It's Time to Ask Ourselves the Climate Change Question

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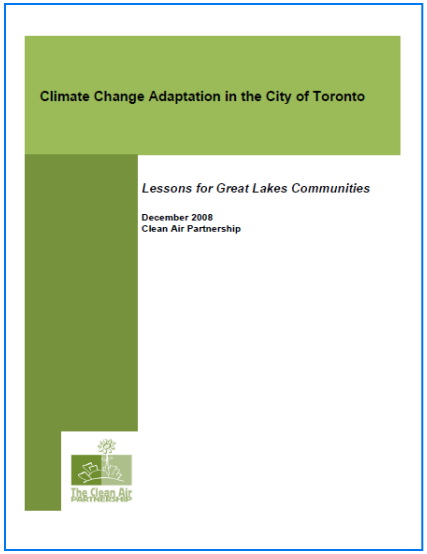
Presentation overview

- Adaptation at Clean Air Partnership
- What is Adaptation?
- What is the Climate Change Adaptation Question?
- Adaptation in Practise
- Adaptation Resources
- Adaptation in the EA process

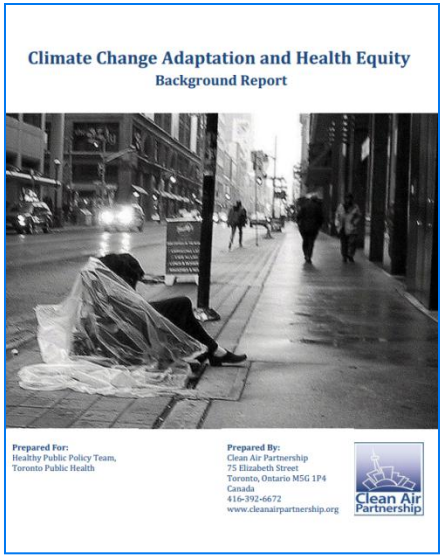
Clean Air Partnership

- **CAP's Vision** is that municipalities are sustainable, vibrant, resilient communities where resources are used efficiently, the air is clean to breathe and greenhouse gas emissions are minimized.
- **CAP's mission** is to help local governments and their partners create sustainable and resilient communities.

Adaptation at CAP



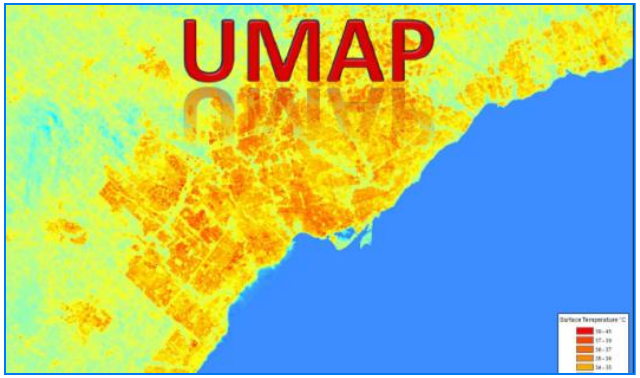
TUCCN
Toronto Urban Climate Change Network



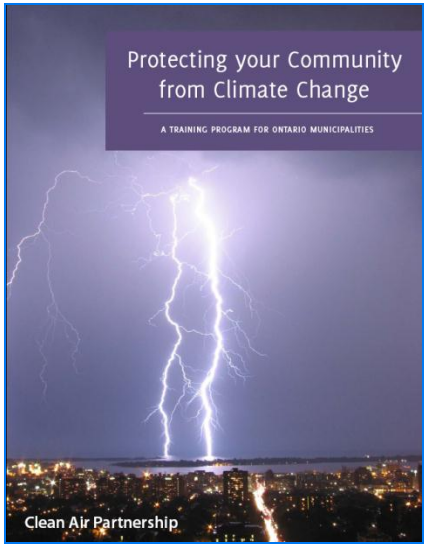
Adaptation at CAP

Clean Air Partnership

ALLIANCE FOR RESILIENT CITIES



c3ontario
CREATING COOL COMMUNITIES



engineerscanada

Adapting *to* our environment

Cuban rainforest vine *Marcgravia evenia*

Requires bats for pollination

Has adapted by developing a concave leaf shape

Works like a satellite dish sending back a strong signal when bombarded with echolocation from bats

Makes it very attractive to bats, increasing reproductive abilities for the vine

Adapting *to* our environment

Cellular adaptive response to chronic radiation exposure in interventional cardiologists European Heat Journal (2011)

2011 study of cardiologists who use a lot of x-rays in their work

These doctors have higher than normal levels of hydrogen peroxide (H_2O_2) in their blood

Elevated H_2O_2 results in production of an antioxidant called glutathione

Glutathione protects human cells agains x-ray damage

Adapting *our* environment

North American Beaver *Castor canadensis*

Strategically fell large trees to build dams

Fell small tress for food

Build lodges with trees to manipulate their environment to enhance ability to feed, nest and mate

Improve waterways through removal of sediments and pollutants including total suspended solids, total nitrogen, phosphates, carbon and silicates

Adapting *our* environment

Addressing climate change

- Mitigate – reduce greenhouse gas emissions

  "Avoid the unmanageable."

- Adapt – take action to reduce vulnerability

  "Manage the unavoidable."

Some Expected Impacts on S. Ontario

- Heat waves, smog
- Damage to buildings, and to water, energy and communications infrastructure and roads from extreme weather events:
  - Intense rains, micro-bursts, floods
  - Freezing rain, hail, freeze-thaw cycles
  - Stronger winds, increased risk of tornados
- Warmer water and declining surface water levels
  - Potential water shortages (though not likely in Toronto)
  - Water quality issues
- Droughts
- Increase in some insect vectors & pests
- Stress on electrical generation/transmission systems
- Stress on urban trees, ecosystems & habitats
- Economic impacts

- http://www.nrcan.gc.ca/sites/www.nrcan.gc.ca.earth-sciences/files/pdf/assess/2007/pdf/ch6_e.pdf

Expected Impacts - Health

HEAT

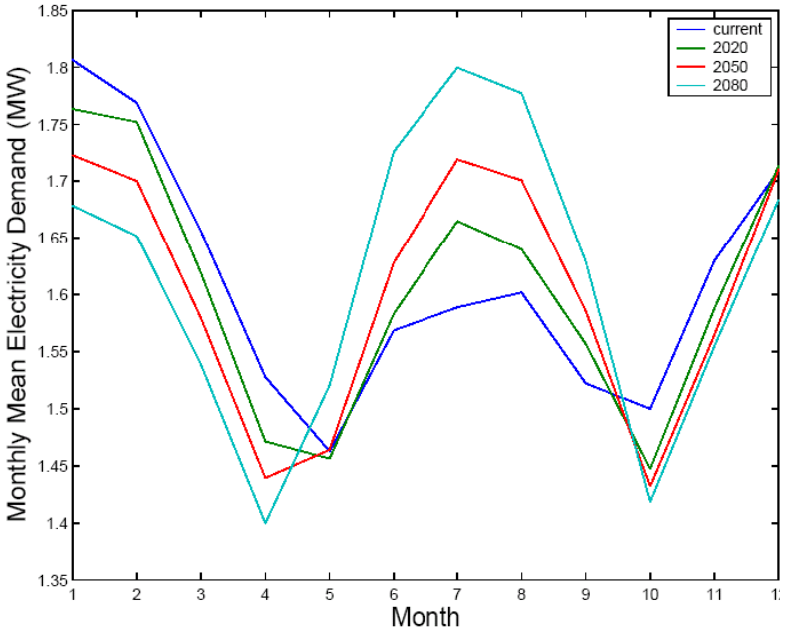
- Heat-related illness & deaths
- Increased smog and related illness and deaths
- More food-borne illness
- Increase in vector-borne diseases such as West Nile and Lyme disease

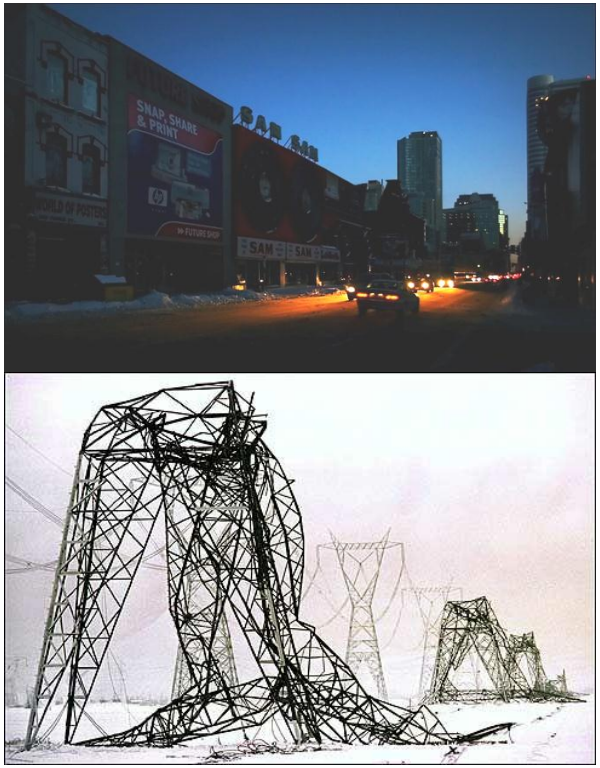
PRECIPITATION

- Increased waterborne disease (e.g. Walkerton)
- Injuries and deaths from flooding
- Increases in basement mould from flooding incidents

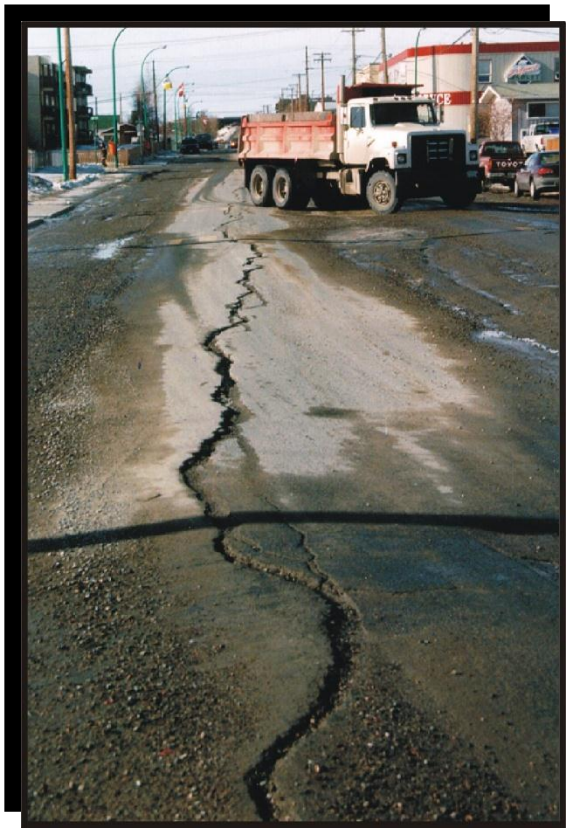
Expected Impacts – Energy

- Rise in average & peak summer demand
- Stress on generation & transmission
- Damage to transmission & distribution capacity from storms, wind
- Decreased hydro power from declining water levels





Expected Impacts – Transportation



- Damage to roads, bridges, culverts
- Disruptions due to blackouts, storms, floods, freezing rain
- Reduced Great Lakes shipping
- More frequent disruption of air traffic

Expected Impacts – Water

- More frequent flooding from intense rainfall events
- Water quality impacts from stormwater runoff, warmer water in lakes and streams and lower lake levels
- More frequent heat waves and droughts (increasing water demand and potentially leading to water shortages)

Expected Impacts - Buildings

- Basement flooding
- Damage from high winds, tornados
- Roof damage from ice dams created by frequent freeze-thaw cycles
- Increased thermal discomfort in buildings without a/c

Expected Impacts – Urban Ecosystems

- Stress on vegetation from heat & drought
- Damage to parks & trees from floods & windstorms
- More pests & disease
- Loss of native biodiversity
- Loss of wetlands & shorebirds

Expected Impacts – Vulnerable Populations

- Homeless
- Low-income people
  - Housing conditions
  - Limited mobility
  - Lack of insurance, savings
- People in poor health
- Isolated seniors
- Infants & small children

Expected Impacts – Government Finances

- Direct costs of repairing weather-related damage to municipal infrastructure, facilities & parks
- Costs for premature replacement of infrastructure
- Expenditures during weather emergencies
- Subsidies for uninsured residents & businesses affected by climate-related events
- Increased insurance costs
- Loss of taxes due to business disruption
- Lawsuits

Adaptation is not new

- Following Hurricane Hazel, the Province developed regulations that restricted developments on flood plains
- Following the August 2005 storm, the City of Toronto developed new overflow protection for Black Creek
- Following heat waves in the 1980's and 1990's, several municipalities developed heat alert and response systems to reduce health effects and deaths from heat

What *is* new for adaptation

- Thinking ahead, rather than looking back (proactive vs reactive)
- Using historical climate trends and climate projections to estimate the impacts of a changing climate
- Planning for the future to avoid potential impacts
- Especially important for:
  - Climate impacts that could inflict multiple deaths or major economic damage
  - Long-lived, costly infrastructure that is expected to serve while the conditions under which it operates are changing
  - Natural systems that benefit all municipalities

Adaptation in Practice

Three present day examples of adaptation in practice

1. **Forest Floor Transplants**
2. **Syndromic Surveillance for Heat**
3. **Winter Road Maintenance**

Forest Floor Transplants

Objective: increase forest survival in parks and ravines by promoting diverse, healthy, self-sustaining forest ecosystems

Issue:
- Increasingly intense weather impacts
- Thin soils
- Soil erosion and contamination issues
- Limited nutrition
- 82kha denuded by smelter emissions by 1978

Problem:
- Newly planted trees do not have sufficient nutrition
- Tree establishment is restricted
- Trees are vulnerable to heat and drought
- Trees are vulnerable to wind
- Thin soil has little organic matter so seedlings are vulnerable to freeze/thaw

Successes and Challenges

6100m^2 transplanted in 2011 (no 2012 figures yet)

Funding

- City provides 15%
- Mining companies provide the rest (Xtrata, Vale, FNX)
- Mining companies also provide staff and maintenance support
- Tree Canada provides trees

Sourcing Mats

- Contingent on highway projects etc
- Sources only secure until 2014 right now

Maintenance

- Mats vulnerable to drought
- Must be transplanted outside dry periods

Syndromic Surveillance for Heat

Objective:

- Reduce morbidity and mortality due to extreme heat in four eastern Ontario health units

Context:

- EHEs expected to be more common and intense
- Large geography (24,000km^2) limits response
- Low population density limits response (27/km^2 – Toronto's is about 4000/km$^{2)}$
- Institutional capacity to handle these events is a concern

Objective achieved in 4 ways

1. Monitor populations for heat-related illness (HRI)
   (Syndromic surveillance of ER visits)
2. Monitor environmental heat
3. Map occurrence of HRIs
4. Develop intervention strategies to integrate with the heat sensors and health data streams

Syndromic Surveillance of ER visits

- Builds on existing syndromic surveillance technologies (eg SARS)
- Real-time monitoring of visits to Emergency Departments
- Chief complaint of triage records used
  - Chief complaint = sunburn, sun stroke, heat stroke, exhaustion
- Over 70 hospitals monitored across Ontario in 18 Health Units
- Average feed is 7,000 Emergency Department visits per day with 600 admissions
- Analysis centre in Kingston, Ontario

Add other data layers

- Deprivation index
- Climate change scenarios
- Cooling centres
- Municipal infrastructure
- Transportation corridors
- Schools and old age homes
- Air Quality Index
- Hospitals

Lessons Learned

- Climate change adaptation can be incorporated into already existing systems
- Just need to understand risks, and identify opportunities for interventions
- Monitoring and evaluation of results is challenging (how do you track what did not happen?)

Winter Road Maintenance Adaptation

York Region

Issue

- Differing winter precipitation can occur throughout the Region on the same day, or the same hour
- Conventional winter maintenance includes sanding or salting roadways, followed by plowing
- New equipment and technologies have become available to help forecast and develop an appropriate response for winter maintenance

Adaptive solution - RWIS

- **Tower and RPU** (Remote Processing Unit)
  - Also transmits EC weather info to patrol trucks
- **Temperature Probe 18 inches in ground**
  - Measures Temperature of Road Base
- **Pavement Sensor (puck) (4x)**
  - Gives Road Surface Temperature
  - Measures Concentration of Salt Brine on road surface
  - Surface condition information dry, wet, ice(% of ice)
- **Atmospheric Instruments**
  - Wind Speed/Direction
  - Relative Humidity/ Air Temperature
  - Precipitation Occurrence (Yes or No for Snow or Rain)

Pre-treated rock salt

- When temp < -12c, rock salt loses potency
- Rock salt now coated with a solution made from beet juice remaining from sugar production
- This salt can emit a higher temperature, and melt ice in colder temps
- Total salt use is down by 10% based on this
- Total cost of salt treatment is down 8%

Challenges

- Financing
  - 50-80k per puck
  - $40/ vehicle / month for GPS
  - Training costs for new equipment
  - Costs of integrating new strategies into current practices
- Public Perception
  - Finding harmony between safety and environmental concerns
  - Perception that warmer winters = considerably reduced costs
- R & D
  - Used to be with MTO, now lies with the Region

How to do it!

1. Assemble an adaptation team
2. Develop awareness and engagement
3. Analysis of local climate trends and climate projections
4. Overview of likely impacts and vulnerabilities
5. Risk assessment to prioritize action
6. Assess and choose among adaptation options
7. Incorporate adaptation goals in key policies
8. Implement projects and programs to reduce risk and increase resilience
9. Track and evaluate effectiveness of adaptation
10. Modify ineffective programs

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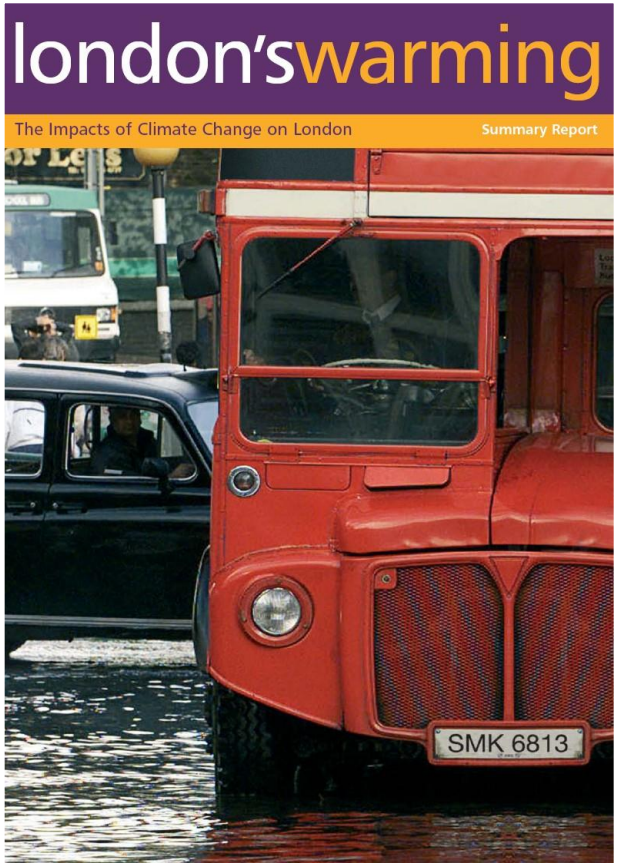
Vulnerability Scans

- Scans that show
  - Community's exposure to climate change
  - Vulnerable sectors and populations
- Useful early step in adaptation planning
- Can put climate change impacts and adaptation on the radar of decision-makers and the public

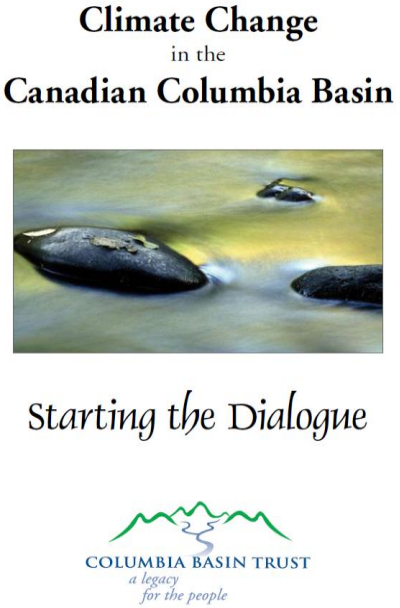


A Scan of Climate Change Impacts on Toronto

- Prepared in 2006 by the CAP with funding by Natural Resources Canada
- Based on a literature review, discussions with scientists, and workshops with staff at the City
- Identified potential impacts for:
  - Water and wastewater
  - Health
  - Energy
  - Transportation
  - Buildings
  - Urban ecosystems
  - Economy

Climate Change in the Canadian Columbia Basin: Starting the Dialogue

- Prepared by Columbia Basin Trust, Pacific Climate Impacts Consortium, UBC
- Outlined recent climate trends in the region, future projections, potential impacts, and some possible adaptations
- Identified impacts for:
  - Water supply
  - Ground transportation
  - Community infrastructure and safety
  - Public health
  - Hydro-electric power
  - Forestry,
  - Tourism and recreation, and
  - Agriculture



Alternative Approaches to Vulnerability Assessment

1. Undertake a scan such as those described previously, with or without the support of an outside organization

2. United Kingdom Climate Impacts Programme (UKCIP) Local Climate Impacts Profile

3. Deloitte Canada's Stepwise Analysis of Sensitivity, Adaptive Capacity and Vulnerability

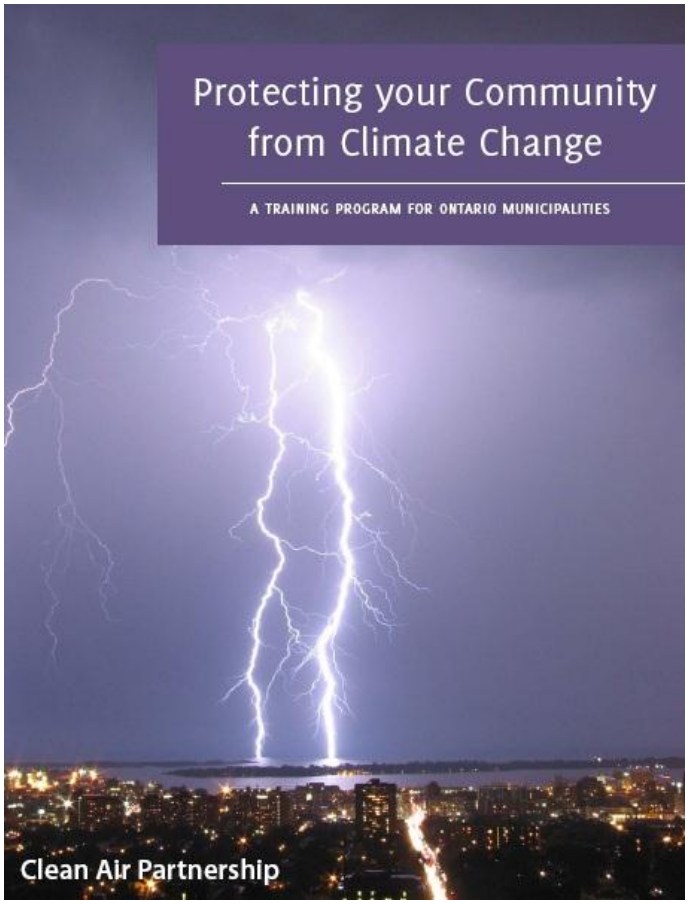
Vulnerability Assessment and Adaptation Planning Resources

- **Clean Air Partnership** – Alliance for Resilient Cities & training program for municipalities on climate change adaptation
- **OCCIAR** – resources website & risk assessment training
- **ICLEI** – developing & testing climate change adaption guide geared to smaller communities
- **Engineers Canada** – detailed climate change risk assessment process for municipal infrastructure
- **Canadian Institute of Planners** – community-based adaptation pilots & developing a guide for land-use planners
- **Canadian Standards Association** – developing an electronic training program
- **Natural Resources Canada** – is publishing case studies of climate change adaptation

Vulnerability Assessment and Adaptation Planning Resources

Adaptation Training Program Resources

http://www.cleanairpartnership.org/municipal_adaptation_program_resources



12 Modules

All powerpoint presentations

All worksheets & exercises

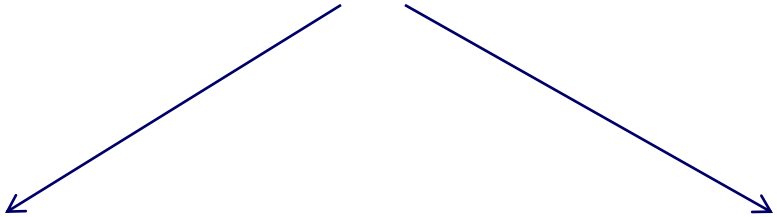
Train the trainers program

Adding and Adaptation Lens to the EA Process

- Climate data is key in infrastructure design
- Historic data is no longer appropriate
- Exclusive use of climate normals can be risky
  - Insufficient loads
  - Insufficient adaptive capacity
  - Unsafe over time
  - Difficult to maintain over time
  - Civil liability for not taking climate change into account

Adding and Adaptation Lens to the EA Process

- Ask, ‘how does climate change impact the project over time’?



PHYSICAL

- Higher wind speeds
- Higher temperature
- Longer duration heat events
- More intense rainfall
- More freeze/thaw cycles
- Sea level rise

FINANCIAL

- Insurance rates
- Property taxes
- Future maintenance costs

Adding and Adaptation Lens to the EA Process

- If identified impacts are Medium or High risk, employ risk assessment
- If risk assessment indicates project is vulnerable to climate changes, practitioner should develop a Project Adaptation Plan
  - ID adaptive measures
  - ID how to prioritize (often based on likelihood and impact of risk)
  - ID how measures will be implemented
  - ID how performance of measures will be monitored

parting anecdote

The Fudai Floodgate

Fudai, Iwate prefecture

530km north of Tokyo

Population 3050

The Fudai Floodgate

Mayor Kotaku Wamura

Served 10 terms

1947 – 1987

Witnessed death of half the town's people in the tsunami of 1933

Vowed to build a tsunami floodgate to protect the town

Called a 'waste of public funds' at the time

The Fudai Floodgate

12 years to build (‘72-’84)

¥3.56 billion ($33m)

205m span

15.5m high

10m is standard height for a Japanese floodgate

Ugly as hell

Not based on past data or trends, but rather on the worst possible future scenario imaginable

The Fudai Floodgate

1933 tsunami killed 433 people and destroyed over 500 homes

2011 tsunami killed 1 person who was on his boat when it hit, destroyed no homes

Adaptation Lessons

- The past will not be the future, it is due diligence to consider likely future conditions
- Identify vulnerabilities, pick the priorities (impact and likelihood)
- Adaptation is not always cheap, nor is it always expensive
- Prevention of future possible impacts is not always popular but the risks and impacts should be considered
- Perfect data is not a prerequisite to adaptation

Questions?

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