TESTIMONY TO VERMONT HOUSE OF REPRESENTATIVES
NATURAL RESOURCES, FISH, AND WILDLIFE COMMITTEE

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I'm here today because I believe that Lake Carmi is a lake in crisis. It is in crisis as a result of activities that occur within its watershed. There have been recent historical changes in these activities. If these conditions for the same as they were 200 years ago, the lake would not be in crisis. Things have changed in the name of and as a result of progress, but these changes are threatening Lake Carmi. The two significant activities to threaten the lake are agricultural use and primary and vacation dwelling. The popular measure of the threat to the lake is the phosphorus level in to or load on the lake. I will discuss the significance of this and other factors as they relate to the two activities that I mentioned.

Before I get into the more technical aspects of my testimony I would like to talk just a bit about my background. I'm a civil engineer, specializing in wastewater treatment. My experience also includes water supply, stormwater, solid waste and hazardous waste engineering. I work for the engineering consulting firm of Tata & Howard in St Johnsbury, and I live in Middlesex. I have been involved in the planning, design and construction for phosphorus removal at Vermont wastewater treatment facilities since 1981. I have implemented more than a dozen phosphorus removal projects that have resulted in reductions of the amount of phosphorus discharged into Lake Champlain. As an engineer, I understand the complexities of removing phosphorus from wastewater and stormwater, as well as the water quality problems resulting from the presence of excess phosphorus and other nutrients in the aquatic environment. I am also a pig farmer, which makes me an expert in that field. This expertise includes a deep understanding of the relationship between animal feed, agronomic practices. There is a correlation between waste, energy, and the environment. This correlation plays an integral part into the problems of Lake Carmi.

Phosphorus is one of the most important nutrients and minerals on the planet. Almost every life-form relies on phosphorus in one of its many forms to perform essential life functions. Phosphorus, just like oil, is a resource with a limited supply on the planet. Around 2010, it was believed that the remaining supply of phosphorus on the planet was approximately 80 years, again similar to oil. The USGS has performed new studies that conclude that the global phosphorus reserves have a supply for 280 years at current utilization rates. This is a good long time, but still a limitation to be aware of. It's important to understand the value of phosphorus in our everyday lives. We can live without oil. We cannot live without phosphorus.

Historic levels of phosphorus in Lake Carmi are about 30 micrograms per liter. if drinking water contains this amount of phosphorus, it is safe to drink. This amount of phosphorus in your drinking water is beneficial to your health. There is no maximum contaminant level for phosphorus in drinking water. However, in the aquatic environments this concentration promotes algae growth. To gain a perspective on this concentration relative to non-impacted waters, Lake Carmi phosphorus concentrations are approximately three times the level of phosphorus in a similar lake that is not impacted by agricultural activities and septic system discharges. Your goal should be to restore Lake Carmi to a phosphorus concentration of 10 milligrams per liter.

The newspaper article that I read about H.730 indicated that 85% of the phosphorus contamination coming into Lake Carmi comes from agricultural sources. This is consistent with both anecdotal claims that 75% of the Lake Champlain phosphorus load is from agricultural sources and the 2008 EPA TMDL report for Lake Carmi, which indicates 85% comes from agricultural sources. These values are accurate.

200 years ago there was not a problem with algae blooms in Lake Carmi. Why has this changed? One reason is that dairy agricultural practices that have shifted from grass-based to corn-based feed. This is the on the ground change that is driving the water quality problems in Lake Carmi. Corn production has doubled in the last 20 years while hay production has dropped twenty percent nationwide. Locally, we have seen a similar increase in corn production and a larger decrease in hay production. This change is significant to phosphorus loading on the lake because run off from corn fields contains 10 times the amount of phosphorus as run off from hay fields. If the practice of growing corn within the Lake Carmi watershed was converted to growing hay only, it would reduce the phosphorus discharge from the same land by 90 percent.

This is a simple solution from a mass balance standpoint. It is a no brainer as far as being a real and fast solution to the water quality problems in Lake Carmi. There is one complication and it is huge. How can can this be implemented without harming the farmers that rely on corn to compete in today's race-to-the-bottom cheap milk industry? The committee assembled here can take steps that will both make the farmer whole and restore Lake Carmi.

Corn yields 5 to 10 times the amount of silage per acre than the equivalent acreage of hay. So with this change from corn to hay, farmers will lose 80 to 90% of their feed production. However, hay has one and a half to three times the amount of protein per unit weight. So, the net loss would only be 25 to 30% production. The cost of hay production is less than the cost of corn production. The farmer ends up with a deficit in the amount of feed required to produce milk. Your role is to fill this deficit by getting feed to the farmer at no added cost to his production. Simply stated, you must give the farmer free feed for his lost production in the conversion from corn to hay. This action alone would reduce phosphorus loads to Lake Carmi by approximately 40%, which is the EPA TMDL target. You can do this.

Have you ever had grass-fed beef or grass-fed milk? Did you taste the difference compared to corn and soy fed products? My answers to both questions are yes.

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Now about wastewater disposal around Lake Carmi and nearby. Approximately 5% of the phosphorus load to Lake Carmi comes from subsurface wastewater disposal systems. This is the only method of wastewater disposal in the Lake Carmi watershed. The amount of phosphorus that reaches the lake from an individual system is directly related to its distance from the lake. This is due to the physical dispersion of the effluent from the septic system into the groundwater table, horizontally and vertically. A simple way of looking at this: A house that is 10 feet away from the lake disperses 10 feet horizontally before it reaches the lake. Yet effluent from a house that's a mile away is dispersed horizontally a mile. Effluent also disperses vertically, but to a much lesser extent. Dispersion, especially vertical dispersion, causes dilution of effluent and results in the portions of the effluent physical bypassing of the lake.

Nitrogen is another important nutrient contained in wastewater that contributes to algae blooms. Nitrogen exists in wastewater in many forms. Ammonia is one nitrogen form that exists in raw wastewater and is reduced by treatment. Ammonia is transformed to nitrate in an aerobic process known as nitrification. Nitrification occurs in subsurface disposal systems after the effluent leaves the septic tank. The process occurs in the soil environment in the presence of aerobic bacteria. The degree of nitrification increases with time. The greater the amount of time that aerobic bacteria are allowed to nitrify the wastewater the less ammonia there is when it reaches the ground water. The septic systems at Lake Carmi are close to and in some cases within the water table. This allows for very little time for nitrification. As a result, ammonia reaches the water table. When there is a short distance between the water table and the lake, the ammonia reaches the lake directly. This is significant because ammonia is the preferred source of nitrogen for cyanobacteria (blue green algae). Although the phosphorus from septic systems is not a major contributor of algae blooms in the lake, the ammonia contribution has a significant role. And, just as phosphorus and ammonia reach the lake quickly, as does other pollutants are concerned such as E. coli and other pollutants. All of these pollutants compromise water quality in the lake. It is important to remove the septic systems from the lakeshore. You can do this, too.

The Agency of Natural Resources has programs in place to assist communities in developing infrastructure, such as that required to provide a sewer system around Lake Carmi. These programs provide 0% financing for these projects. Federal grants of approximately 50% and low interest loans are available, too. To ensure implementation of this important project it would be beneficial at least, if not essential, for the State to insure assure that the prospective users of the system are protected from excessive user fees and costs. This is something that you can do too.

The tools are in place to make this happen. The project is more likely to succeed with assurances from the State that the users of the wastewater system will not be harmed by excessive fees. I have started planning for wastewater treatment facilities in January and had them operational for Thanksgiving of the same year. This is a solution that although it may not be implemented in 2018 it could certainly be operational by late 2019. It would take a team effort of State, community and federal partners that would be enhanced with legislative initiatives. You can do this.

It's all pretty simple. End the growing of corn in the watershed. Make farmers whole financially as a result of changing from corn to hay. Build a wastewater system to serve the homes immediately around the lake at least, but consider expanding to nearby areas, where it makes sense to do so. Assure the community that their user costs will not be excessive. Provide extra State funding and support to make the project affordable and timely. You can do all this.

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Federal dairy and tax policies drive the use of corn feed. Consider taking legal action against the federal government for the damages to the Lake Carmi community that have resulted from these policies.

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For what it’s worth: greenhouse gas emissions from corn silage production are three times greater perennial legume production (i.e. alfalfa and clover), the difference is greater in reference to hay production.

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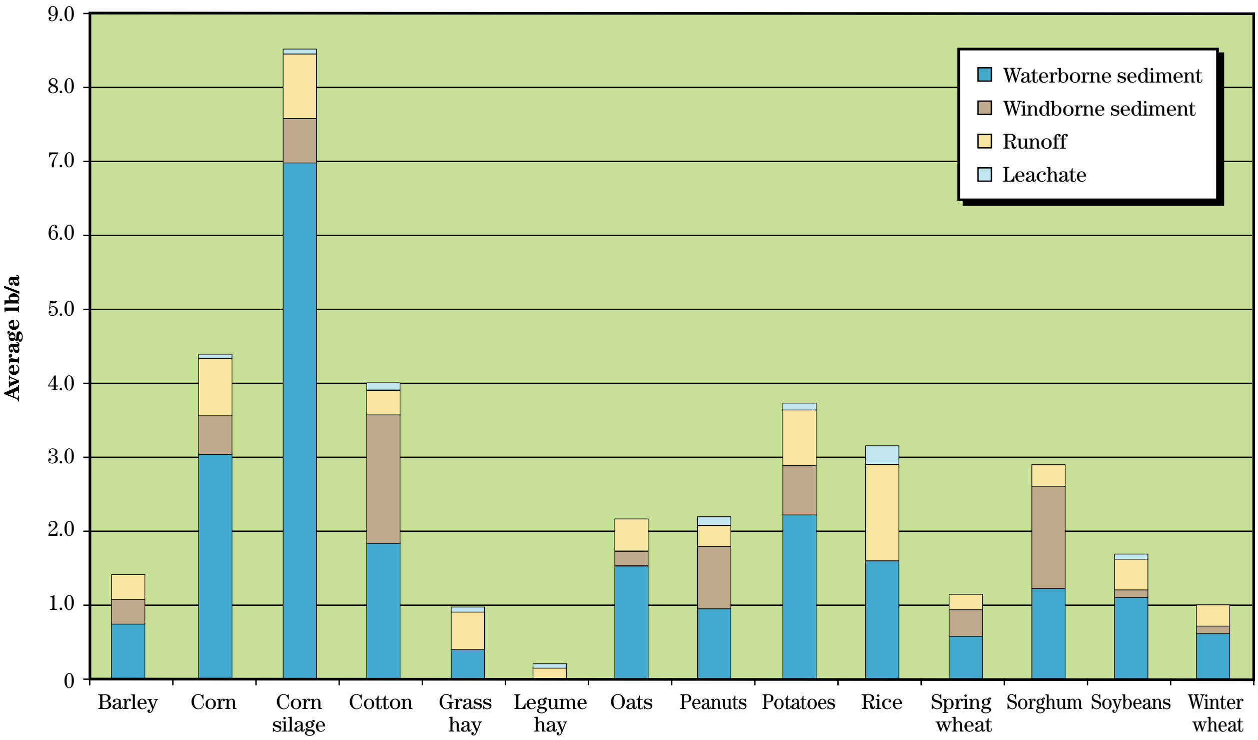
References:

1. Model Simulation of Soil Loss, Nutrient Loss, and Change is Soil Carbon Associated with Crop Production, USGS, June 2006.
2. USEPA Onsite Wastewater Treatment Systems Manual.
3. Distribution of Specific Conductance, Boron and Phosphorus in a Sewage Contaminated Aquifer Near Ashumet Pond, MA, USGS, 1996.
4. Energy Use and Greenhouse Gas Emissions from Crop Production Using the Farm Energy Analysis Tool, American Institute of Biological Sciences, Bioscience, 2013.

Figure 30 Average annual per-acre estimates of phosphorus loss–by crop



Note: Phosphorus loss is reported here as elemental phosphorus.

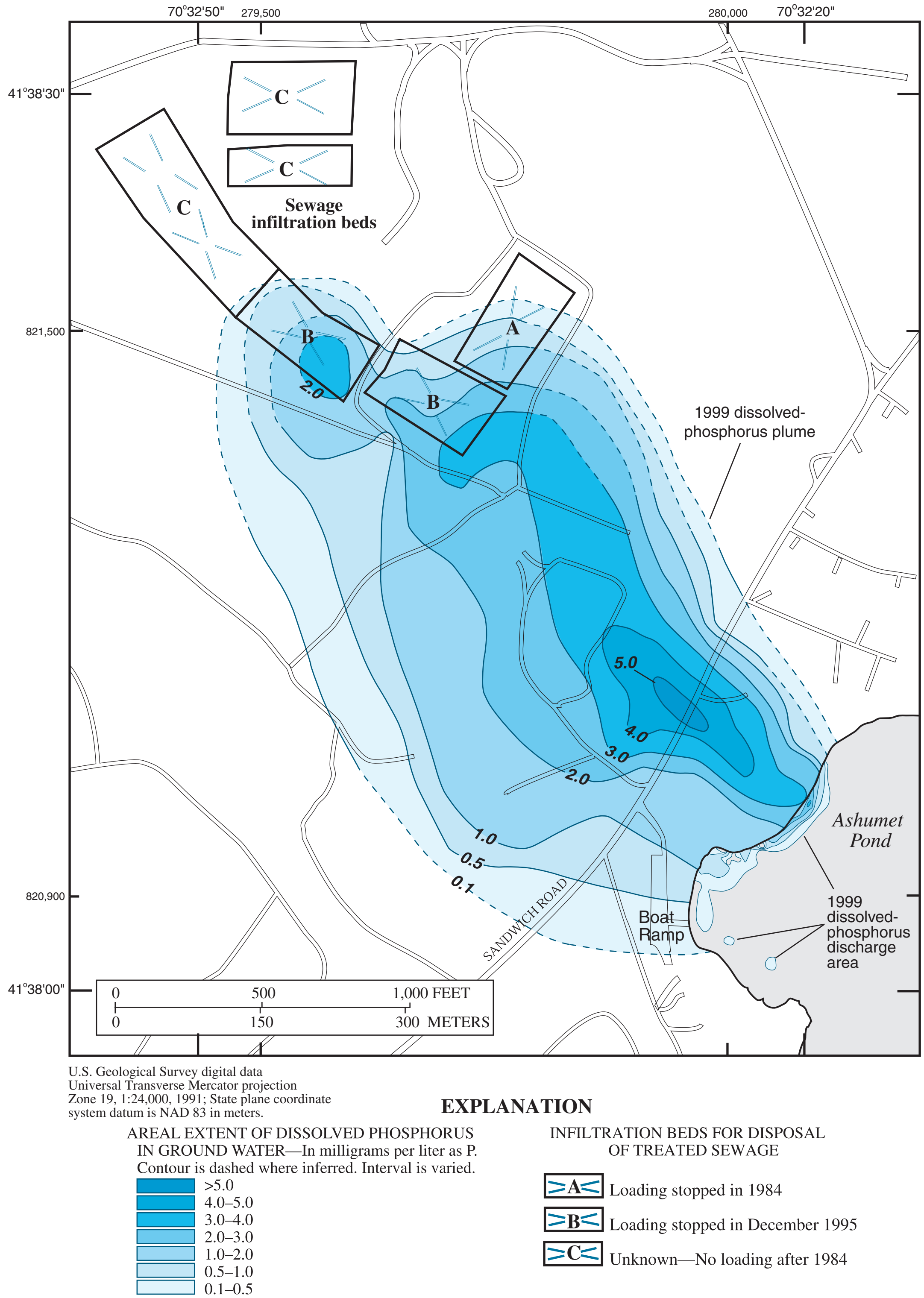


Figure 10. Areal distribution of dissolved phosphorus in ground water near Ashumet Pond, Massachusetts, May–October 1999.

been criticized (see Jones 1989), labor, in itself, is a useful metric for comparing crops and cropping systems and is a critical factor in farm management decisions independent of the energy or GHG implications.

Greenhouse gas emissions. Across all crops, the largest contributor to the total amount of GHG emissions was N_2O, which ranged from 157 kg CO_2e per ha per year (17% of the total) in soybeans to 1539 kg CO_2e per ha per year (45% of total) in corn silage. N production and on-farm fuel followed N_2O emissions, representing 16% and 14%, respectively, across all crops. When it was averaged across crops, N_2O emissions accounted for the greatest GHG contribution, with 44% of the total, followed by N production (16%), on-farm fuel (14%), lime (12%), K_2O (4%), P_2O_5 (3%), transportation of inputs (3%), seed (2%), herbicide (1%), drying (1%), and insecticide (0.6%).

GHG emissions from crop inputs ranged from 847 to 3283 kg CO_2e per ha per year, and soybeans had the lowest input, followed by red clover, alfalfa, hybrid poplar, barley grain, wheat grain, rye silage, willow, wheat silage, switchgrass, canola, sugar beets, miscanthus, corn grain, and corn silage (figure 4). N fertilizer had a large impact on GHG emissions, because a small portion of the N that is applied to soil is converted to N_2O, which has a high GWP.

Greenhouse gas intensity. Canola and the crops grown for grain (barley, corn, and wheat) were estimated to have the greatest GHG intensity (figure 4). Although soybeans did not require N fertilizer, the relatively low yield of this crop increased its intensity. For the other crops, high N requirements and the associated soil N_2O emissions contributed to the higher GHG intensity. The higher-yield crops tended to have lower GHG intensities. Miscanthus had the lowest GHG intensity (0.006 kg CO_2e per MJ_{output}), which was mainly a function of its high yield potential. The two perennial legume forage crops, alfalfa and red clover, had relatively low GHG intensities, which was a function of their relatively high yields and low input requirements, whereas silage crops with comparable yields but greater input requirements had higher GHG intensities. Although corn silage production was estimated to result in the greatest GHG emissions across all crops, the high energy output from corn silage caused its GHG intensity to be relatively low.

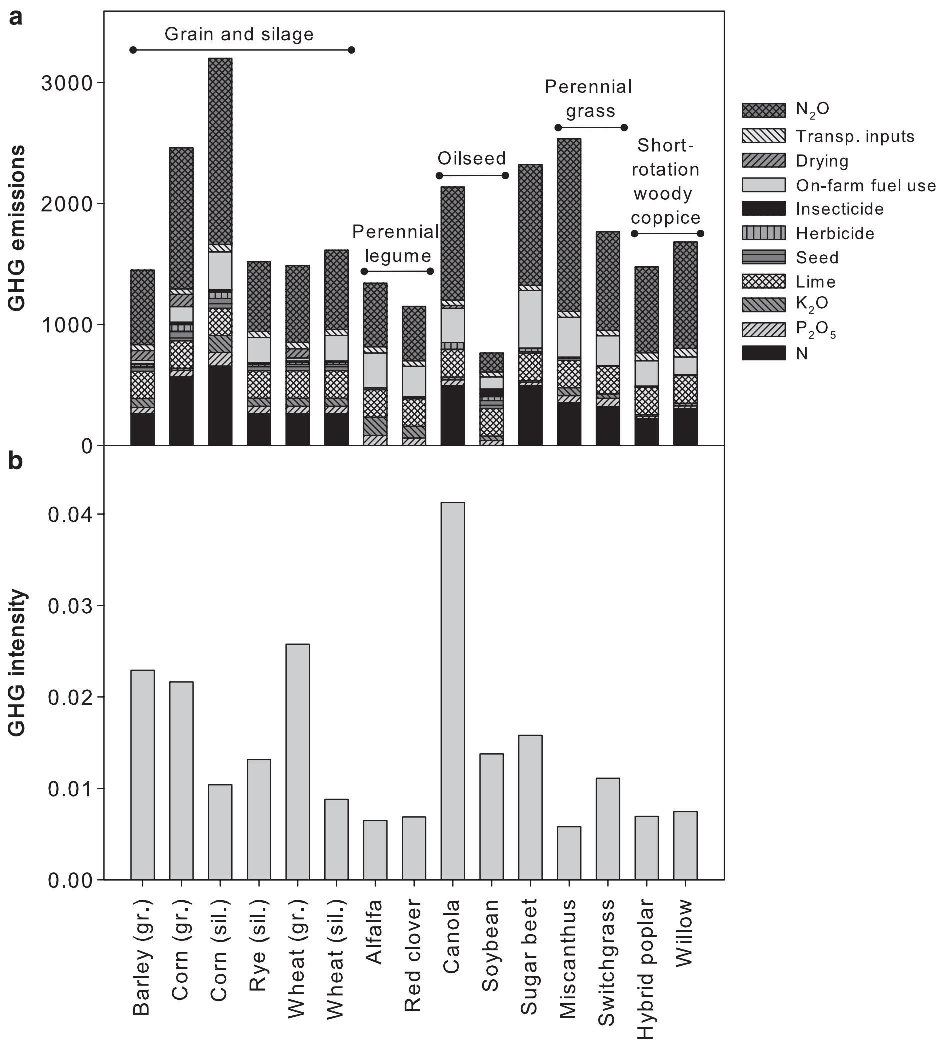


Figure 4. (a) Greenhouse gas (GHG) emissions (in kilograms of carbon dioxide equivalents per hectare per year) associated with each crop. (b) GHG intensity calculated as the ratio of GHG emissions to the output of energy for each crop (in kilograms of carbon dioxide equivalents per megajoule of biomass energy output). Abbreviations: gr., grain; K_2O, potassium oxide; N, the amount of carbon dioxide emissions necessary to produce and transport nitrogen fertilizer; N_2O, nitrous oxide emissions from nitrification and denitrification occurring on and off the farm; P_2O_5, phosphorus pentoxide; sil., silage; Transp., transportation.

Sustainable management practices

In addition to the choice of crop, decisions about management practices can have a large impact on energy use and GHG emissions. To illustrate the effects of integrating sustainable management practices and the flexibility of FEAT, we compared three different corn production scenarios: tillage farming and synthetic fertilizer (the standard scenario), no-till farming with synthetic fertilizer, and no-till farming with a legume cover crop. The details of the management of and inputs to these scenarios were