M E M O R A N D U M

Date: **January 5, 2011**
To: ***Bear Creek Watershed Association***
From: Russell N. Clayshulte, Manager
Re: **Coyote Gulch Data Summary**

Figure 1 **Coyote Gulch Discharges into Bear Creek Reservoir**

Figure 2 Coyote Gulch Sample Sites

Table 1 2004-2010 nutrient data for Coyote Gulch Collected by the City of Lakewood and Bear Creek Watershed Association

	Nitrate Nitrogen (mg/l)			Total Phosphorus (ug/l)		
Date	CG Upper #2	CG Lower	Delta Change	CG Upper #2	CG Lower	Delta Change
September 20, 2004	1.1					
October 4, 2004	1.5					
November 18, 2004		2.2				
January 11, 2005	5.4	3.3	39%			
February 7, 2005	7.25	3.38	53%	30	50	-67%
March 2, 2005	3	5.49	-83%	40	30	25%
April 5, 2005	3.34	1.78	47%	170	160	6%
April 13, 2005		1.21			120	
May 10, 2005	5.49	1.33	76%	320	10	97%
June 16, 2005	4.13	0.47	89%	120	90	25%
July 6, 2005	3.99	0.42	89%	140	60	57%
August 4, 2005	0.71	0.53	25%	280	810	-189%
September 9, 2005	4.25	0.8	81%	70	50	29%
October 11, 2005	0.47	0.52	-11%	260	230	12%
November 18, 2005	4.87	2.07	57%	180	140	22%
December 8, 2005	6.28	4.18	33%	10	10	0%
January 5, 2006	3.05	4.85	-59%	10	30	-200%
February 7, 2006	5.04	2.9	42%	30	100	-233%
March 21, 2006	2.11	1.08	49%	70	170	-143%
April 10, 2006	0.11	0.1	9%	3,910	420	89%
May 3, 2006	4.06	0.07	98%	70	30	57%
June 13, 2006	3.2	0.07	98%	160	180	-13%
July 5, 2006	1.54	0.82	47%	280	160	43%
July 10, 2006	1.01	0.42	58%	160	80	50%
August 10, 2006	5.93			70		100%
August 18, 2006	0.32	1.64	-413%	160	110	31%
September 7, 2006	3.98	0.07	98%	80	80	0%
October 5, 2006	3.57	0.04	99%	160	10	94%
October 20, 2006	3.84	0.89	77%	30	10	67%
November 15, 2006	5.9	3.41	42%	10	10	0%
November 20, 2006	3.69	1.92	48%	10	10	0%
December 5, 2006	1	1.66	-66%	60	30	50%
January 18, 2007		1.98			10	
February 8, 2007		0.77			50	
March 23, 2007		0.11			190	
April 25, 2007	1.44	2.13	-48%	380	270	29%
May 10, 2007	1.52	1.69	-11%	70	60	14%
June 20, 2007	0.75	1.37	-83%	70	120	-71%
July 11, 2007	0.64	0.04	94%	140	50	64%
August 8, 2007	1.14	0.82	28%	120	100	17%
September 12, 2007	1.82	1.56	14%	50	20	60%
October 12, 2007	2.3	1.96	15%	20	10	50%
November 11,2007	2.77	2.71	2%	80	80	0%
December 11,2007	2.58	2.65	-3%	40	50	-25%
January 8, 2008	3.34	3.27	2%	50	60	-20%
February 12, 2008	2.66	2.65	0%	70	50	29%

	Nitrate Nitrogen (mg/l)			Total Phosphorus (ug/l)		
Date	**CG Upper #2**	**CG Lower**	**Delta Change**	**CG Upper #2**	**CG Lower**	**Delta Change**
March 24, 2008	2.01	1.82	9%	20	30	-50%
April 28, 2008	1.22	0.91	25%	30	30	0%
May 19, 2008	0.35	0.2	43%	40	50	-25%
June 24, 2008	0.58	0.1	83%	50	40	20%
July 28, 2008	0.7	0.6	14%	20	15	25%
August 26, 2008	0.82	0.5	39%	90	80	11%
September 29, 2008	1.05	0.79	25%	50	40	20%
October 27, 2008	1.15	0.93	19%	30	20	33%
November 20, 2008	1.55	1.21	22%	60	60	0%
December 15, 2008	2.1	1.9	10%	40	30	25%
January 26, 2009		2.08			30	
February 23, 2009	2.84	2.42	15%	40	30	25%
March 16, 2009	2.16	1.76	19%	60	50	17%
April 27, 2009	0.42	0.43	-2%	90	90	0%
May 18, 2009	0.52	0.37	29%	50	60	-20%
May 28, 2009	0.82	0.84	-2%	230	240	-4%
June 22, 2009	1.62	1.38	15%	90	80	11%
July 20, 2009	0.85	0.59	31%	140	90	36%
August 17, 2009	1.37	1.2	12%	90	80	11%
September 21, 2009	1.02	1.25	-23%	180	180	0%
September 28, 2009	1.33	1.09	18%	70	60	14%
October 19, 2009	2.16	1.86	14%	50	30	40%
November 16, 2009	1.26	1.22	3%	50	50	0%
November 18, 2009	1.38	1.33	4%	60	70	-17%
December 14, 2009	2.98	2.96	1%	90	60	33%
January 25, 2010	3.8	3.57	6%	40	40	0%
February 22, 2010	3.52	3.01	14%	40	40	0%
March 29, 2010	1.3	1.31	-1%	80	80	0%
April 26, 2010	1.02	0.94	8%	90	90	0%
May 24, 2010	1.7	1.37	19%	60	50	17%
June 29, 2010	0.88	0.73	17%	110	90	18%
July 26, 2010	0.89	0.67	25%	90	90	0%
August 23, 2010	1.01	0.75	26%	70	60	14%
September 27, 2010	1.64	1.4	15%	140	130	7%
October 26, 2010	1.6	1.44	10%	40	50	-25%
November 15, 2010	2.62	2.49	5%	5	5	0%
December 2, 2010	3.94	3.59	9%	20	5	75%
Average	**2.34**	**1.50**	**36%**	**148**	**87**	**41%**
Deviation	**1.68**	**1.28**		**557**	**127**	

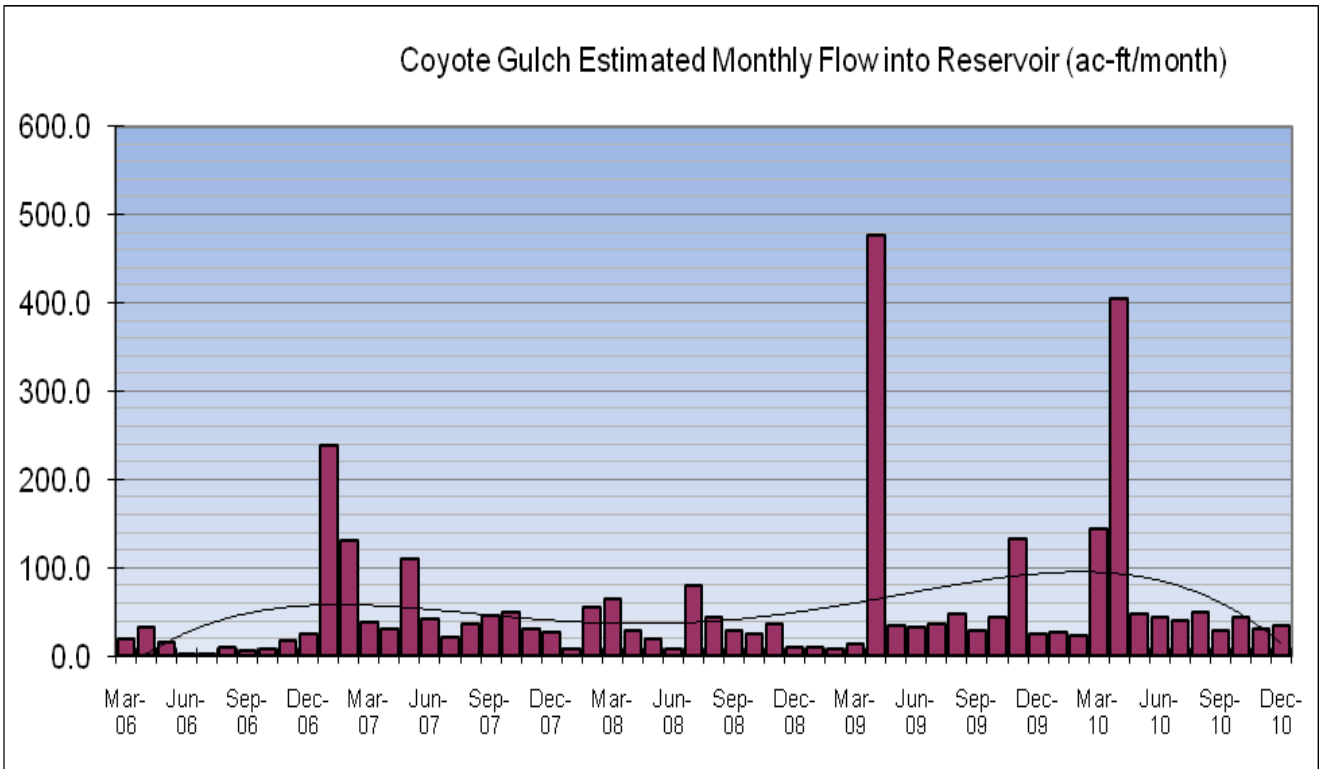

Figure 3 Coyote Gulch Estimated Monthly Flow Summary

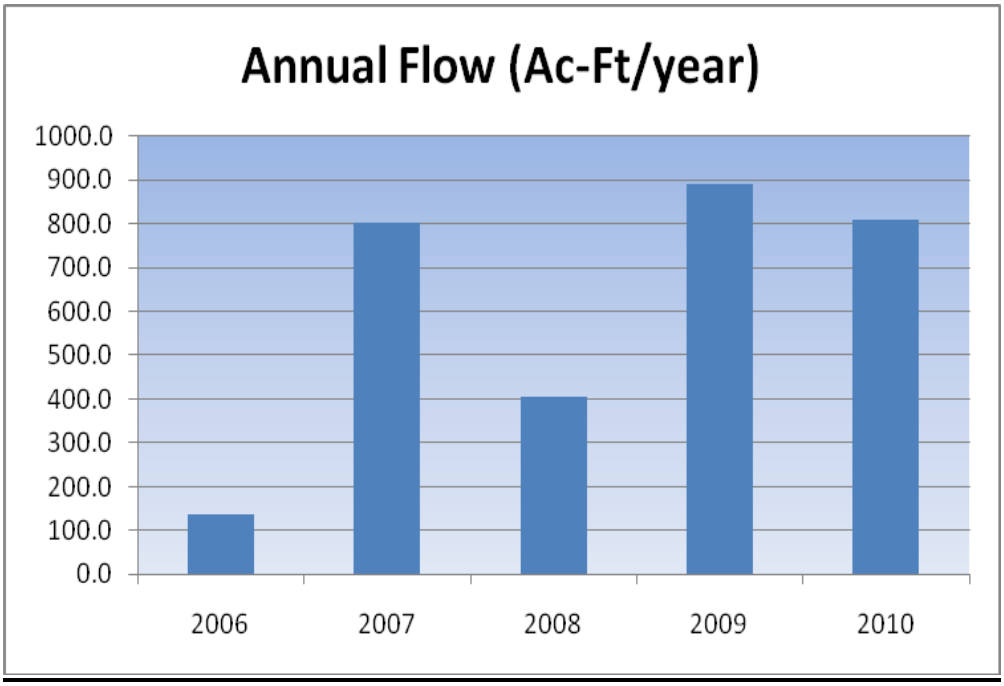

Figure 4 Annual Estimated Flow from Coyote Gulch into Bear Creek Reservoir

Table 2 2006-2010 Nitrate and Total Phosphorus Load Estimates from Coyote Gulch into Reservoir (Base Flow). Load estimates don't include any storm loading or higher flows from spring runoff, which would increase annual loading numbers.

Avg Conc.			Loading Pounds/Month				Field Notes
			Reservoir		Above Project		
Nitrate	T. Phos		Nitrate	T. Phos	Nitrate	T Phos	
3.95	20	**Jan-06**					Planning in Progress; site visits, limited upstream data
3.97	65	**Feb-06**					Planning in Progress; site visits, limited upstream data
1.595	120	**Mar-06**	85.56	6.44			**Start Association Paired Data Set Monitoring**
0.105	2165	**Apr-06**	9.35	192.78			Representative base-flow
2.065	50	**May-06**	86.42	7.11			Representative base-flow
1.635	170	**Jun-06**	4.24	0.44			Representative base-flow
0.9475	170	**Jul-06**	0.26	0.05			Representative base-flow
2.63	113	**Aug-06**	72.00	3.10			Representative base-flow
2.025	80	**Sep-06**	37.72	1.49			Representative base-flow
2.085	53	**Oct-06**	48.83	1.23			Representative base-flow
2.67	10	**Nov-06**	125.78	0.47			Representative base-flow
1.66	30	**Dec-06**	113.00	2.04			Representative base-flow
1.98	10	**Jan-07**	1,288.58	6.51			**Start Construction By-pass 15-Jan-07**
0.77	50	**Feb-07**	275.62	17.90			By-pass, Construction
0.11	190	**Mar-07**	11.58	20.01			By-pass, Construction
2.13	270	**Apr-07**	182.73	23.16	133.32	32.60	By-pass reverted 12 April 07
1.69	60	**May-07**	506.21	17.97	430.45	6.01	**Complete Construction End May/ revegetation in progress**
1.37	120	**Jun-07**	153.69	13.46	81.69	7.85	site Recovery, not stable
0.04	50	**Jul-07**	2.29	2.86	34.85	8.01	**Recovery Period; Revegation plantings complete**
0.82	100	**Aug-07**	82.62	10.08	114.86	12.09	Stabilizing vegetation
1.56	20	**Sep-07**	195.40	2.51	227.97	6.26	Stabilizing vegetation
1.96	10	**Oct-07**	261.52	1.33	482.24	2.67	Stabilizing; numerous weeds; small fish lower sections
2.71	80	**Nov-07**	221.38	6.54	226.28	8.06	side runoff
2.65	50	**Dec-07**	187.61	3.54	161.58	2.51	snow and ice
3.27	60	**Jan-08**	71.23	1.31	72.76	0.68	snow and ice
2.65	50	**Feb-08**	396.88	7.49	398.37	7.05	mostly melted; good flow; heavy algal matting lower
1.82	30	**Mar-08**	322.13	5.31	355.76	1.69	Heavy Localized storms, Data collection for storm runoff
0.91	30	**Apr-08**	71.86	2.37	102.98	2.53	Stabilized vegetation/ Trees
0.2	50	**May-08**	10.89	2.72	21.92	2.51	Stabilized vegetation/ Trees
0.1	40	**Jun-08**	2.18	0.87	23.69	2.04	Representative base-flow
0.6	15	**Jul-08**	130.70	3.27	217.30	6.21	Representative base-flow
0.5	80	**Aug-08**	58.54	9.37	118.34	12.99	well established wetland

Avg Conc.			Loading Pounds/Month				Field Notes
			Reservoir		Above Project		
Nitrate	T. Phos		Nitrate	T. Phos	Nitrate	T Phos	
0.79	40	**Sep-08**	79.59	3.05	105.79	5.04	Representative base-flow
0.93	20	**Oct-08**	70.91	1.31	81.42	2.12	Representative base-flow
1.21	60	**Nov-08**	79.08	6.05	177.27	6.86	Representative base-flow
1.9	30	**Dec-08**	46.56	0.74	51.46	0.98	ice, light flow
2.08	30	Jan-09	50.97	0.74	0.00	0.00	ice, light flow
2.42	30	Feb-09	52.72	0.65	201.07	2.83	ice, light flow
1.76	50	Mar-09	67.09	1.91	99.99	2.78	Representative base-flow
0.43	90	Apr-09	558.51	116.90	687.34	147.29	Heavy Localized storms, Data collection for storm runoff
0.37	60	May-09	77.18	12.51	136.78	13.15	Representative base-flow
1.38	80	Jun-09	124.01	7.19	163.22	9.07	Trees Established
0.59	90	Jul-09	59.44	9.07	113.41	18.68	Representative base-flow
1.2	80	Aug-09	163.38	10.89	175.33	11.52	Representative base-flow
1.09	60	Sep-09	83.11	4.57	119.51	6.29	Representative base-flow
1.86	30	Oct-09	222.85	3.59	211.74	4.90	Representative base-flow
1.27	50	Nov-09	459.94	18.11	401.42	15.93	Representative base-flow
2.96	60	Dec-09	201.50	4.08	421.96	12.74	Representative base-flow
3.57	40	Jan-10	262.94	2.95	108.13	1.14	ice, light flow
3.01	40	Feb-10	195.69	2.60	260.78	2.96	ice, light flow
1.31	80	Mar-10	515.31	31.47	537.49	33.08	ice, light flow
0.94	90	Apr-10	1,036.65	99.25	859.20	75.81	Heavy Localized storms, Data collection for storm runoff
1.37	50	May-10	177.54	6.48	220.31	7.78	Representative base-flow
0.73	90	Jun-10	87.51	10.79	105.49	13.19	Representative base-flow
0.67	90	Jul-10	72.90	9.79	81.94	8.29	Representative base-flow
0.75	60	Aug-10	101.69	8.14	211.38	9.02	Representative base-flow
1.4	130	Sep-10	110.55	10.27	148.13	12.96	Representative base-flow
1.44	50	Oct-10	173.55	6.03	115.16	2.88	Representative base-flow
2.49	5	Nov-10	212.57	0.43	311.38	0.36	Representative base-flow
3.59	5	Dec-10	330.51	0.46	283.59	2.38	Representative base-flow

Table 3 Average and total pounds pre month at monitoring sites as base load (all data)

Average Loading Pounds Per Year

		Reservoir		Above Project	
		Nitrate	T Phos	Nitrate	T Phos
Pre-construction	**2006-2007**	200.7	20.0		
Post-Construction	**2007-2008**	128.7	4.4	160.9	5.2
	2009*	142.0	6.7	185.9	8.9
	2010*	203.7	8.1	216.7	8.5
		Loading Pounds After Stable			
		Reservoir		**Above Project**	
		Nitrate	**T. Phos**	**Nitrate**	**T Phos**
	Total Pounds	**5,948**	**409**	**6,875**	**456**
	Average	**180**	**12**	**208**	**14**
	Median	**102**	**5**	**148**	**6**
	2009*/2010* average loadings per year excludes April storm loadings				

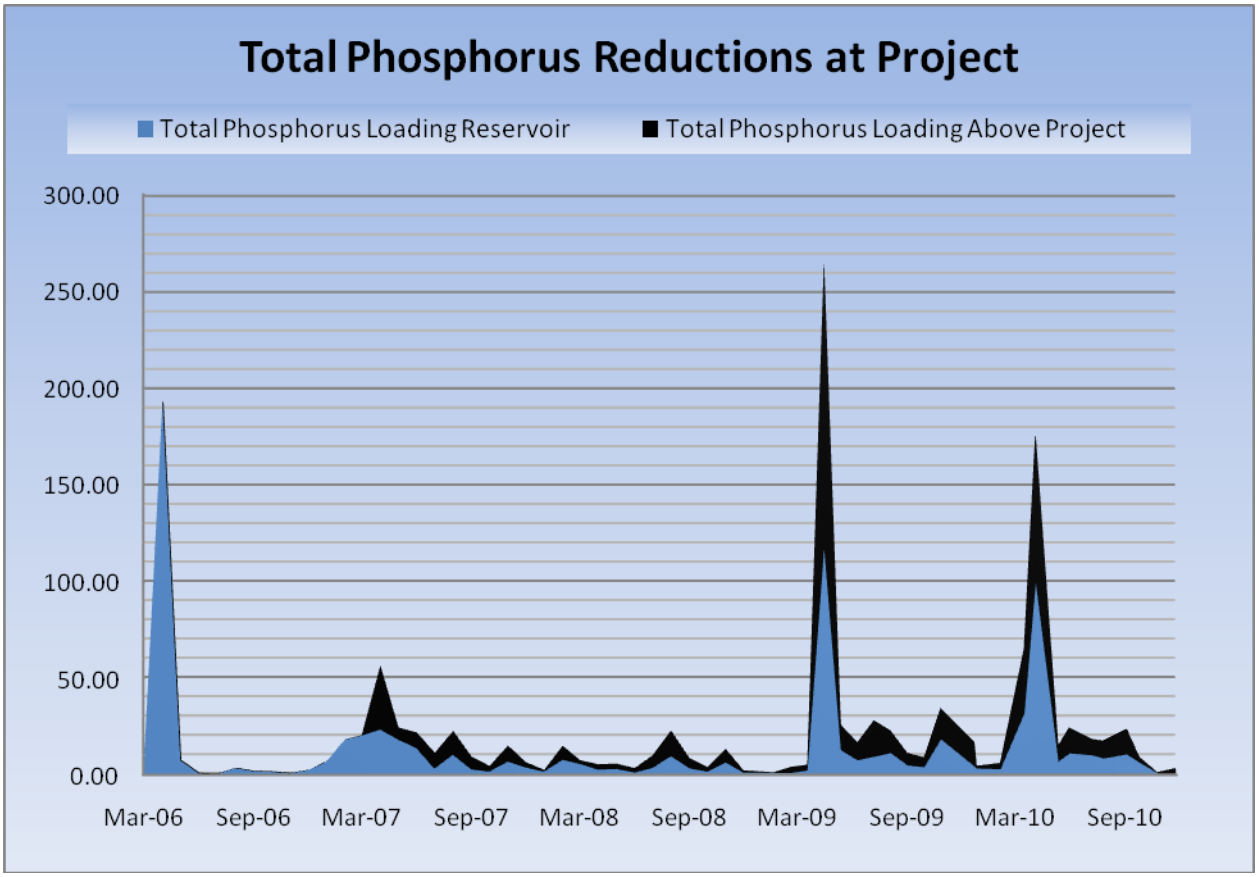

Figure 5 Total Phosphorus Reductions

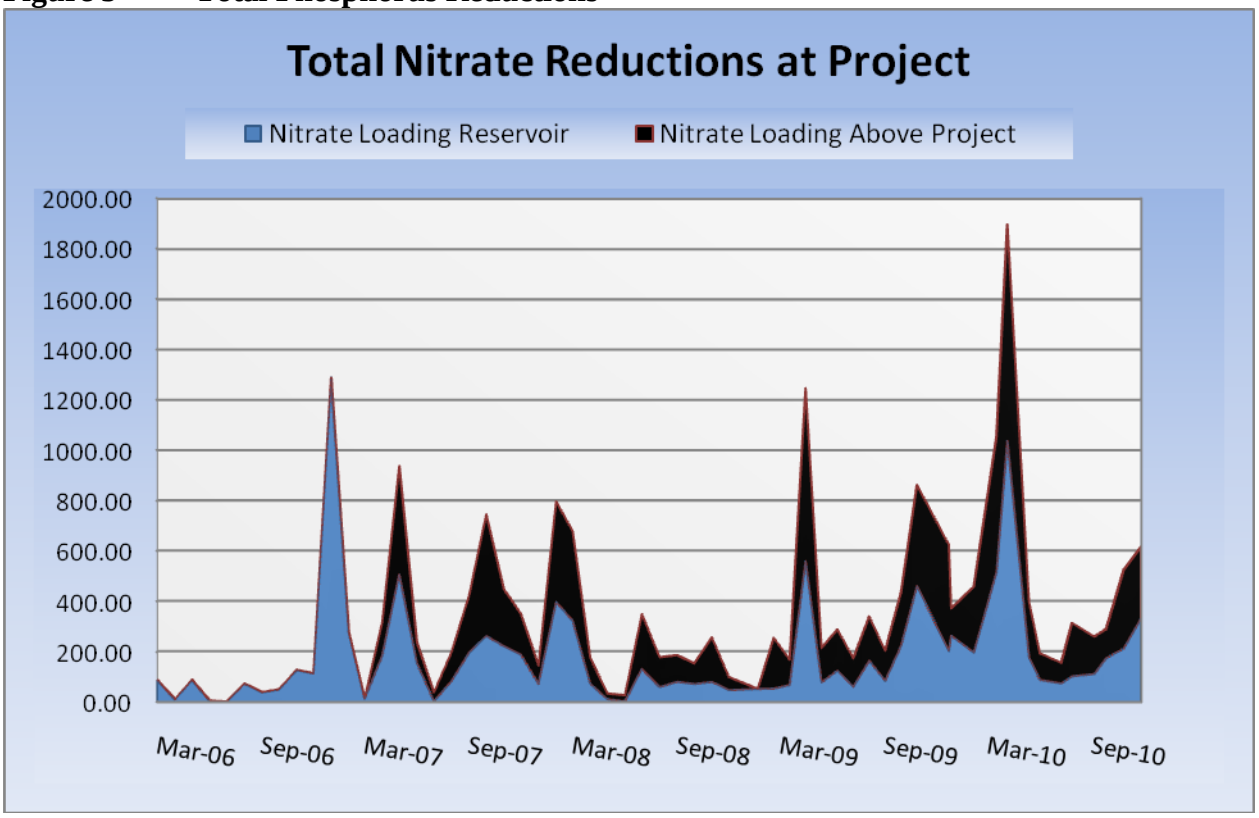

Figure 6 Nitrate Reductions

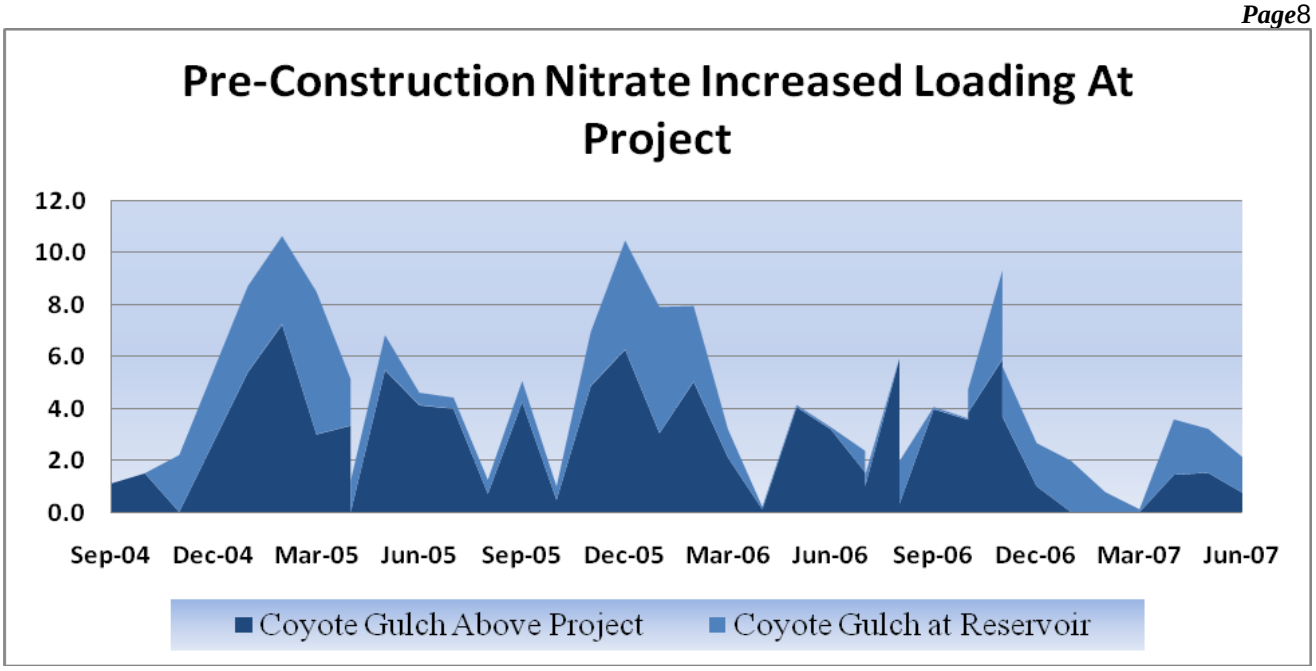

Figure 7 Pre-Construction Nitrate Trends

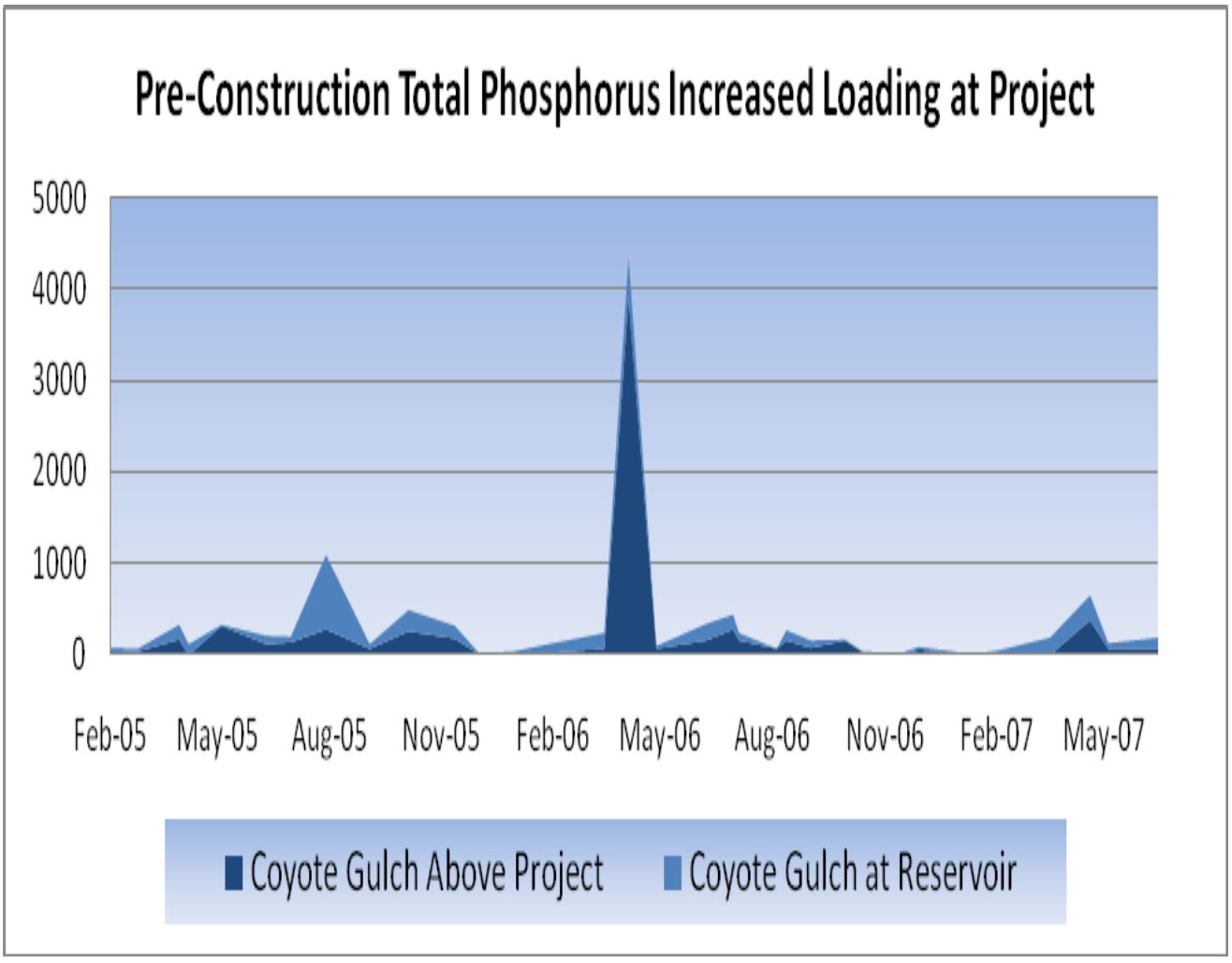

Figure 8 Pre-Construction Total Phosphorus

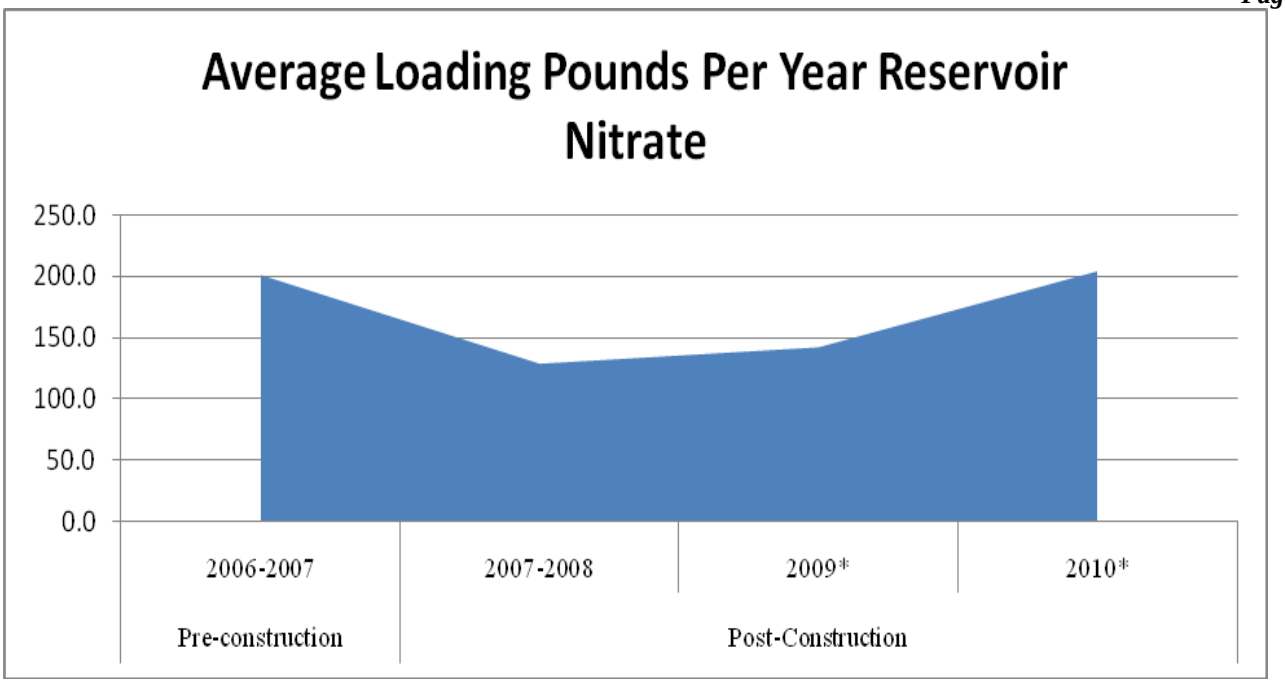

Figure 9 Average Annual Pounds of Nitrate Reaching Reservoir

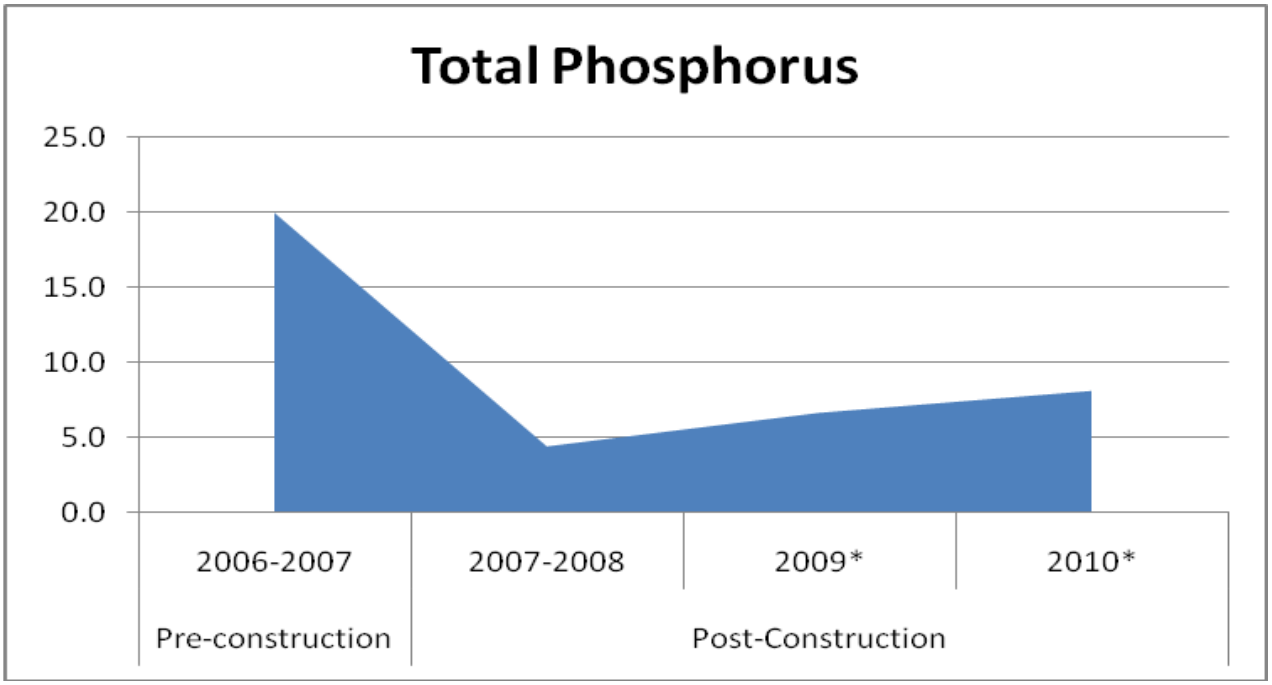

Figure 10 Average Annual Pounds of Total Phosphorus Reaching Reservoir

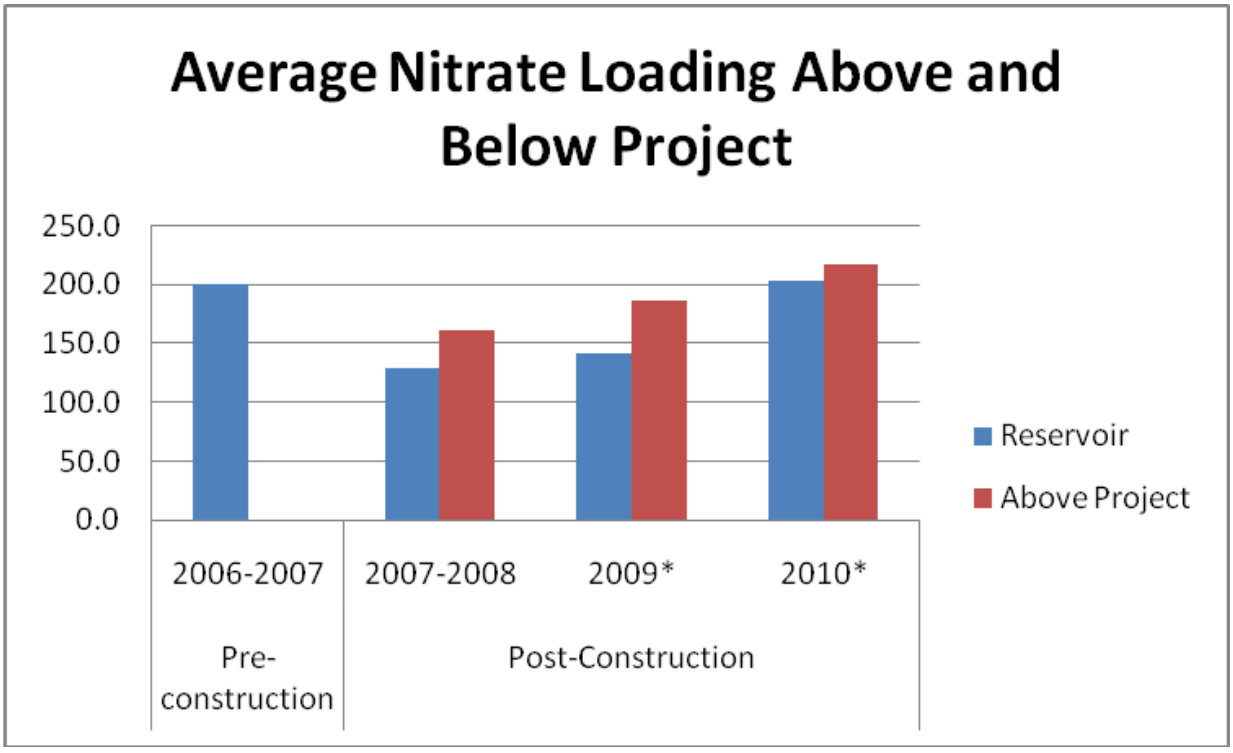

Figure 11 Average Nitrate Loading Above and Below Project

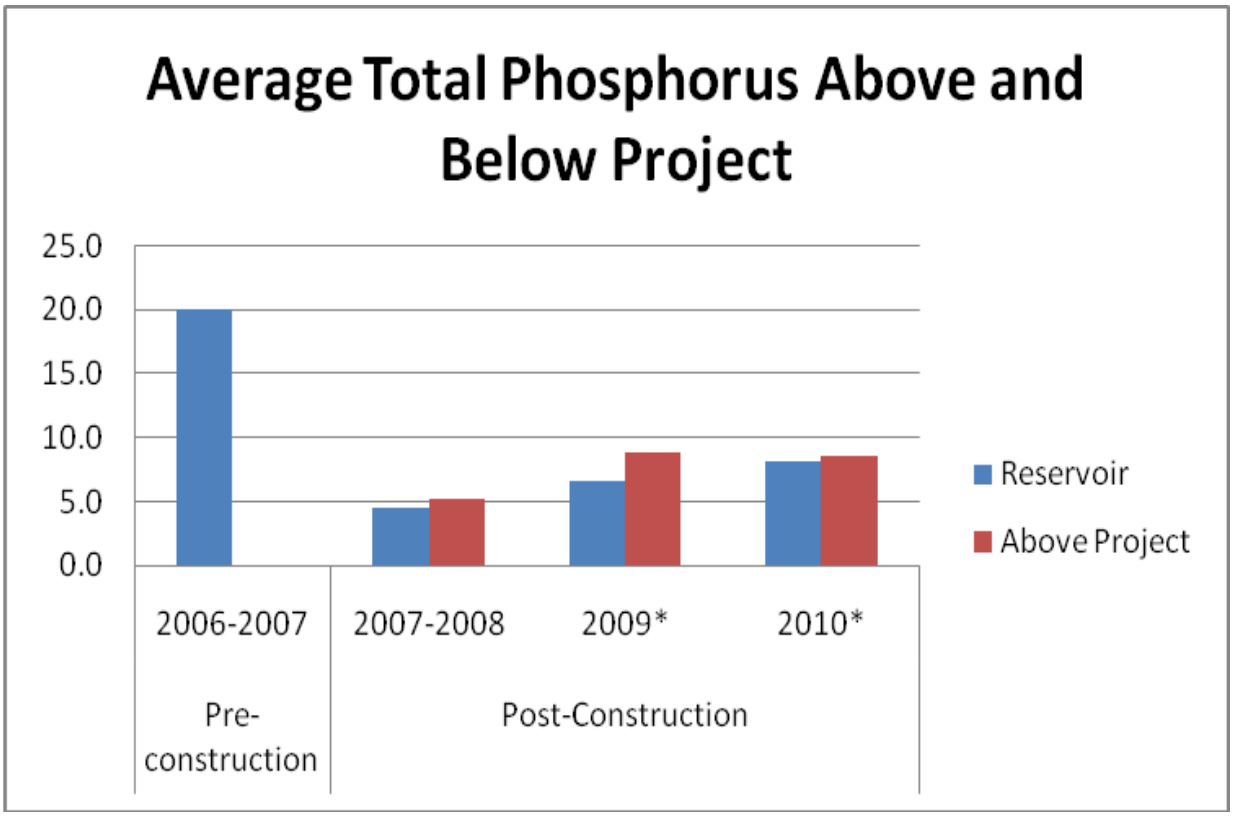

Figure 12 Average Total Phosphorus Above and Below Project

Figure 13 Coyote Gulch Pre-Construction

Figure 14 Coyote Gulch During Construction

Figure 15 New Stone Check Dam Installed

Figure 16 Coyote Gulch Construction Completion without vegetation

Figure 17 Check Dam from Figure 15 with Vegetation

Figure 18 Coyote Gulch as Stabilized in Fall 2009