

Technical Memorandum BCWA



Date: January 27, 2016
To: Bear Creek Watershed Association
From: Russell N. Clayshulte, Manager
Re: BCWA TM 2015.03 Kerr Swede Gulches 2015 and Complete

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Kerr/Swede Gulch E. coli Study

The Colorado 303(d) list included Swede Gulch as a low priority for E. coli (Figure 1). The mainstem is Kerr/Swede Gulch with the western gulch upstream of the upper confluence as Kerr Gulch and the eastern tributary as Swede Gulch (Figure 2). Swede Gulch discharges into Kerr Gulch (Figure 3).

The Division and Association agreed this area maybe a good candidate to understand the contribution of nutrients from septic systems and other land use practices (e.g., horse stabling operations) to the water quality in tributaries (Figure 4). The Division and Association agreed there is a water quality problem that requires further investigation. The Association completed the 6th year of a complete 5-year monitoring program to evaluate E. coli and nutrients on Kerr/Swede Gulch (confluence with Bear Creek, below confluence of Swede Gulch and just upstream of confluence on Kerr Gulch) and lower Swede Gulch.

The Association monitored E. coli at 4-sites (Figure 1 and 2) from January (provided winter flows) through December. The Association also collected data for flow, temperature, pH, specific conductance and Dissolved Oxygen using the field probe and nutrient samples for laboratory analyses. The Association monitored nitrogen and phosphorus. The Association conducted the E. coli analyses. Table 1 shows the 2015 field data summary for Kerr/Swede Gulch sample sites. Table 2 shows the flow data. Table 3 shows the Geometric means for E. coli. The E. coli standard is 126/100ml (Measured as a geometric mean of data). There were no exceedances of the E. coli standard. Table 4 shows the nutrient concentration and load data.

In the 2015 303(d) Listing Rulemaking Hearing, the Association recommended this segment for de-listing from the 303(d), since. The Association provided the WQCD with the BCWA MSD12 Kerr Swede Master, which contained the full data record for the investigation. The 5-year data set showed no E. coli problem. The WQCD supported the position and recommended de-listing. The Association supported the Divisions recommendation to delist Kerr/ Swede Gulch for E. coli based on the Association data record. The Water Quality Control Commission supported the recommendation and the segment was delisted.

The four-point monitoring program established by the BCWA has been an effective strategy to identify and document potential contamination along the lower Kerr/ Swede Gulch drainage. The monitoring has allowed the BCWA to track low level E. coli and nutrient loading from OWTS, horse stabling operations, clear-cutting operations, nonpoint sources and forested lands, even under adverse conditions.

The BCWA has developed *Fact Sheet 51- Reducing Risk of Ecoli Contamination of Waterways*. This fact sheet defines some of the steps that were used on Kerr/ Swede Gulch and will be applied throughout the watershed whenever an E. coli problem is identified. In essence, the fact sheet defines a process that serves as a management tool to reduce the risk of E. coli contamination in all stream segments.

After the original low priority 303(d) listing for E. coli, the BCWA conducted investigations along Kerr/ Swede Gulches to identify potential sources. Since there is no centralized wastewater service to this area, all home sites use OWTS for sanitary service. The BCWA identified locations of OWTS in the lower drainage and made a preliminary evaluation to determine if there was surfacing wastewater. No obvious septic system failures were observed. There were several functional outhouses in the lower drainage identified by the BCWA that were addressed by Jefferson County Public Health and no longer pose a potential contamination source. The BCWA also identified the locations of stabling operations throughout the drainage.

The BCWA had conversations with several landowners and stabling operations. In the lower drainage, a horse stable on Kerr Gulch provided a stream buffer by moving the primary stabling area away from the stream. The owner was also willing to remove manure stockpiles immediately adjacent to Kerr Gulch. On Swede Gulch, the owner of a larger stabling operation voluntarily hauled off three trailers of manure reducing the loading potential of E. coli entering Swede Gulch. Jefferson County and the BCWA are currently exploring more options to address water quality degradation caused by stabling and grazing operations.

The BCWA suspected the house located at the mouth of Kerr Gulch was the primary source for the original E. coli value that caused the listing. This house had been allowed to install a non-standard vertical septic system due to space limitations, which directly discharged into Kerr Gulch. The septic system's leach field was severely undersized for the conditions. After this house burned down, there was no longer a measureable E. coli problem for Kerr/ Swede Gulches at this monitoring site. As requested by the BCWA, Jefferson County Public Health will require an advanced OWTS to serve a new house built on this lot. In the mean time, the BCWA continued the monitoring program to verify no other major sources of E. coli contamination were present in the lower drainage.

The BCWA developed and implements *BCWA Policy 4: Review Policy for Manure Management and Stabled or Confined Animal Nutrient Generation*. This policy provides Jefferson County with a tool to address water quality concerns associated with stabling operations.

The BCWA considers the disposal of, including but not limited to, household waste, construction waste, yard waste, organic material (e.g., pine needles) or other plant materials into waterways within the watershed as nonpoint source pollution (*BCWA Policy 18 Illegal Material*



Dumping as a Pollutant in Bear Creek Watershed). This form of waste disposal can harm water quality and is not an acceptable practice in the watershed. These incidents of illegal material dumping are reported to and addressed by the proper authorities (e.g., Jefferson County staff) for appropriate responses.

Segment 5 Bear Creek:

Swede, Kerr, Sawmill, Troublesome, and Cold Springs Gulches, and mainstem of Cub Creek from the source to the confluence with Bear Creek.

Water Quality Standards for Segment 5

- Temperature =TVS(CS-II) °C;
 - April-October =18.2 (MWAT)/23.8 (DM) °C;
 - November-March =9.0 (MWAT)/13.0 (DM) °C
- D.O.=6.0 mg/l; D.O.(sp)=7.0 mg/l
- pH=6.5-9.0
- E. Coli=126/100ml (Measured as a geometric mean of data)



Figure 1 Sample Site at Kerr/Swede Confluence

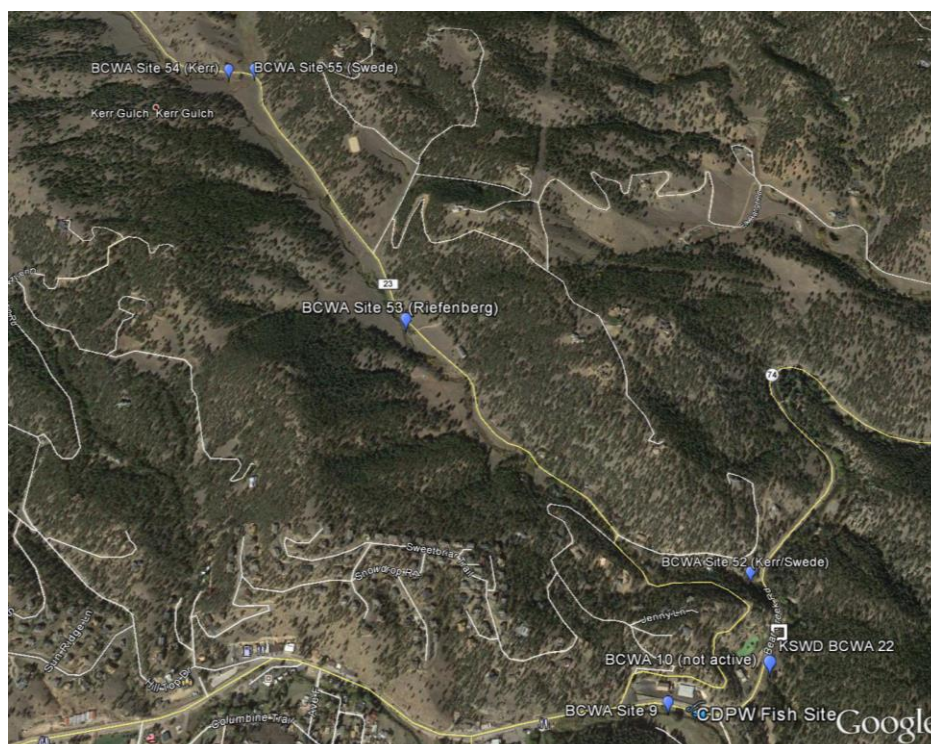


Figure 2 Sample Sites On Kerr Gulch



Figure 3 Swede Gulch Drains into Kerr Gulch

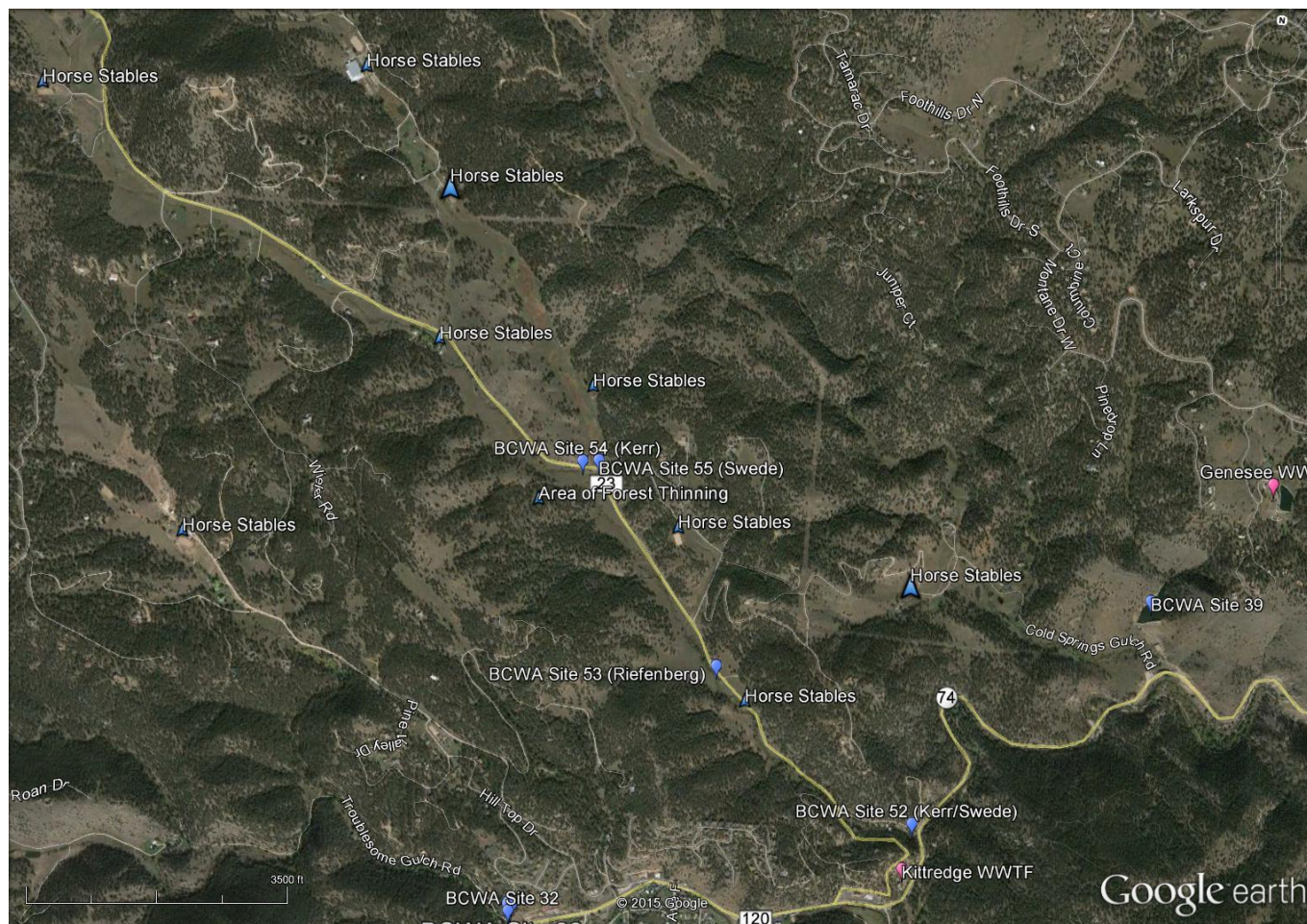


Figure 4 Horse Stable Operations in Kerr Gulch. There are at least 9 larger stable operations, with one facility on Swede Gulch that can house >45 horses.

2015 Data Summary

Table 1 2015 Field Measurements

BCWA Site	Time	Temp (C)	pH	SC (ms/cm)	DO (mg/l)	E. Coli (CTS/100ml)	Clarity	% Periphyton Coverage	Est Periphyton Thickness
1/5/2015									
Site 52 - Confluence	1:02	0.0	8.16	0.99	14.74	52	c	0%	0.0
Site 53 - Riefenberg	1:18	0.0	8.21	1.058	12.58	11	c	20%	2.0
Site 54 - Kerr	1:32	0.0	8.35	0.967	15.6	8	c	0%	0.0
Site 55 - Swede	1:25	0.0	8.08	1.145	13.51	1	c	10%	1.0
2/17/2015									
Site 52 - Confluence	12:20	0.6	8.12	0.993	16.61	8	c	0%	0.0
Site 53 - Riefenberg	12:35	0.1	8.13	0.986	14.48	2	c	10%	2.0
Site 54 - Kerr	12:55	0.5	8.1	0.995	14.47	4	c	2%	1.0
Site 55 - Swede	12:45	0.4	8.03	1.067	14.05	8	c	0%	0.0
3/23/2015									
Site 52 - Confluence	12:25	6.3	7.78	0.989	13.73	1	c	5%	1.5
Site 53 - Riefenberg	12:36	8.7	7.83	0.986	12.83	1	c	44%	2
Site 54 - Kerr	12:50	9.9	7.82	0.933	10.82	10	c	12%	1.5
Site 55 - Swede	12:46	10.3	7.7	1.105	10.85	1	c	24%	1.5
4/20/2015									
Site 52 - Confluence	12:47	6.7	8.13	0.999	10.67	40	c	2%	1.0
Site 53 - Riefenberg	1:00	8.8	8.16	0.997	9.79	60	c	25%	1.5
Site 54 - Kerr	1:15	9	8.21	0.845	8.74	41	m	5%	1.0
Site 55 - Swede	1:10	8.5	8.07	1.033	8.31	16	m	10%	1.0
5/26/2015									
Site 52 - Confluence	9:34	7.0	7.96	1.15	13.91	79	c	0%	0.0
Site 53 - Riefenberg	10:05	7.9	8.13	1.00	13.52	6	c	0%	0.0
Site 54 - Kerr	10:28	9.0	8.22	0.954	13.05	11	c	5%	1.0
Site 55 - Swede	10:20	10.0	8.15	1.094	12.2	4	c	40%	1.0
6/15/2015 & 6/22/2015									
Site 52 - Confluence	12:32	13.3	8.11	0.985	10.86	11	sm	5%	1.0
Site 53 - Riefenberg	12:47	14.6	8.15	0.98	10.38	1	sm	18%	2.0
Site 54 - Kerr	1:03	13.8	8.27	0.982	10.56	1	sm	6%	1.0
Site 55 - Swede	12:57	15.6	8.19	1.023	10.26	14	sm	3%	1.0
7/6/2015									
Site 52 - Confluence	12:36	13	8.11	1.019	12.42	8	c	1%	0.0
Site 53 - Riefenberg	12:51	13.1	8.19	1.023	11.21	18	c	5%	1.0
Site 54 - Kerr	1:05	12.9	8.2	0.986	11.03	2	c	2%	0.0
Site 55 - Swede	1:00	14.4	8.16	1.113	10.8	13	c	2%	0.0
8/25/2015									
Site 52 - Confluence	12:10	12.9	7.86	1.01	9.4	13	c	20%	1.5
Site 53 - Riefenberg	12:32	13.4	7.88	1.02	9.19	6	c	50%	3.0
Site 54 - Kerr	12:50	13.6	7.88	1.001	8.79	2	c	2%	0.0
Site 55 - Swede	12:45	15.8	7.84	1.117	8.06	6	c	5%	1.0
9/28/2015									
Site 52 - Confluence	10:38	8.8	8.07	1.013	10.13	2	c	45%	3
Site 53 - Riefenberg	10:50	8.8	8.02	1.027	12.74	1	c	50%	3
Site 54 - Kerr	11:00	9.5	7.99	1.021	12.03	10	c	15%	2
Site 55 - Swede	10:55	10.2	7.93	1.151	11.48	4	c	10%	1
10/28/2015									
Site 52 - Confluence	10:00	4.6	7.76	1.039	12.72	3	c	50%	3
Site 53 - Riefenberg	10:30	4.1	7.72	1.034	12.97	1	c	70%	4
Site 54 - Kerr	12:10	4.1	7.72	1.044	11.05	2	c	10%	2
Site 55 - Swede	12:05	4.7	7.56	1.084	11.68	3	c	1%	1
11/16/2015									
Site 52 - Confluence	10:50	1.1	8.1	1.041	13.31	12	c	20%	2
Site 53 - Riefenberg	11:08	1.2	8.12	1.048	12.73	2	c	35%	3
Site 54 - Kerr	11:22	1.8	8.2	1.037	12.09	5	c	2%	2
Site 55 - Swede	11:17	1.7	8.07	1.097	12.19	2	c	3%	2
12/7/2015									
Site 52 - Confluence	10:38	0	8.19	1.116	12.57	1	c	5%	2
Site 53 - Riefenberg	10:50	0	8.19	1.095	15.26	5	c	35%	3
Site 54 - Kerr	11:10	1.5	8.16	1.045	14.61	30	sm	2%	1
Site 55 - Swede	11:05	1.5	8.1	1.26	14.33	2	sm	2%	1

Table 2 2015 Flows

	Acre-Feet/ month												Total
	31	28	31	30	31	30	31	31	30	31	30	31	
Site	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Site 52 - Confluence	15.3	24.4	36.0	70.8	119.9	99.6	107.8	46.7	47.0	95.6	59.0	47.9	770
Site 53 - Riefenberg	8.3	5.6	18.9	52.6	88.5	71.0	74.5	24.0	16.2	78.9	40.5	27.0	506
Site 54 - Kerr	8.4	3.7	10.9	17.5	54.7	25.1	18.3	18.7	8.9	36.3	13.1	14.1	230
Site 55 - Swede	0.7	1.7	8.2	31.0	40.0	37.2	29.3	7.1	8.3	45.4	22.0	9.2	240

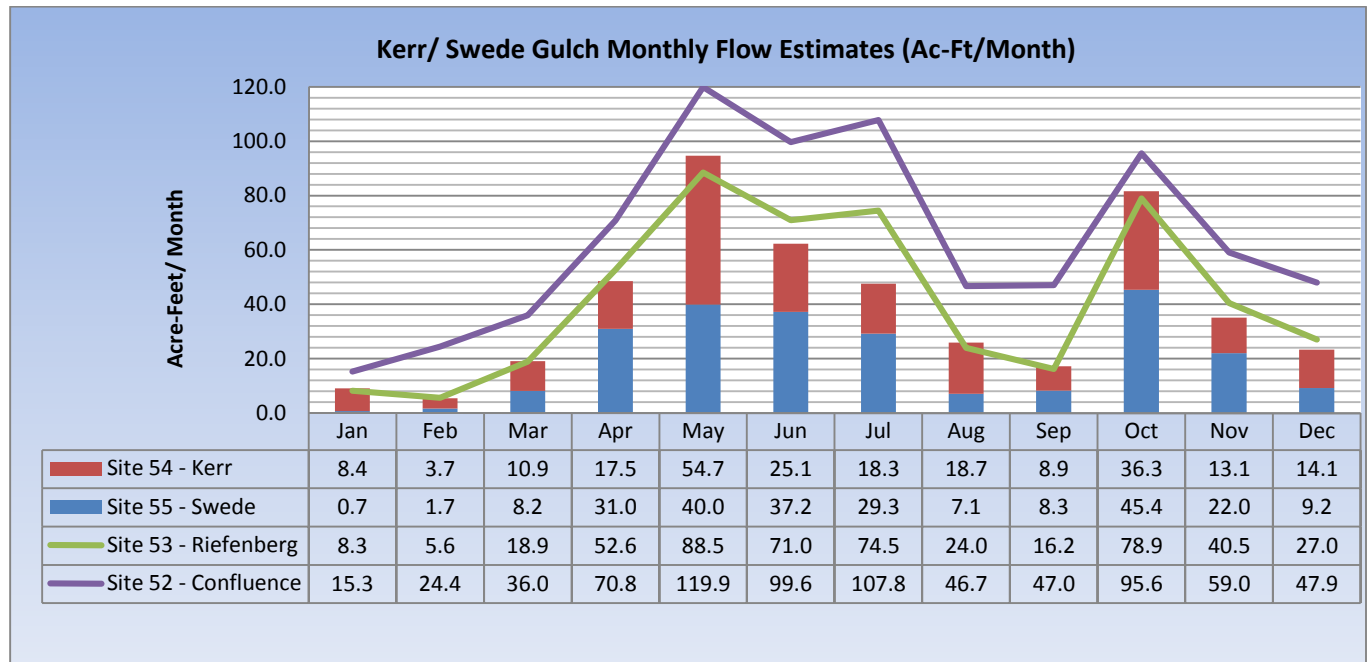


Figure 5 Flow Record

Table 3 E. coli Geometric Mean Results

BCWA Site	E. coli Summary, Geometric Mean								
	2010	2011							
	May-Dec	J-D (Annual)	Jan-Feb	Mar-Apr	May-Jun	Jul-Aug	Sep-Oct	Nov-Dec	May-Oct
	n=36	n=48	n=8	n=8	n=8	n=8	n=8	n=8	n=24/6
Sites 52-55			14	2	6	5	6	2	6
Site 52 - Confluence	10	6							15
Site 53 - Riefenberg	13	4							9
Site 54 - Kerr	16	5							3
Site 55 - Swede	11	3							2
2012									
Sites 52-55	5		3	1	11	26	10	3	13
Site 52 - Confluence	3								6
Site 53 - Riefenberg	4								9
Site 54 - Kerr	10								32
Site 55 - Swede	3								13
2013									
Sites 52-55	3		2	1	9	14	1	3	5
Site 52 - Confluence	2								4

E. coli Summary, Geometric Mean

Site 53 - Riefenberg	2							5
Site 54 - Kerr	6							14
Site 55 - Swede	3							3
2014								
Sites 52-55	4	3	2	5	11	5	4	6
Site 52 - Confluence	3							6
Site 53 - Riefenberg	2							3
Site 54 - Kerr	8							11
Site 55 - Swede	6							7
2015								
Sites 52-55	6	6	8	7	7	2	4	5
Site 52 - Confluence	8							9
Site 53 - Riefenberg	4							3
Site 54 - Kerr	6							3
Site 55 - Swede	4							6

Table 4 2015 Nutrient Loading

Site	Parameter (ug/l)	5-Jan	17-Feb	23-Mar	20-Apr	26-May	15-Jun	6-Jul	25-Aug	28-Sep	28-Oct	16-Nov	7-Dec	Avg
Site 52 - Confluence	Total Nitrogen	917	763	599	555	1353	1285	1205	864	553	722	870	1038	894
	Nitrate/Nitrite as N, dissolved	614	526	346	394	1090	1016	896	605	513				667
	Ammonia Nitrogen	57	29	16	27	22	19	42	13	20				27
	Phosphorus, total	19	50	10	47	18	38	107	22	13	11	51	13	33
Site 53 - Riefenberg	Total Nitrogen	512	571	270	483	1014	1099	1071	625	415	622	669	913	689
	Nitrate/Nitrite as N, dissolved	355	206	88	153	668	796	737	451	326				420
	Ammonia Nitrogen	127	21	27	18	17	15	50	15	16				34
	Phosphorus, total	34	10	12	31	9	30	66	29	14	18	6	15	23
Site 54 - Kerr	Total Nitrogen	722	628	477	487	1073	1400	1058	578	440	700	665	948	765
	Nitrate/Nitrite as N, dissolved	498	363	266	219	781	1130	724	400	363				527
	Ammonia Nitrogen	42	29	28	21	21	31	45	21	22				29
	Phosphorus, total	61	130	21	90	12	41	61	47	27	55	47	23	51
Site 55 - Swede	Total Nitrogen	487	390	297	432	1058	880	1254	702	409	832	820	1273	736
	Nitrate/Nitrite as N, dissolved	103	34	25	127	758	571	822	453	289				354
	Ammonia Nitrogen	36	33	24	23	26	17	46	22	22				28
	Phosphorus, total	83	125	11	169	17	23	53	31	33	72	41	76	61
Load Pounds/ Month														
Site	Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total/yr
Site 52 - Confluence	Total Nitrogen	38.1	50.8	58.7	107.0	441.6	348.7	353.8	109.9	70.8	187.9	139.8	135.5	2042.5
	Nitrate/Nitrite as N, dissolved	25.5	35.0	33.9	76.0	355.8	275.7	263.1	77.0	65.7	0.0	0.0	0.0	1207.5
	Ammonia Nitrogen	2.4	1.9	1.6	5.2	7.2	5.2	12.3	1.7	2.6	0.0	0.0	0.0	39.9
	Phosphorus, total	0.8	3.3	1.0	9.1	5.9	10.3	31.4	2.8	1.7	2.9	8.2	1.7	79.0
Site 53 - Riefenberg	Total Nitrogen	11.5	8.7	13.9	69.2	244.4	212.4	217.3	40.8	18.3	133.7	73.7	67.2	1111.1
	Nitrate/Nitrite as N, dissolved	8.0	3.1	4.5	21.9	161.0	153.8	149.5	29.4	14.4	0.0	0.0	0.0	545.8
	Ammonia Nitrogen	2.9	0.3	1.4	2.6	4.1	2.9	10.1	1.0	0.7	178.8	0.0	0.0	204.8
	Phosphorus, total	0.8	0.2	0.6	4.4	2.2	5.8	13.4	1.9	0.6	0.0	0.7	1.1	31.6
Site 54 - Kerr	Total Nitrogen	16.5	6.4	14.2	23.2	159.9	95.7	52.8	29.5	10.7	69.1	23.7	36.5	538.1
	Nitrate/Nitrite as N, dissolved	11.4	3.7	7.9	10.4	116.4	77.2	36.1	20.4	8.8	0.0	0.0	0.0	292.3
	Ammonia Nitrogen	1.0	0.3	0.8	1.0	3.1	2.1	2.2	1.1	0.5	0.0	0.0	0.0	12.2
	Phosphorus, total	1.4	1.3	0.6	4.3	1.8	2.8	3.0	2.4	0.7	5.4	1.7	0.9	26.3
Site 55 - Swede	Total Nitrogen	11.1	4.0	8.8	20.6	157.6	60.2	62.6	35.8	9.9	82.2	29.2	49.0	531.0
	Nitrate/Nitrite as N, dissolved	2.3	0.3	0.7	6.0	112.9	39.0	41.0	23.1	7.0	0.0	0.0	0.0	232.6
	Ammonia Nitrogen	0.8	0.3	0.7	1.1	3.9	1.2	2.3	1.1	0.5	0.0	0.0	0.0	12.0
	Phosphorus, total	1.9	1.3	0.3	8.0	2.5	1.6	2.6	1.6	0.8	7.1	1.5	2.9	32.2

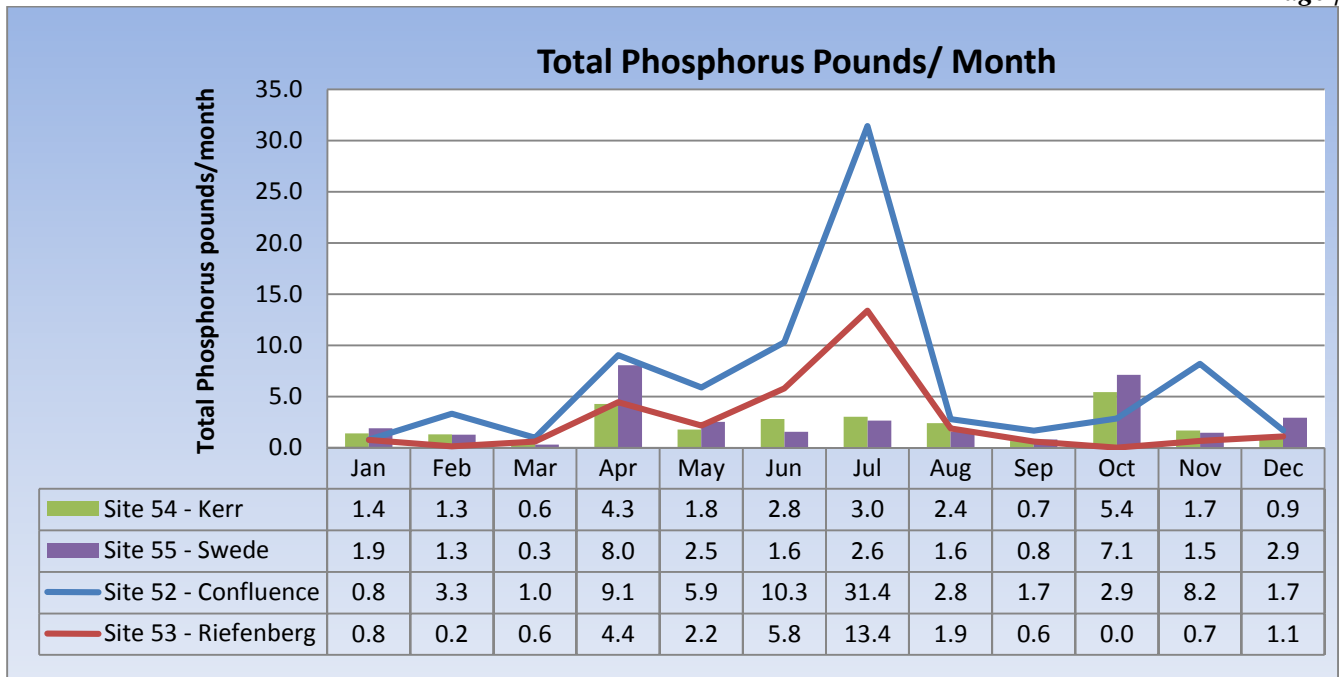


Figure 6 Total Phosphorus Loading

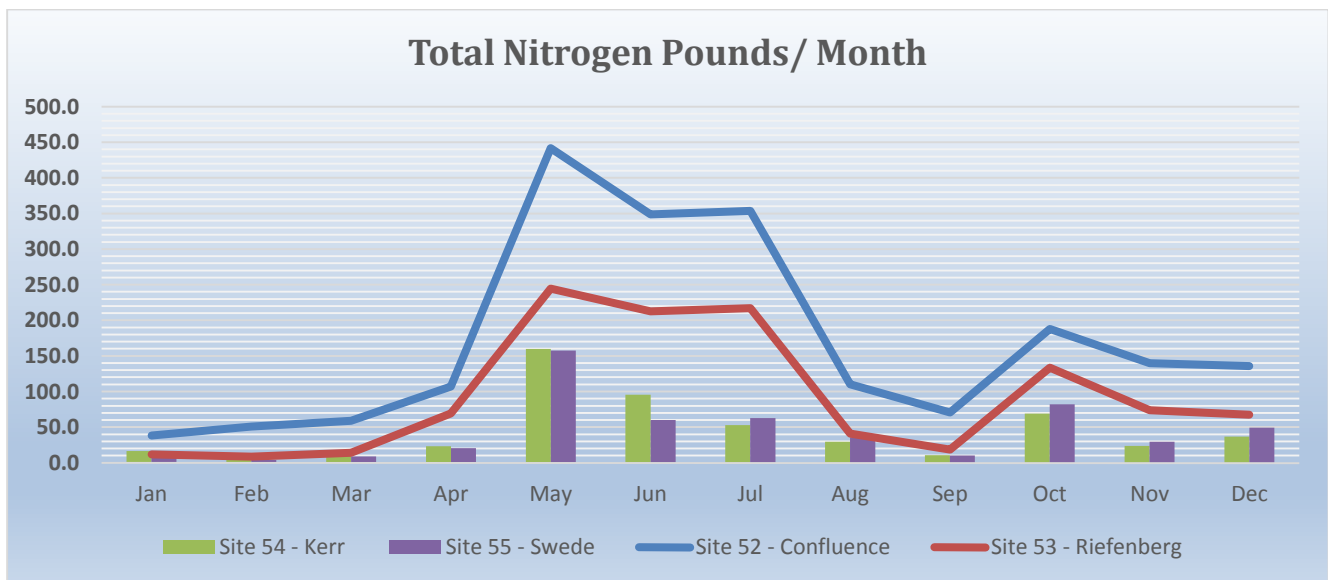


Figure 7 Total Nitrogen Loading