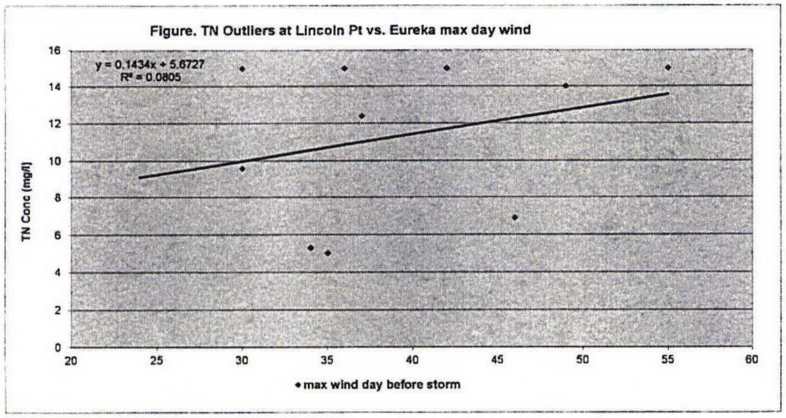


Figure. TN Outliers at Lincoln Pt vs. Eureka max day wind
y = 0.1434x + 5.6727
R² = 0.0805
TN Conc (mg/l)
max wind day before storm

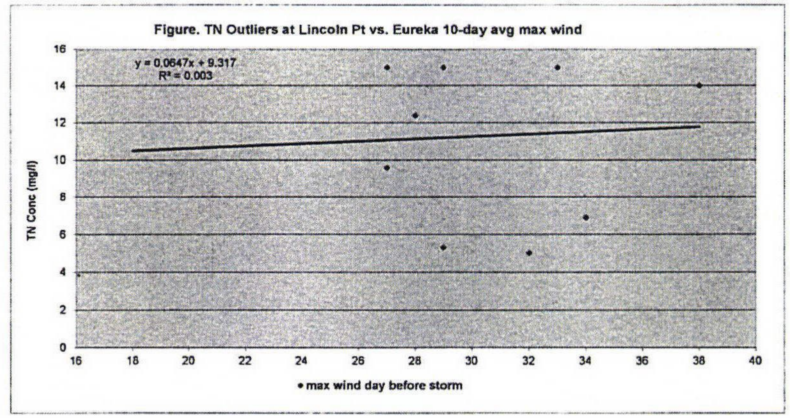


Figure. TN Outliers at Lincoln Pt vs. Eureka 10-day avg max wind
y = 0.0647x + 9.317
R² = 0.003
TN Conc (mg/l)
max wind day before storm

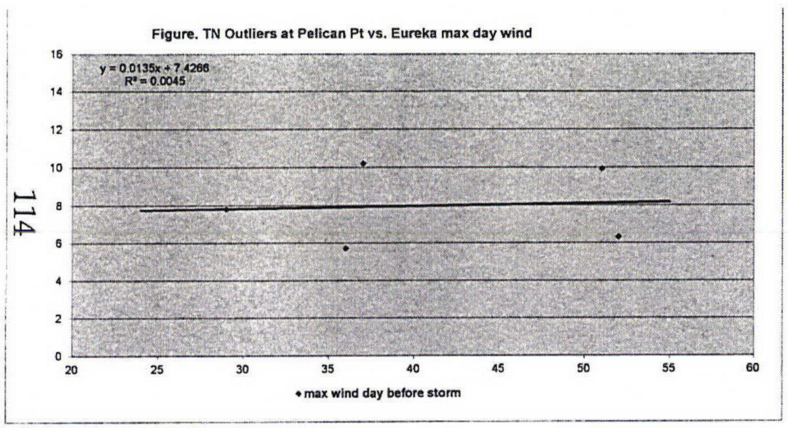


Figure. TN Outliers at Pelican Pt vs. Eureka max day wind
y = 0.0135x + 7.4266
R² = 0.0045
max wind day before storm

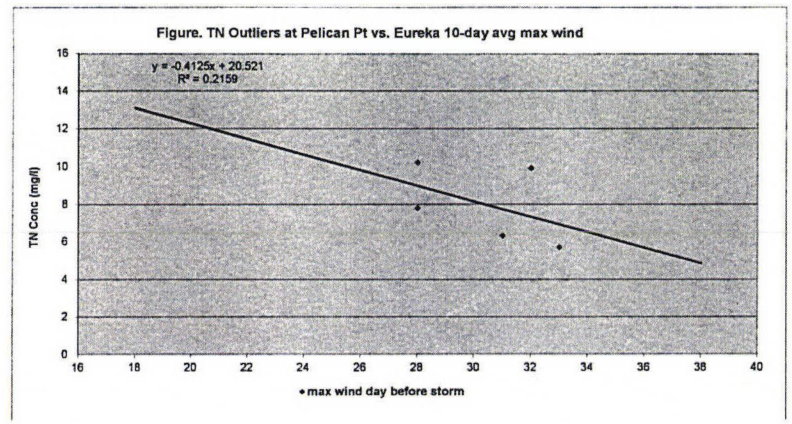


Figure. TN Outliers at Pelican Pt vs. Eureka 10-day avg max wind
y = -0.4125x + 20.521
R² = 0.2159
TN Conc (mg/l)
max wind day before storm

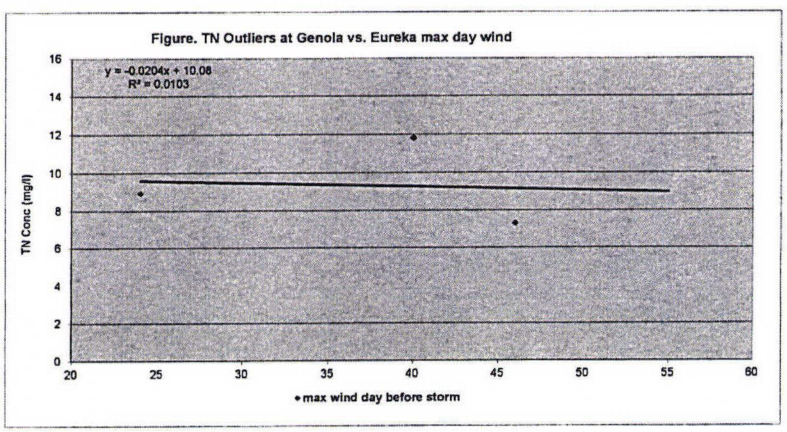


Figure. TN Outliers at Genola vs. Eureka max day wind
y = -0.0204x + 10.08
R² = 0.0103
TN Conc (mg/l)
max wind day before storm

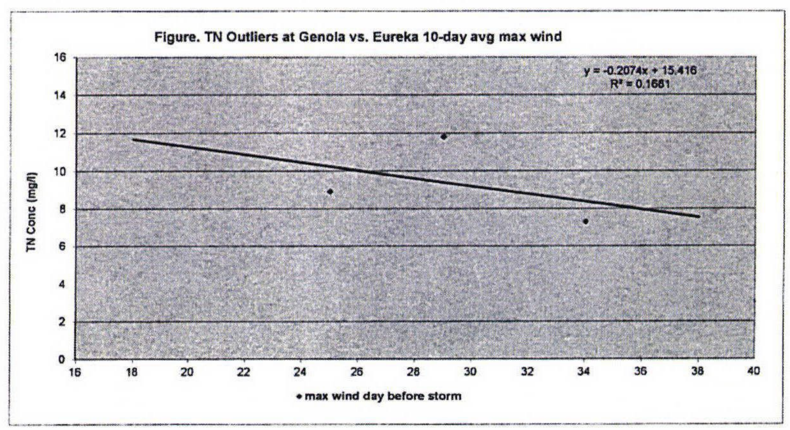


Figure. TN Outliers at Genola vs. Eureka 10-day avg max wind
y = -0.2074x + 15.416
R² = 0.1661
TN Conc (mg/l)
max wind day before storm

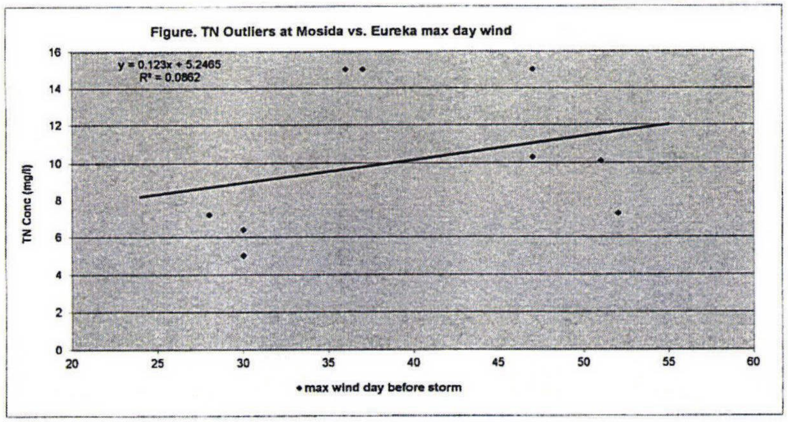


Figure. TN Outliers at Mosida vs. Eureka max day wind
y = 0.123x + 5.2465
R² = 0.0862
TN Conc (mg/l)
max wind day before storm

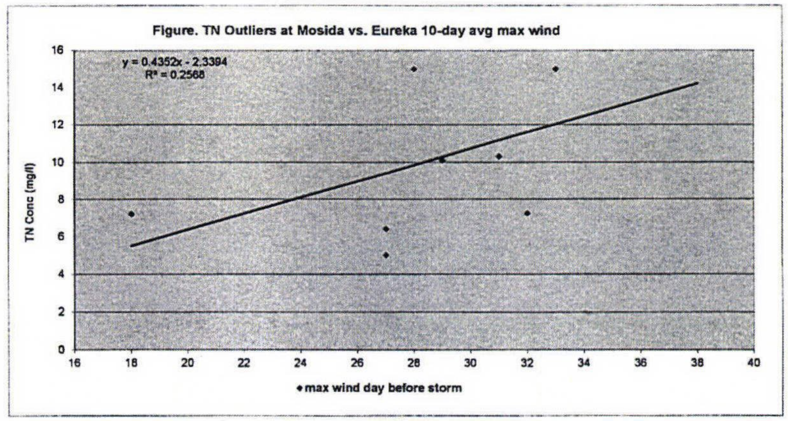


Figure. TN Outliers at Mosida vs. Eureka 10-day avg max wind
y = 0.4352x - 2.3394
R² = 0.2568
TN Conc (mg/l)
max wind day before storm

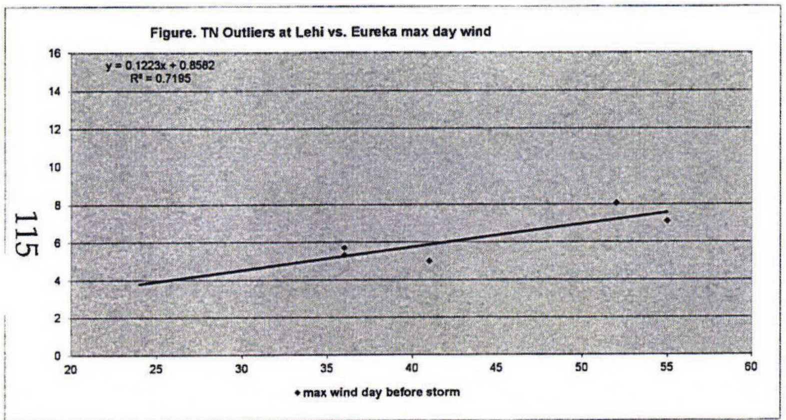


Figure. TN Outliers at Lehi vs. Eureka max day wind
y = 0.1223x + 0.8582
R² = 0.7195
max wind day before storm

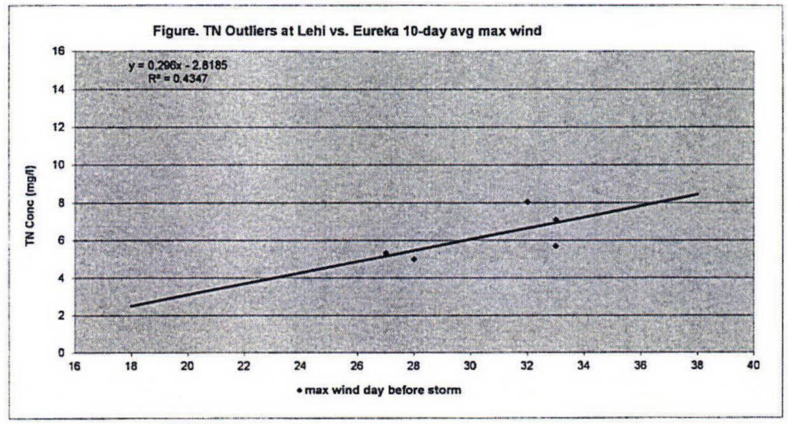


Figure. TN Outliers at Lehi vs. Eureka 10-day avg max wind
y = 0.296x - 2.8185
R² = 0.4347
TN Conc (mg/l)
max wind day before storm

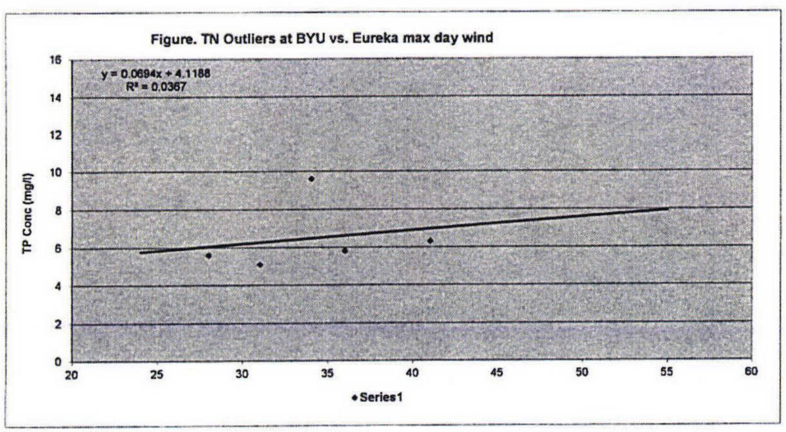


Figure. TN Outliers at BYU vs. Eureka max day wind
y = 0.0694x + 4.1188
R² = 0.0367
TP Conc (mg/l)
Series1

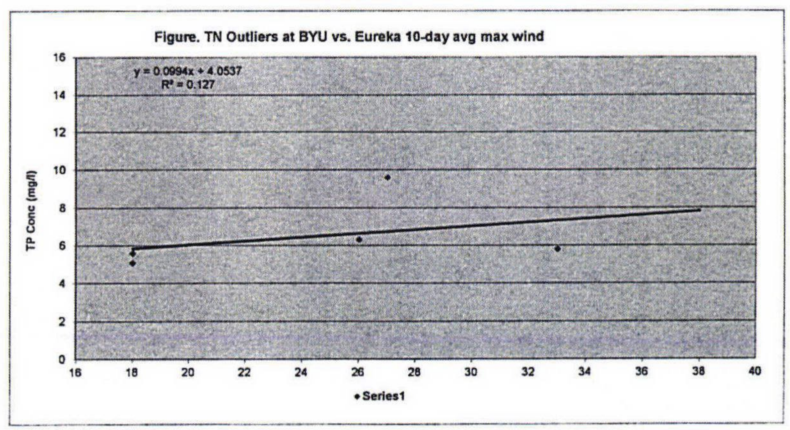


Figure. TN Outliers at BYU vs. Eureka 10-day avg max wind
y = 0.0994x + 4.0537
R² = 0.127
TP Conc (mg/l)
Series1

Figure 11Yb

Figure 11Za

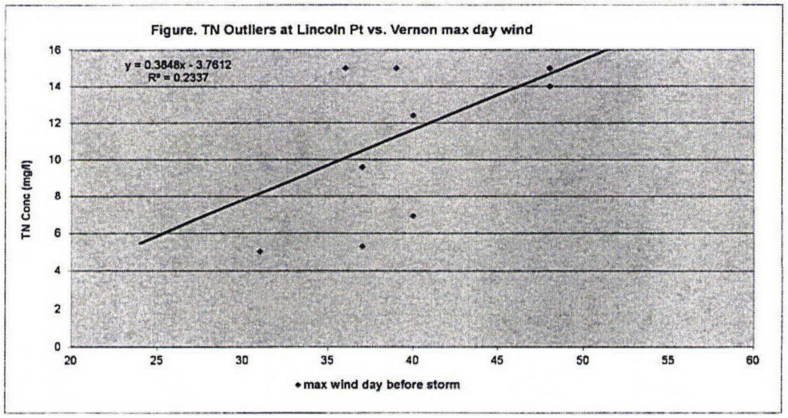


Figure. TN Outliers at Lincoln Pt vs. Vernon max day wind
y = 0.3848x - 3.7612
R² = 0.2337
TN Conc (mg/l)
max wind day before storm

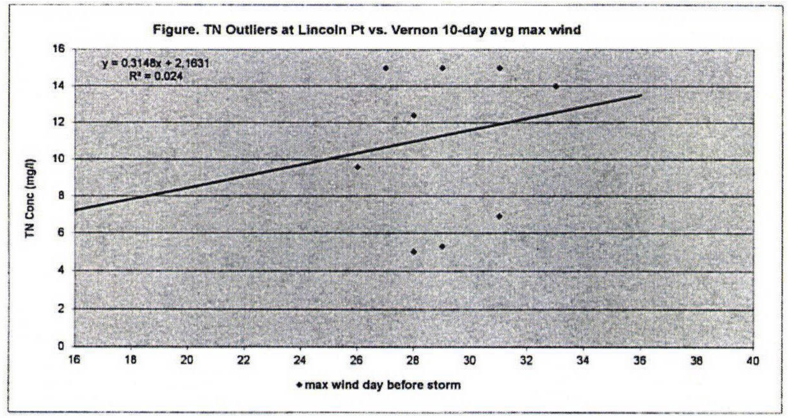


Figure. TN Outliers at Lincoln Pt vs. Vernon 10-day avg max wind
y = 0.3148x + 2.1631
R² = 0.024
TN Conc (mg/l)
max wind day before storm

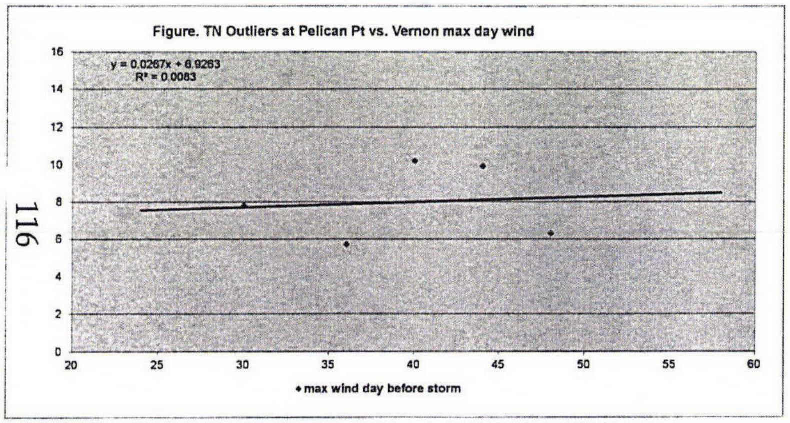


Figure. TN Outliers at Pelican Pt vs. Vernon max day wind
y = 0.0267x + 6.9263
R² = 0.0083
max wind day before storm

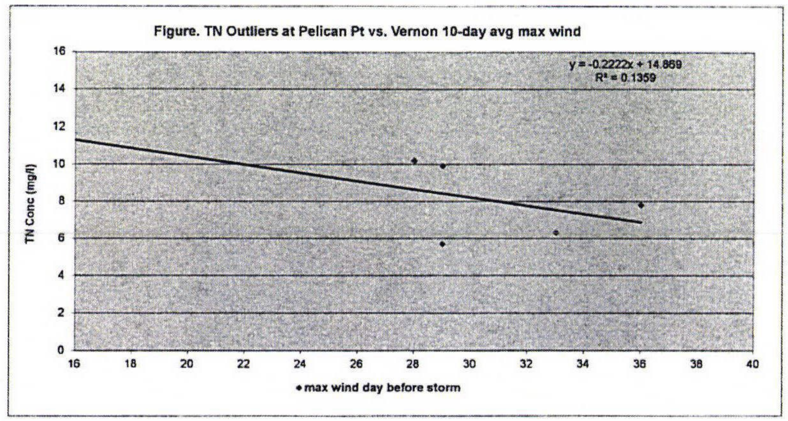


Figure. TN Outliers at Pelican Pt vs. Vernon 10-day avg max wind
y = -0.2222x + 14.869
R² = 0.1359
TN Conc (mg/l)
max wind day before storm

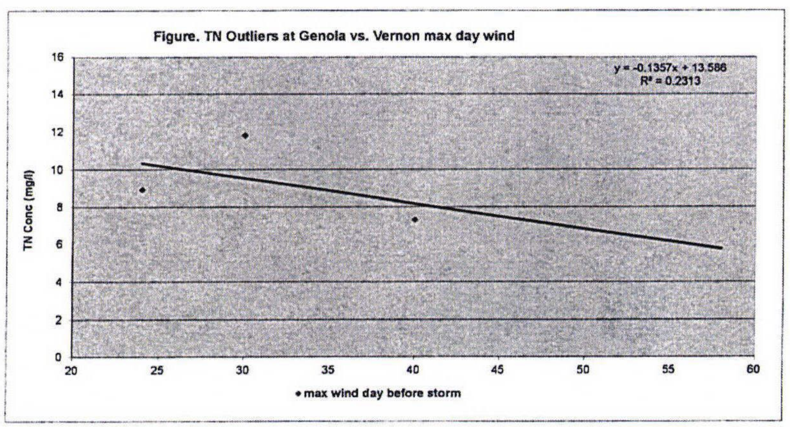


Figure. TN Outliers at Genola vs. Vernon max day wind
y = -0.1357x + 13.586
R² = 0.2313
TN Conc (mg/l)
max wind day before storm

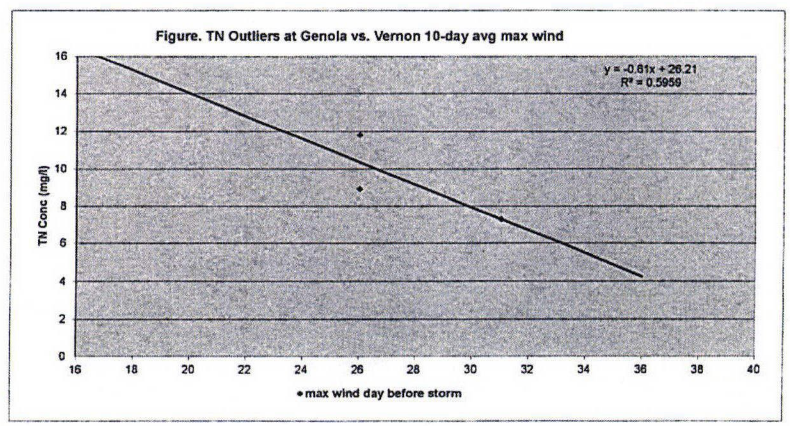


Figure. TN Outliers at Genola vs. Vernon 10-day avg max wind
y = -0.61x + 26.21
R² = 0.5959
TN Conc (mg/l)
max wind day before storm

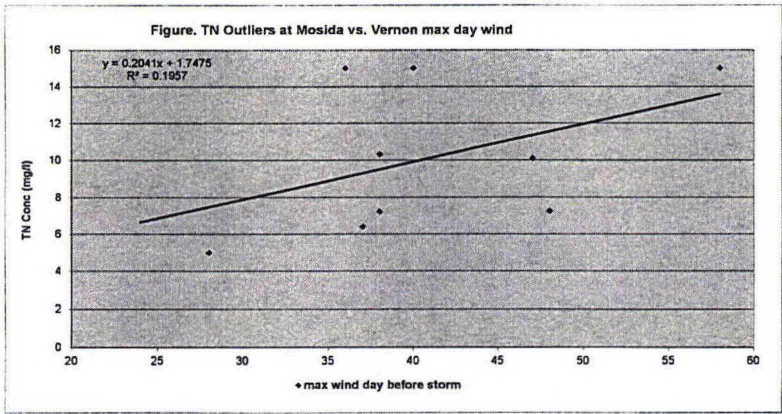


Figure. TN Outliers at Mosida vs. Vernon max day wind
y = 0.2041x + 1.7475
R² = 0.1957
TN Conc (mg/l)
max wind day before storm

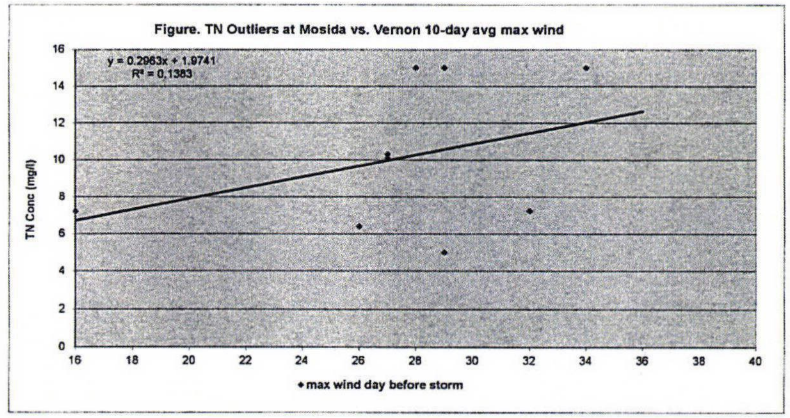


Figure. TN Outliers at Mosida vs. Vernon 10-day avg max wind
y = 0.2963x + 1.9741
R² = 0.1383
TN Conc (mg/l)
max wind day before storm

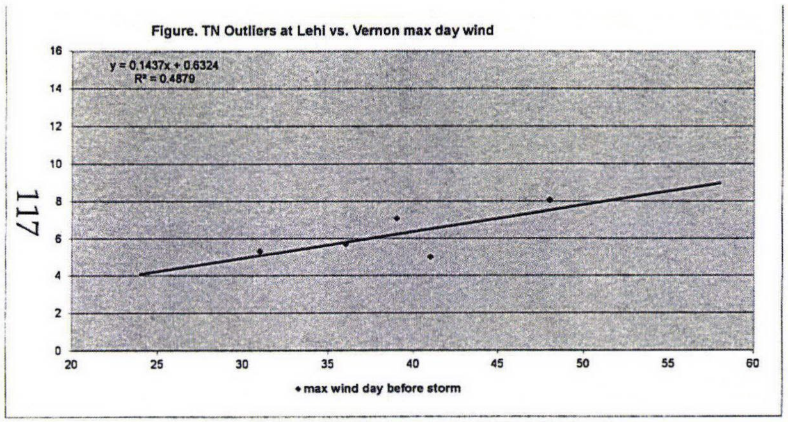


Figure. TN Outliers at Lehi vs. Vernon max day wind
y = 0.1437x + 0.6324
R² = 0.4879
max wind day before storm

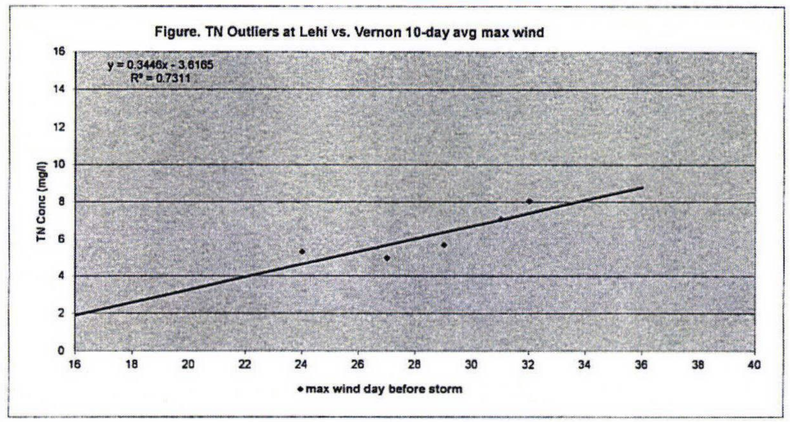


Figure. TN Outliers at Lehi vs. Vernon 10-day avg max wind
y = 0.3446x - 3.6165
R² = 0.7311
TN Conc (mg/l)
max wind day before storm

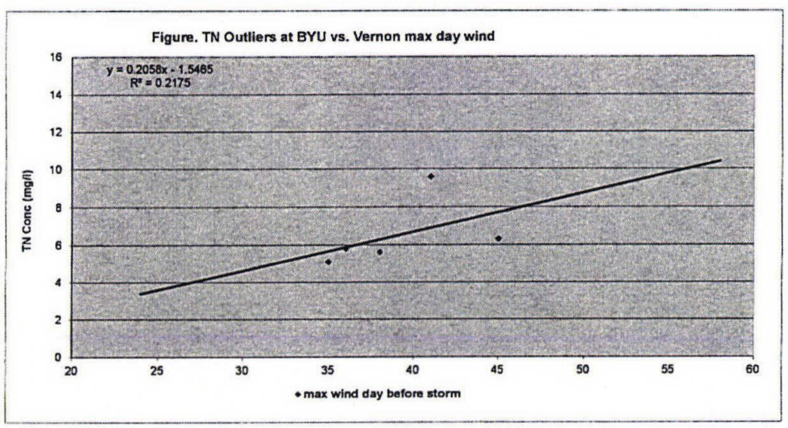


Figure. TN Outliers at BYU vs. Vernon max day wind
y = 0.2058x - 1.5465
R² = 0.2175
TN Conc (mg/l)
max wind day before storm

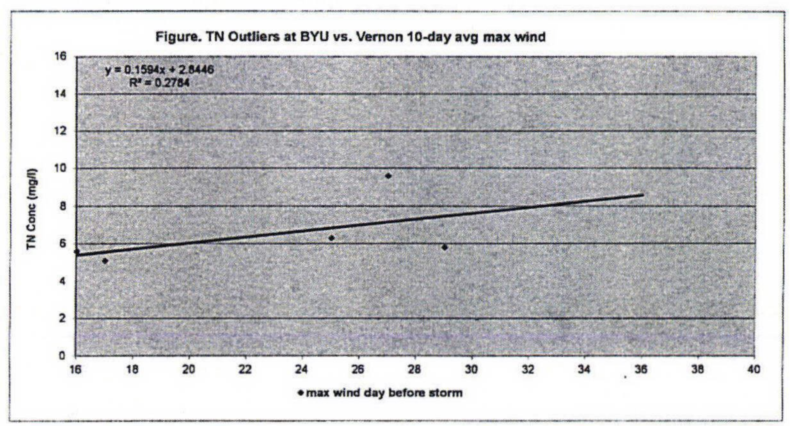


Figure. TN Outliers at BYU vs. Vernon 10-day avg max wind
y = 0.1594x + 2.8446
R² = 0.2784
TN Conc (mg/l)
max wind day before storm

Figure 11Zb

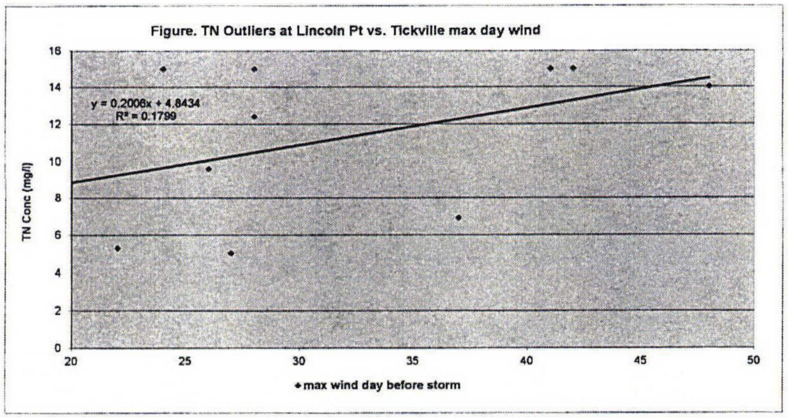


Figure. TN Outliers at Lincoln Pt vs. Tickville max day wind

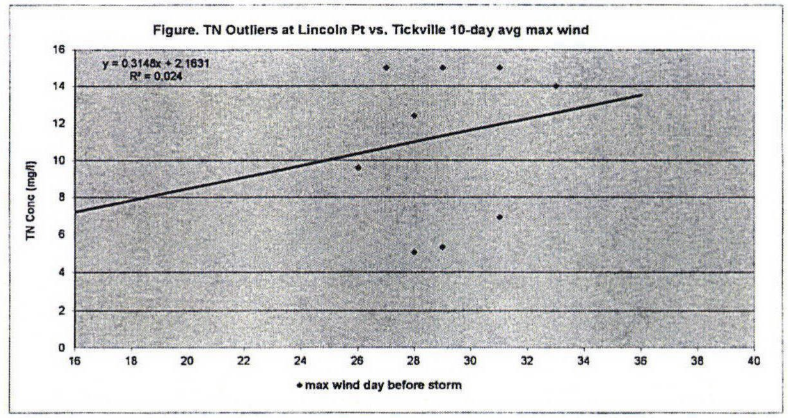


Figure. TN Outliers at Lincoln Pt vs. Tickville 10-day avg max wind

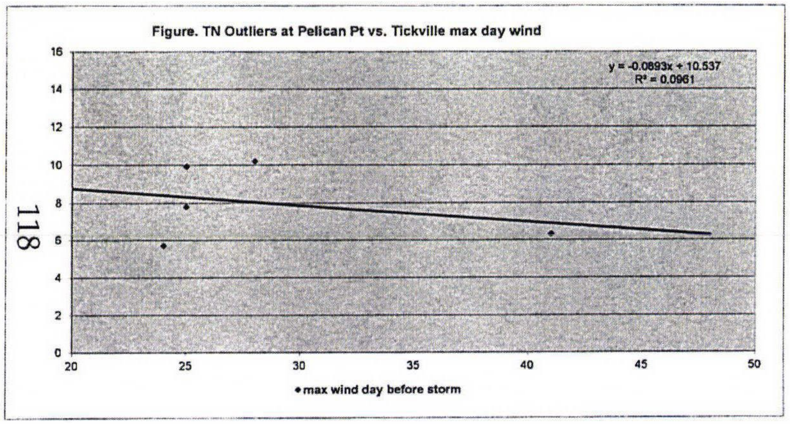


Figure. TN Outliers at Pelican Pt vs. Tickville max day wind

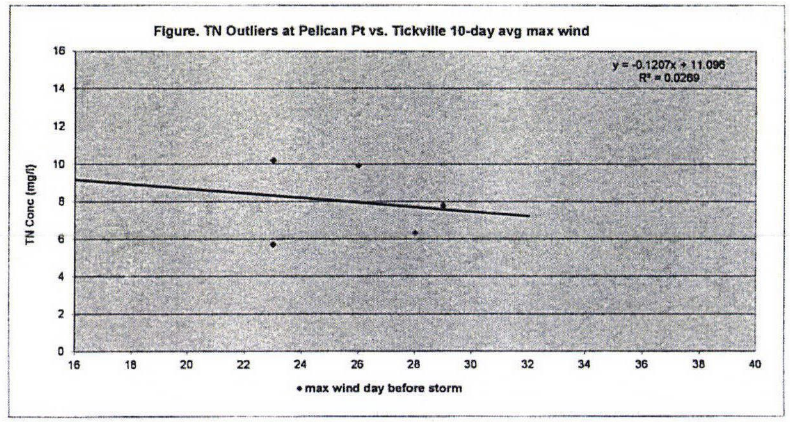


Figure. TN Outliers at Pelican Pt vs. Tickville 10-day avg max wind

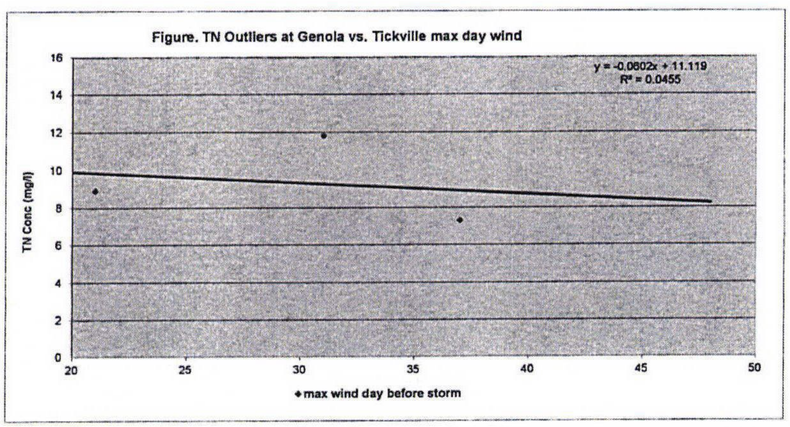


Figure. TN Outliers at Genola vs. Tickville max day wind

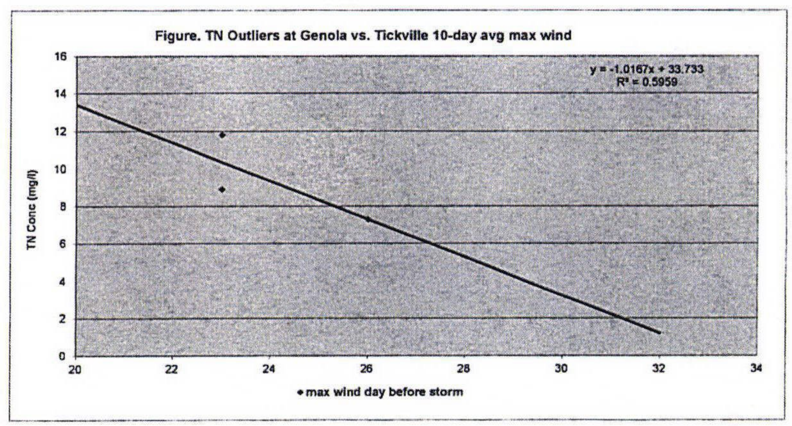


Figure. TN Outliers at Genola vs. Tickville 10-day avg max wind

Figure 11AAa

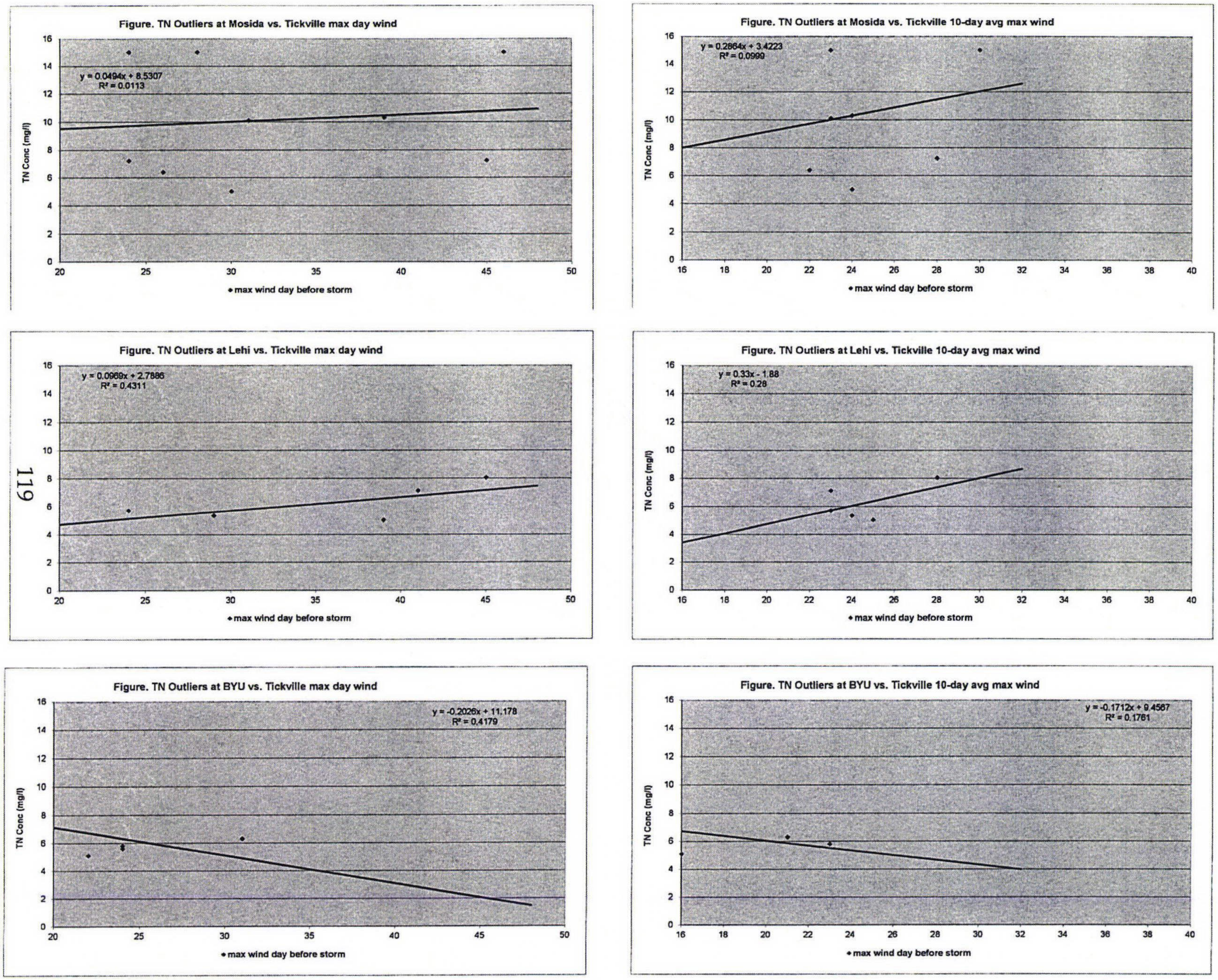


Figure 11AAb

Regarding the figures and discussion above, and the table below, of the 12 negative trends, 6 are for Genola with both daily max wind and 10-day avg max wind, and at all 3 wind stations

Why Genola negative??? and why both max day and 10-day avg max???

Of the other 6 negative trends, 3 are for Pelican Pt with 10-day avg max wind at all 3 wind stations, 1 for PP with 10-day avg max at Tickville, and 2 for BYU with both max and 10-day avg max winds at Tickville.

The 1 flat trend is for Pelican Pt with daily max wind at Eureka.

Method 2 Summary Table. No. of Trends on Plots of TN > 5 vs. Max Wind (mph)				
Station - trend	**Max Wind**	**10-day Avg Max**	**Totals**	**Percentages**
Eureka – positive	4	4	8	8/12 = 66%
flat	1	0	1	1/12 = 8%
negative	1(Gen)	2(Gen,PP)	3	3/12 = 25%
Vernon – positive	5	4	9	9/12 = 75%
flat	0	0	0	0%
negative	1(Gen)	2(Gen,PP)	3	3/12 = 25%
Tickville – positive	3	3	6	6/12 = 50%
flat	0	0	0	0%
negative	3(Gen,PP,BYU)	3(Gen,PP,BYU)	6	6/12 = 50%
Totals – positive	12	11	23	23/36 = 64%
flat	1	0	1	1/36 = 3%
negative	5	7	12	12/36 = 33%

<u>Method 3</u>: My next attempt at comparing the TN outliers and the wind is to consider the number of days between the samples / storms, i.e., the number of days back from a TN measurement to the previous measurement / storm. The time between storms / samples is somewhat related to the wind which transports air-born nutrients to the sampler and to the lake.

I have that data for "number of days between storms" which are shown on Table 11F. I plotted the "number of days between storms" vs. TN outliers at 6 of my sampling stations and the graphs are shown on Figure 11AB.

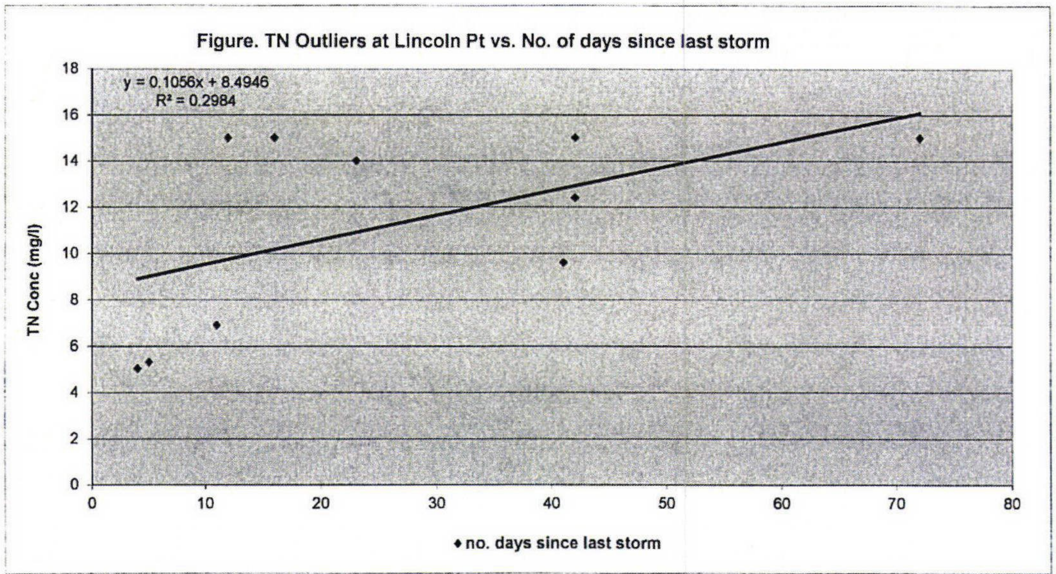
There are 3 positive (increasing) trends, 1 flat (slope < 0.020) trend, and 2 negative (decreasing) trends at Pel Pt and BYU. More time between samples / storms means more time for <u>windblown</u> dust, including nutrients, and other dry atmospheric deposition to accumulate on the funnels and in the samplers, and, of course, on the lake. These results (only 3 of 6 positive) are somewhat different from the TP results (5 of 6 positive). But, we may tentatively conclude that "most of the time," the more time between samples / storms, the higher the TN concentrations.

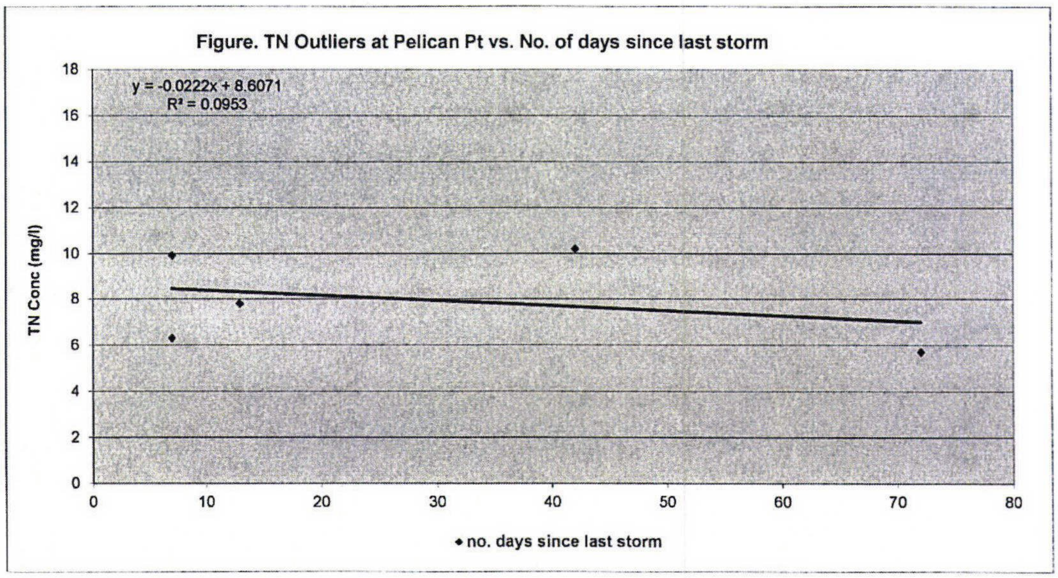
Any more conclusions and observations???

Table 11F TN Outliers (TN > 5 mg/l): Concentrations and Locations

values > 15 are assigned values of 15 (7 values out of ~ 400)

	date	LincolnPt	# days since precip	PelicanPt	# days	Genola	# days	Elberta	# days	Mosida	# days	Lehi	# days	BYU	#days
1	8-Jan-17													9.59	5
2	22-Feb-17	15	12												
3	27-Feb-17	5.31	5					6.26	5						
4	30-Mar-17											5.33	3		
5	8-Apr-17									7.24	10	8.05	10		
6	21-Apr-17	5.03	4												
7	17-May-17	6.9	11			7.3	11								
8	13-Jun-17	14	23												
9	20-Jun-17			9.91	7										
10	17-Jul-17					11.8	57								
11	25-Jul-17	15	42												
12	10-Aug-17	15	16									7.11	16		
13	5-Nov-17													6.3	51
14	17-Nov-17							6.9	12						
15	9-Jan-18									7.2	20			5.6	20
16	16-Mar-18							8.5	30						
17	23-Mar-18			6.3	7										
18	20-Apr-18			7.8	13										
19	30-Apr-18											5	10		
20	3-May-18					8.9	4								
21	22-Aug-18	15	72	5.7	72					15	72	5.7	72	5.8	72
22	3-Oct-18	12.4	42	10.2	42					15	42				
23	10-Oct-18									5	7				
24	21-Jun-19									10.3	31				
25	1-Aug-19	9.6	41							6.4	41				
26	9-Aug-19									10.1	8				
27	20-Nov-19													5.1	60
28	23-May-20									15	59				
	total	10	10	5	5	3	3	3	3	9	9	5	5	5	5





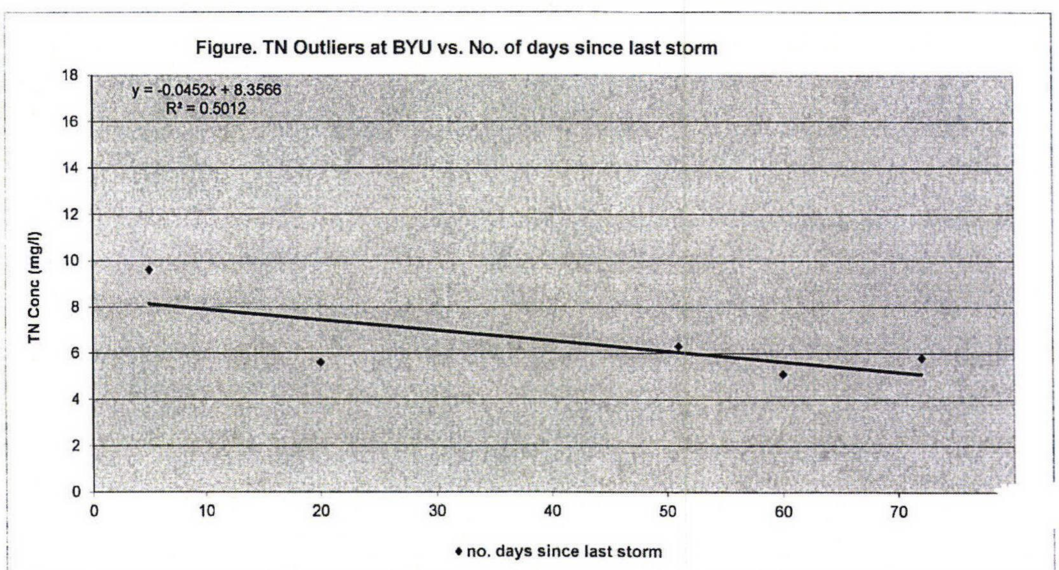
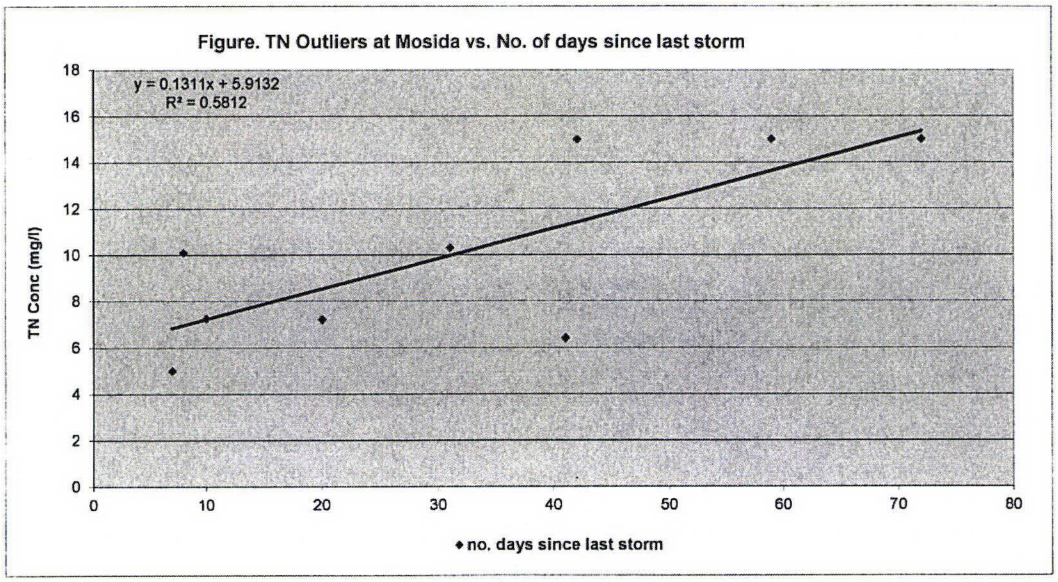
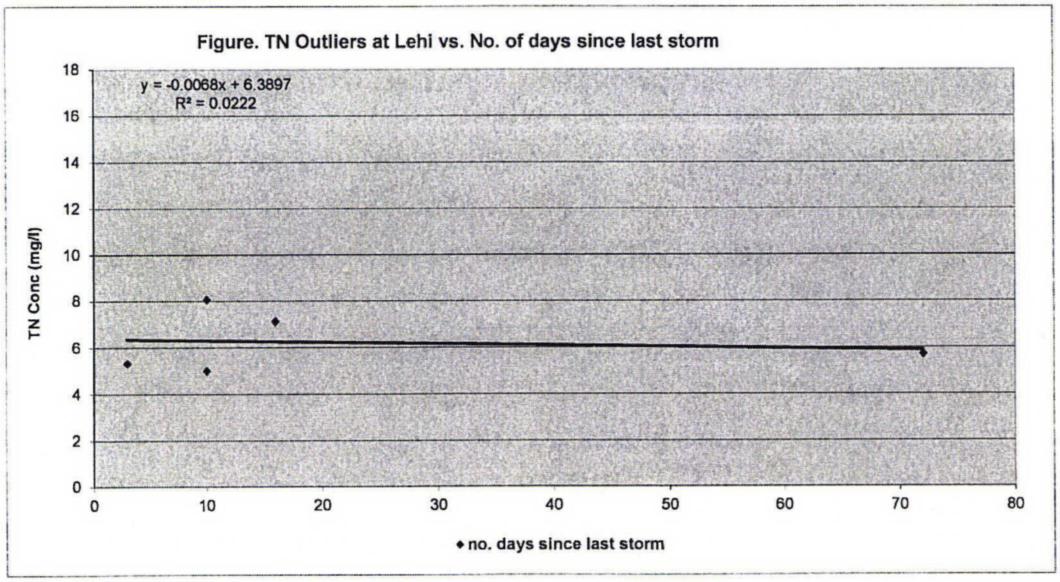


Figure 11ABa





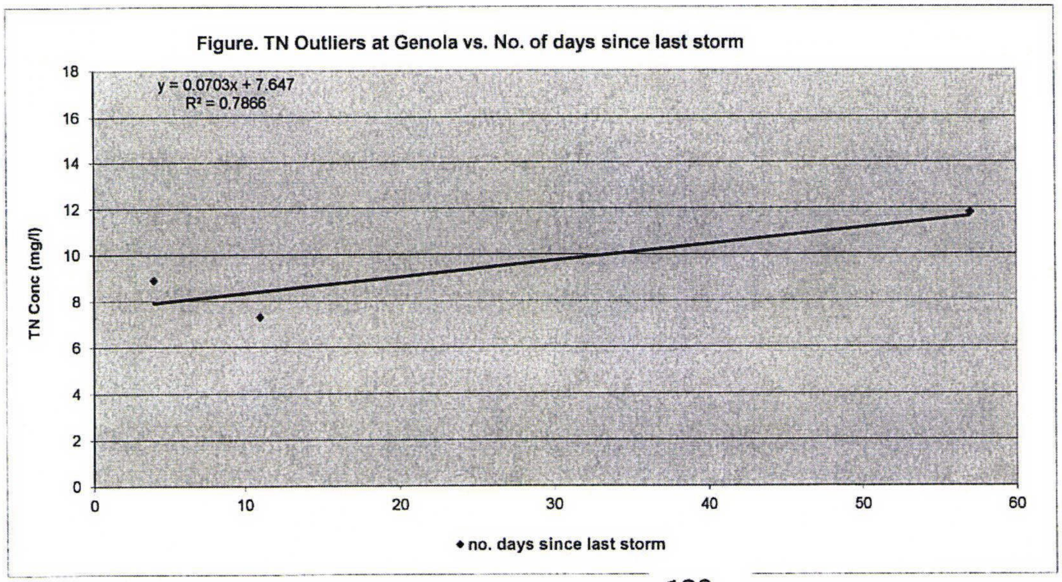


Figure 11ABb

Method 4: Another way to compare wind to TN high values is to plot all the 3½ years of daily max wind (mph) from the Eureka station (that's a lot of data, about 3.6 x 365 = 1300 pts) along with the max wind the day before the sample on the 28 dates with TN > 5 outliers. These are shown on Figure 11AC for each year.

In 2017, there were ~ 11 of the 14 dates with samples of TN > 5 which were in fact on dates when the max daily wind was quite high, some of the highest winds during that year. Other high wind days may have been when there were dry cold fronts creating windy conditions, or when I didn't get a sample.

In 2018, there were ~ 5 of the 9 dates with samples of TN > 5 which were on several dates when the max daily wind was quite high, but not on all the highest wind days. Maybe lots of dry cold fronts and lots of TN measurements not > 5.

In 2019, there were ~ 3 of the 4 dates with TN > 5 which were on dates when the daily max wind was high, some of the highest that year. There were lots of TN samples taken in 2019, but apparently not many high TN sample measurements.

In 2020, so far, there is 1 of 1 dates with TN > 5 which were on a date with high daily max winds. There were in fact lots of dry windy fronts that passed thru this year. We'll see what happens the rest of the year?

In summary, over the past 3½ years, there have been ~ 20 of the 28 dates with TN > 5 mg/l which were dates when the Eureka daily max winds were relatively high, some of the highest those years. That's ~ 72 % of the time, the same percentage as for TP > 1 mg/l.

There is good reason to believe also that the results shown above with Eureka wind on these 28 dates would be essentially the same with Vernon and Tickville wind. Figures 11A, 11B and 11C show that the wind data at Vernon and Tickville are about the same as the wind data at Eureka in terms of wind trends, lows and highs. Eureka and Vernon wind magnitudes are about the same, while Tickville wind magnitudes are somewhat lower.

Therefore, the results shown on Figure 11AC would likely be similar for Vernon and Tickville. (Maybe someday I'll plot those also?)

I think this method of comparisons and these plots are a good way of showing / suggesting that there is a positive relationship / correlation between high winds and high TN concentrations.

Something else here???

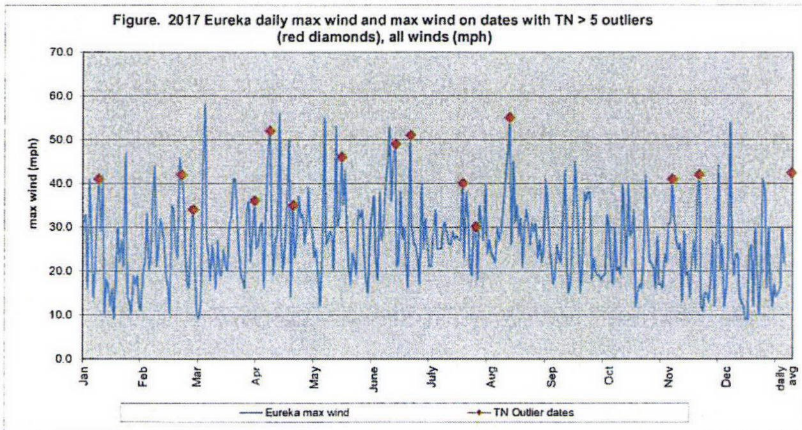


Figure. 2017 Eureka daily max wind and max wind on dates with TN > 5 outliers (red diamonds), all winds (mph)

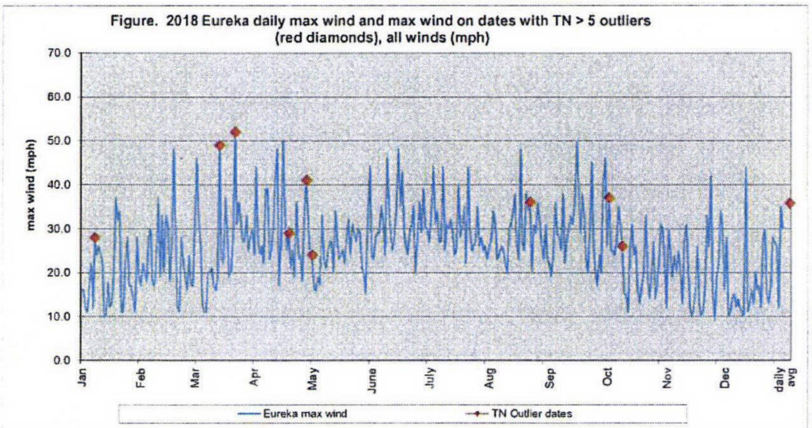


Figure. 2018 Eureka daily max wind and max wind on dates with TN > 5 outliers (red diamonds), all winds (mph)

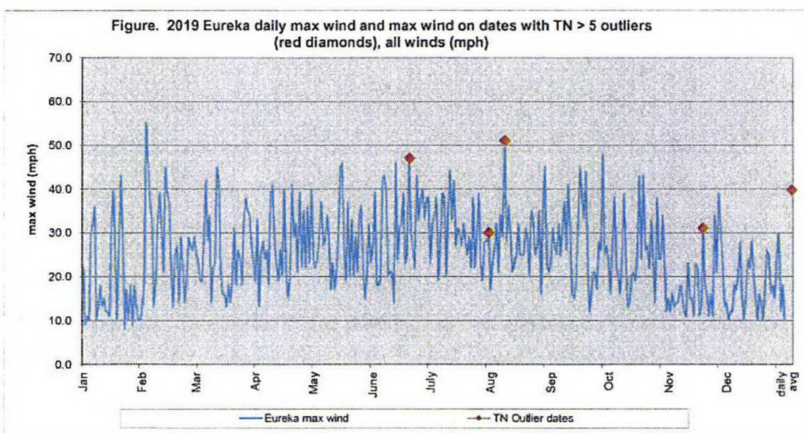


Figure. 2019 Eureka daily max wind and max wind on dates with TN > 5 outliers (red diamonds), all winds (mph)

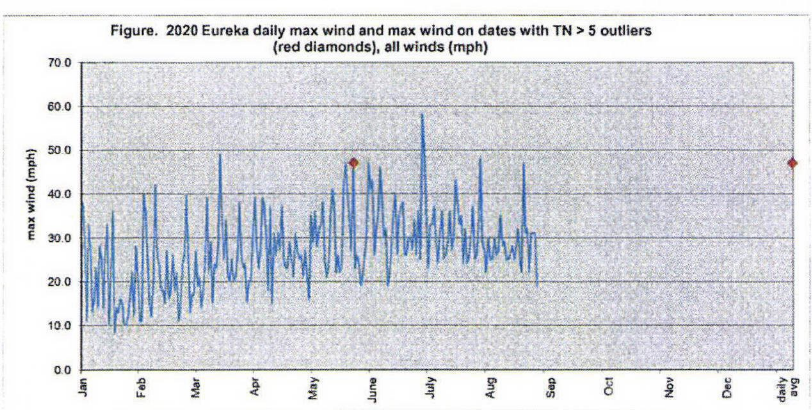


Figure. 2020 Eureka daily max wind and max wind on dates with TN > 5 outliers (red diamonds), all winds (mph)

Figure 11AC

Section 4

Revised Report Comments - Dr. Gay

Review of Document: Dr. Miller Bulk Air Deposition Report - 2020 Response to Gay (full) Report.

David A. Gay, Ph.D.
March 1, 2021

General Comments

Overall, I was very happy with the report. It cleared up some questions that I had, improved the deposition calculation by including precipitation events that were not sampled, and showed several new analyses that will hopefully narrow down any existing questions. I only have one issue that I would prioritize (addressed first). The remainder is mostly comments, new ideas that could be explored, and or minor points.

Most Important Comment

1. Page 2, Para 3: TP Analysis. What I would have suggested here would be exactly what Dr. Wood has done—calculate weekly deposition using concentration and precipitation for every week that valid data is available. But for the weeks where precipitation did occur, but no concentration data is available (invalid, no sample, etc.), then this is the week to insert a Precipitation Weighted Mean Concentration value.

   But how do you make this PWM C? In NADP, we determine the PWMC for all of the valid samples for the entire year. So, if we have 50 weeks per year with precipitation, but only 45 valid weekly precipitation concentrations, then we calculate the PWMC value for the 45 samples and insert this value for the five weeks with missing/invalid precipitation concentrations. Dr. Wood did something very similar to this (and it is possible that I just did not understand that he did exactly the same thing).

   I personally think that the PWMC for insertion into weekly calculations should be done on a seasonal basis. Although, but both ways are valid and appropriate.

   It is also important to note that for NADP, if there are 13 or more invalid/missing concentrations per year, the annual average is not calculated. This follows Dr. Wood's point that in some months there are very few (if any) valid concentrations present to do a PWMC calculation, and he used multiple years. I also think this is a good idea. An estimate of concentration for a station in January 2017 (for example) is probably better made with a measurement at this station in January 2019, rather than a concentration from July of 2017. So, I like the multi-year approach.

   I think the best solution to this PWMC approach is the following:

   - Do all PWM of concentration by site

- Estimate concentration for every observation (week) with precipitation needs for the deposition value to be more correct than without it
- Do a simple arithmetic average of these values if you have multiple observations of concentration in a week for a site (replicate analytical results, etc.)
- Calculate monthly PWM concentrations by site, as the sum of weekly ppt x conc and divided by sum of the ppt (see image below) for all measured weeks
- Substitute weeks with precipitation and no measurement with the PWMC value for that month and site. If there are no concentrations measured that month for the site, use observations for the same month/site from other years (as Dr. Wood has done with all "Jan" values for three years as the PWMC for January).
- Now, you have a reasonable estimate for all sites and months for all weeks with precipitation to make the best estimate of deposition to the lake. See NADP specifics in this figure, and the attachment of the entire NADP explanation.

> raingage. Individual precipitation events are aggregated into precipitation-weighted mean concentrations (mg/L) by Equation 1.Wet deposition fluxes (as kg/ha) are calculated using precipitation measurements at the monitoring sites by multiplying the sample concentration by the total amount of precipitation that fell during the sample collection period (Equation 2).
>
> $$\overline{C}_{ppt.wt} = \frac{\sum_{i=1}^{n}(C_{w,i} \times P_{w,i})}{\sum_{i=1}^{n} P_{w,i}} \quad (1)$$
>
> where: $\overline{C}_{ppt.wt}$ = precipitation-weighted mean concentration, mg/L
> $C_{w,i}$ = precipitation concentration for individual event, mg/L
> $P_{w,i}$ = Precipitation depth for individual event, mm
> n = number of events
>
> $$D_w = \overline{C}_{ppt.wt} \times P_{TOT} \times 10^{-1} \quad (2)$$
>
> where: D_w = wet deposition, kg/ha
> $\overline{C}_{ppt.wt}$ = precipitation-weighted mean concentration, mg/L
> P_{TOT} = total precipitation depth for period, cm
>
> NADP/NTN ion concentrations are reported in units of mg/L. Concentrations can be converted

Dr. Wood has a note that says "because the ppt values cannot be separated out by location" referring to table 1a and 1c. I am not 100% sure what was meant here. What I think it means that there is one value for ppt depth for all sites and I think that is fine. You can certainly have significantly different precipitation depth for any ppt event around the valley. This is true, but it is certainly the rule that one ppt depth measurement is used for an entire region. But I guess if you are talking about a large lake with complicating topography, it could be worth investing in a few rain gages around the lake. But I would choose more measurements of concentration, personally.

Again, I am not certain that Dr. Wood did not do this exact same thing, but if not, I would suggest adding in the NADP method. This could add some independent support for the results. I am thinking some of the comments would be "well, NADP does it somewhat differently…" I am not saying the NADP method is better than the methods here, but just more widely accepted. I also feel that by following the NADP method, it will provide another annual estimate of deposition. I also feel that the NADP deposition estimate will be fairly close to what Dr. Wood has included here.

Other Specific Comments

2. Just to be clear, I think any method for determining PWMC should be done by site, and not use Site A PWMC for site C PWMC. I am pretty sure that this is the Dr. Wood method. I just wanted to be clear on this point.
3. It is an excellent idea to add monthly surface area estimates to the lake. It is likely to be a significant variation over the year, and an improvement of the wet/bulk deposition measurements.
4. Overall, Dr. Wood makes many separate estimate total depositions for Utah Lake assuming different things and using varying approaches. I think this is always good because it gives the reader/decider a sense of the range of predictions from the different calculations. Given a long-term measurement project like this, you are always going to have missing data, as we do here. It is a given. For deposition studies, you have to account for the weeks that have precipitation but are missing concentration. So, accounting for these is a good addition to Dr. Wood's existing work. Estimating deposition will fill in these missing values in some fashion and doing a variety of "models" is a good thing, as mentioned above.

   With that said, overall, the different estimates of deposition/loading presented here are not that different. I think this is a good thing. You are saying you estimated bulk deposition in a number of ways, and the answers were all fairly similar (all in the same ballpark). This indicates to me that the range is reasonably small, and the "true" answer is likely to be in this range. I would present them all in the report to support the project.
5. One comment that I should have thought of before, is the idea of high concentration division (> 1mg/L TP and >5 mg/L TP, etc.). I do not think I have seen the concentration and precipitation data together. Within the NADP data, we have many samples with very high concentration outliers, but with little precipitation leading to little deposition. Quite likely Dr. Wood has already done this, but I could see a criticism of the project being that we are removing high concentration samples when precipitation depth is heavy. I think a better overall approach would be to remove low precipitation samples (like 0.01-inch precipitation depth samples) that likely have high concentrations but little deposition. This idea sort of follows from the PWM concentration idea; the 0.01-inch precipitation depth sample has little impact upon PWM concentration and deposition totals. It also goes to the overall idea that