

## MEMORANDUM

**Date:** February 5, 2014  
**To:** *Barr-Milton Watershed Board of Directors*  
**From:** *Bear Creek Watershed Association*  
**Re:** **BCWA Site 45 Load Estimates**

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The Bear Creek Watershed is in the defined “data” shed for the BMW pH/DO TMDL. Discharge from Bear Creek Reservoir is identified as a “point” source and input to the BMW pH/DO TMDL and model. As such, our BCWA site 45 is identified as a source that contributes about 1.8 % of the external load of Total Phosphorus (See Table 1). The BMW pH/DO TMDL defines the contribution of Total Phosphorus from Bear Creek for both Barr Lake and Milton Reservoir at 1,167 kg/year or 2,672.7 pounds/year. In the period from 2000 through 2013, the average Total Phosphorus at BCWA site 45 was 1,785 pound/year (Table 2).

A problematic year was 2007, based on the flow predictions at the downstream Sheridan gage (Table 2 and Figure 1). Although the Association believes the actual flow at site 45 was less than measured at Sheridan, the total load would still exceed the target of 2,672.7 pound/year.

In September 2013, an exceptional flood event occurred within Bear Creek Watershed. The reservoir became a major flood control structure. The rains began in earnest on September 9, 2013 in the upper watershed. The U.S. Army Corps of Engineers shut the outflow gates on Bear Creek Reservoir on September 13, 2013. The pool rose from 1,817 acre-feet to about 15,000 acre-feet (5 trillion gallons) on September 22, 2013. The surface area was about 500 acres or 70% of surface acre capacity. Although Bear Creek Reservoir returned to normal pool by the end of October, the water quality in the reservoir may be altered for years to come. As a result of the flooding event, the reservoir received a massive nutrient load from the watershed flushing. A substantial amount of nutrients were discharged into lower Bear Creek operational flood discharges. During the 45-day event, 5,026 pounds of total phosphorus and 36,500 pound of total nitrogen was released from the reservoir. The Association estimates about 10,000 pounds of total Phosphorus was retained within the reservoir, probably incorporated in the massive sediment deposits.

The Total Phosphorus load target at BCWA site 45 was met in 11 out of 13 years of reviewed data. The target Total Phosphorus listed in the BMW pH/DO TMDL can be met under the current BCWA management program. The BMW pH/DO TMDL expects any reduction in this target Total Phosphorus load will occur by in-canal treatment in the Barr-Milton Watershed prior to discharge into those waterbodies.

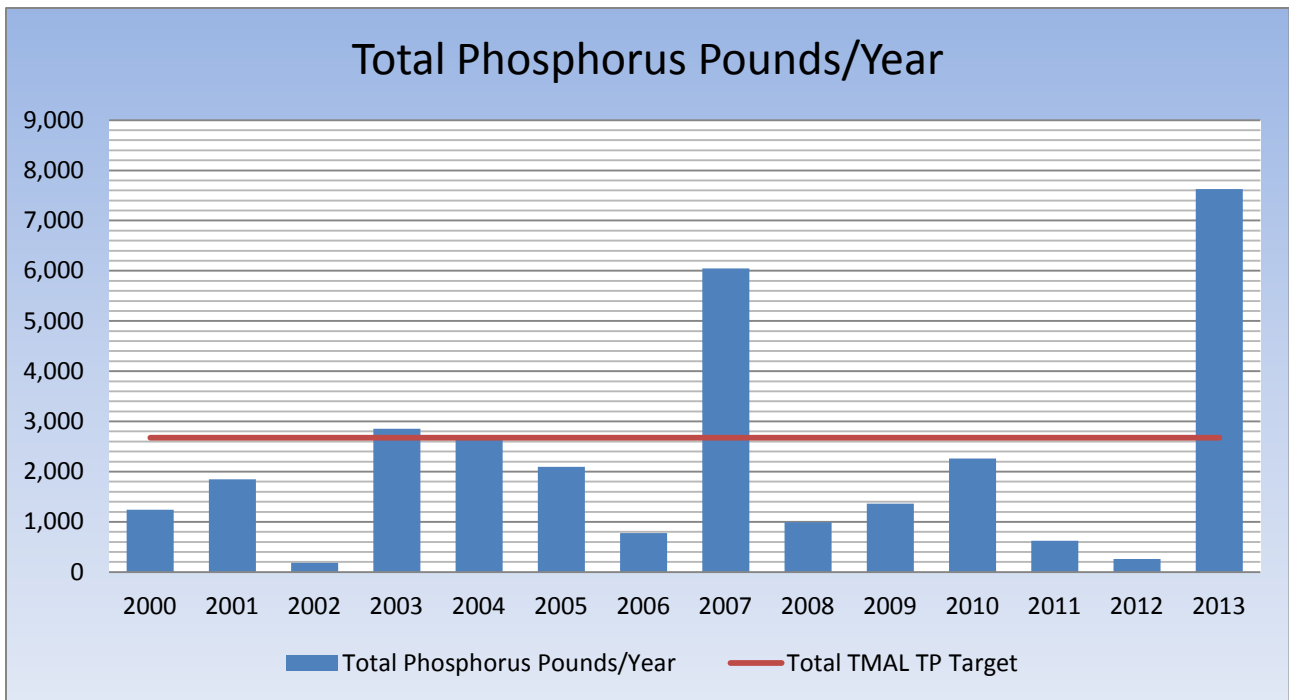
Since nitrogen is an issue, the Association estimated the nitrate loading at BCWA site 45 from 2000-2012. Figure 2 and Table 2 shows the Nitrate-Nitrogen loading at BCWA site 45. Table 2 also includes total nitrogen loading from site 45 for 2011 and a full year of data for 2012. The Association has developed and will maintain a spreadsheet for BCWA site 45 that contains water quality data and nutrient loading estimates (Summary data is shown in Table 3, spreadsheet available upon request). The Association will collect Total Nitrogen/ Total Phosphorus pairs for

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12 months/year (unless no flow or completely frozen) at BCWA site 45. The Association has a stream staff gage at the weir above site 45, which allows the Association to make better estimates of the flow at the monitoring station.

**Table 1 Model Prediction Compared with BCWA Data**

Source	Average Conc. (ug/l)	Total TP TMAL Load		Barr Load		% of Total Load	Milton		% of Total Load
		Kg/yr	Pounds/Year	Kg/yr	Pounds/Year		Kg/yr	Pounds/Year	
Barr-Milton TMDL Model Bear Creek	32-80	1,167	2,672.7	1,091	2,505.2	1.60%	76	167.5	0.20%
BCWA Bear Creek Site 45 from 2000-2013	41.2 (7-260)	999	2,203						



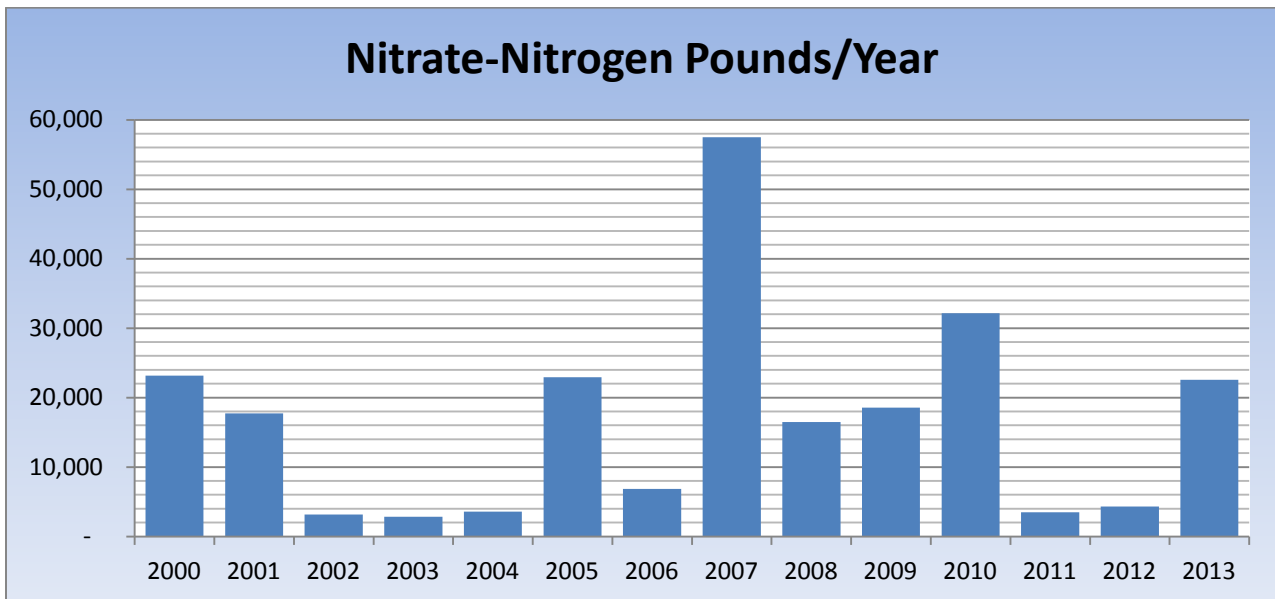
**Figure 1 Total Phosphorus Load Estimate at BCWA Site 45**

**Table 2 Load Estimates at BCWA Site 45**

	Total Phosphorus Pounds/Year	Nitrate Pounds/Year	Total Nitrogen Pounds/year	Flow ac-ft/yr
2000	1,243	23,146		15,113
2001	1,847	17,736		15,906
2002	187	3,182		2,317
2003	2,856	2,856		21,215
2004	2,667	3,569		33,706
2005	2,094	22,936		31,605
2006	776	6,837		11,748

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	Total Phosphorus Pounds/Year	Nitrate Pounds/Year	Total Nitrogen Pounds/year	Flow ac-ft/yr
2007	6,047	57,496		67,725
2008	991	16,470		20,307
2009	1,361	18,576		21,503
2010	2,259	32,148		29,462
2011	624	3,467	10,632	9,432
2012	260	4,315	7,897	5,868
2013	7,627	22,576	80,028	45,726
<b>Average</b>	<b>1,785</b>	<b>16,364</b>		



**Figure 2 Nitrate-Nitrogen loading at BCWA site 45**

**Table 3 2010-2012 Summary Data from Site 45**

	<b>Avg</b>	Median	Max	SD	Min
Temperature, °C	<b>13.9</b>	14.8	24.1	6.9	1.3
Total Suspended Solids, mg/L	<b>8.3</b>	6.2	94.7	9.3	0.0
Specific Conductance us/cm	<b>272.7</b>	288.7	677.0	186.8	0.2
Fecal Coliforms, colonies per 100 ml			275.0		
E. coli cts/100 ml (Geo Mean)	<b>2.5</b>		41.0		
Dissolved Oxygen, mg/L	<b>9.1</b>	8.9	12.7	1.9	4.9
pH	<b>8.3</b>	8.3	9.4	0.5	7.0
Total ammonia-nitrogen, ug/L	<b>52.3</b>	37.6	218.0	49.2	3.0
Nitrate-nitrogen, ug/L	<b>257.1</b>	177.4	1700.2	255.3	0.0
Soluble Reactive Phosphorus (SRP), ppb	<b>12.5</b>	6.6	76.4	14.0	0.1
Total Dissolved Phosphorus (TDP), ppb	<b>20.4</b>	14.3	96.0	16.8	2.0
Total Particulate Phosphorus (TPP), ppb	<b>17.3</b>	12.4	136.8	19.2	2.6
Total Phosphorus (Total P), ppb	<b>41.2</b>	30.4	259.0	33.5	7.0