

[The Lake Carmi Implementation Team](#) has been in place since 2015 to support communications and trust-building among partners working to reduce phosphorus in the Lake Carmi watershed. Partner organizations implement actions legislated by the Vermont Clean Water Act of 2015. In support of the Implementation Team’s efforts, the Vermont Department of Environmental Conservation (DEC) conducted supplemental biweekly lake monitoring and sampling during the field seasons of 2016 and 2017. Summer 2017 brought a perfect storm of factors. Unusually high levels of rainfall early in the season caused erosion and runoff of phosphorus-laden sediments that fueled early summer algal blooms triggered by warm temperatures (Figures 1-3). Typical summer stratification conditions (Figure 4) led to a lack of mixing in the lowest layer of the lake and depletion of oxygen by biological activity there (Figure 5). Under these conditions, phosphorus was released from the sediment and built up in the lowest layer (Figure 6). Cool temperatures for a short period in August then caused mixing of the lake column, and the phosphorus in the lowest layer mixed up through the water column. This extra injection of phosphorus caused the intense algal blooms we witnessed in late August and early September. An extended period of unusually warm weather from late September through November caused extension of the cyanobacteria bloom.

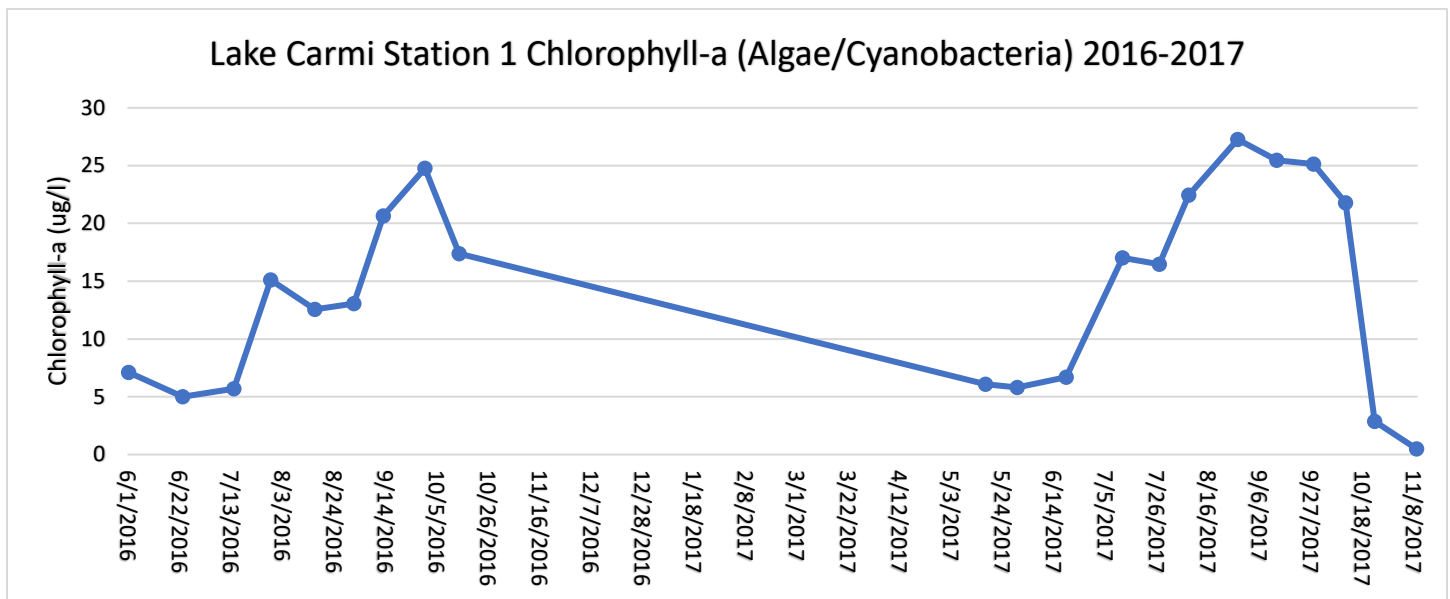


Figure 1. Chlorophyll-a measured as a proxy for algae/cyanobacteria concentration (intense prolonged blooms in summer/fall 2017).

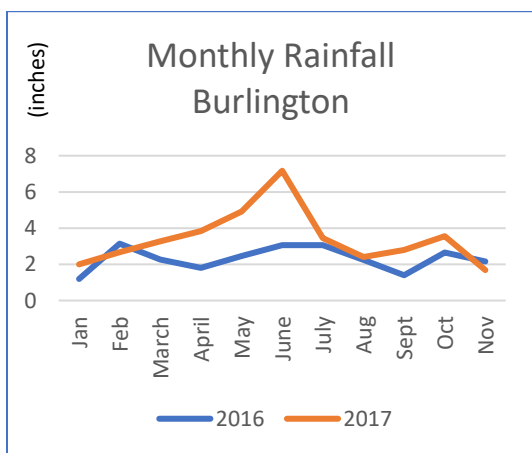


Figure 2. In 2017 late spring rains caused unusual levels of runoff from Lake Carmi’s watershed, bringing phosphorus-laden sediments that led to an early start to algal blooms.

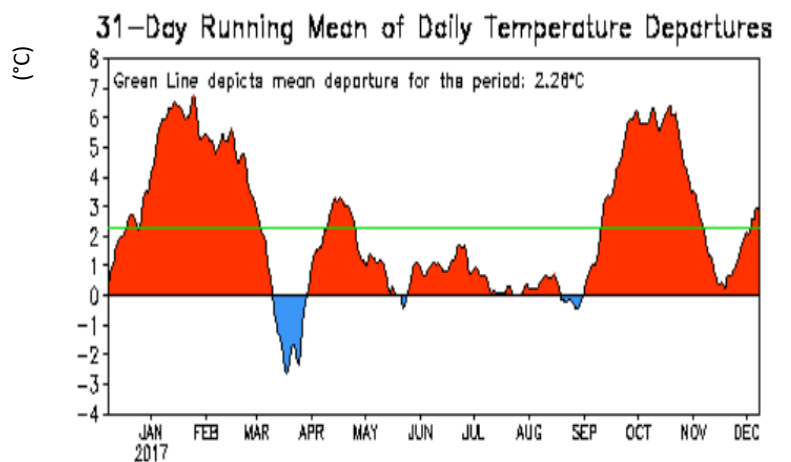


Figure 3. Cooler than normal temperatures in late August 2017 allowed Lake Carmi to mix during typical summer stratification, and then an extended warm spell exacerbated bloom conditions.<sup>1</sup>

<sup>1</sup> [http://www.cpc.ncep.noaa.gov/products/global\\_monitoring/temperature/tn72617\\_1yr.gif](http://www.cpc.ncep.noaa.gov/products/global_monitoring/temperature/tn72617_1yr.gif)

### Lake Carmi Station 1 Water Temperature Vertical Profiles 2016-2017

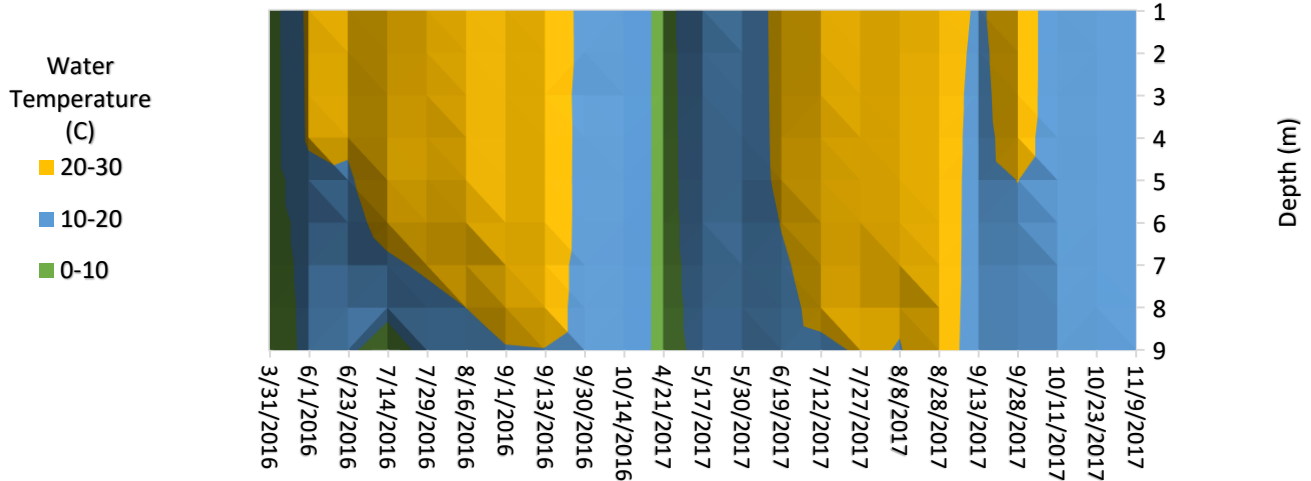


Figure 4. The water column in Lake Carmi cooled and mixed in late August 2017, before stratifying again with warmer temperatures.

### Lake Carmi Station 1 Dissolved Oxygen Vertical Profiles 2016-2017

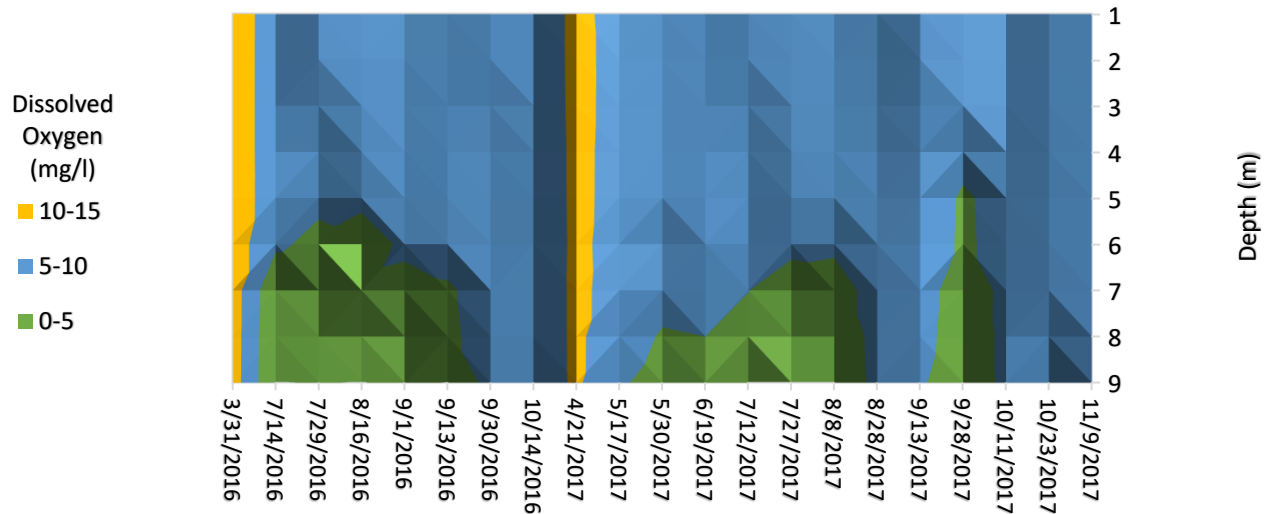


Figure 5. The water column in Lake Carmi mixed in late August 2017. Note the lack of oxygen near the lake bottom (7-9 m) during late July and late September 2017. Anoxic conditions allow release of phosphorus.

### Lake Carmi Station 1 Total Phosphorus Vertical Profiles 2016-2017

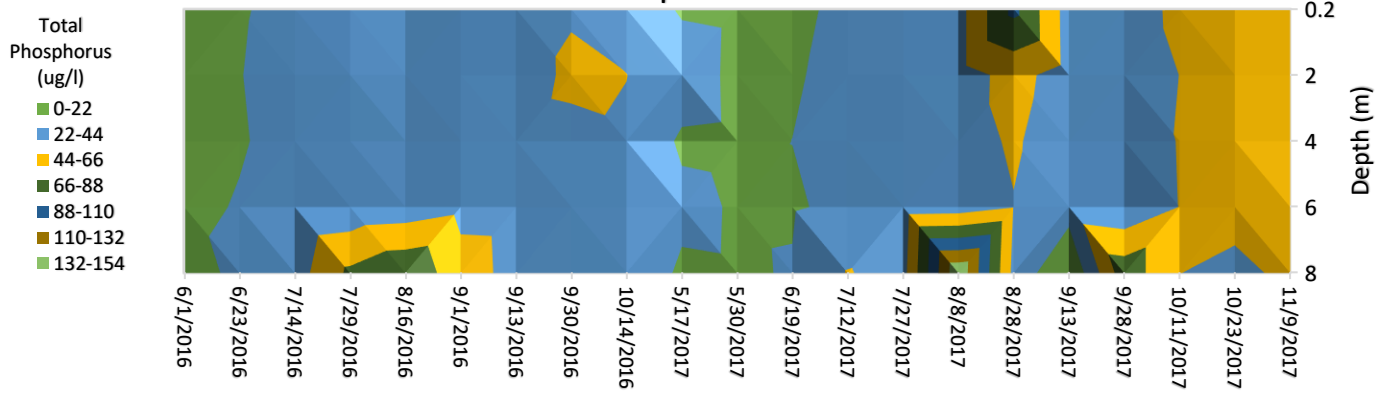


Figure 6. Total phosphorus accumulated near the lake bottom (8 m) during early August and late September 2017 and then mixed into the water column fueling intense cyanobacteria blooms.