

# Beach Health: *E.coli* levels and Effective Management Practices at St. Lawrence River Beaches

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# St. Lawrence River Institute

- Research centre located in Cornwall, Ontario, Canada
- Mandate is **research, education and community action** relating to large river systems, with a focus on the St. Lawrence River ecosystem
- A non-governmental organization, work with a wide variety of individuals, groups, agencies and communities to fulfill its environmental mission





## Remedial Action Plan delisting criteria relating to the beach closings and water contact sports Beneficial Use Impairment

- 1) At public beaches, no more than 20% of weekly five sample *E. coli* geometric means exceed the Provincial Water Quality Objective during an annual swimming season.

# St. Lawrence River Beaches

- Most beach research involves Lake beaches
- Many of the beaches were created after the flooding involved in the creation of the Moses Saunders Dam





# Swim advisory postings in Ontario

- Provincial Water Quality Objective is set at 100 cfu/100 mL for a geometric mean in 5 samples
- Swim advisory postings at public beaches are the result of high levels of fecal indicator bacteria (*Escherichia coli*) most often the result of:
  - Bird and wildlife droppings
  - Agricultural and urban storm water runoff
  - Combined sewer overflows & faulty septic systems
  - Environmental factors
    - Sediment type, river or lake flow patterns and weather



# Some of the Challenges

- In the Cornwall area, public beach areas are monitored by the EOHU
- No further investigations are made to determine the sources or mitigation measures for these bacterial appearances
- For *E. coli* results it can be up to 48 hr from sample collection to beach posting
- *E. coli* levels can vary substantially from day to day and studies have found little or no correlation between fecal indicator bacteria levels from one day to the next

# Beach Health Project

- The St. Lawrence River Institute of Environmental Sciences has partnered with the Eastern Ontario Health Unit, The Raison Region Conservation Authority, & the St. Lawrence Parks Commission to study 4 candidate beaches along the St. Lawrence River



# Objectives of the Beach Health Project

- Characterize 4 local candidate beaches
- Identify possible sources of microbial contamination
- Identify best management practices
- Develop a preliminary predictive model





# Beach Health Project

- Started in 2009
  - Identified the identified the potential collaborative partners
  - Identified the 4 candidate beaches
  - Preliminary sampling

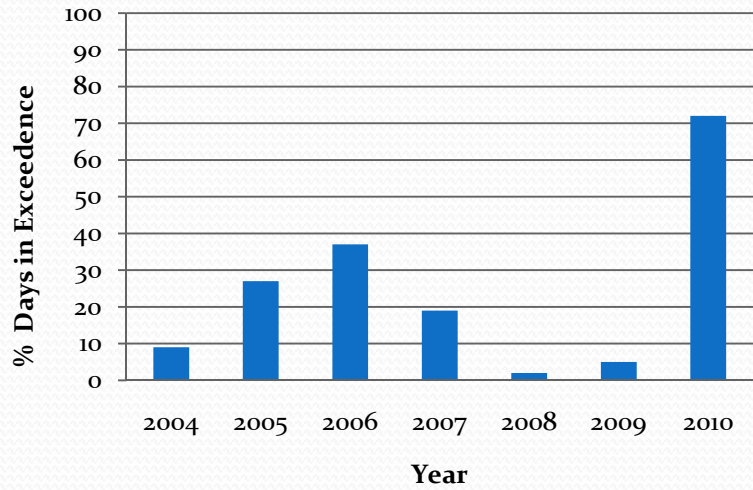


# Beach Health Project

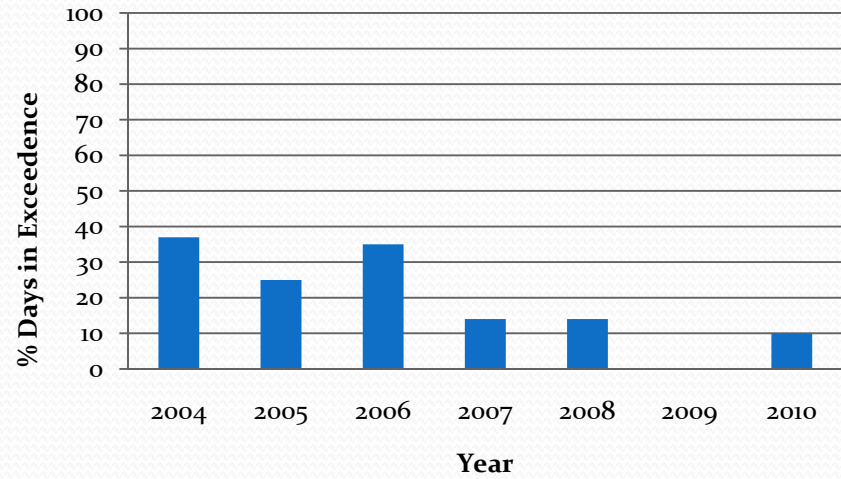
- Sampling parameters:
  - E.coli,
  - TSS,
  - Turbidity,
  - Specific Conductivity,
  - Dissolved Oxygen,
  - Water Temp.
  - Flow
  - pH
- Sanitary surveys
- Weather stations at each beach monitor
  - Wind speed, direction, and gust
  - Air Temp
  - Relative humidity
  - Rain fall
- Mapping

# Historical Data

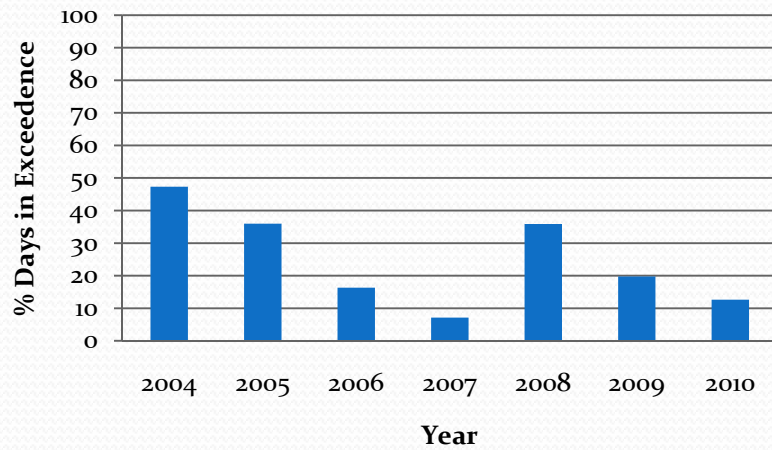
## Farran Beach



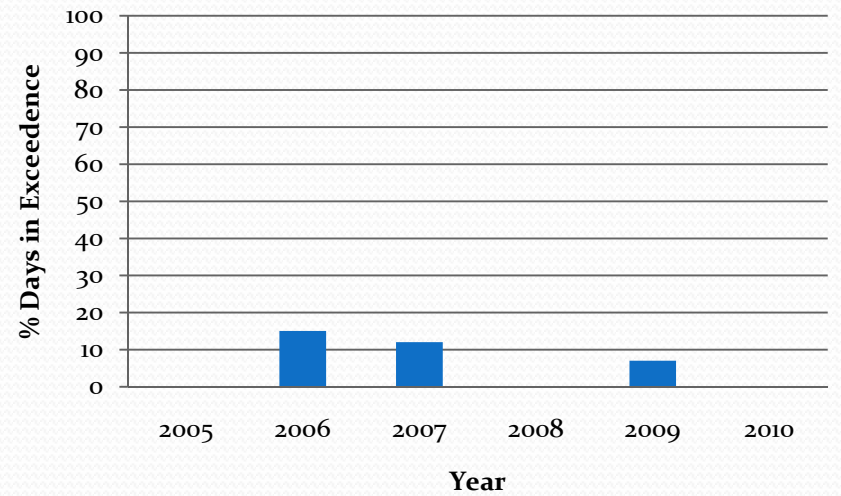
## Crysler Beach



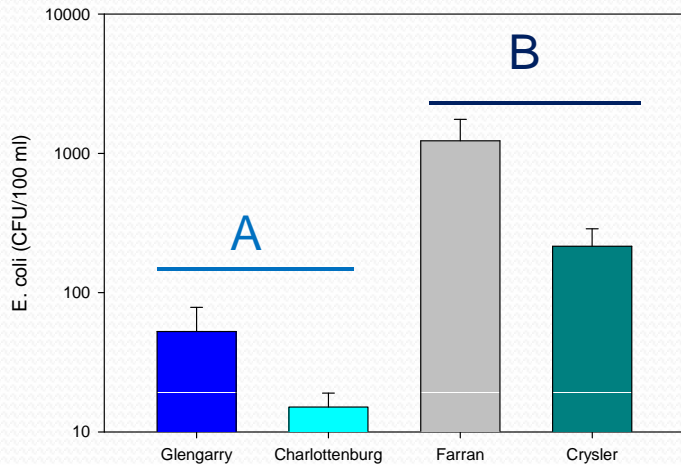
## Glengarry Park Beach



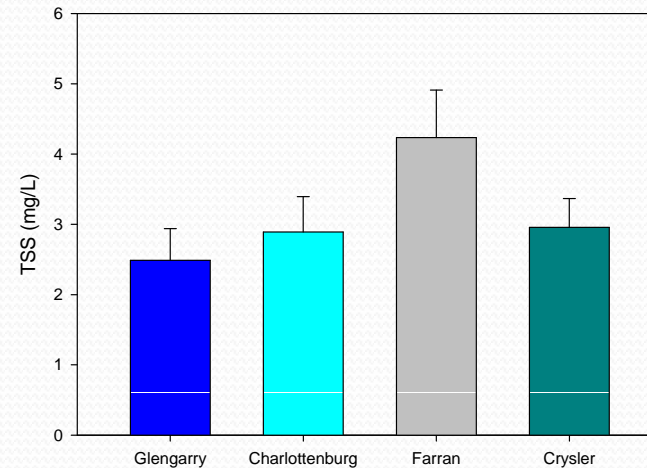
## Charlottenburg Park



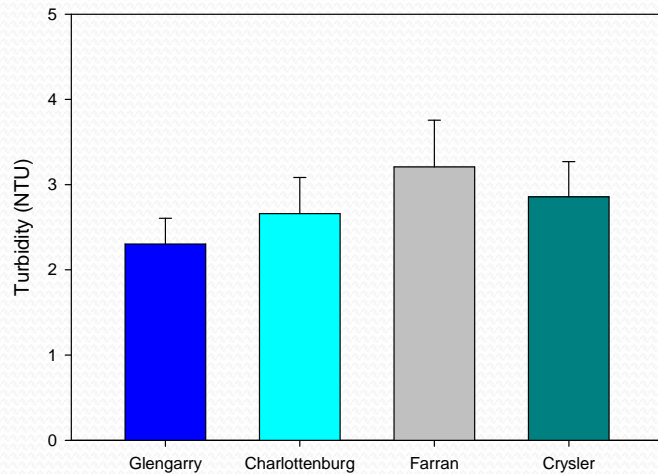
# Spatial variations (One way Anova)



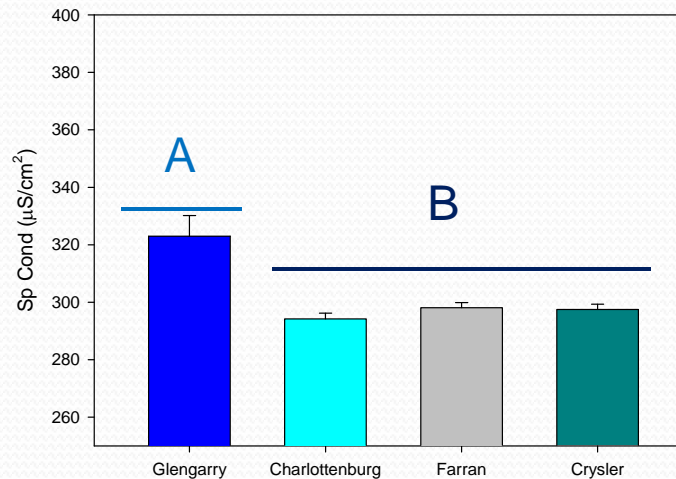
$r^2 = 48$   
 $N = 103$   
 $P < 0.0001$



$P > 0.05$



$P > 0.05$

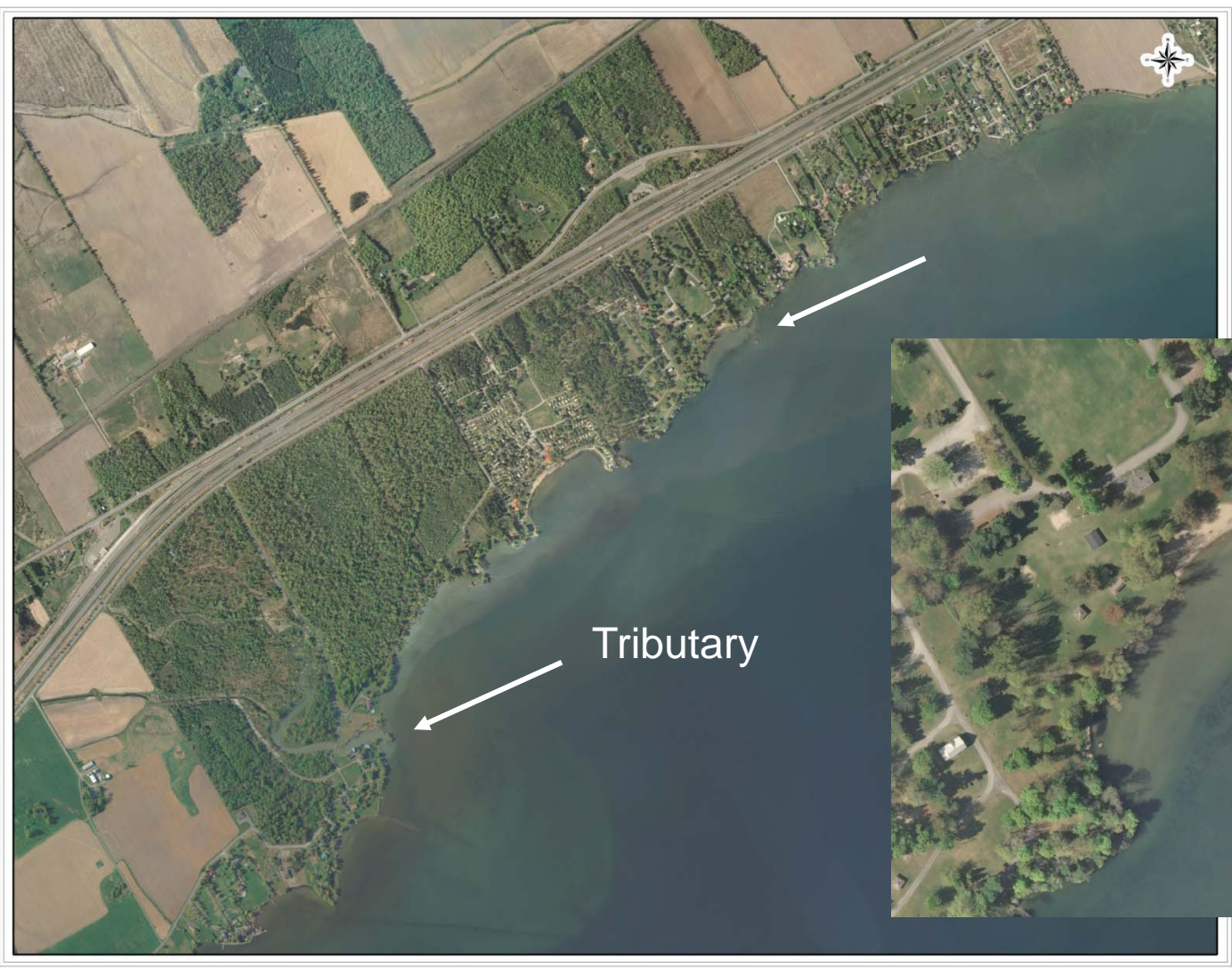


$r^2 = 0.25$   
 $N = 103$   
 $P < 0.0001$

E. Coli levels were significantly higher in beaches above the dame (Farran & Crysler)

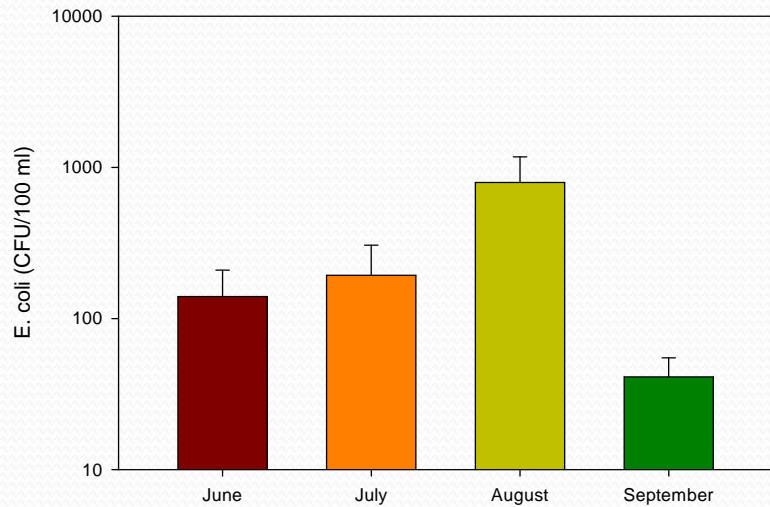
Higher conductivity at Glengarry beach could stem from tributary inflows

# Glengarry Beach

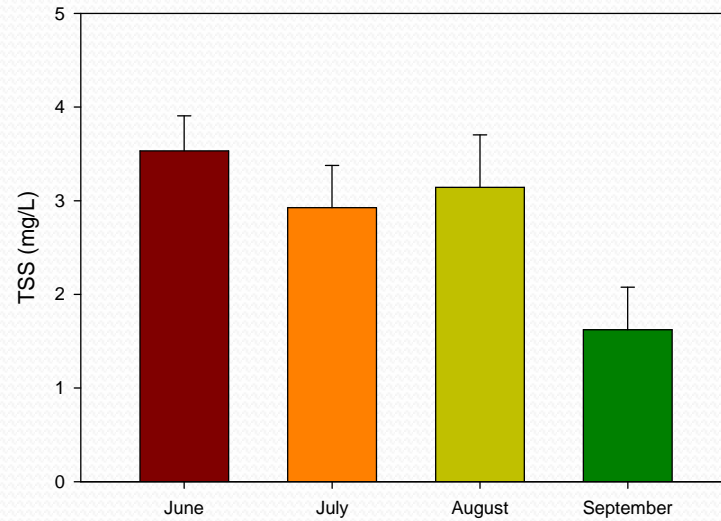




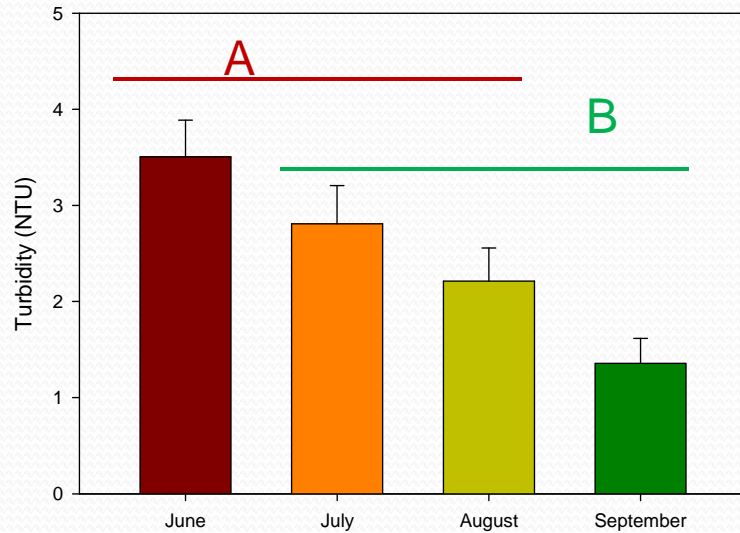
# Temporal variations (one way Anova)



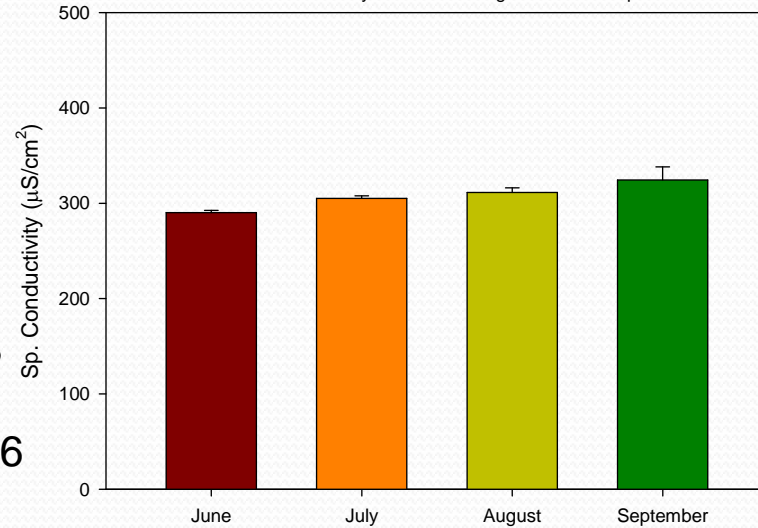
$P > 0.05$



$P > 0.05$



$r^2 = 0.63$   
 $N = 16$   
 $P = 0.006$



$P > 0.05$

# Methods: Variance partition for *E. coli* data

REML (REstricted or RESidual Maximum Likelihood)= Randomized variance analysis

Beach

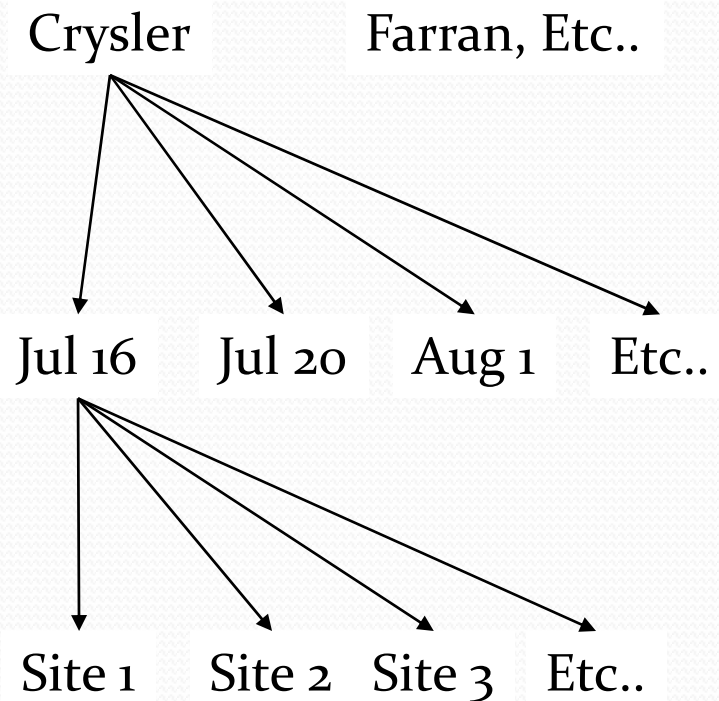
(Inter-beach variations)

Dates [Beach]

(Inter-dates variations)

Sites [Beach, Dates]

(Within site-variations)



## Results: Variance partition for *E. coli* data

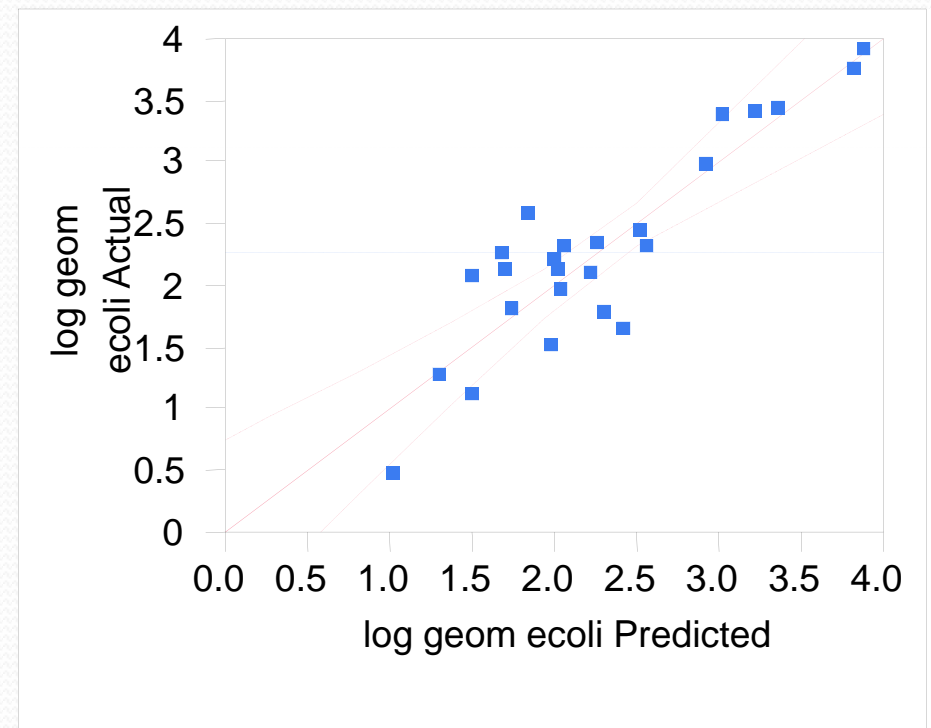
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<b>Data Set</b>	<b>Random effects</b>	<b>Variance Component</b>	<b>% of variance</b>
Summer 2010	Beach	6.79	39.7
	Date	48.55	40.3
	Sample Site	7.85	0

- 80% of the variance is explained by the Beach and date
- Within a beach at a given date the *E. coli* values were homogenous  
-re-evaluate the # of sites needed at each beach

# Multiple Regression Models

- Farran alone
  - $r^2 = 0.81$
  - $p < 0.0001$
  - $n = 25$
- Variable selection included TSS, Turbidity, Temp





# Next Steps

- Continue data collection in the summer 2011
- Continue to work with beach managers to evaluate management practices that may improve beach conditions
- Estimate the economic impact of beach closures at St. Lawrence River beaches

# Thank you!

## Collaborative Partners



ST. LAWRENCE RIVER INSTITUTE



EOHU  
Eastern Ontario  
Health Unit



BSEO  
Bureau de santé  
de l'est de l'Ontario



## Research Funding



THE ONTARIO  
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LA FONDATION  
TRILLIUM  
DE L'ONTARIO



Raisin Region  
Conservation Authority

Office de protection de la  
nature de la region Raisin



St. Lawrence College