Climate Change in Alaska
Transportation Infrastructure and Climate Change

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The Department of Transportation and Public Facilities (DOT&PF) manages the State’s transportation infrastructure in a very challenging environment. Many facilities in the Alaska’s interior, northern, and southwest regions are underlain by ice-rich permafrost.
Alaska Department of Transportation and Public Facilities

- Over 14,000 Miles of Public Roadway
- Over 5,600 Miles of State owned road
- 845 Bridges
- 257 Rural Airports
- 28 Harbors
- 720 Buildings (DOT owned or managed)
Alaska Compared to the Continental U.S.A.

Barrow = Duluth, Minnesota
Ketchikan = Jacksonville, Florida
Nome = Omaha, Nebraska
Akutan = El Paso, Texas
DOT&PF AIRPORTS IN ALASKA
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In Cooperation With The
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION And
FEDERAL AVIATION ADMINISTRATION

LEGEND
Airport (DOT&PF Controlled)
National Highway System
Alaska Highway System
Road System
Ferry Routes
Railroad
DOT&PF Region Boundary
Potential Climate Change Impacts

- Melting/Warming permafrost
- Increased storm frequencies and intensity
- Increased Coastal erosion due to lack of sea-ice
- Increased river and shore erosion
- Sea-level rise
- Increasing temperatures
Potential Impacts to Infrastructure

Melting/Warming Permafrost

- Current estimate is the Northern Region M&O spends approximately $10+ million annually due to melting permafrost.
- This represents a fraction of the need.
- Costs will increase if warming trend continues.

Tok Cutoff Highway
Potential Impacts to Infrastructure
Melting/Warming Permafrost

- Increased highway and airport surface distress
- Increased Active Layer Detachments (slope sloughing and failures)
- Embankments built over permafrost will need to be thicker to prevent the underlying ground from thawing
- Public buildings may require relocation/reconstruction if their foundations thaw
Longitudinal Shoulder Cracking
Ice-Rich Permafrost Thawing
Potential Impacts to Infrastructure

Increased Storm Frequencies and Intensities

- Changes in timing, frequency, form and/or intensity of precipitation may cause related and increasing natural processes, including:
  - Debris flows
  - Avalanches
  - Floods
- Significantly increases M&O costs
Potential Impacts to Infrastructure

Increased Storm Frequencies and Intensities

- Coastal communities and their infrastructure are vulnerable to accelerated coastal erosion due to storm activity and wave action eroding shorelines once protected by shore-fast sea ice.
Potential Impacts to Infrastructure

Loss of Shore-fast Sea Ice

- Erosion rate: These two photos were taken 2 hours apart, note the ATV tracks in the road (note the 55 gallon barrel). This road no longer exists.
- In 1997, Shishmaref lost 125 feet of beach in a single storm
Flooding
Western Alaska Storm Damage

Affected
- Highways
- Buildings
- Airports
- Waysides

Nome
Western Alaska Storm Damage

Nome-Council Highway

Kotzebue
Potential Impacts to Infrastructure

General Warming Trend

A longer seasonal transition period from fall to winter and winter to spring may require a different and potentially more costly approach to snow and ice control.
Potential Impacts to Infrastructure

General Warming Trend

- The continued warming trend will likely result in the increase in erosion of shorelines and riverbanks which will impact any facility constructed adjacent to the waterbody.

- Aufeis problems will likely increase as melt water flows out of warming zones of permafrost, requiring additional maintenance.
Potential Impacts to Infrastructure
General Warming Trend

- An increase in the frequency and severity of hot days could result in more highway and airport problems related to asphalt softening and traffic-related pavement damage and rutting

- Milder winters, with more freeze-thaw cycles, would accelerate road deterioration and increase maintenance costs
Potential Impacts to Infrastructure

General Warming Trend

- Warming temperatures are altering the blend of vegetative growth on the North Slope of Alaska.
- Increasing temperatures will allow a variety of invasive plants and insects to prosper in Alaska.
What is DOT & PF Doing Now

- Shoreline Protection
- Relocation
- Evacuation Routes/ Shelters
- Flood Mitigation
- Drainage Improvements
- Permafrost Protection
What is DOT & PF Doing Now
Shoreline Protection
Kivalina Airport (FEMA)

- Placed supersacks on the coastal side of airport property to protect the taxiway after sea storm
- Used local labor and materials
- Developing a more permanent
  - $5.3M Const est.
  - Scheduled 2009 if FEMA approves
Kivalina
What is DOT & PF Doing Now

Shoreline Protection

Kotzebue Shore Avenue (FHWA)

• FHWA funded project to construct approximately 4400 lineal feet of sheet pile erosion protection
• Design complete
Kotzebue Roads - Shore Avenue
Mertarvik Barge Facility

- Scope of Project: Construct 30,000 foot staging area with 16 foot wide boat ramp at Mertarvik
- Design: Nearing completion $250K
- Construction: estimated $1.8 million
- Total Project Cost: $2.8 million (includes $800K from Economic Development Administration - remainder General Funds)
- Schedule
  - Advertise February 25, 2009
  - Bid Opening March 27, 2009
  - Substantial Completion: July 15, 2009
Mertarvik Barge Facility

Barge Landing Site

Barge Landing

Relocated Buildings
Shishmaref Relocation Road

*Reconnaissance Study*

- Field work started in 2007
- Reconnaissance studies are broad in scope - provide overview of challenges and issues
- Major issue at Shishmaref is materials costs
- Scope: Evaluate the possibilities of a road from Ear Mountain to a barge site on the coast.
- Working in cooperation with the National Park Service
- Potential road alignments currently being evaluated
What is DOT & PF Doing Now
Evacuation Routes
Gambell Evacuation Road

- FHWA funded
- Construct an evacuation road to safe
ground during storm events
- Currently the Environmental Document is
  under review
- The project is underfunded
What is DOT & PF Doing Now

Evacuation Routes - Point Hope

• Point Hope Evacuation Road Rehabilitation
  – FHWA funded project to raise the elevation of the road above flood levels
  – Construction in 2009

• Point Hope Evacuation Road Extension
  – FHWA project in Design (NSB) to extend the evacuation road as funding allows.
  – Construction in 2010
Coastal erosion has plagued the airport in recent years, likely exacerbated by climate change and marginal sea ice conditions.

Various erosion protection measures have been attempted.

Currently an airport relocation project is scheduled for FFY11 or FFY12 (under design).
What is DOT & PF Doing Now
Flood Mitigation
Koyukuk Airport Improvements

- Airport project completed in 2006
- Lengthened and widened runway.
- Raised grade above the 100 year flood levels
- Total Cost: $9.2 M
- Requested funding for evacuation road
What is DOT & PF Doing Now

Drainage Improvements

Steese and Taylor Highways

- Fires denuded slopes along the highway
- Impacts include:
  - Falling trees
  - Mudslides
  - Increased water flow necessitating additional drainage
What is DOT & PF Doing Now

Drainage Improvements

Steese Highway
What is DOT & PF Doing Now
Permafrost Protection

- Deeper embankments
- Foam board insulation
- Air Convection Embankments (ACE)
- Post foundations
- Passive and mechanical refrigeration
What Needs to be Done

- Increase the collection and density of data ranging from
  - stream flow records
  - precipitation and other weather related data records
  - geotechnical and foundation information
  - other hydrologic data

- Investigate alternative design, construction, and maintenance techniques to address the changing environment
What Needs to be Done

- Continue partnering with the University of Alaska and other State and Federal agencies to address the most immediate needs of communities already being impacted
- Identify the critical information we need to gather to be able to address future impacts of climate change
Thank You

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