Tile Drains
A Comparison of Subsurface and Surface Drainage in Vermont

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Problem Statement

Currently, the scientific community and regulatory bodies of Vermont do not know much about how tile drains impact surface waters. This is largely due to the complexity of comparing surface runoff from fields without tile drains to the discharge of those fields with tile drains. While comparative studies have been conducted elsewhere, little data has been collected in Vermont. It is important to understand that we cannot assume that results of these studies are directly applicable to Vermont. Variation in soils, topography, climate, and agricultural practices can significantly alter the surface runoff and/or tile drainage.

Justification

The aim of this project is to assess whether or not there is a difference between subsurface (tile drains) and surface drainage from agricultural fields into surrounding bodies of water. This project contributes to the larger project of tile drains because there is not a lot of information out there in comparing these two types of drainage systems. The information gathered from this project could be vital in determining “best management practices” in regards to minimizing detrimental impacts on surface waters. With this new information something could be implemented to address the issue. It is important to know this information so that some sort of regulation could be set up to help with the problem and that also the information gets out there. With the information out there, and available to the public, farmers with these drainage systems as well as the state are better prepared to address the issue. The farmers could benefit by finding out one method is better than the other, which could save them investment capital in a drainage system. The state could also benefit in finding out that one drainage system is better than the other so that they could then publicize and inform farmers of this information. Also with that knowledge, the state could focus their attention towards the drainage system causing the most harm and find means to combat that issue.

Literature Review


This article will be helpful in achieving the project goal because it discusses the effects that a clay soil has on drained fields with respect to nitrogen and phosphorous leaching. The study takes place in Sweden, but because the soil is clay and there is a snow melt factor, it would seem relatable to Vermont. As stated earlier it is difficult to find information on Vermont out there so it will be helpful to find studies set in similar conditions.

This article discusses and compares natural and subsurface drainage, with respect to phosphorus runoff. It takes place in southern Quebec and is dealing with the Pike watershed, which Missisquoi Bay happens to be part of. The soils in this study are also very similar to Vermont with clay and sandy loams. Because of this, the data from this study is very relatable to conditions in Vermont.


This article describes a situation in Finland that originally had an old subsurface drainage system in a clay soil. This experiment then wanted to see what effect an improved drainage system would have on erosion as well as nitrogen and phosphorous leaching. Again the soil is similar to Vermont and the results from this study could give some clues on what the state and farmers could do to improve their drainage systems.


This study was done in southwestern Ontario in a sandy loam soil. What the researchers wanted to see in this study is if there was a difference between a classic free tile drainage system and a controlled drainage system in regards to productivity of corn and nitrate leaching. In general it was found that the controlled system was better in all aspects. This information would be helpful to farmers as well as the state.


This is another study done in southern Sweden that deals with the effects controlled drainage has on nitrogen and phosphorus runoff and crop production in an sandy loam soil. It shows that controlled drainage decreases the amount of nitrogen and phosphorus leaching into water and also an increase in crop production. Again, this information would be helpful to farmers as well as the state.

This is another relevant study conducted in Scandinavia that focuses on phosphorus loss by tile drains. This is especially applicable to our research as clay heavy soils that are prone to cracking is prevalent in Vermont. Cracked soils allow concentrated nutrients to flow directly to the tile drains instead of properly spreading throughout the soils.

B. Ball Coelho, R. Murray, D. Lapen, E. Topp, A. Bruin, Phosphorus and sediment loading to surface waters from liquid swine manure application under different drainage and tillage practices, Agricultural Water Management, Volume 104, February 2012, Pages 51-61, ISSN 0378-3774, http://dx.doi.org/10.1016/j.agwat.2011.10.020.
(http://www.sciencedirect.com/science/article/pii/S0378377411002927)

This study focuses on how the application of liquid manure affects phosphorus and sediment loading of surface waters. As we are primarily comparing the different effects on surface waters between drained and undrained agriculture fields, this study provides unique insight into side by side comparative analysis.

Probable Contribution/Deliverables

● An extensive report will be delivered to the Vermont Department of Environmental Conservation and will containing the following:
  ○ Compiled data and information about the effectiveness of tile drains
  ○ Data comparing surface and subsurface drainage for Vermont soils
  ○ Justifications for or against the usage of tile drains on agricultural fields
  ○ Possible alternatives to improve drainage, specifically controlled drainage

Proposed Effort

Due to the lack of information provided on tile drains in Vermont and New England, the first step in this project will entail an extensive amount of research. The literature reviews will provide us with information and data on tile drains in other regions of the world, and thus allow us to move forth with the project. We aim to use the collected research from other regions in order to apply it to the soils and climate of Vermont. The overall goal will be to provide a substantial analysis and comparison of surface versus subsurface drainage. This report is intended to provide the Vermont DEC with enough information about tile drains to accurately make decisions about regulations and how to appropriately move forth with the issue of tile drains in Vermont.

To provide more background information, as well as a potential opportunity for further research, we plan to meet with Joshua Faulkner (Farming and Climate Change Coordinator, UVM) and Eric Young (Adjunct Faculty Lecturer, Plant and Soil Science, UVM) both of whom have done extensive research on tile drainage. We hope that their knowledge could provide us with not only more information and direction about the debate of tile drains in Vermont, but also the possibility for further exploration with projects regarding the issue. We also intend to contact the William H. Miner Agricultural Research Institute of New York in order to inquire about research being done on tile drains in New England. Access to that data could greatly impact the accuracy of our assessment and comparison with regards to the specific soil types and climate in the region.
Effort Assignment

We aim to distribute work on the project evenly and maintain a collaborative approach among group members throughout the entire process. All members will partake in the research and literature review in order to provide substantial background information and assessment.

Tasks:

- Research
  - water quality from subsurface tile drains
  - water quality from surface runoff
  - alternative agricultural drainage options
- Communication
  - Joshua Faulkner
  - Eric Young
  - William H. Miner Agricultural Research Institute
  - Marli Rupe
- Data Compilation
  - drainage of soils in Vermont
  - Surface versus subsurface drainage quality
- Assessment
  - analysis of water quality from tile drains versus surface runoff
  - suggestions for best practices
  - suggestions for alternative options (controlled drainage)
- Final Report