

Total Phosphorus and *Escherichia Coli* Levels in Small Streams of Centennial Brook Watershed



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Introduction

Small streams are crucial to local water quality because of their ability to regulate the nutrient levels in downstream environments [1]. Research has shown that catchment land use contributes significantly to a stream's water quality [2]. Urban land use has been shown to contribute to phosphorus concentrations in streams through human wastewater plants, industrial waste, and general pollutants associated with highly populated residential areas [2]. Many studies have identified agricultural land use as a major contributing factor to *E. coli* loading [3, 4], but few have been able to draw specific conclusions about how *E. coli* is transported through watersheds, and even fewer have focused on the transport of *E. coli* through streams. In this Study I examined the impact of land use on small streams by sampling for total phosphorus and *Escherichia coli* in a watershed with diverse catchment land uses.

Materials and methods

I sampled small streams in the Centennial Brook Watershed in South Burlington, VT over four sampling dates in fall 2011. Five sites in the CBW were sampled, with four sites located near the headwaters originating in South Burlington, and one site located near the watershed's outlet into the Winooski River. One site, located in the middle of the Centennial Woods Natural Area, was lost after the first sampling date due to beaver dam construction that halted stream flow. Sampling dates were determined by previous day rainfall, with the exception of October 2nd, where rainfall occurred on the sampling date. Three replicate samples each were collected for analysis of TP and *Escherichia coli*. Samples were analyzed for Total Phosphorus (TP) using spectrophotometry, and *E. coli* using the Colilert method. Catchment land use data was determined through GIS mapping.

Abstract In the fall of 2011, five stream sites were sampled in the Centennial Brook Watershed on four separate sampling dates. These samples were analyzed for total phosphorus (TP) loads and *Escherichia coli* (*E. coli*) concentrations. Four of the sites were located near the headwater inputs of South Burlington, VT, and one site was located near the outlet of the watershed into the Winooski River. The highest average TP loads were found at the Carrigan Drive sample site, with an average of 26.1 g/hr. The highest *E. coli* concentrations were found at the Grove street site with an average concentration of 1917 MPN. The high TP loads and *E. coli* were associated with catchments dominated by urban and agricultural land use, respectively. Data collected on October 2nd, 2011 showed the highest values for both TP loads and *E. coli* concentrations, and had the most rainfall of all the sampling dates. Overall, TP loading and *E. coli* were associated with catchment land use and rainfall accumulation.

Results

Total Phosphorus (TP) loads for the sampling site at Carrigan Drive were consistently higher than the other four sites, with an average TP load of 26.1 g/hr, compared with the next highest load at the Grove Street site that had an average TP load of 10.7 g/hr (figure 1). The catchment for the sampling site at Carrigan drive had the highest percent urban land use, and lowest percent forested land of all sites sampled (table 1). In addition, this site receives its headwaters from a storm-water pond adjacent to the Sheraton hotel, which collects storm run-off from the University of Vermont campus, and portions of the South Burlington commercial and residential areas.

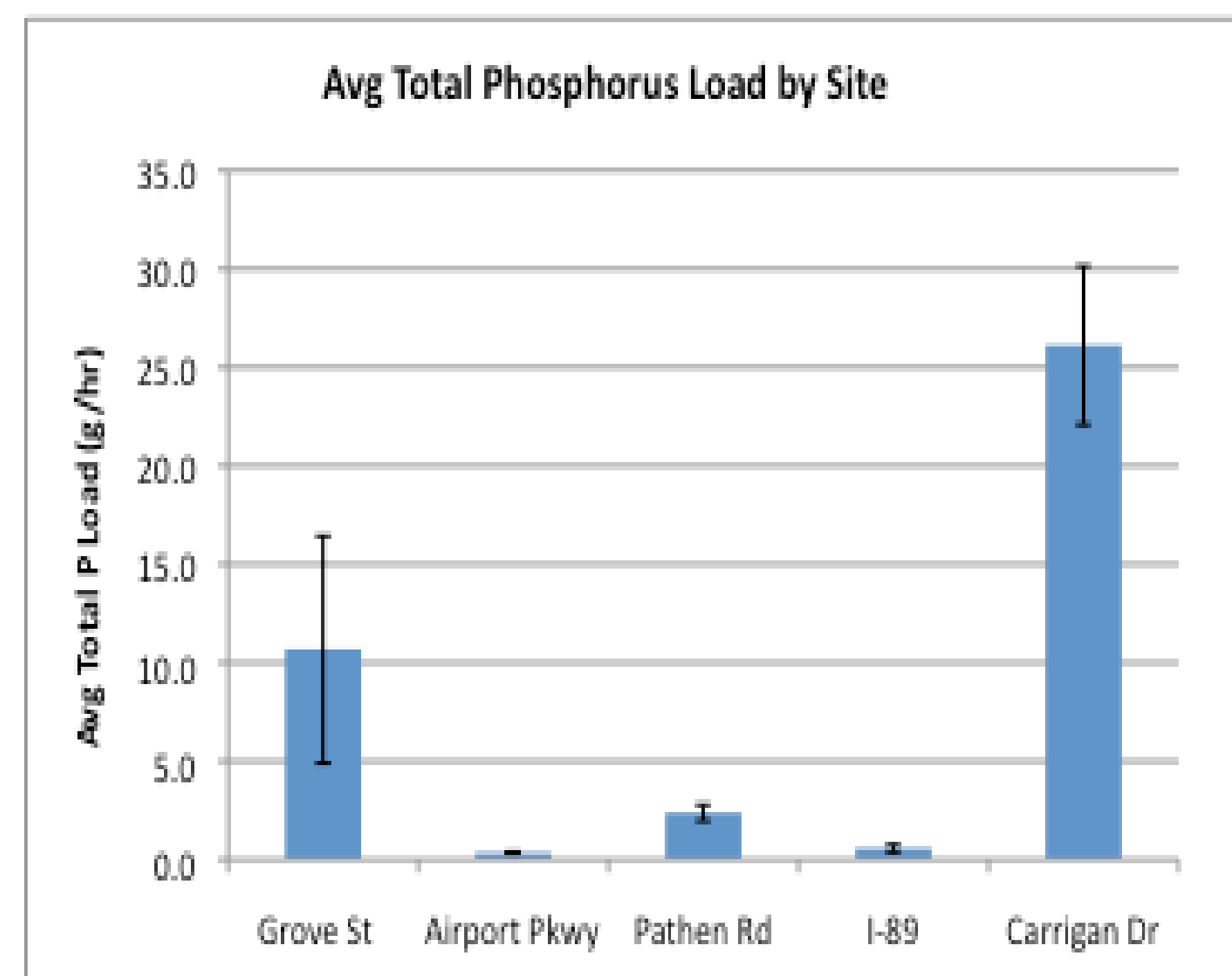


Figure 1 displays the average of all measured total phosphorus loads for each sampled site.

The highest average *E. coli* concentrations occurred at the Grove Street and Carrigan Drive locations, with concentrations of 1917 MPN and 827 MPN respectively (figure 2). Located near the outlet to the Winooski River, the catchment for the Grove Street sampling site contains 7.66 acres of agricultural area; about seven times greater than the I-89 site whose catchment contains the next greatest area of agricultural land (table 1).

Sampling Site	Catchment Area Acres	Agricultural Acres	Percent Catchment Urban	Percent Catchment Forested
Grove Street	830.15	7.66	0.511	0.313
Airport Pkwy	88.01	0	0.718	0.118
Patchen Road	165.24	0.9	0.598	0.215
Carrigan Drive	87.19	0.23	0.817	0.028
I-89	27.29	1.17	0.347	0.377

Table 1 contains GIS data for catchment land use at each sampling location.

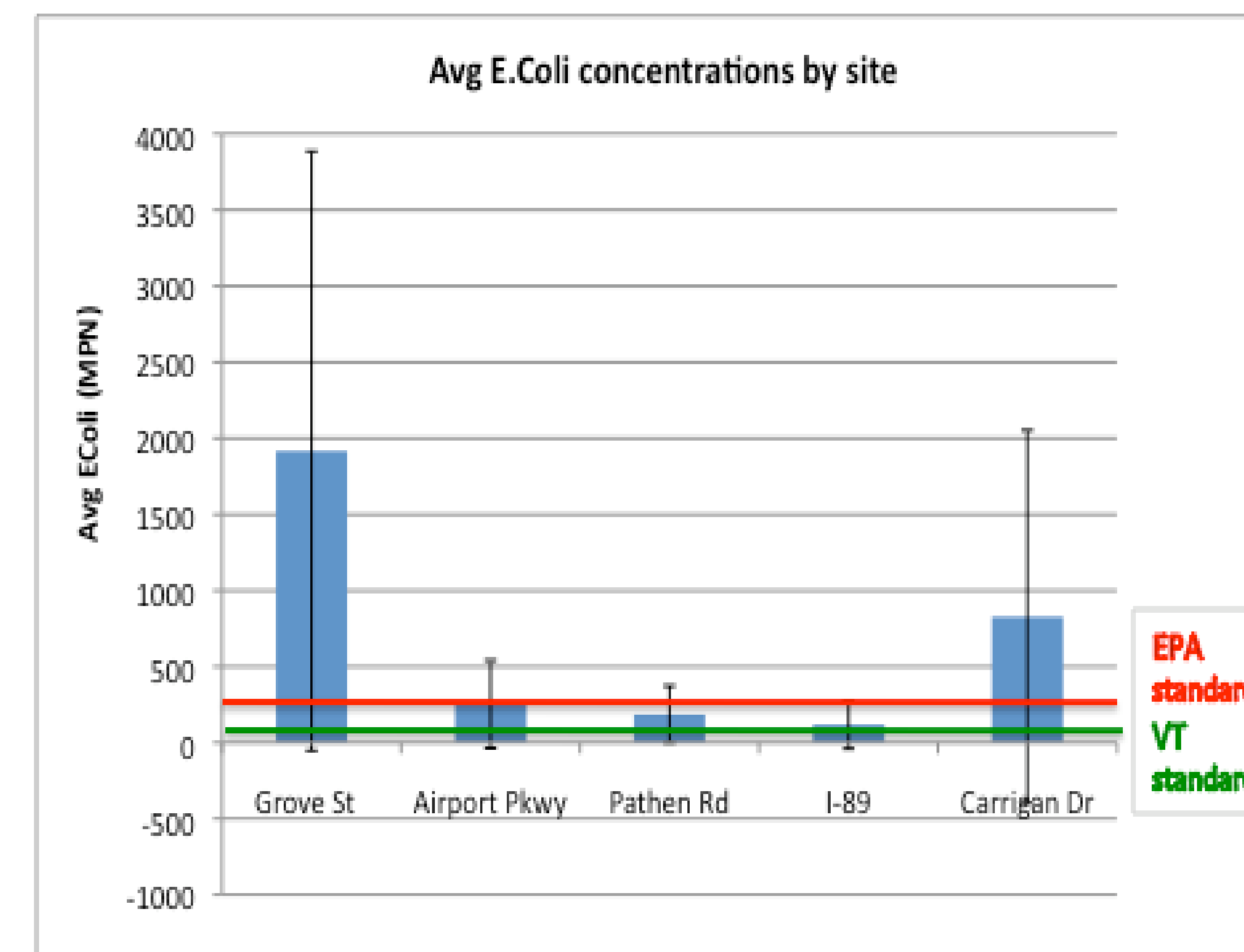


Figure 2 displays the average *E. coli* concentrations in MPN for each sampling location. The red line represents the Environmental Protection Agency (EPA) standard for *E. coli* concentration (MPN) of recreational waters of 235 MPN [7], and the green line represents the VT standard for *E. coli* in recreational waters of 77 MPN [6].

The highest average TP loads (figure 3) and *E. coli* concentrations (figure 4) occurred on October 2nd, 2011. A total of 0.33 inches of precipitation accumulated on the sampling date (5). There was no measured rainfall on any other sampling date, though all date were preceded by previous day rainfall.

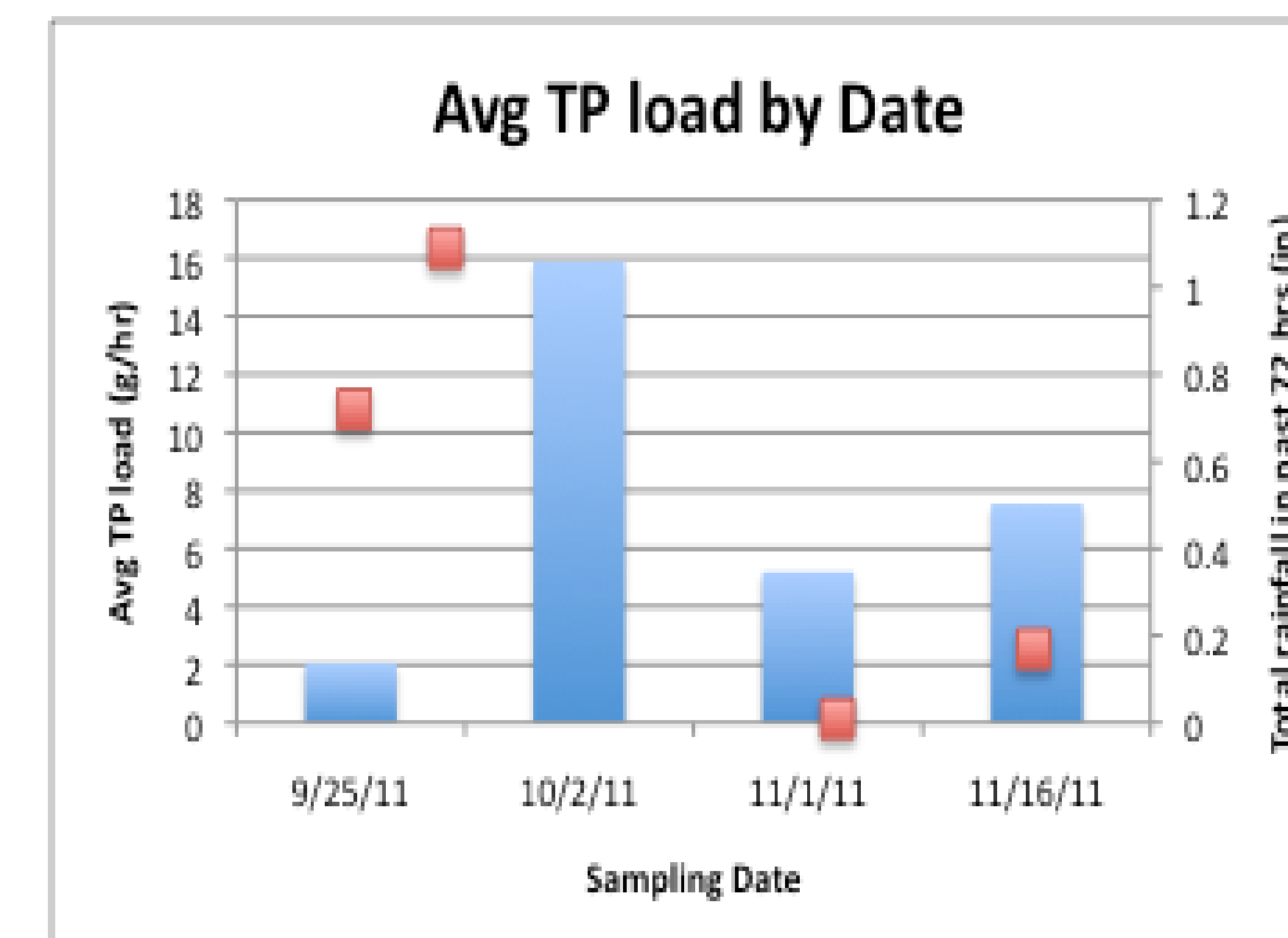


Figure 3 displays the average total phosphorus load for all sites compiled, for each sampling date. The red dots indicate inches of rainfall accumulated in the past 72 hours for each date [5].

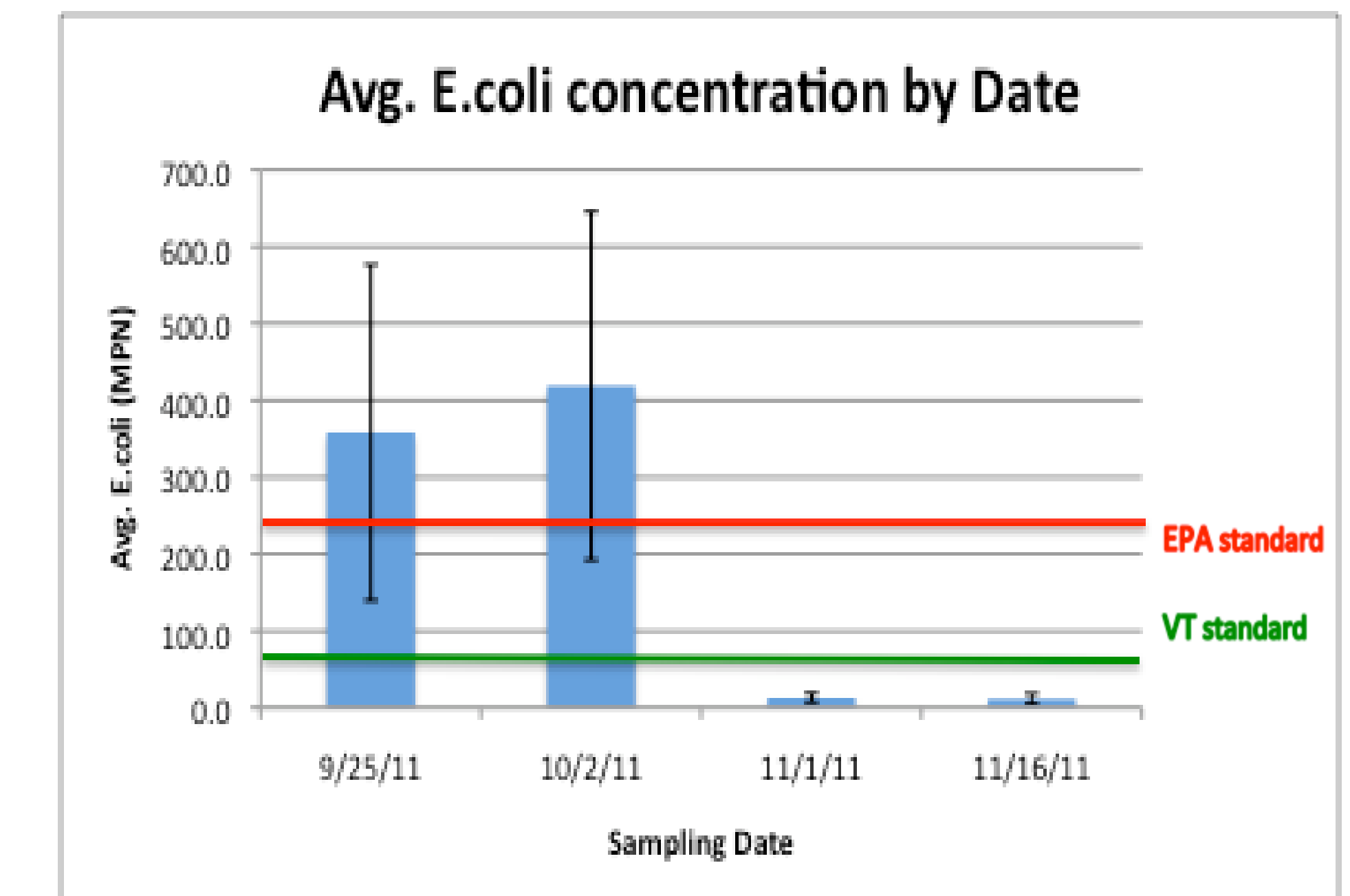


Figure 4 displays the average *E. coli* concentrations in MPN for all sites compiled, for each sampling date. The red line represents the EPA standard for *E. coli* concentration in recreational waters of 235 MPN [7], and the green line represents the VT standard for *E. coli* concentration in recreational waters of 77 MPN [6].

Conclusions

- Total Phosphorus loads and *E. coli* concentrations in small streams of CBW are impacted by local land use and rainfall.

- The highest average TP loads were associated with catchments characterized by high urban land-use.

- The highest *E. coli* concentrations were associated with catchments characterized by high agricultural land use.

- The sampling date with the greatest rainfall accumulation was associated with the highest average TP loads and *E. coli* concentrations.

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Acknowledgments

- Vermont EPSCoR Streams Project: for funding and resources
- Eamon Towhig, University of Vermont: for advising

