**PROJECT TITLE**: **Understanding and managing persistent chloride pollution in freshwaters**

**I. PROJECT STATEMENT**

Ponds and wetlands near roads are most impacted by road salt contamination but least well understood due to lack of information. This project will *1)* **provide understanding of chloride persistence in road side waterbodies**, leveraging collaboration among local water management agencies and participating high schools, and use that information to *2)* **design new storm water BMP systems and retrofit old ones in ways that will minimize chloride impacts** on downstream lakes and rivers, and *3)* **provide opportunities for science education and public outreach** through sharing of low cost monitoring tools and workshops to raise awareness of road salt impacts on water quality.

Minnesota's lakes and rivers are experiencing rising levels of chloride contamination primarily due to winter road salt applications. Storm water ponds and wetlands provide essential services by controlling flooding and removing pollutants from storm water before it flows downstream to lakes and rivers. Although more than 40,000 road affected ponds and wetlands have been identified by the state, very little is known about how chloride affects these shallow waters. Our preliminary studies show that chloride levels are far greater in these waterbodies than nearby lakes and streams. In fact, springtime chloride levels are often similar to seawater, and extremely high levels can persist well into the summer at levels 10 to 100 times above the state's chloride standard – suggesting that current pond designs maximize impacts of road salt on freshwater ecosystems during summer, instead of protecting them from pollution. Currently, we do not know how widespread these contamination patterns are, nor how to design and manage these water systems to minimize chloride levels during the summer when they have the strongest biological impacts on native species.

Understanding of the persistence and impacts of chloride on storm water systems represents a high priority in Minnesota since many thousands of ponds and wetlands are in need of maintenance (such as removal of accumulated sediment or repair of inlet/outlet structures). Ponds could be redesigned to minimize chloride impacts - if sufficient knowledge existed to do so. This collaborative project will support a major expansion of data collection and enable interdisciplinary education of students and the public, towards building an understanding of how chloride accumulates and persists into summer in ponds and wetlands. These efforts will aid the development of ways to implement ponds into the landscape to achieve the best water quality outcomes for the limited funds available to concurrently address the dual problem of overdue maintenance of storm water systems and chloride contamination management. Partnerships with local schools and agencies will create environmental educational opportunities and enhance collaboration among scientists.

**II. PROJECT ACTIVITIES AND OUTCOMES**

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| **Activity 1 Title:** *Collaboration, technology, and outreach to understand chloride persistence in surface waters*  **Description:** We currently lack information to determine how chloride moves through the 40,000+ storm water ponds and wetlands statewide that are affected by road runoff. We will develop a low cost sensor system and make the design widely available, cost effective, adaptable and easy to use for students, educators, and watershed management agencies. We will use the system in collaborative research with several schools and agencies to understand chloride persistence in shallow waters (at least 40 sites). These collaborations will expand the scale of data collection, promote education and outreach through workshops, and establish a model for future information sharing between researchers, practitioners, educators, and the public. Data collected will provide understanding of the conditions under which chloride persists in surface water bodies in order to identify waters most likely to be impacted by chloride during the summer biologically active period, and to inform development of pond designs to minimize impacts, described below in Activity 2.  **ENRTF BUDGET: $182,468** |  |

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| **Outcome** | **Completion Date** |
| *1. Low cost design and manual for chloride sensing in surface waters for research and education* | *Dec 2020* |
| *2. Collaborative network for monitoring chloride in 40 shallow water bodies* | *Mar 2021* |
| *3. Workshops for teachers, students and professionals on low cost monitoring systems* | *Dec 2022* |
| *4. Data to predict chloride persistence in waterbodies near roads* | *Dec 2022* |

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| **Activity 2 Title:** *Pond design to minimize summertime impacts of chloride on freshwater ecosystems*  **Description:** If winter applied road salt is retained in ponds and wetlands and released downstream in the summer, as our preliminary data show, its negative impacts on aquatic life will be maximized, both within the ponds and in downstream lakes and rivers. We will use data collected in Activity 1 with water quality modeling to determine best pond and wetland designs, as well as maintenance or retrofit methods that minimize chloride impacts on aquatic life and water quality in watersheds. Results will be made available via a final report, and methods and tools developed will be built to integrate with existing water quality models used by practitioners; these products will be made publicly available.  **ENRTF BUDGET: $116,532** |  |

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| **Outcome** | **Completion Date** |
| *1. Model of chloride persistence in shallow water bodies* | *July 2022* |
| *2. Optimal designs to minimize chloride levels in ponds and wetlands during summer* | *Jan 2023* |
| *3. Dissemination of results via web tool, and publications* | *June 2023* |

**III. PROJECT PARTNERS AND COLLABORATORS:**

*Partners receiving ENRTF funding*

* Dr. Jacques Finlay, PI, Professor, Department of Ecology, Evolution, and Behavior, UMN-Twin Cities
* Dr. Ben Janke, co PI, Saint Anthony Falls Lab, UMN-Twin Cities
* Dr. Bill Herb, co Pi, Saint Anthony Falls Lab, UMN-Twin Cities
* Dr. Pete Marchetto, co PI, Assistant Professor, Bioproducts and Biosystems Engineering, UMN-Twin Cities

*Collaborators not receiving ENRTF funding*

* Dr. John Gulliver, Professor, Department of Civil, Environmental and Geo-Engineering, UMN-Twin Cities
* Mike Trojan and Brooke Asleson, Minnesota Pollution Control Agency

**IV. LONG-TERM IMPLEMENTATION AND FUNDING:**

Road salt accumulating in surface waters has direct and indirect harmful effects on aquatic life, and may be detrimental to the function of many ponds and wetlands being used for storm water management. Development of alternate deicers will help reduce chloride impacts but use of chloride will undoubtedly continue for driving safety. Current storm water systems are unknowingly constructed in ways that maximize effects of winter road salt during the summer. Knowledge gained in this project can be used to design new storm water BMP systems and retrofit old ones over the next decades in ways that will minimize chloride impacts. The tools and approaches developed in this project will provide the basis for expansion of collaborative monitoring, and engagement of students in multiple areas: engineering, technology, physics, environment science, data collection and analysis. The project will commence July 1, 2020 and conclude June 30, 2023.