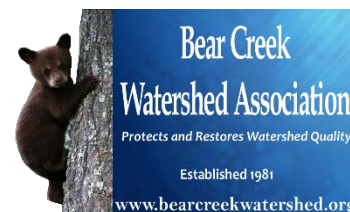


# Water Quality Special Study Data

## Bear Creek Watershed Association



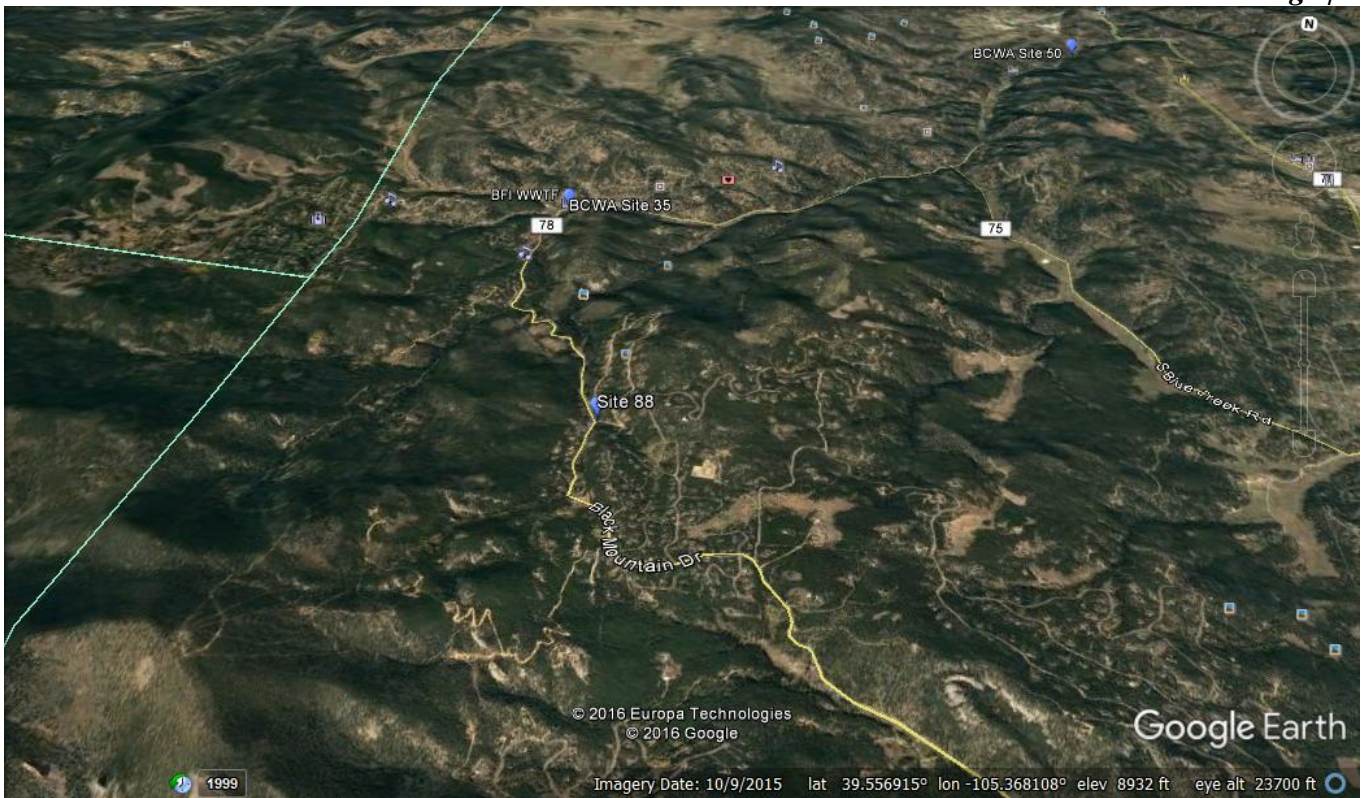
**Accepted:** March 8, 2017  
**WQSD06 Nutrient Loading Cub Creek 2012- 2016**

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**Study Design & Purpose** - The BCWA is addressing measured water quality concerns on selected tributary drainages along Bear Creek. The Association has a special monitoring effort in progress to determine surface water quality affected by Onsite Wastewater Treatment Systems (OWTS) near Cub Creek. There are an estimated 5,450 people in the Cub Creek drainage that utilize OWTS. The only wastewater treatment system is at Brook Forest Inn and only serves that facility. The Association monitors upstream and downstream on Cub Creek where there are > 1,000 OWTS. Many these systems are located within the alluvial corridor. These systems have a greater potential to seep nutrients into Cub Creek.

Total nitrogen and total phosphorus concentrations and loads from Cub Creek [BCWA Sites 38 and 88 (Upper Cub Creek and Site 50 (lower Cub Creek Cub Creek)], indicate a nutrient loading concern that is not attributable to the Brook Forest Inn wastewater discharge. There has been speculation that this nutrient loading could be associated with and other unspecified upstream nonpoint source loads. The BCWA has sampled Cub Creek from 2012-2016, as part of the watershed sampling program. In 2016 a special field investigation was done to identify potential upstream “hot” spots along this creek. The special survey’s nutrient results are included in this data summary. The total phosphorus load distinctly increases from upstream to downstream. The measured nitrogen levels appear to decrease with instream uptake. The visual evidence of nutrient loading in Cub Creek is very evident at the lower site (50) with the coverage of periphyton (algal growth) on hard substrate in the stream often exceeding 50% by late summer.

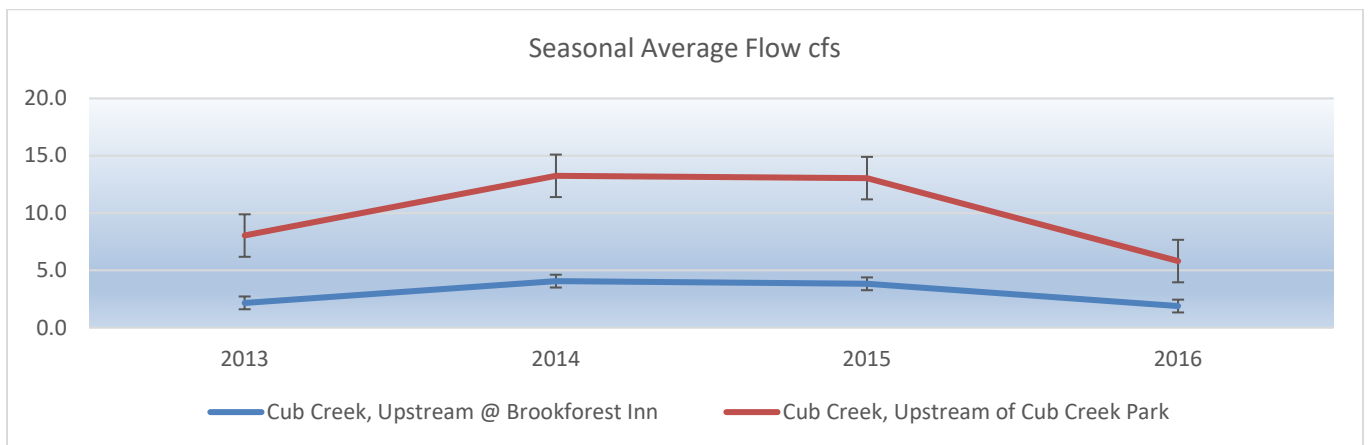
A special study of Cub Creek from 2012-2016 shows this tributary discharges from 250 to 3,040 pounds of total phosphorus per monitoring season into Bear Creek downstream of Evergreen Lake. The seasonal average total phosphorus load in upstream waters is 304 pounds with the downstream average substantially increasing to 1,378 pounds. While there are other types of nonpoint source nutrient sources within the Cub Creek corridor, OWTS are the most likely source for the excess total phosphorus loading along Cub Creek. This nutrient loading has also been seen on other tributaries within the watershed that have OWTS (e.g., Kerr/ Swede Gulch, *TM 2015.03 Kerr Swede 2015 Complete* and Yankee Creek, *BCWA WQSD02 Upper Bear*) or at special monitoring sites located downstream of a OWTS cluster (Troublesome, *BCWA WQSD01 Troublesome*). Consequently, the BCWA believes the phosphorus load in this drainage is a result of seepage from these OWTS located within the alluvial corridor. This is a major nutrient contributing tributary in the middle of the watershed.



**Figure 1** Cub Creek Sample Sites; upstream site 35 and site 88, downstream site 50

**Table 1** Seasonal Flow Cub Creek 2013-2016

Site Location by Stream Segment	Year	Ac-ft/month						
		May	Jun	Jul	Aug	Sep	Oct	Nov
Cub Creek, Upstream @ Brookforest Inn	2013		23	15	19	599	97	27
	2014	166	178	590	166	178	209	
	2015	750	292	178	74	12	98	
	2016	579	92	9	7	6	2	
Cub Creek, Upstream of Cub Creek Park	2013		199	28	183	2,107	220	147
	2014	633	178	2,871	725	167	301	
	2015	1,328	1,767	682	898	18	61	
	2016	708	964	272	98	54	16	



**Figure 2** Seasonal Average Flow Cub Creek

**Table 2      2012 Nutrient data set**

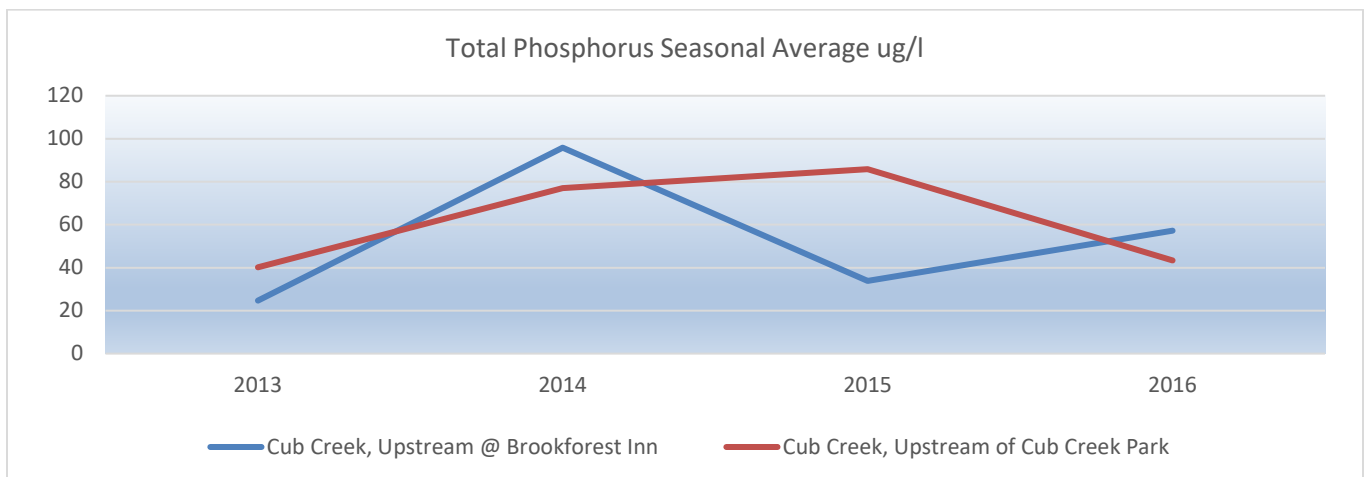
2012	Jun		Jul.	Aug.	Seasonal Average
	TN Ug/l	T Phos Ug/l	T Phos Ug/l	T Phos Ug/l	
Cub Creek, Upstream @ Brookforest Inn	397	16	27	14	19
Cub Creek, Upstream of Cub Creek Park	361	28	16	17	20

**Table 3      Total phosphorus and total nitrogen concentrations on Cub Creek 2013-2016**

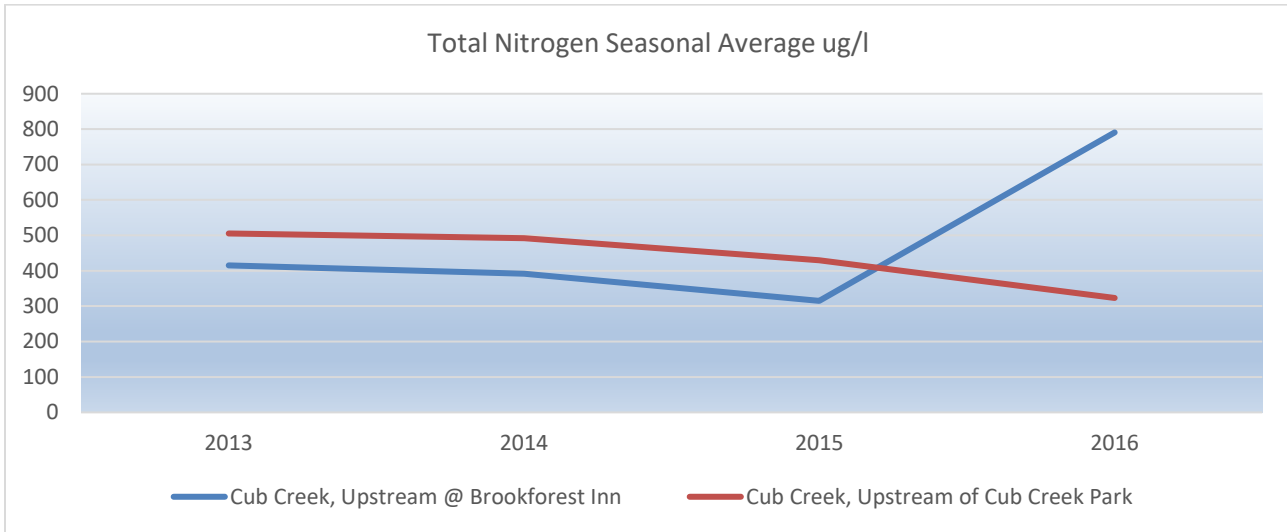
Site Location by Stream Segment	Year	Total Phosphorus ug/l							Seasonal Average ug/l
		May	Jun	Jul	Aug	Sep	Oct	Nov	
Cub Creek, Upstream @ Brookforest Inn	2013		58	15	27	26	11	11	25
	2014	17	12	510	11	11	14		96
	2015	41	28	29	22	75	8		34
	2016	113	15	28	26	28	133		57
Cub Creek, Upstream of Cub Creek Park	2013		12	36	35	48	66	44	40
	2014	19	16	377	13	16	21		77
	2015	93	256	55	78	20	13		86
	2016	65	34	22	54	35	50		43

Site Location by Stream Segment	Year	Total Nitrogen ug/l							Seasonal Average ug/l
		May	Jun	Jul	Aug	Sep	Oct	Nov	
Cub Creek, Upstream @ Brookforest Inn	2013		265	414	826	385	348	255	416
	2014	521	241	781	287	169	353		392
	2015	499	327	219	235	271	339		315
	2016	473	266	757	976	976	1296		791
Cub Creek, Upstream of Cub Creek Park	2013		133	758	672	375	400	694	505
	2014	751	330	914	214	253	490		492
	2015	629	558	297	435	218	439		429
	2016	644	278	460	251	171	135		323



**Figure 3      Total phosphorus seasonal average**



**Figure 4 Total nitrogen seasonal average**

**Table 4 Seasonal loading total phosphorus and total nitrogen 2013-2016**

		Total Phosphorus pounds/month								
Site Location by Stream Segment	Year	May	Jun	Jul	Aug	Sep	Oct	Nov	Seasonal	% Increase
Cub Creek, Upstream @ Brookforest Inn	2013		4	1	1	42	3	1	52	
	2014	8	6	820	5	5	8		851	
	2015	84	22	14	4	2	2		129	
	2016	178	4	1	0	0	1		184	
Cub Creek, Upstream of Cub Creek Park	2013		7	3	17	275	40	18	359	694%
	2014	33	8	2,947	26	7	17		3,038	357%
	2015	336	1,232	102	191	1	2		1,864	1445%
	2016	125	89	16	14	5	2		253	137%
		Total Nitrogen pounds/month								
Site Location by Stream Segment	Year	May	Jun	Jul	Aug	Sep	Oct	Nov	Seasonal	% Increase
Cub Creek, Upstream @ Brookforest Inn	2013		17	17	43	628	91	19	814	
	2014	235	117	1,255	130	82	201		2,020	
	2015	1,019	260	106	47	9	91		1,532	
	2016	746	66	19	18	16	9		874	
Cub Creek, Upstream of Cub Creek Park	2013		72	59	334	2,151	240	278	3,133	385%
	2014	1,295	160	7,145	423	115	402		9,539	472%
	2015	2,274	2,685	552	1,063	11	73		6,658	435%
	2016	1,242	730	340	67	25	6		2,410	276%

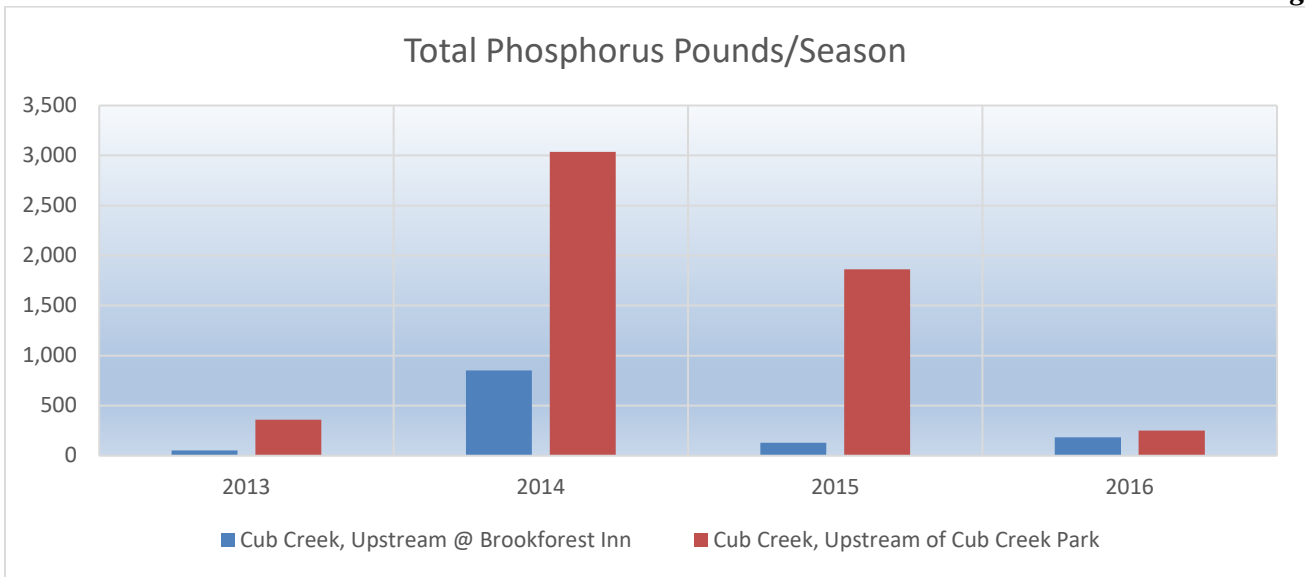


Figure 5 Total phosphorus loading

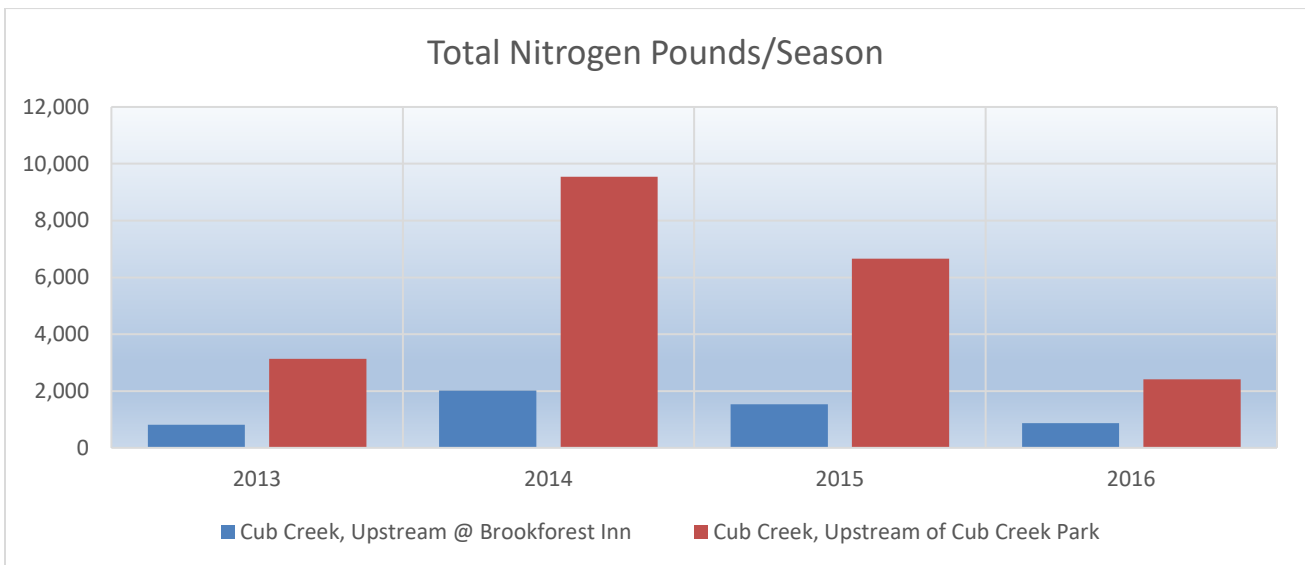


Figure 6 Total nitrogen loading

Table 5 2016 Special nutrient study

2016 Special Study	May	Jun	Jul	Aug	Sep	Oct	
	<b>Ac-ft/Month</b>						<b>Season</b>
Upper Cub Creek	579	92	9	7	6	2	<b>695</b>
Lower Cub Creek Park	708	964	272	98	54	16	<b>2111</b>
	<b>Total Phosphorus Pound /month</b>						<b>Season</b>
Upper Cub Creek	178.2	3.7	0.7	0.5	0.5	0.9	<b>108</b>
Lower Cub Creek Park	125.3	89.2	16.3	14.5	5.1	2.2	<b>249</b>
	<b>Total Nitrogen Pound /month</b>						<b>Season</b>
Upper Cub Creek	746	66	19	18	16	9	<b>1496</b>
Lower Cub Creek Park	1242	730	340	67	25	6	<b>1858</b>