



MINIMIZING THE ENVIRONMENTAL IMPACTS OF DEICING

World Road Association (PIARC)

XIII International Winter Road Congress,
Québec City

February 8 to 11, 2010

Morton Satin

Salt Institute, Alexandria, VA



MINIMIZING THE ENVIRONMENTAL IMPACTS OF DEICING

Research Supported

- **Assessment of Best Management Practices**
(Prof. Michael Stone, University of Waterloo)
- **Novel Modeling of Stormwater Management**
(Prof. Bahram Gharagahi, Guelph University)



MINIMIZING THE ENVIRONMENTAL IMPACTS OF DEICING

Assessment of Best Management Practices

(Prof. Michael Stone, University of Waterloo)



Assessment of Best Management Practices Project Rationale and Context

Code of Practice for the Environmental Management of Road Salt - 2004

**–better manage road salts to minimize
environmental impacts of chlorides while
maintaining road safety.**



Project Rationale and Context

TAC Syntheses of Best Practices for Road Salt Management

- 1. Salt Management Plans**
- 2. Training**
- 3. Road and Bridge Design**
- 4. Drainage and Stormwater Management**
- 5. Pavements and Salt Management**
- 6. Vegetation Management**
- 7. Design and Operation of Road Maintenance Yards**
- 8. Snow Storage and Disposal**
- 9. Winter Maintenance Equipment and Technologies**

<http://www.tac-atc.ca/English/information-services/readingroom.cfm>



Project Rationale and Context

Assumption:

Voluntary, state-of-the-art salt management practices when applied as per Code recommendations will benefit the environment and road authorities by:

- reducing chloride levels**
- improving water & soil conditions**
- increasing operational efficiency**
- improving roadway safety**
- providing cost savings**



Knowledge Gaps

- No systematic analysis of the environmental benefits of Code recommendations
- Rigorous data required for Environment Canada formal review of Code of Practice in 2010



Filling the Gaps

Project designed to assess the efficacy of current voluntary road salt management practices for reducing environmental chloride.



Specific Objectives

- 1. Review the status of salt management practices in the Regional Municipality of Waterloo, ON.**
- 2. Collect, analyze and report historical road salt application rates in Regional Municipality of Waterloo and compare this information with data from other municipalities not employing best practices.**



Anticipated Project Outcomes

A rigorous assessment of current voluntary road salt management programs designed to reduce chloride inputs from winter road maintenance practices.

Workshop/International Conference: provide a forum for researchers and stakeholders to discuss the successes and challenges of winter road maintenance practices and to demonstrate the utility of recent innovations/practices to provide guidance to improve policy documents and practice.



Anticipated Project Outcomes

Recommendations for improving policy and practice related to mitigating adverse environmental impacts associated with winter road maintenance practices

Provide data for Environment Canada Code of Practice Review



Research Team

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Dr. J. Marsalek Environment Canada

Dr. D. Rudolph Earth Science, U. Waterloo

Dr. J. Price Geography, U. Waterloo

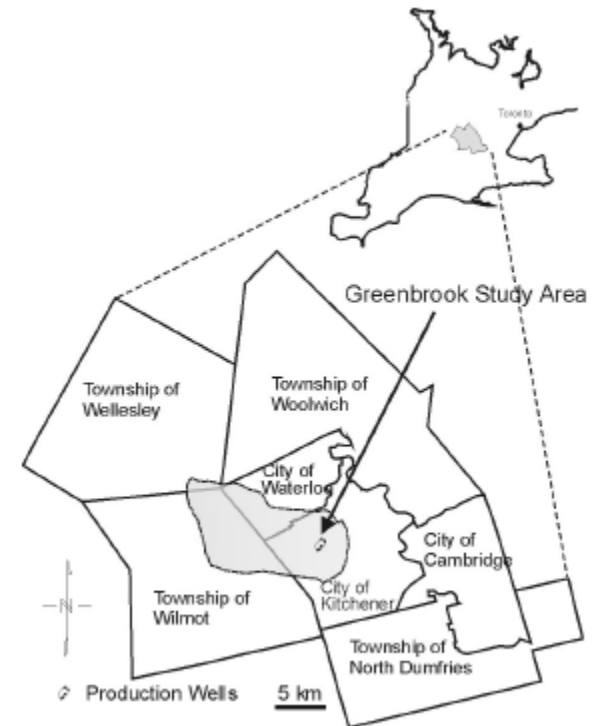
Dr. S. Tighe Environmental Engineering, U. Waterloo

Dr. M. Emelko Environmental Engineering, U. Waterloo

Dr. D. Saini Environment & Resource Studies, U. Waterloo

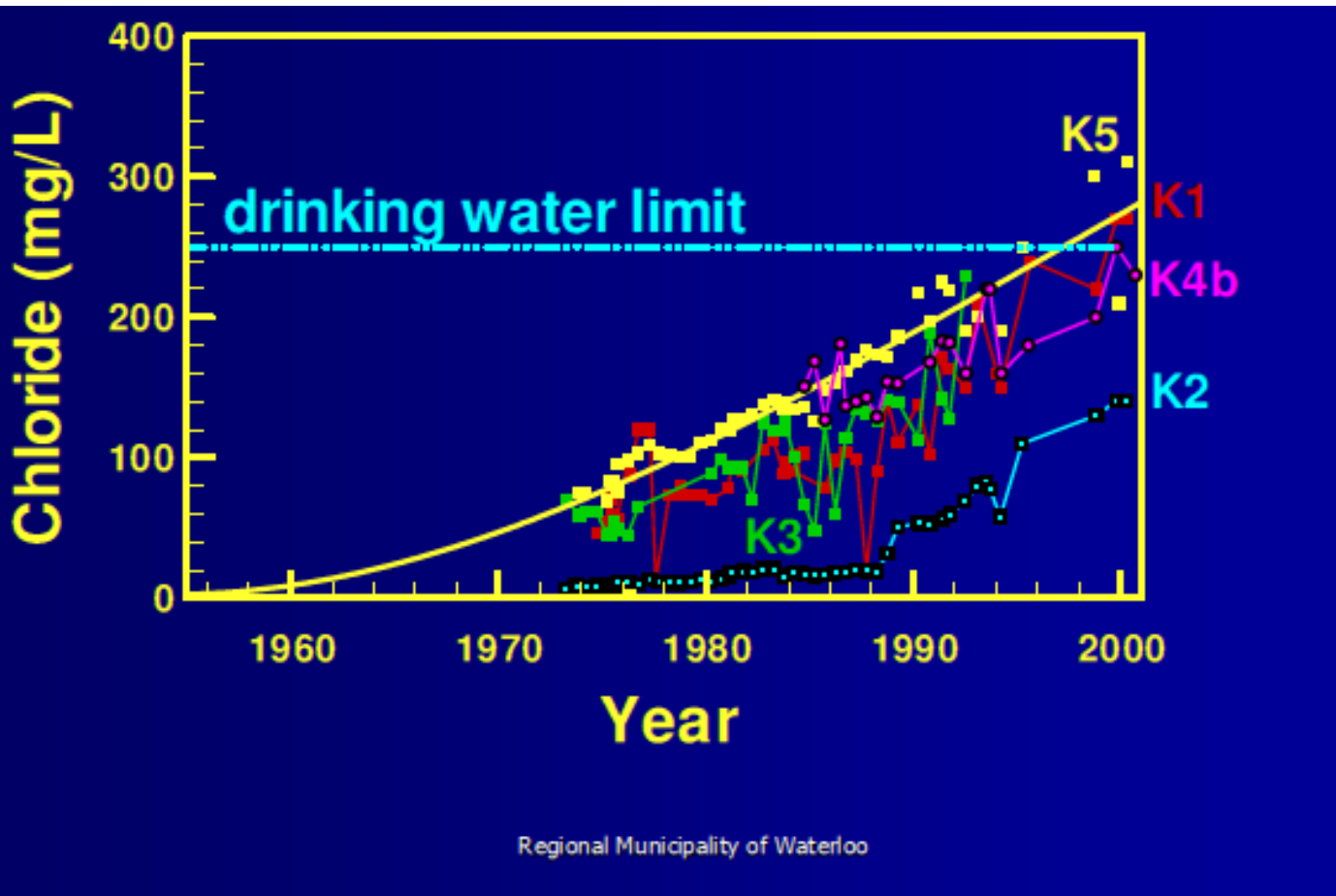
Regional Municipality of Waterloo

- RMOW population: ~500,000
- 20 major well fields, 9 of which are situated within urban areas.
- 3 key well fields show increasing chloride trends.

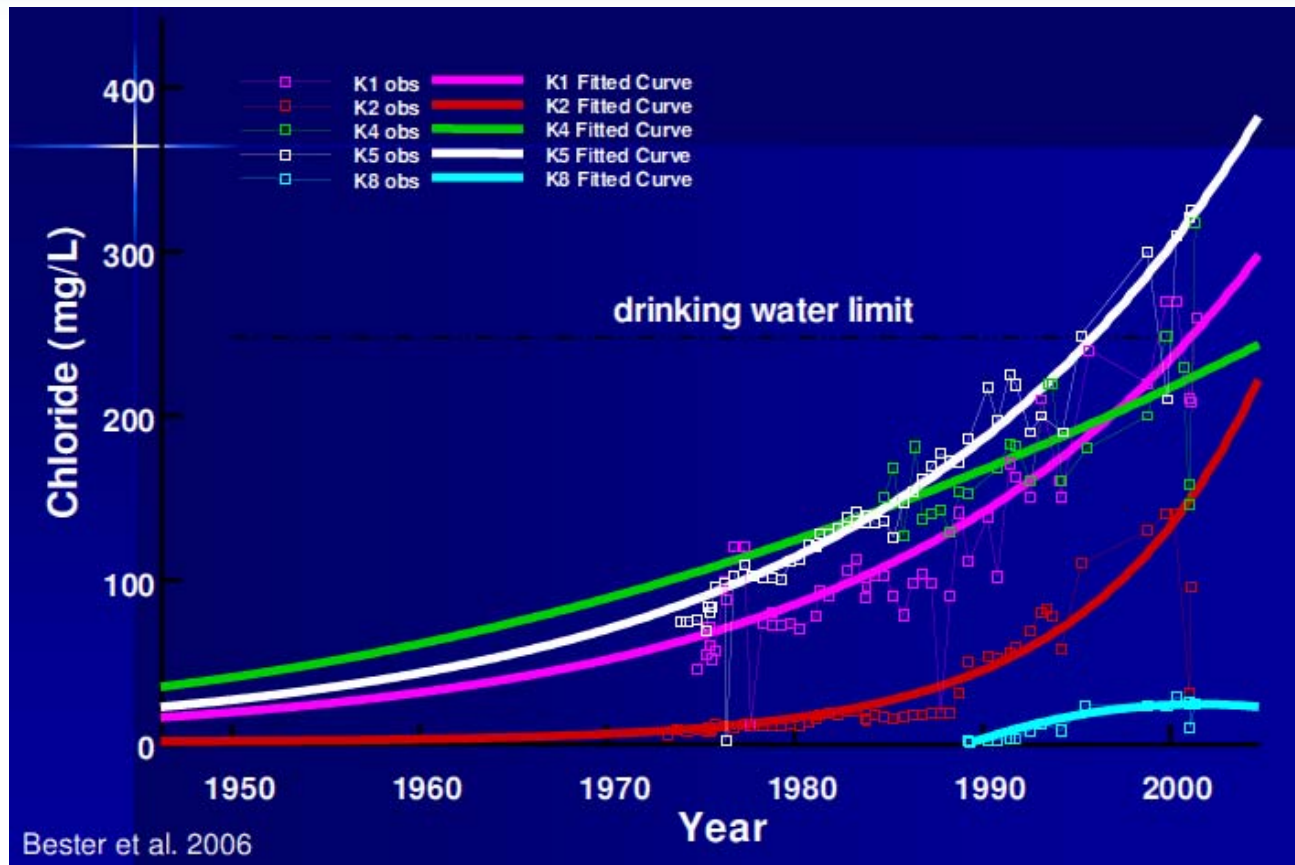




Chloride Concentration at the Greenbrook Well Field

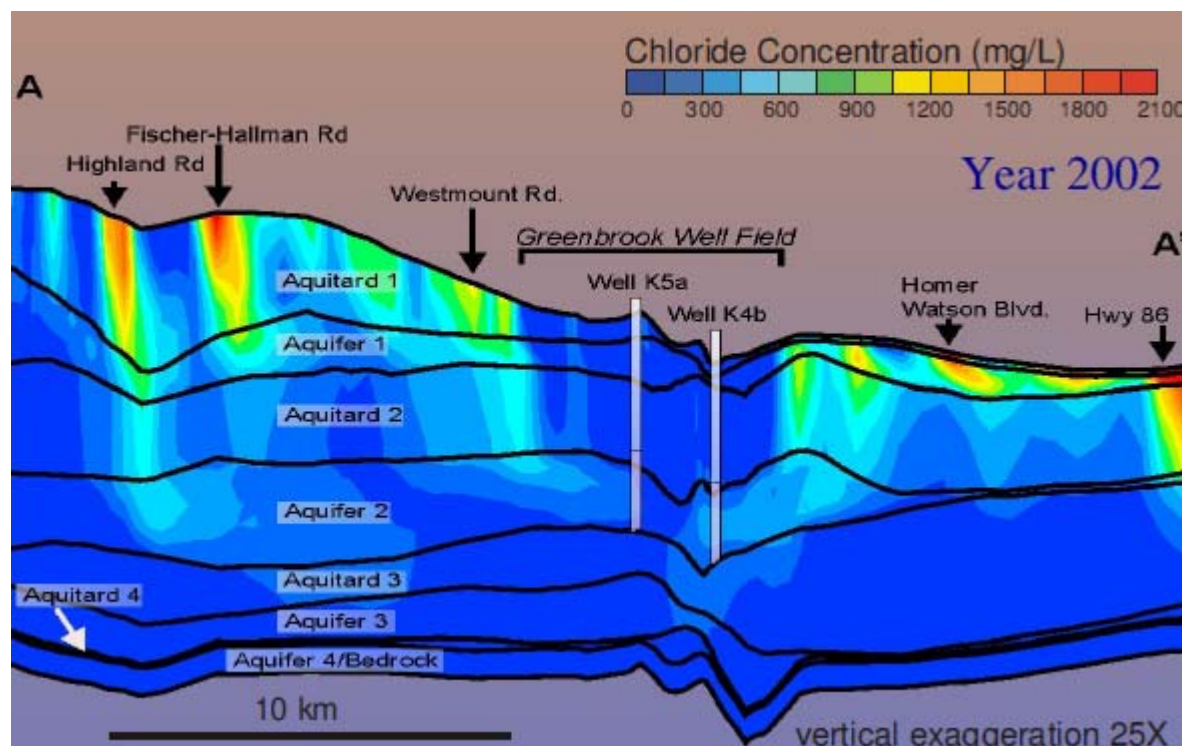


Calibration – Observed Data



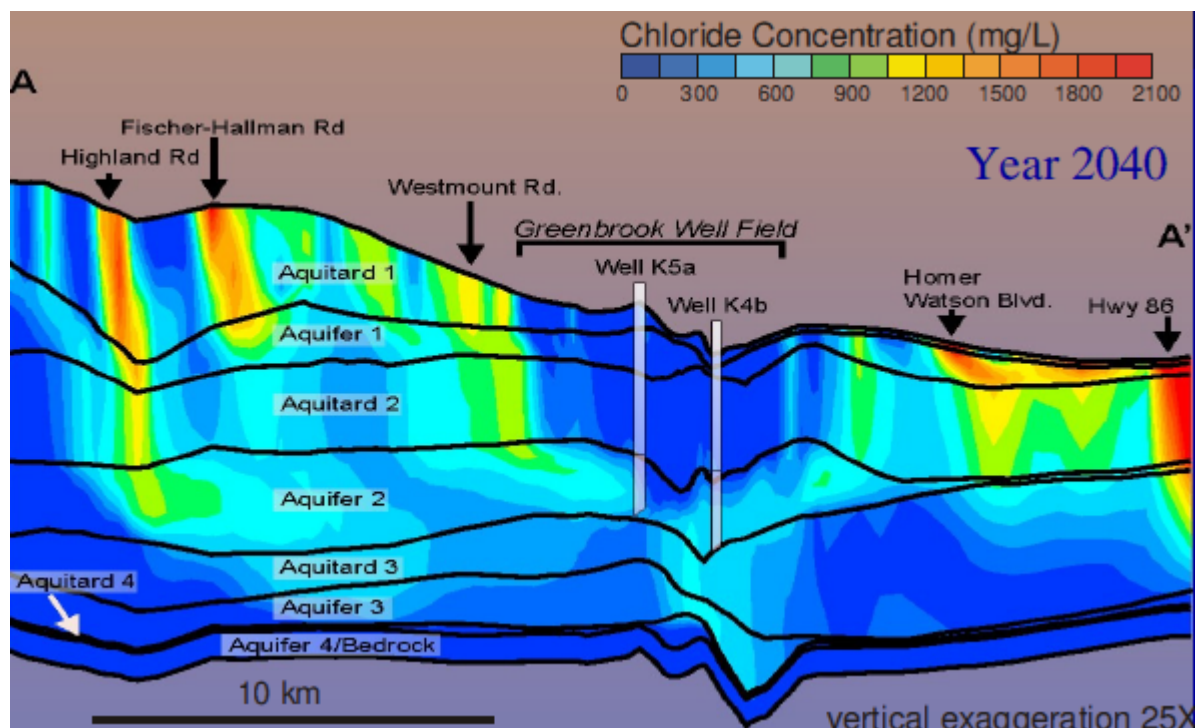
* Bester, M. L., E. O. Frind, J. W. Molson, and D. L. Rudolph. (2006). "Numerical Investigation of Road Salt Impact on an Urban Well Field". *Groundwater* 44:165 - 175.

Cross section 'A--A A' for 2002*



*Bester, M. L., E. O. Frind, J. W. Molson, and D. L. Rudolph. (2006). "Numerical Investigation of Road Salt Impact on an Urban Well Field". *Groundwater* 44:165 - 175.

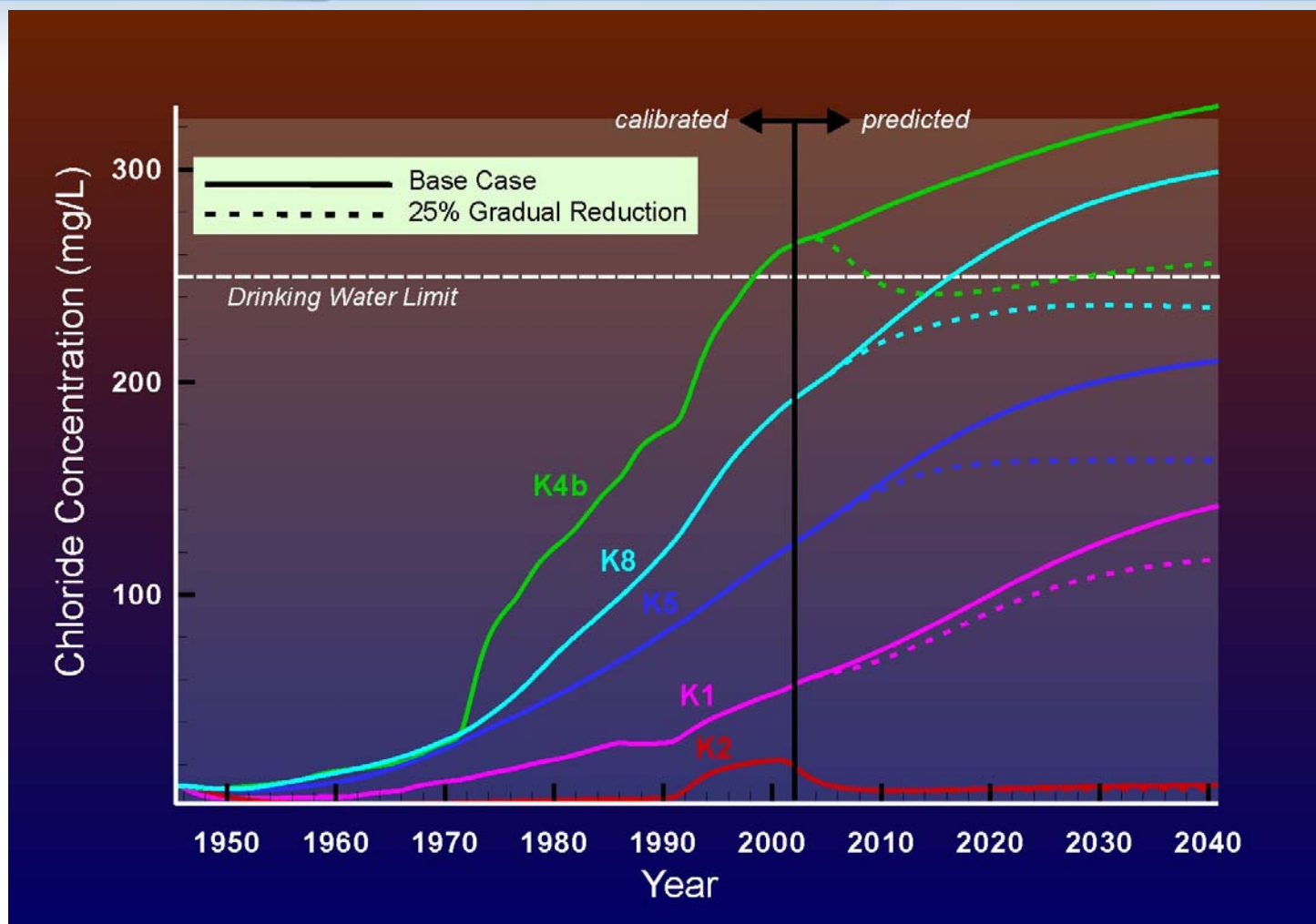
Cross section 'A—A' for 2040*



*Bester, M. L., E. O. Frind, J. W. Molson, and D. L. Rudolph. (2006). "Numerical Investigation of Road Salt Impact on an Urban Well Field". *Groundwater* 44:165 - 175.



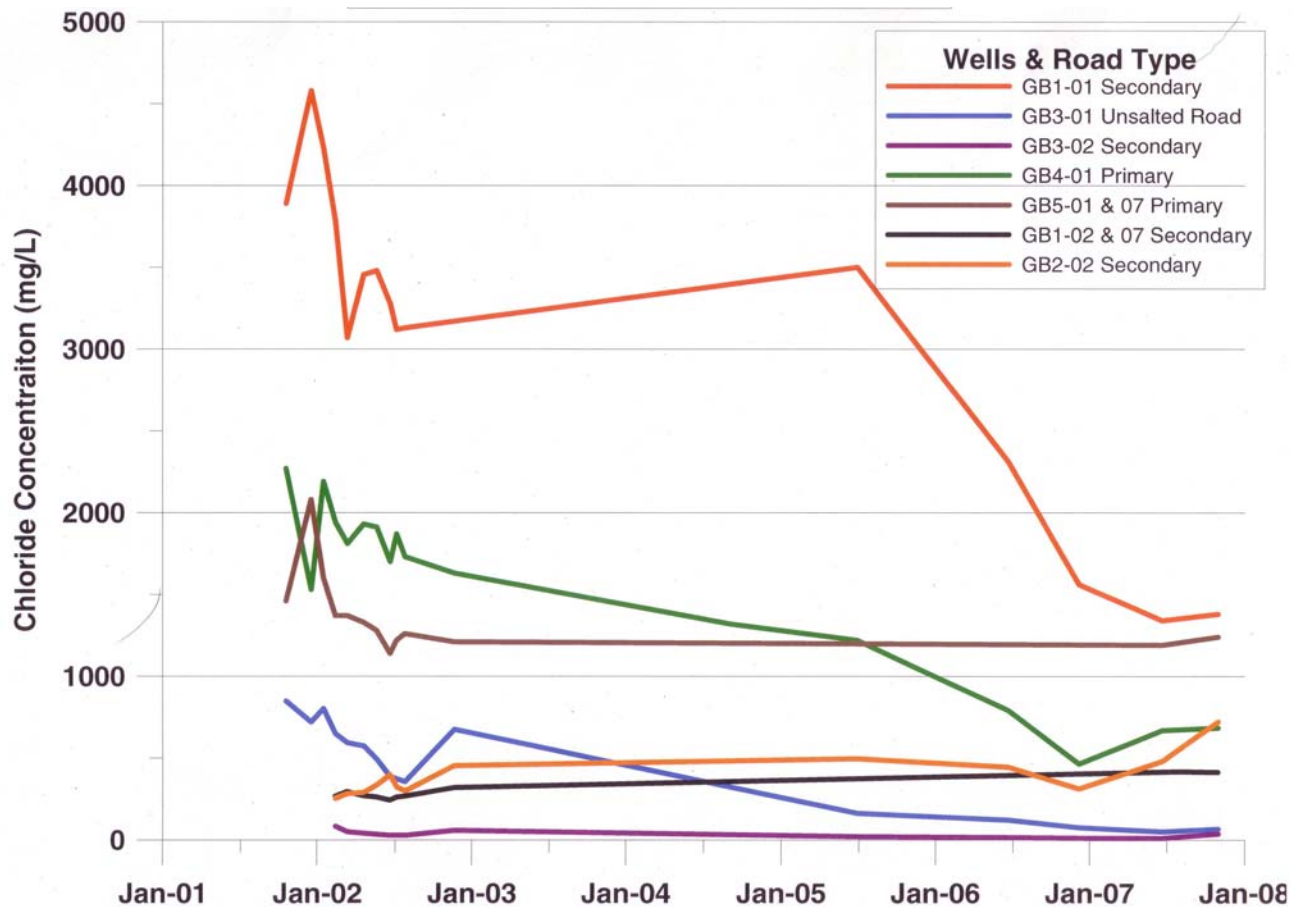
25% Reduction in Road Salt





Initial Indications

Greenbrook Well Field Road Salt Monitoring





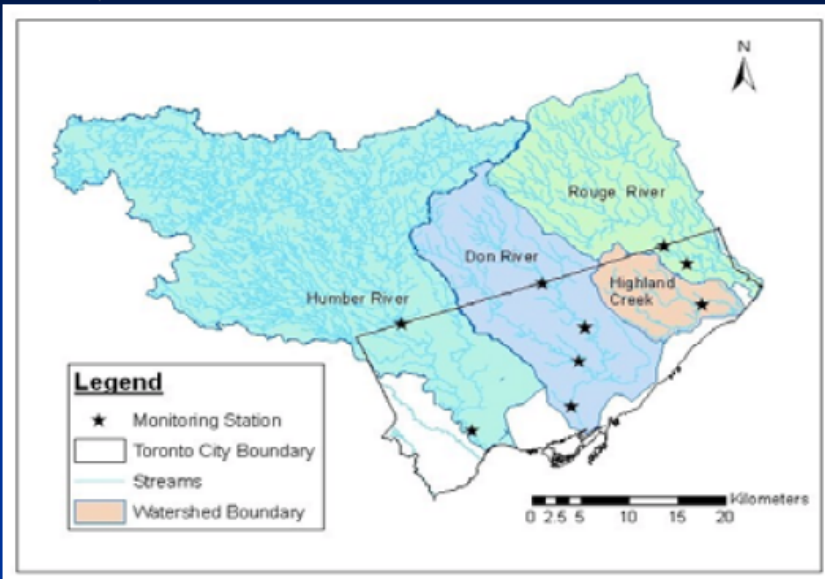
MINIMIZING THE ENVIRONMENTAL IMPACTS OF DEICING

Novel Modeling of Stormwater Management

(Prof. Bahram Gharabaghi, Guelph University)

Novel Modeling of Stormwater Management

City of Toronto Chloride Monitoring Stations



Chloride Guidelines: Drinking Water and Irrigation

■ Drinking Water

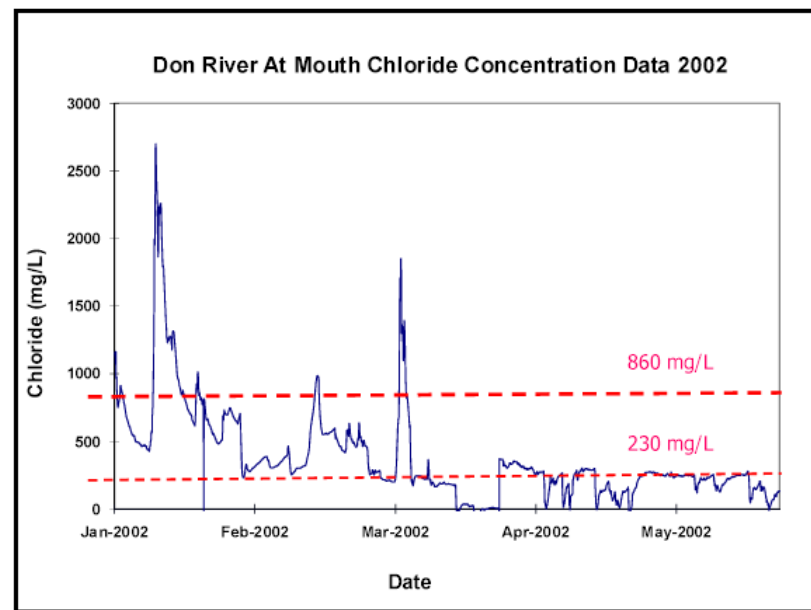
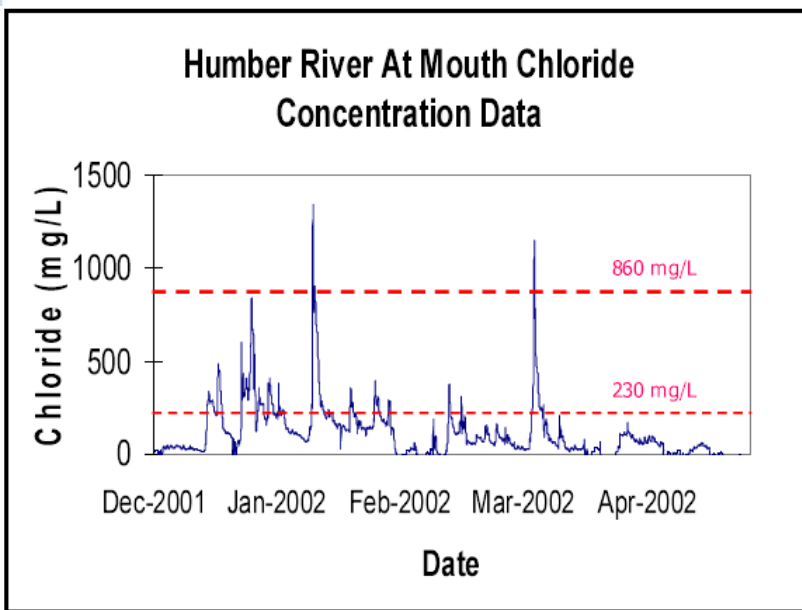
- Chloride: **250 mg/L** (aesthetic objective)
- Sodium: **200 mg/L** (aesthetic objective) (medical officer to be notified when Na concentrations exceed 20 mg/L)

■ Irrigation Water

- Chloride: 100 to 700 mg/L



Chloride peaks during winter maintenance





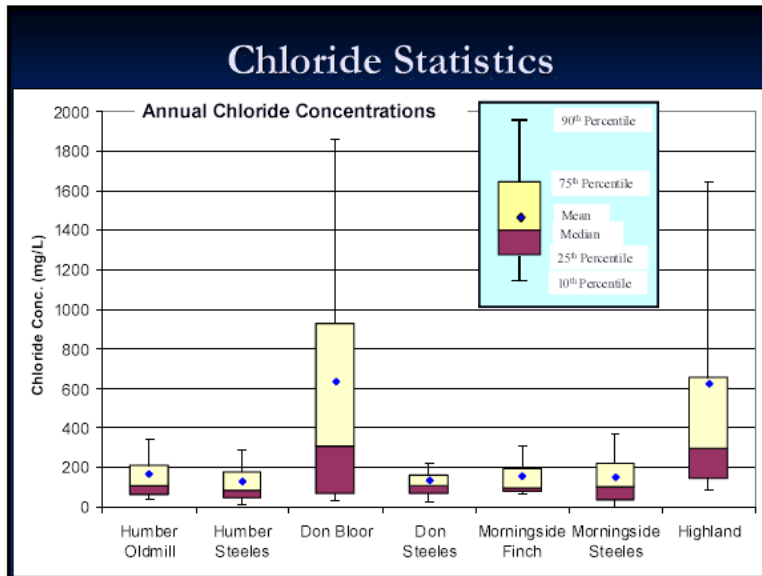
Goals of research program

Research Objectives

1. Advance scientific knowledge on urban stormwater runoff with focus on salt-induced snow melt ;
2. Evaluate the effectiveness of various salt management practices; and
3. Optimize salt management practices using advanced modeling tools and real-time weather forecast



Determination of Exceedance Events



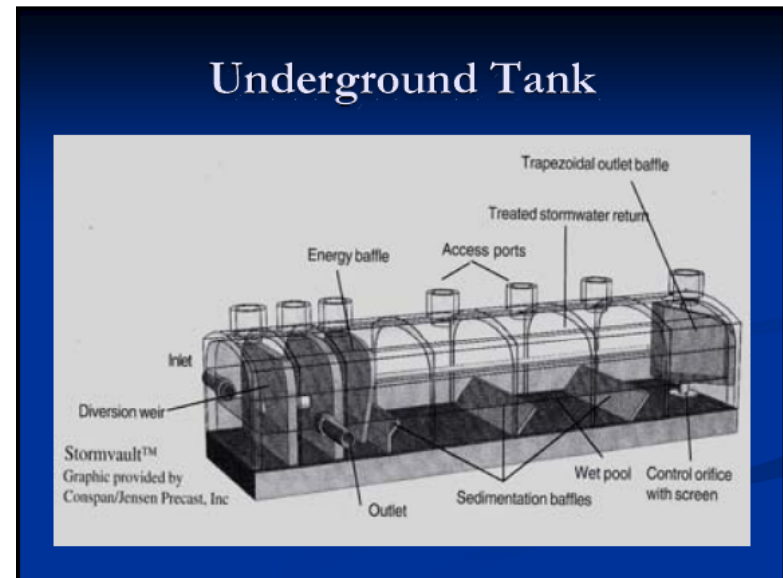
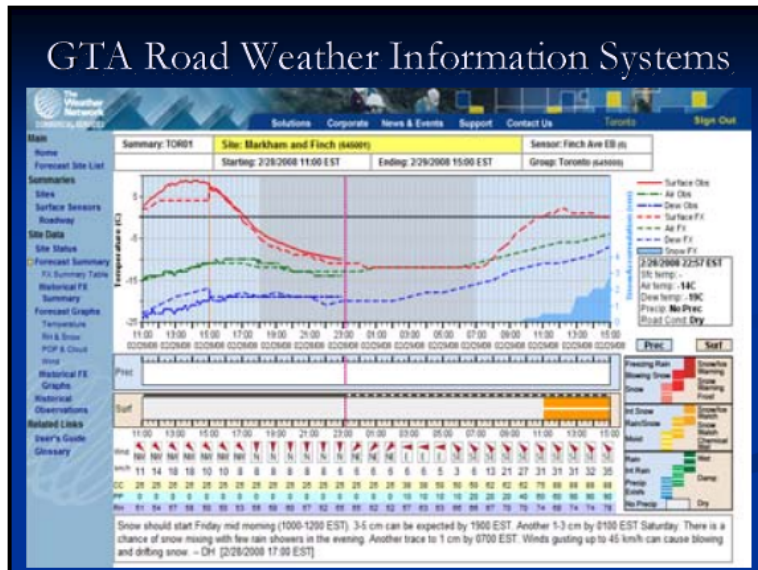
Chloride Event Statistics for Don River at Bloor Monitoring Station

Year	Chloride Threshold	No. of Events	Total Duration of Exceedance (hr)	Mean Event Duration (hr)	Standard Deviation (hr)	Mean Event Max. Conc. (mg/L)	Standard Deviation (mg/L)
2002	230 mg/L	12	2522	209	± 223	826	± 785
	860 mg/L	8	413	51	± 46	1460	± 558
	1,500 mg/L	3	81	27	± 26	1993	± 565
2003	230 mg/L	7	3080	454	± 902	809	± 1103
	860 mg/L	8	1611	201	± 229	1653	± 905
	1,500 mg/L	7	961	137	± 148	2301	± 746
2005	230 mg/L	12	1629	135	± 186	1711	± 1817
	860 mg/L	8	354	44	± 39	2488	± 1679
	1,500 mg/L	7	142	20	± 19	3020	± 1443

Note: Year 2004 was removed from the table because of limited data availability.

Using the latest in Weather Information Systems, application rate analysis, groundwater data modeling,

and computer-controlled stormwater storage management, the goal is to level out and minimize chloride discharges and their impact on the environment





Thank You!



The screenshot shows the Salt Institute website homepage. At the top left is the Salt Institute logo. To its right is a navigation menu with links: About Us, Contact Us, News, events & media, Education Center, Salt FAQ, and Member Center Login. Below the navigation is a search bar with the text "Enter Keywords" and a search icon. A main content area features a large image of a snowy road with the headline "Salt Matters: Highway Safety" and a placeholder text "Lorem ipsum dolor sit amet, consectetur adipisicing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam." Below this is a "Did You Know?" section with another placeholder text and a "Read More" link. To the right of the main content is a "News" section with three articles: "Road salt in short supply, local officials find" by Sam Kusic, "Area road crews ready to fight winter's worst" by Mike Hoeff, and "Calendar".

Salt Institute

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 The Salt Institute
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