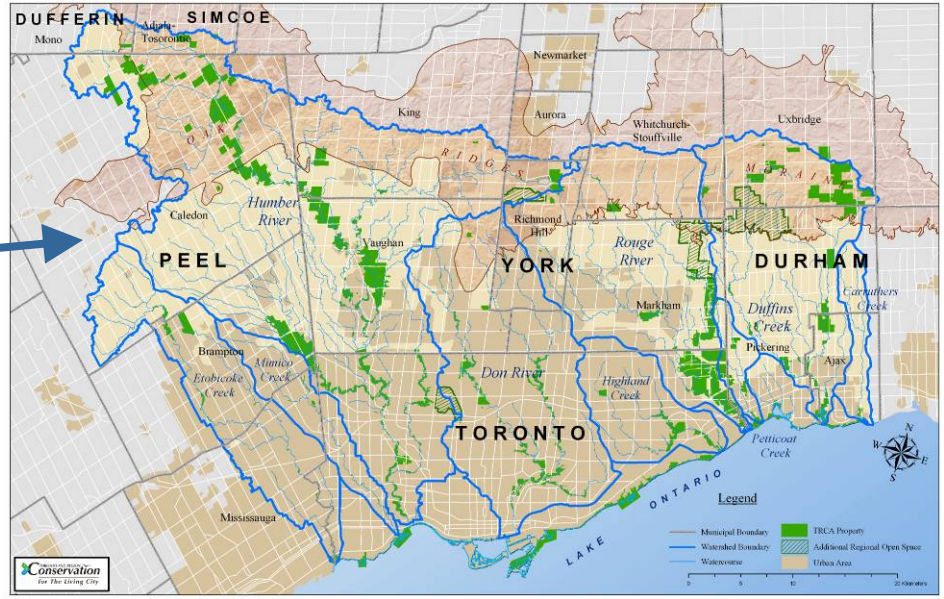
Climate Change:

Natural Heritage Risk Assessment Framework
&
Adaptive Management

Biodiversity and Climate Change Webinar
April 11, 2012

Toronto & Region Conservation Authority

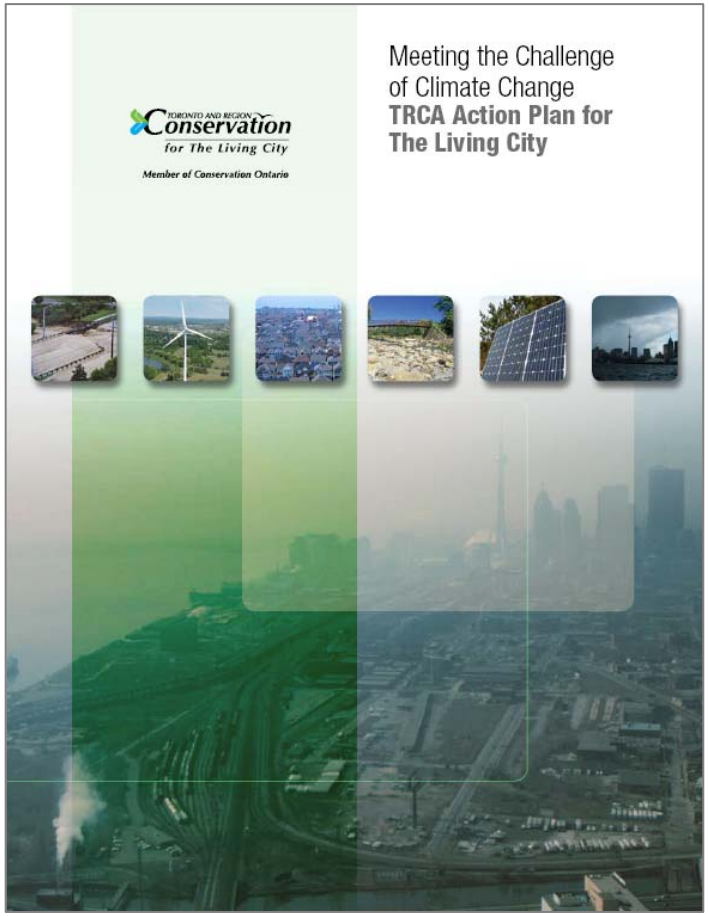
- Government agency dedicated to conserving, restoring, and managing natural resources on a watershed basis



Presentation Outline

- Overview of TRCA Climate Change Initiatives
- Details on the Natural Heritage Risk Assessment Framework (RAF)
- Applications of the RAF
- Next Steps

TRCA Climate Change Strategic Plan



Adaptation Priorities:

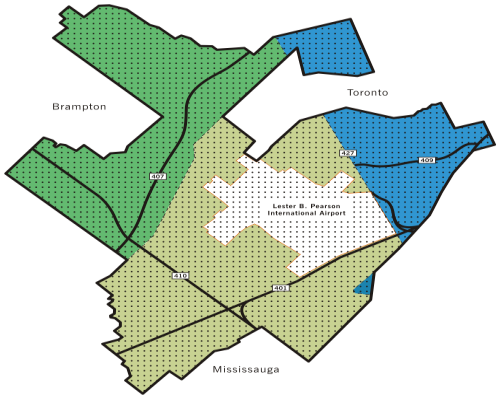
- Increase understanding of local climate change impacts
- Reduce risks to communities
- Build a resilient natural system

Mitigation Priorities:

- Promote a culture of conservation
- Greening TRCA operations
- Leadership through partnership

TRCA Partnerships

- Climate Consortium for Research Action and Integration (CC-RAI)
- Partners in Project Green



PPG Project Area

Climate CONSORTIUM FOR Research Action and Integration

TRCA Transformation Engagement Projects

- Mapping the Potential for Underground Thermal Energy Storage in the GTA
- Biogas Plant Feasibility Study
- Energy Performance Targets for Existing Buildings
- Canadian Association of Sustainability Practitioners
- Measuring Environmental Sustainability Performance of Development

TRCA Risk Assessment & Adaptation Projects

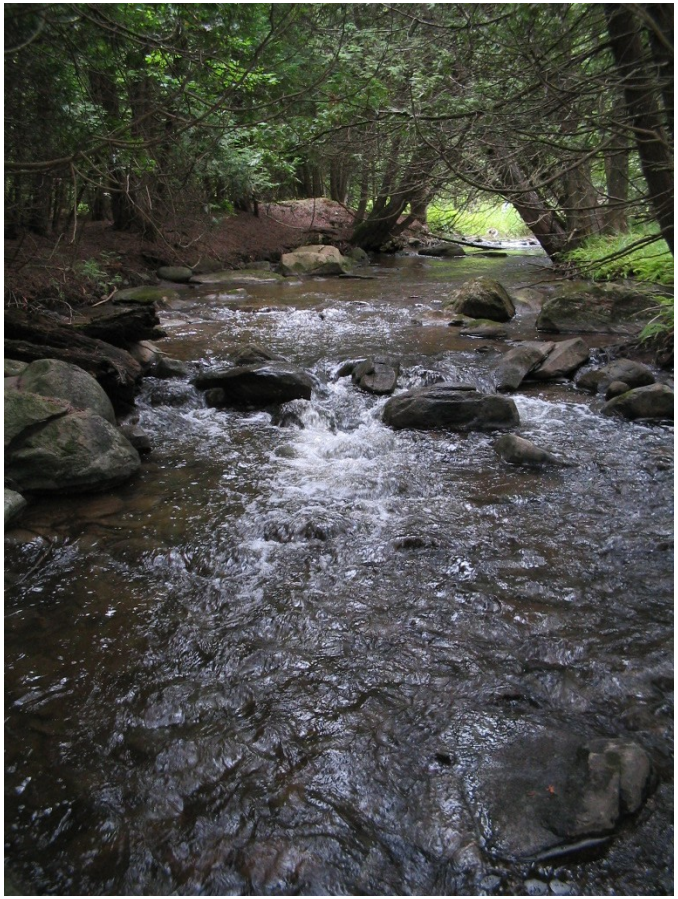
- Risk assessments of TRCA flood control dams (with Engineers Canada)

- Ecosystem Impacts Framework

Natural Heritage Risk Assessment Framework (RAF)

- Assess impacts of key climatic parameters on natural heritage components
- Terrestrial and Aquatic
- Identify risk, prioritize management actions, monitor, and adapt

- Beacon Environmental



Data Sources for Climate Change Impact Studies – finding the key parameters

- Global Climate Models (GCMs)
- Dynamical downscaling – Regional Climate Models (RCMs)
- Statistical downscaling
- Climate trends
- Expert judgment and hypotheses

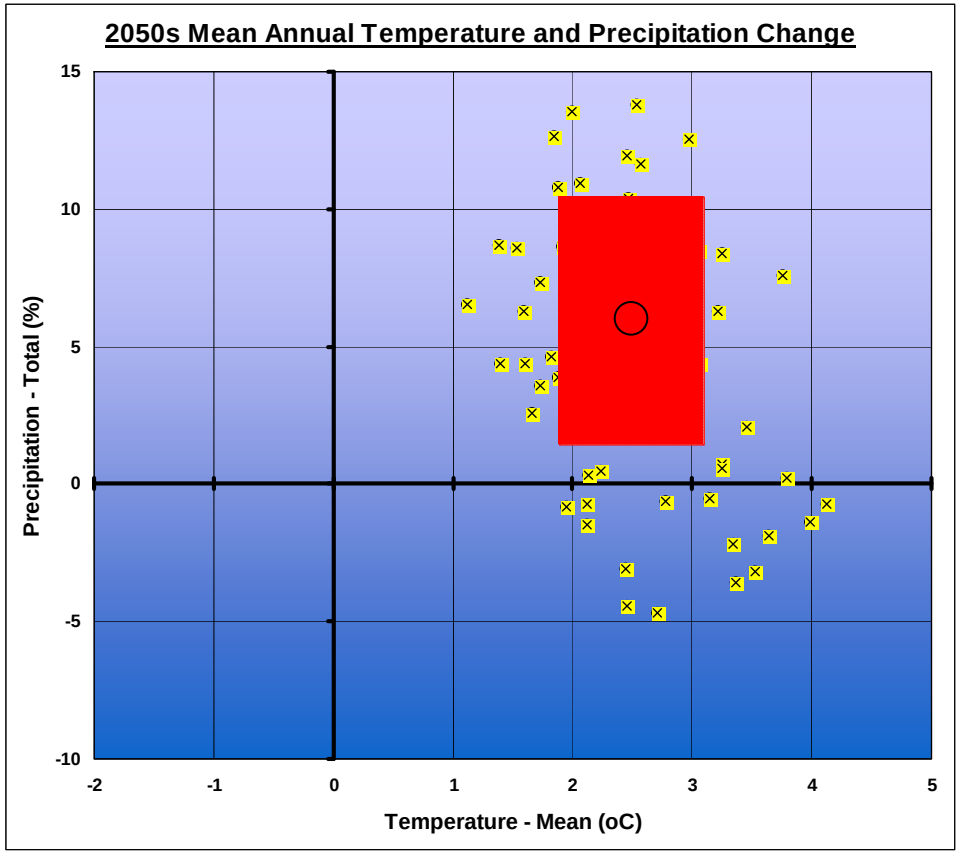
What do the Experts Recommend?

- IPCC and Environment Canada recommend that climate change impact studies utilize an "ensemble approach" that considers the output from all or many models
  - Acknowledges that no one model is the most accurate
  - Accounts for uncertainty and the range of potential outcomes
  - The average/median of an ensemble is considered more likely to represent future climate conditions than any single model
  - Improves on past approaches that considered a single model, or "bracketed" best and worst case models

Is there Ensemble Data for the GTA?

- **Yes** – from Global Climate Models
- No other tool has available output from multiple models and multiple greenhouse emissions scenarios for Canada, Ontario, or GTA
- Regional climate modelling and statistical downscaling studies relevant to the GTA are generally limited to a single model and emissions scenario

Global Model Output for the GTA – “2050s”



Average Annual Temperature

Min: +1.1°C Max: +4.1°C

Median: +2.5°C Std dev: 0.6°C

Average Annual Precipitation

Min: -4.7% Max: + 13.8%

Median: +6.0% Std dev: 4.4%

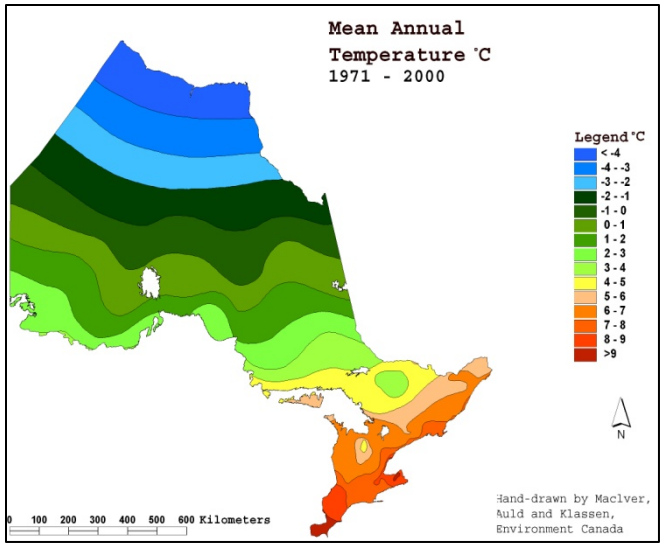
Natural Heritage RAF – Primary Drivers

- Increase Average Annual Temperature:

  +2.5°C

- Increased Average Annual Precipitation:

  +5% to 6%



Potential Secondary Drivers

Consequence	Temp.	Precip.	Terrestrial (T) and/or Aquatic (A)	Comments
Increase in seasonal temperature	X		Both	• High level of certainty based on modelled data • Increase predicted across all seasons by approximately 2.5°C (i.e., does not differ from annual mean)
Decrease in seasonal precipitation (summer)	X	X	Both	• Low certainty for summer decrease, modeled data inconsistent • Intensity likely low
Increase in seasonal precipitation (winter, spring, fall)		X	Both	• Similar to annual rate for all seasons except winter which higher • moderate certainty
Increase in evapo-transpiration	X		Both	• Literature indicates increase, but no modelled data available • Intensity not available • May be offset by increase in precipitation
Decrease in lake water levels	X	X	A	• Literature indicates decrease, but no modelled data available • Decrease expected between 30 and 100 cm • Caution required as Lake Ontario water level is artificially managed
Increase in water temperature	X	X	A	• Moderate level of certainty as directly related to air temperature • Uncertainty regarding magnitude of change • Surface water temperature is also influenced by groundwater
Increase in drought frequency	X	X	Both	• Literature indicates increase, but no modelled data available • Intensity not available • Inconsistent with increase in precipitation
Decrease in summer soil moisture	X	X	T	• Unlikely • Locally variable

The Framework: 7 Steps

1. Identification of natural heritage components and elements
2. Identification of measurable indicator related to element
3. Assess whether an effect is anticipated on indicator
4. Assess likelihood and magnitude (RISK) of the anticipated effect
5. Assign risk level
6. Develop management options
7. Monitoring and feedback for Adaptive Management

ASSESSMENT FRAMEWORK

TERRESTRIAL

- VEGETATION
- AMPHIBIANS
- REPTILES
- BIRDS
- MAMMALS
- INSECTS
- LANDSCAPE CONNECTIVITY

AQUATIC

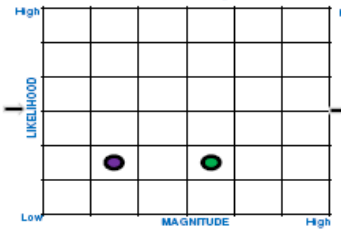
- FISH
- BENTHIC INVERTEBRATES

ELEMENT
Woodland Breeding Amphibians

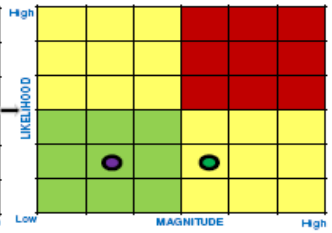
INDICATORS	CLIMATE CHANGE EXPECTATIONS: Temp Increase (~2.5° C)	CLIMATE CHANGE EXPECTATIONS: Precip Increase (~5-6%)
Species Richness (species in quadrats)		
Occupied salamander breeding ponds (ponds occupied in survey)	●	
Hydroperiod of woodland pools (days of standing water in selected pools)	●	

No Measurable Effect ○ Effect Anticipated

RISK
Likelihood/Magnitude



RISK MATRIX



High Risk | Medium Risk | Low Risk

RISK ASSESSMENT SUMMARY

- No risk to **species richness** as a result of key drivers
- Low risk to **occupied salamander breeding ponds** as a result of temperature increase and increased evaoptranspiration (and stable summer precipitation)
- Low risk to **hydroperiod of woodland pools** as a results of temperature increase and increased evaoptranspiration (and stable summer precipitation)

MANAGEMENT OPTIONS

- Deepen breeding pools
- Increase pool catchment
- Create new pools
- Reconnect forest
- Increase forest within 1000 m of pools
- Reintroduction program - eggs
- Reintroduction program – adult/ larva

PRIOROTIZED MANAGEMENT OPTIONS → **RECOMMENDATIONS** → **MONITORING**

Beacon Environmental &TRCA

TERRESTRIAL | **AQUATIC**

VEGETATION | AMPHIBIANS | REPTILES | BIRDS | MAMMALS | INSECTS | LANDSCAPE CONNECTIVITY | FISH | BENTHIC INVERTEBRATES

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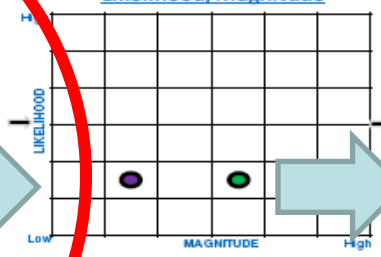

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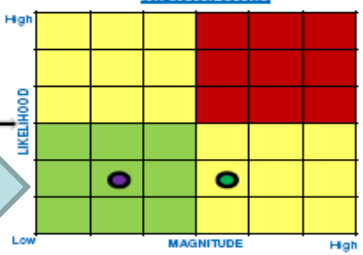

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Using the RAF

- 3 examples in RAF report:
  - Salamander
  - Forest birds
  - Northern Pike
- Urban Forest Study - TRCA
- Brook Trout– Ryerson University

Climate Change and the Urban Forest

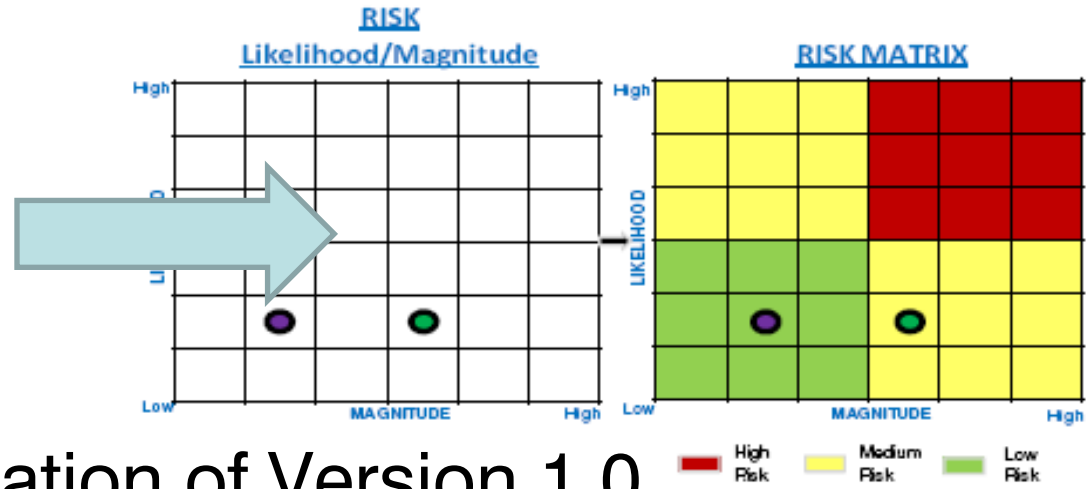
http://foxhavenjournal.com/wp-content/uploads/2008/08/dead-oak-tree.jpg

- Data on GTA forest structure
- Impacts of climate change
  - Temperature increase
  - Precipitation increase
  - CO_2
- Apply RAF
- Management Guidance:
  - Recommend species selection and location (pending)
- Other common stressors
  - e.g. poor soils, urban heat island

Brook Trout and Climate Change

- Long term data set for GTA – trout presence and distribution, temperature and precipitation (50 years +)
- Can a "climate change signature' be identified for coldwater fish species (separate from other stressors)?
- Can access to this type of data increase confidence in the assessment of risk?
- Results pending

Next Steps



- Broad Application of Version 1.0
- Training
- User Feedback –GAPS, vulnerabilty
- Version 2.0 of Risk Assessment Framework

Thank you!