

**Allen Brook Water Quality Monitoring**  
**Final Report**  
**2007 – 2014**

The Williston Conservation Commission (WCC) is pleased to submit this Report to summarize the results of the 2007 to 2014 sampling seasons. In 2014, the WCC sampled 9 locations along the Allen Brook (see Figure 1). The parameters sampled included Total Phosphorus (TP), *E. coli*, and Turbidity (NTU). Total Nitrogen and chloride tests were dropped this year in response to funding availability, as part of an effort to reduce the overall size of the sampling program.

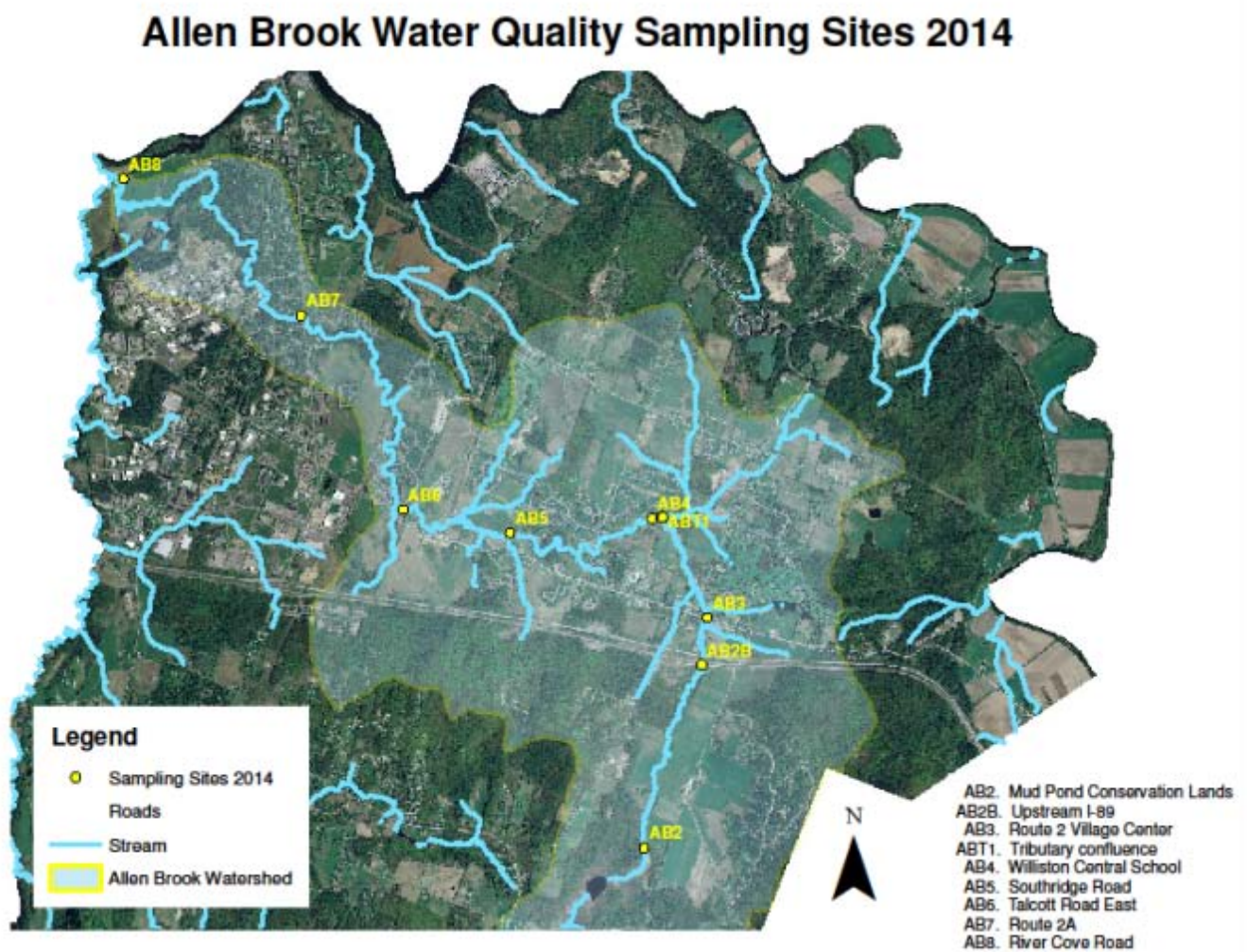
The Allen Brook has been rated as an impaired water body by the state of Vermont, due to its excess nutrient load and high rates of *E. coli*. These conditions impair the streams for wildlife and human recreation as well. Excess nutrients can be introduced to water systems from agricultural runoff, storm water and wastewater, as well as around the house items like detergents and fertilizer. The purpose of this report is to identify trends so that informed actions can be taken and concentrated on in problem areas.

**Sampling Locations**

<b>Site #</b>	<b>Description</b>
AB2	Mud Pond Conservation Land, downstream of pond. Has been a sampling site for TN (2007-2013), TP (2007-Present), <i>E.coli</i> (2007-Present), Chloride (2010-2013), and Turbidity (2010-present)
<del>AB2B</del>	<del>Upstream of South Road/4-89 crossing</del> (eliminated in 2015). Previously sampled for TN, TP, <i>E. coli</i> , and Turbidity
AB3	Upstream of Route 2 crossing in Village Center. Has been a sampling site for TN (2007-2013), TP (2007-present), <i>E.coli</i> (2007- present), Turbidity (2010-present)
<del>AB3B</del>	<del>Along Bike Path, W of N. Williston Rd, downstream of small tributary.</del> (Eliminated in 2014). Previously samples for TN, TP, <i>E. coli</i> , and Turbidity
ABT1	Major tributary north of Central School ball fields, downstream of beaver lodge. Has been a sampling site for TN (2008,2010), TP (2008-present), <i>E.coli</i> (2010), Turbidity (2010-present)
AB4	Williston Central School- behind ball fields, south of 338 Southfield Drive (access through this yard). Has been a sampling site for TN (2007- 2010, 2013), TP (2007- present), <i>E.coli</i> (2007- present), Chloride (2010), Turbidity (2010- present)
<del>AB4B</del>	<del>Just downstream of Old Stage road crossing</del> (eliminated 2014). Has been a sampling site for TN (2008,2010), TP (2008-2013), <i>E.coli</i> (2008), Chloride (2010), Turbidity (2010-2013)
AB5	Just upstream of Southridge Road crossing. Has been a sampling site for TN (2007-2010), TP (2007- present), <i>E.coli</i> (2007,2010), Chloride (2010), Turbidity (2007- present)
AB6	Just upstream of Talcott Road East crossing (access from Fire Station). Has been a sampling site for TN (2007-2013), TP (2007-present), <i>E. coli</i> (2007-

	present), Chloride (2010- 2013), Turbidity (2010- present)
AB7	Under Route 2A crossing (large culvert). Has been a sampling site for TN (2007- 2010), TP (2007- present), E.coli (2007- 2008), Chloride (2010), Turbidity (2007, present)
AB8	Just upstream of River Cove Road crossing. Has been a sampling site for TN (2007- 2013), TP (2007- present), E.coli (2007- 2010), Chloride (2010- 2013), Turbidity (2010- present)

Figure 1:



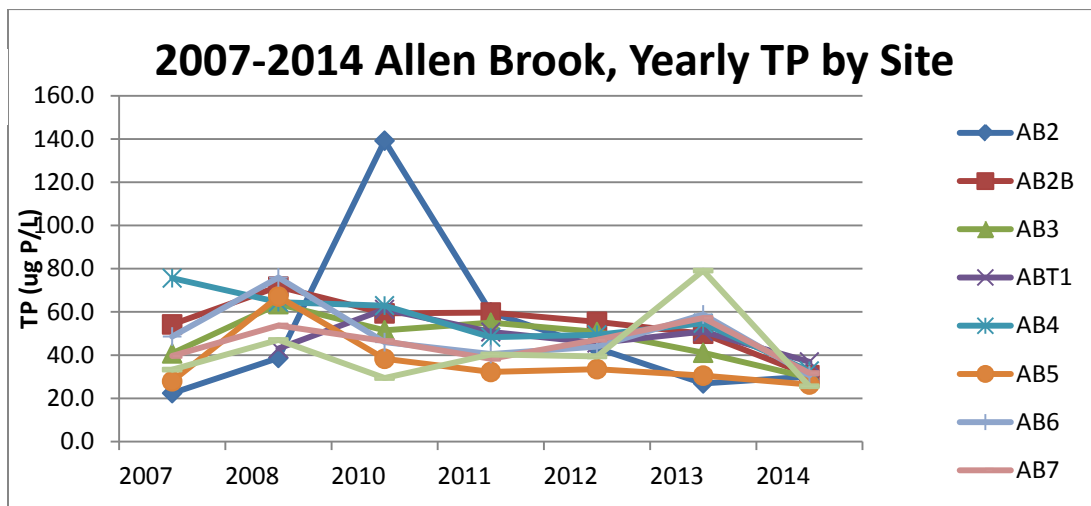
## Trends in Data

To illustrate and compare the sampling data gathered from 2007-2014 (no samples were taken in 2009). The mean concentration of each parameter was calculated for each monitoring site for each year. Comparing the data in this way brought some interesting trends to light. Below is a summary of the findings for each parameter.

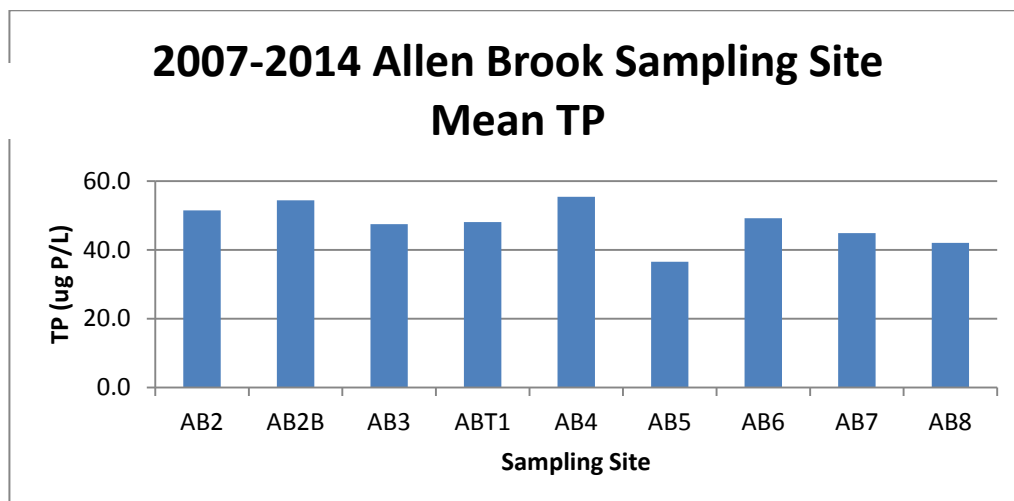
### Total Phosphorous: (see graphs 1 & 2)

TP concentrations were greatest at sampling site AB4 and lowest at AB5. The means suggest that the upstream sampling sites (AB2-AB4) tend to have just a slightly higher total phosphorus concentration than the downstream reaches (AB5 to AB6). We would expect to see these results because agricultural land is concentrated in the upstream reach. Also, since Phosphorus binds to soil, we would expect to see less TP in the water column as the chemical moves further away from its source (a.k.a. moves downstream). Consequently, we might expect that the greater the concentration of turbidity, the lesser the concentration of TP. 2008 proved to be the year with the highest concentration of phosphorus and 2014 had the lowest concentration since 2007.

Graph 1:



Graph 2:



**E. coli:** (see graphs 3 & 4)

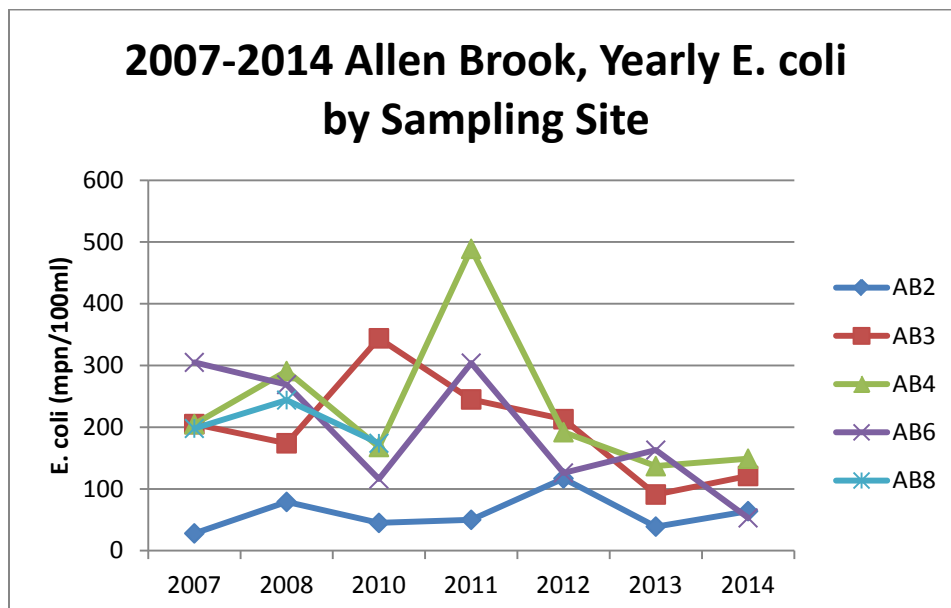
Concentrations of *E. coli* showed some consistent trends for some sites and some inconsistencies for others. Site AB2 is the furthest upstream site, located within a protected wetland area. Sites AB4 and AB6 are both located downstream of residential development. Site AB 3 is located downstream from agricultural uses.

Site AB2 was the only sampling location to consistently remain below 100 mpn/100ml, except for a slight rise in 2012. This trend makes sense as AB2 is situated in a conservation area where the only inputs would be wildlife related. Over the 7 year sampling period, site AB4, located behind the Allen Brook elementary school, averaged the highest *E. coli* concentrations. On 7/7/2011 the sample at AB4 showed a very large spike in *E. coli*. When cross referencing this date with the Flow data there was an increase in flow from 3.1 cf/s on June 30<sup>th</sup> to 23cf/s on July 7<sup>th</sup>. The high average *E. coli* concentrations in 2011 are also likely reflective of the high flow events associated with Hurricane Irene in August of that year.

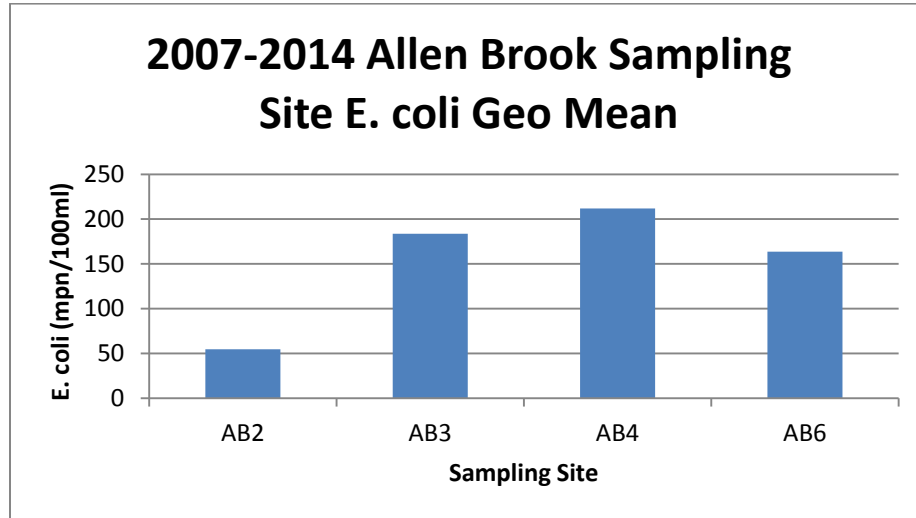
All Sites exceeded the EPA standard and VT standard on one or more sampling events in 2014 (see Table 1). However, in 2013 and 2014 *E. coli* colonies were lower at all sampling locations than in previous years. Whether this stabilizing trend will continue is yet to be seen.

We feel that source sampling (DNA testing) at points AB3, AB4 and AB5 could be valuable for determining the origin (human, bovine, etc.) of these *E. coli* concentrations, and the conservation commission is looking into sources of funding for this effort. If the *E. coli* at AB3 was determined to be bovine in origin, the farmland bordering the Allen Brook between sites AB2 and AB3 should be checked to ensure that there is an appropriate sized buffer between the fields and the stream. Also, it might be worthwhile to try and raise awareness amongst the farmers to try and not spread manure during or before significant rain events.

Graph 3:



Graph 4:

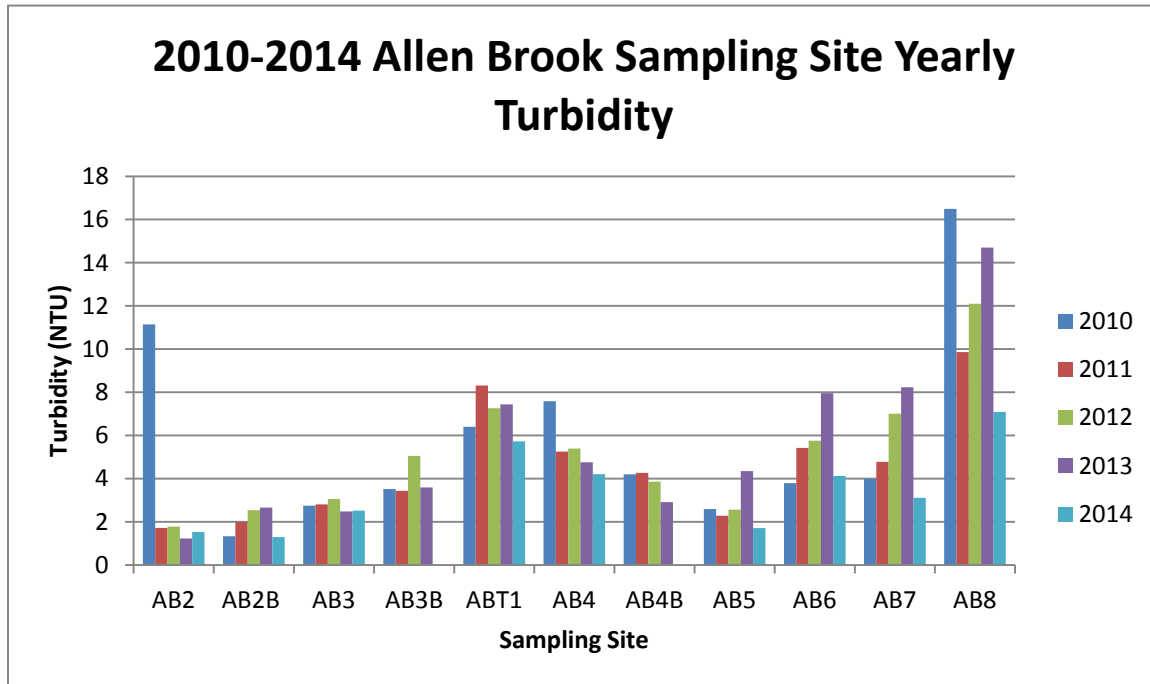


**Turbidity:** (see graphs 5 & 6)

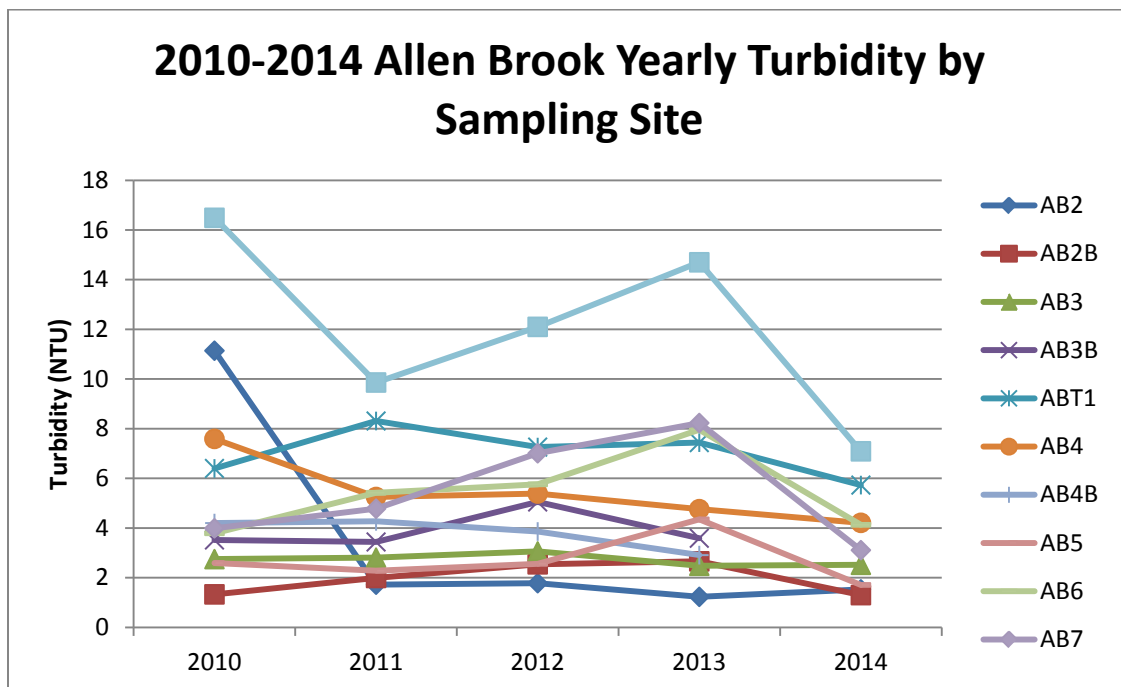
As opposed to TP, the Turbidity was generally greater downstream than upstream. This trend makes sense as the level of turbidity tends to be cumulative in the water and there is a greater amount of impervious surface and developed areas located in the downstream stretch of the Allen Brook, which could cause excess sediment to be washed into the stream during a storm event. Notably, overlaying Stream Flow data with the yearly mean Turbidity showed no significant correlation.

Overall, Site AB8 had the highest turbidity and had about a 2x higher concentration than AB7, suggesting a source area for turbidity between these two sampling points. Notably, AB8 is downstream from an area of industrial development which may be responsible for some illicit discharge or stream buffer encroachment. Also, the Allen Brook travels through an area of severely eroded farmland along River Cove Road immediately upstream from site AB8. This site, the Griswold Farm, was the site of a 4 acre streambank restoration project in 2012-2013 which is being managed by Friends of the Winooski River. It may take additional time for stabilization to occur along this corridor and to be reflected in the sampling results. Between 2008 and 2014 stream buffer restoration projects were implemented along other stretches of the Allen Brook in the vicinity of sampling points AB4, AB5 and AB6 with the intention of reducing stream bank erosion (see attached map). 2014 was a relatively low turbidity year across all the sampling points. Whether this will remain a consistent trend has yet to be determined.

Graph 5:



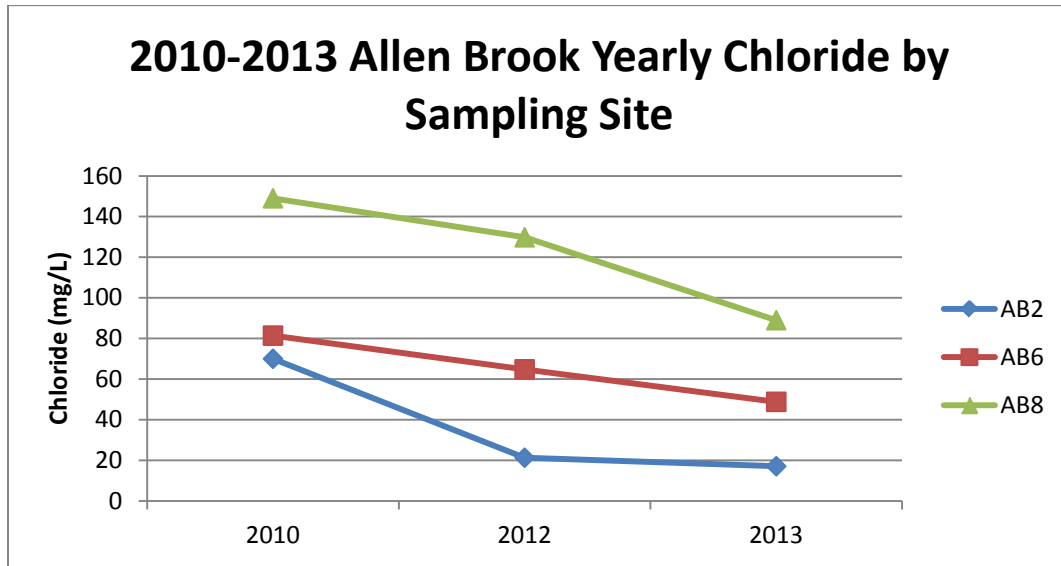
Graph 6:



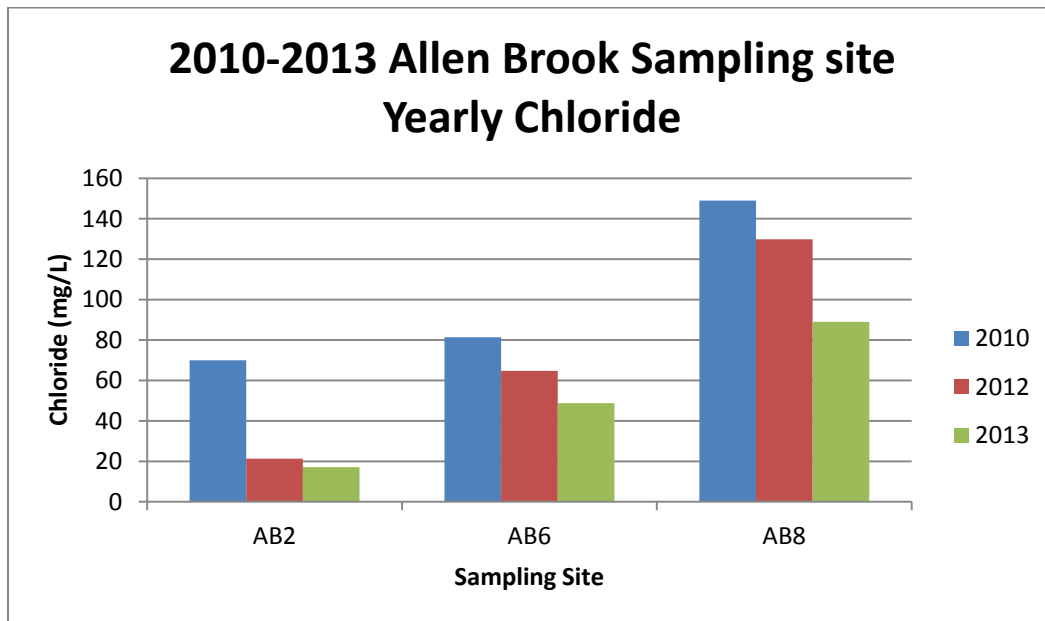
**Chloride:** (see graphs 7 & 8)

Chloride was first sampled in 2010 for all sites, skipped in 2011, brought back in 2012 and 2013, but only sampled at AB2, AB6, and AB8. It was dropped again in 2014. The limited data available shows a trend towards an increasing concentration further downstream and a decrease in concentration across the board over the three year span.

Graph 7:



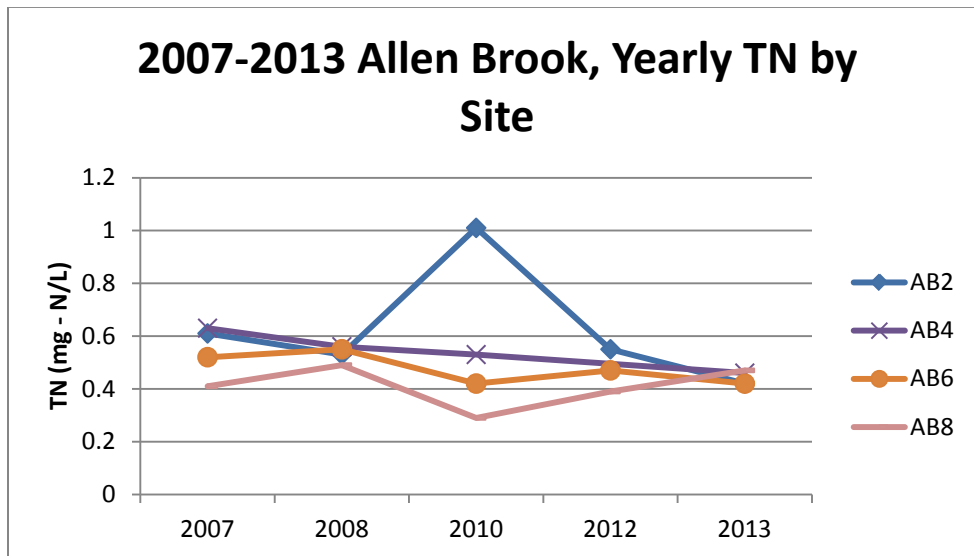
Graph 8:



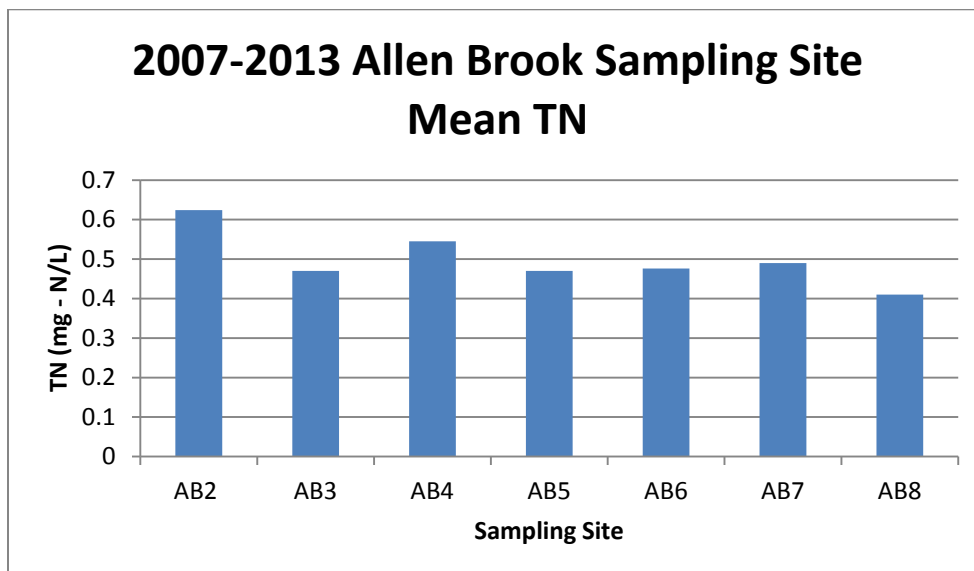
**Total Nitrogen:** (see graphs 9 & 10)

Total Nitrogen was sampled at every site from 2007 to 2010. It was dropped in 2011 and brought back for 2012 and 2013 though only for sites AB2, AB6, and AB8. It was dropped again for 2014. Total nitrogen doesn't vary all that much site to site. When looking at the three sites with the most data (AB2, AB6, and AB8) which have five years worth of data, it appears that there is a decline in concentration the further downstream you go. However, when including sites AB3, AB5, AB7 which have three years of data and AB4 which has four years there is no real trend.

Graph 9:



Graph 10:





## State and Federal Water Quality Standards

When comparing our ambient monitoring results with the available state and federal standards (numerical standards do not yet exist for TN and TP), we found that the Allen Brook exceeded standards for *E. coli* and Turbidity. The Allen Brook did not exceed the federal standards for Cl. Below is a summary of each parameter.

### Total Nitrogen & Total Phosphorous:

State and federal numeric criteria for TN and TP are not yet developed.

### E. coli:

All sampling sites exceeded Federal (235 colonies/100mL) and State (77 colonies/100mL) standards for *E. coli* at least once if not multiple times during each sampling season except in 2013 when site AB2 did not exceed the EPA's standard. Over the seven year sampling span, 37% of the samples were above the Vermont Standard, 34% were above the EPA standard and 29% were lower than both.

	Result over 235 colonies/100 ml (EPA contact standard)
	Result over 77 colonies/100 ml (VT state contact standard)

Table 1:

2014 Allen Brook E.coli sample results									
Site Name	6/05/2014	6/19/2014	7/17/2014	7/31/2014	8/12/2014	8/28/2014	9/11/2014	9/29/2014	Geometric Mean
AB2 (Mud Pond Conservation Lands)	70	64	115	162	261	28	24	19	63.90
AB3 (Route 2 Village Center)	40	88	119	86	308	178.9	111	214	121.39
AB4 (Williston Central School)	71	250	166	326	236	131	921	9	149.24
AB6 (Talcott Road East)	72	206	58	299	47	27	12	17	53.45

### Turbidity:

The cold water fish habitat standard (10 NTU) for Turbidity was exceeded at ABT1, AB3 and AB8 at different times during the 2014 sampling season. Looking at the average values for every site over the 7 year period shows that only site AB8 has a mean over 10 NTU.

Table 2:

2014 Turbidity Data (NTU)									
Date	Sampling Site								
	AB2	AB2B	AB3	ABT1	AB4	AB5	AB6	AB7	AB8
6/5/2014	0.95	1.12	0.97	3.59	1.87	1.27	2.27	2.64	2.67
6/12/2014	1.32	2.6	13.5	3.6	2.12	2.81	4.01	3.57	4.53
6/19/2014	0.75	1.67	0.98	3.67	2.36	1.67	2.65	5.06	3.67
6/26/2014	0.67	2.56	2.79	6.26	4.7	5.11	5.51	8.35	7.64
7/3/2014	2.12	0.51	1.2	17.4	9.38	0.92	3.22	2.38	4.06
7/10/2014	1.09	1.35	2	4.83	2.46	2.08	2.86	3.35	2.98
7/17/2014	2.51	0.92	1.17	5.18	2.48	1.02	3.82	1.92	5.74
7/24/2014	1.74	0.56	1.21	8.34	2.74	2.21	6.99	2.8	3.85
7/31/2014	0.98	1.66	2.64	10.5	2.97	1.43	4.41	4.29	3.52
8/7/2014	0.8	0.79	1.03	4.46	3.31	1.17	3.49	2.34	4.79
8/12/2014	2.15	0.65	1.38	3.48	4.68	1.07	3.84	1.98	9.7
8/21/2014	1.4	2.65	1.77	8.1	4.26	1.32	3.52	2.69	6.45
8/28/2014	2.16	1	2.32	3.77	4.75	1.48	4.38	2.4	9.72
9/4/2014	1.31	3.17	1.41	4.28	3.52	1.33	5.3	2.72	10.6
9/11/2014	2.12	0.46	2.03	3.64	6.7	1.96	5.45	2.82	14.1
9/18/2014	3.09	0.23	3	3.41	7.92	1.32	4.7	1.62	14.2
9/29/2014	0.89	0.2	3.39	2.86	5.32	0.83	3.76	1.96	12.3

**Chloride:** Vermont has not yet developed numeric criteria for Cl, so the federal criteria are used (chronic criteria of 230 mg/L and acute criteria 860 mg/L). No sampling sites exceeded the federal limit. The maximum concentration of 150 mg/L was found at Site AB8 in 2010, which is well below the federal standards.

### **Summary:**

After seven years of data, trends are starting to become apparent. Higher concentrations were found at site AB4 for TP and *E. coli*. Site AB8 tended to have higher concentrations of Turbidity and Chloride. In general, a common trend is that concentrations tend to start out relatively low at AB2, increase until AB4, then start to drop off a little bit before increasing again towards AB8, which are reflective of the shift from rural land use activities (such as livestock operations) to suburban land use activities (such as higher density residential, commercial/industrial uses and more impervious surface). The Allen Brook has a serious pollution problem. The biological source (human vs. other animal) of *E. coli* contamination should be identified so that remediation efforts can be planned for and implemented. The industrial complex in the vicinity of AB8 should be checked to ensure that there is no illicit discharge contributing to turbidity concentrations at AB8. However, trends do show that concentrations of these various sources of water quality pollution seem to be decreasing over time. Whether this is due to better management, stream restoration efforts, or natural processes is yet to be determined.