Stream Crossings and Climate Resilience

Alison Bowden
Jessica Levine
Sarah Murdock
Themes

• Changing the conversation to include resilience in decision making

• Case study: FHWA Resilience Project
  – economic and social dimension of resilience

• Goals & linkages in current (Federal?) policy opportunities
Discussion Questions

• What still needs to change, at what level(s) of organization, to incorporate risk and resilience in decision making?

• How critical is economic data, and how do you make decisions about risk and resilience with incomplete information about costs & risks?
Ecological Integrity

...the long-term capability of an ecological community to sustain its composition, structure and function and its resiliency to stress
Flow Regime
(lows, high pulses, floods)

Physical Habitat
Water Quality
Connectivity
Energy Supply
Species Interactions

Ecological Integrity
Ecosystem Services
The range and distribution of hydraulic units is a function of the **dynamic** equilibrium of a stream.
The Climate Challenge

Prediction: temperature increases ranging between 6 and 11°F
- more summer droughts
- warmer stream conditions
- more stress on brook trout

Prediction: precipitation increases between 10 and 15% and more frequent and intense storms
- more high water events
- more stress on infrastructure
- human communities more at risk
Intense Rain

T. Madsen & N. Willcox. 2012
DANGER ROAD CLOSED

BRIDGE CLOSED AHEAD
LOCAL TRAFFIC ONLY

Road Closed

Flooded Road

Turtle in the Mud
Stream Simulation Design

- Opening is large relative to length.
- Width ≥ 1.2 times bankfull width.
- Culvert bed matches stream bed.
Flood Effects on Road–Stream Crossing Infrastructure: Economic and Ecological Benefits of Stream Simulation Designs
Goals in Policy: Army Corps Nationwide Permit

“Stream Crossings and Work

(a) All permanent crossings of streams shall be... designed and constructed to (i) withstand and prevent the restriction of high flows, (ii) maintain low flow conditions, and iii) not obstruct movement of aquatic life...”
Road-Stream Crossings: Costs & Benefits, New Partnerships

Jessica Levine, TNC Canada
New England Transportation & Wildlife Conference
9/23/14
Culverts can provide multiple benefits

**ECONOMIC:**
- Avoided flood damage
- Avoided travel delays
- Avoided loss of business/tourism income from road closures
- ROI improves over time

**SOCIAL:**
- Improved safety and mobility, including access to emergency services
- Avoided health impacts

**ECOLOGICAL:**
- Fish populations with access to cold, upstream waters
- Improved habitat
- Decreased erosion of banks
- Avoided water quality impacts
The Economic Case: Costs

- **Short-term**: Construction costs for stream simulation-like culverts 15-200% more than traditional hydraulic design culverts
- **Long-term**: Storm-related maintenance and replacement costs can make these culverts cost effective in 25-50 years
- Many design options, costs vary widely (NY, ME, VT, MN, NH, AK)
- Little data collection/retention
- Up-front cost a major obstacle
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What about the benefits?
FHWA Climate Resilience Pilot
Climate Vulnerability and Economic Assessment for At-Risk Transportation Infrastructure in the Lake Champlain Basin, NY

1. Prioritize road-stream crossings and road segments
2. Develop engineering-based design adaptation options
3. Create an economic tool that evaluates the full benefits and costs
4. Incorporate climate vulnerability assessments into existing standards and guidelines
FHWA Economic Tool

A tool to aid NYSDOT in decision making about when it makes sense to invest in improved culverts, by:

- Evaluating costs of different design options for different types of sites
- Including a suite of social, economic, and environmental benefits
Culvert Decision Support Tool

Costs ($)
- DOT capital costs
- DOT O&M costs
- DOT replacement costs

Quantifiable benefits ($)
- Economic benefits
- Social benefits

Environmental benefit multiplier
- Stream condition
- Connectivity improvement

Risk reduction multiplier
- Criticality
- Vulnerability

Benefits x Environmental multiplier x Risk reduction multiplier

Project costs over 75 years
Culvert Decision Support Tool

“Quantifiable” benefits

Results expected in 2015...

Economic
- Avoided freight disruption
- Avoided flood damage

Social
- Mobility (travel time savings)
- Safety (avoided injuries and fatalities)
Working with Local Highway Departments
New Partnerships, New Funding Models

Fish passage
Climate adaptation
Hazard mitigation
Community resiliency
Local contributions
Ongoing Work

- Implementation projects: NY, VT, MA, ME, etc.

- Information gathering and sharing best practices, lessons learned, costs

The ultimate goal? Climate- and fish-friendly culverts are business-as-usual
Changing Climate
Growing Sea Level Rise Impact
Cost of Disasters Is Increasing

Figure 18. Billion-dollar weather and climate disasters, 1980–2012

Data source: NOAA 2013a
Increasing Impact of Floods

• FEMA/AECOM 2013 study: 100-year floodplains will grow by ~45% over the next 90 years, 70% due to climate change & 30% to population growth

• 25% flood insurance claims outside SFHA
Need to Incorporate Future Flood Risk

What matters regarding flood risk is not just next year’s flood risk but the integrated flood risk over the lifetime of the project.

A 2005 storm in Toronto caused $647 million in damages, including destruction of this culvert (left, $4 million) in losses, which was replaced with a larger, more resilient culvert (right). Source: Toronto Environment Office. Photo credit for damaged culvert: Jane-finch.com. Photo credit for new culvert: City of Toronto Transportation Services.
Post Disaster vs. Pre Disaster Funding
FEMA Mitigation Spending

Fiscal Years: FY08 to FY14

- Hazard Mitigation Grant Funding
- PreDisaster Mitigation Funding
- FEMA Hazard Mitigation Related Funding in NFIP

Dollars in millions
THE PRESIDENT’S CLIMATE ACTION PLAN

Executive Office of the President

June 2013

http://www.whitehouse.gov/administration/eop/ceq
THE PRESIDENT'S PLAN WILL
PREPARE THE U.S. FOR THE IMPACTS OF CLIMATE CHANGE

WE’VE MADE GREAT PROGRESS

The Administration and partners developed national strategies to help decision makers address the impacts of climate change on natural resources — fish, wildlife, and plants — and oceans.

PROGRESS:

- In 2012, federal agencies released Climate Change Adaptation plans for the first time, outlining strategies to protect their operations, missions, and programs from the effects of climate change.
- The US Global Change Research Program, NOAA, NASA, and FEMA developed and released interactive sea level rise maps and a calculator to aid rebuilding efforts in NY and NJ after Superstorm Sandy.

THERE’S MORE WORK TO DO
Moving forward, the Obama Administration will help states, cities, and towns build stronger communities and infrastructure, protect critical sectors of our economy as well as our natural resources, and use sound science to better understand and manage climate impacts.

SUPPORT CLIMATE-RESILIENT INVESTMENTS

At the community level by removing policy barriers, modernizing programs, and establishing a short-term task force of state, local, and tribal officials to advise on key actions the federal government can take to support local and state efforts to prepare for climate change.

REBUILD AND LEARN FROM SUPERSTORM SANDY

By piloting innovative strategies in the Superstorm Sandy-affected region to strengthen communities against future extreme weather and other climate impacts and building on a new, consistent flood risk reduction standard established for the Sandy-affected region, agencies will update their flood risk reduction standards for all federally-funded projects.

LAUNCH AN EFFORT TO CREATE SUSTAINABLE AND RESILIENT HOSPITALS

In the face of climate change through a public-private partnership with the healthcare industry.

MAINTAIN AGRICULTURAL PRODUCTIVITY

By delivering tailored climate resilience tools to farmers, ranchers, and forest landowners to help them understand and prepare for the impacts of climate change.

PROVIDE TOOLS FOR CLIMATE RESILIENCE

Including existing and newly developed climate preparedness tools and information that state, local, and private-sector leaders need to make smart decisions.
State, Local, and Tribal Leaders Task Force on Climate Preparedness

– Recommend how federal programs can best support resilience and what barriers need to be removed

Interagency Council on Climate Preparedness and Resilience

– Modernize Federal Programs to Support Climate Resilience Investments
Potential Administrative Actions

• Federal Interagency Floodplain Management Task Force “FIFMTF” - Executive Order 11988 (1977) developing in floodplains is “simply a bad Federal investment and should be avoided. Currently 100-yr flood but should it go beyond…"

• Mitigation Framework Leadership Group – “MitFlg”. Federal Flood Risk Management Standard – 1 foot above best available flood data standard
• Stafford Act (post disaster funding)
  – Public Assistance program
  – Hazard Mitigation Grant Program
  – Predisaster Mitigation Program

• National Flood Insurance Program
  – Mitigation Grant funding
  – Community Rating System
Hazard Mitigation Plans

Nationwide Mitigation Plan Status Map
As of April 2011

Legend:
- Approved Status
- Expiring
- Expired
- Expiring in 90 days
- No Data in National MLS

Approved Hazard Mitigation Plans
Association for State Floodplain Managers estimates adequate flood mapping for nation ~$4.5 - $7.5 billion & $116 - $275 million annually to maintain.

National Flood Insurance Program Reauthorization

• Created a Technical Mapping Advisory Council “TMAC” to make recommendations to FEMA;

• Included natural resources/non-structural flood mitigation features; requirement to map “future conditions” like sea level rise
Challenges Remain for Access to Flood Mitigation Funds

FEMA WON’T FUND CULVERT PLAN FOR VERMONT ROADS WASHED OUT BY IRENE

-JOHN HERRICK JUL. 17 2014, 6:39 PM

Question: Can FEMA Public Assistance $ to help upgrade culverts?

Answer to VT: Plans don’t meet uniform ‘codes and standards’ and therefore don’t qualify
TNC’s 4 Priorities for the Transportation Bill Reauthorization

- Habitat Connectivity
- Resiliency
- Mitigation
- Federal Road Program
Habitat Connectivity

- Strengthen language on consideration of habitat connectivity.

Resiliency

- Incorporate changing climate and weather impacts on road and infrastructure design.

Mitigation

- Programmatic mitigation plan (expansion of RAMP program). Apply avoid, minimize, offset on regional scale.
- Enabling landscape scale interagency planning and coordination.

Federal Road Program

- Support increased funding for all federal land road programs - BLM, USFS, FWS & NPS
Thank you

Questions and discussion

Alison Bowden, abowden@tnc.org
Jessica Levine, jlevine@tnc.org
Sarah Murdock, smurdock@tnc.org