

# Arctic Civil Infrastructure and Adaptation to Climate Change AASHTO Climate Change Symposium



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# Public Infrastructure and Climate Change – ADOT/PF

- 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

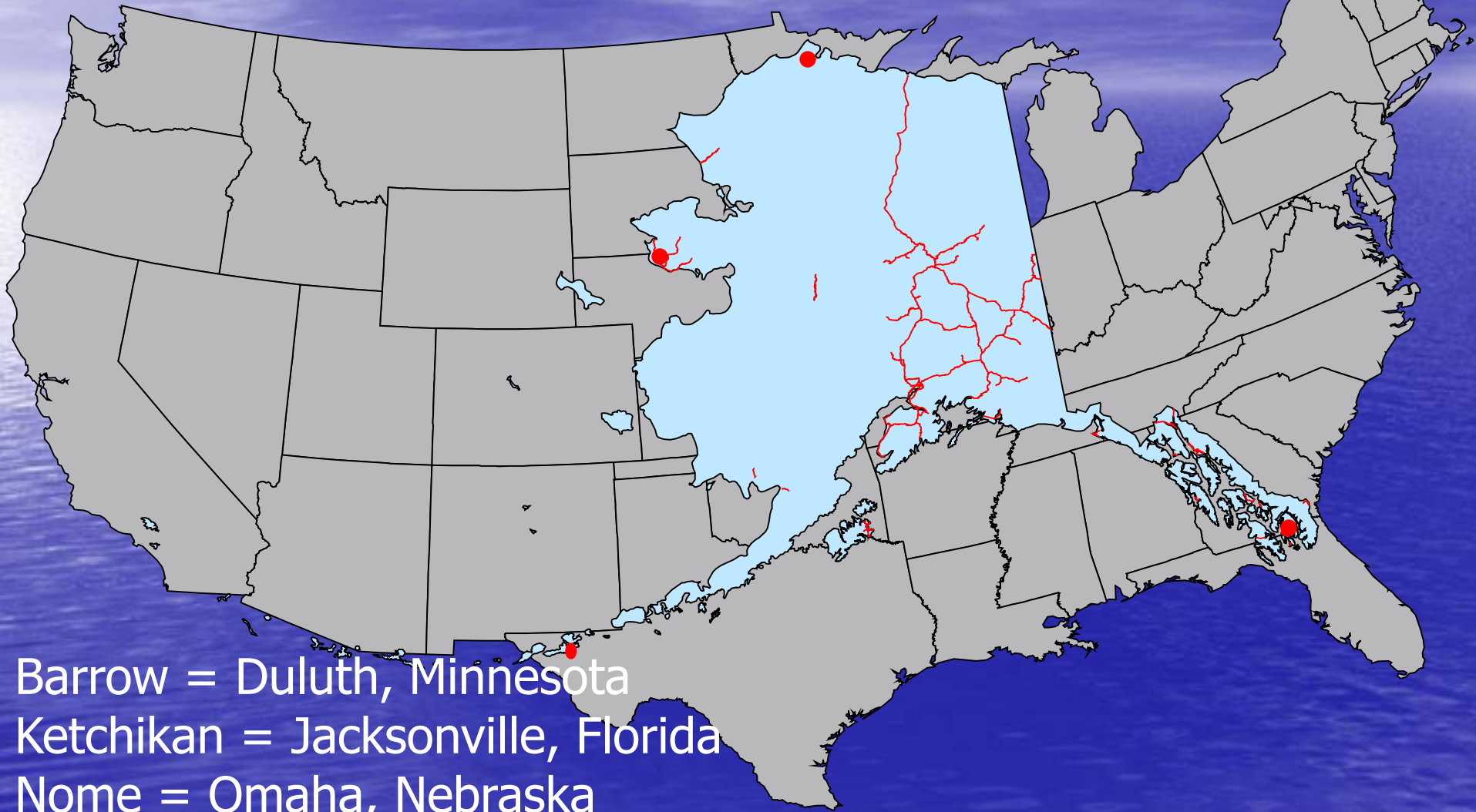


# Alaska Department of Transportation and Public Facilities

- 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

# 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



Nome-Council Road



Copper River Highway

# Climate Change Impacts

- **Loss of the subsistence way of life**



# *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



# Permafrost Problems

Dalton Highway Frost Heaves



Alaska Highway Damage and rutting



Glenn Highway Distress



Mile 15-18 Elliot Highway Pavement  
Rutting



# Longitudinal Shoulder Cracking



# Thaw Settlement



# Ice-Rich Permafrost Thawing



# 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

**Open Water Jan 2007**

**Open Water Feb 2006**





# *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



# *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



- 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 ADOT & PF Doing Now

- **Shoreline Protection**
- **Relocation**
- **Evacuation Routes/Shelters**
- **Drainage Improvements**
- **Permafrost Protection**



# Alaska Communities at Risk

- The USACE has identified over 180 communities that are threatened by erosion



# Six Communities in Jeopardy

- Kivalina\*
- Shishmaref\*
- Newtok\*
- Unalakleet
- Koyukuk
- Shaktoolik



\* Have already begun relocation plans

# Administrative Order 238

14 September 2007

## Established Alaska Climate Change Sub-Cabinet

- ❖ **Alaska Climate Change Strategy**
  - **Adaptation, Mitigation, & Research Needs**
- ❖ **Quick Action**
  - **Immediate Action Workgroup**
    - **A Model for Working with Communities through Interagency Partnership and Meaningful Local Involvement**



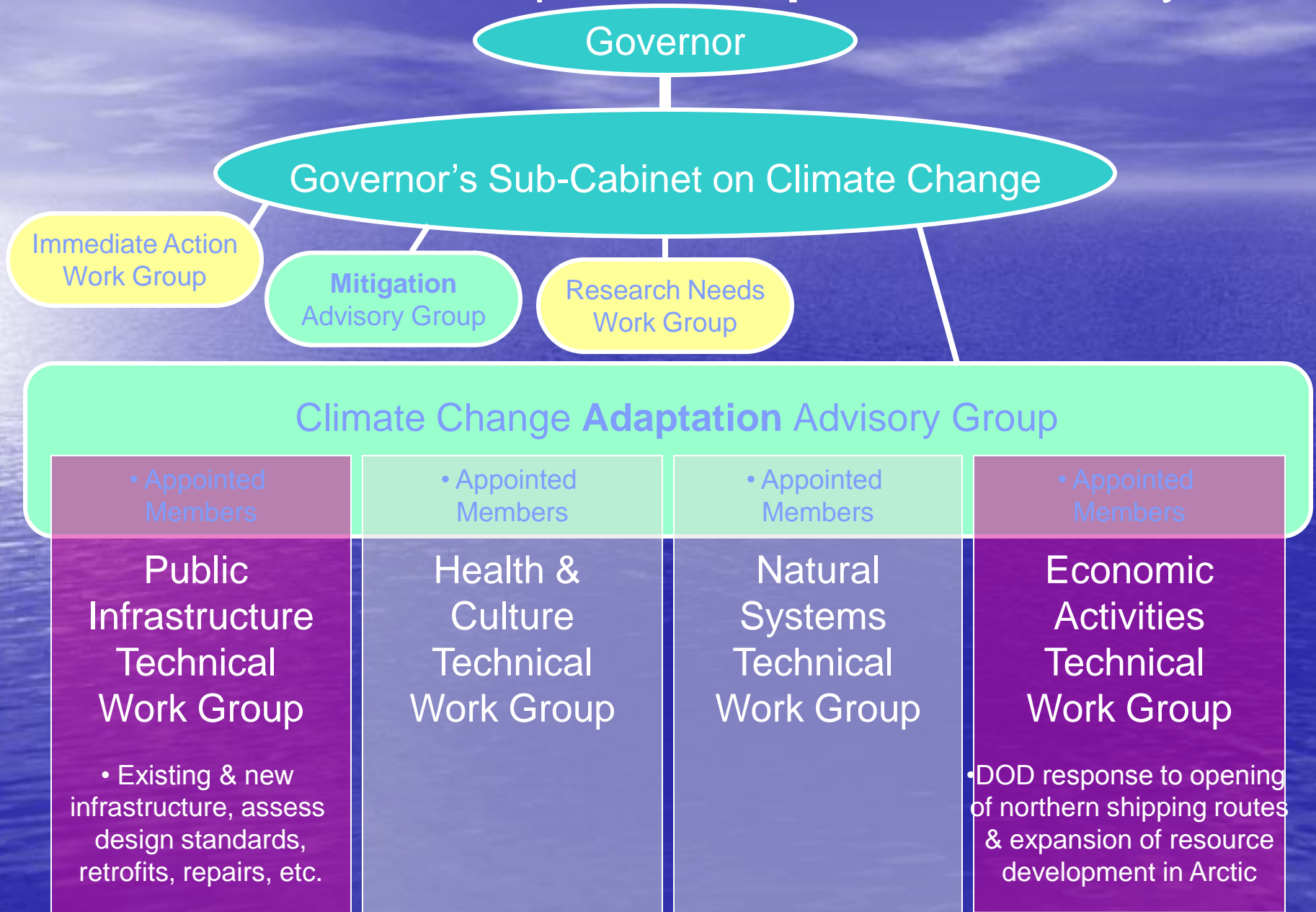
# Immediate Action Workgroup

## IAWG Mission



To close a planning and execution gap identified by Governor Palin and the Congressional delegation by creating a unifying mechanism to assist the communities of Newtok, Shishmaref, Kivalina, Koyukuk, Unalakleet, and Shaktoolik . These communities face imminent threats of loss of life, loss of infrastructure, loss of public and private property, or health epidemics caused by coastal erosion, thawing permafrost and flooding.

# Technical Work Groups for **Adaptation** Advisory Group



# Components of the Alaska Climate Change Strategy

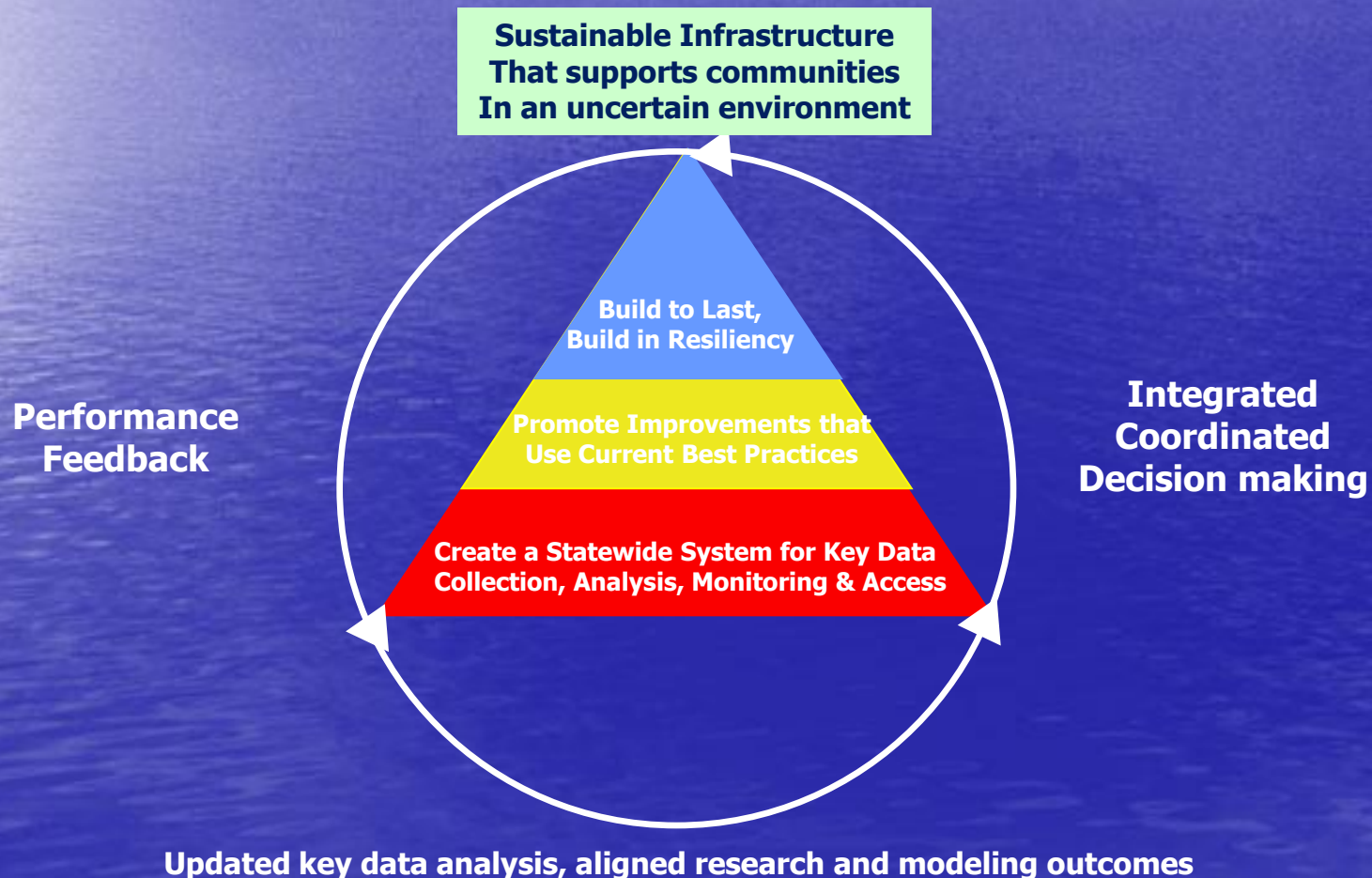
## Overview of Public Infrastructure

### Policy Recommendations:

- Create a Coordinated and Accessible Statewide System for Key Data Collection, Analysis, and Monitoring
- Promote Improvements that Use the Current Best Practices
- Build to Last; Build Resiliency into Alaska's Public Infrastructure

# Components of the Alaska Climate Change Strategy

The recommended adaptation options are designed as an integrated system. The three policies (in the triangle) build upon and support one another. Process of continued, routine communication and feedback is essential to adapt and refine actions taken over time.



# Components of the Alaska Climate Change Strategy

- **Adaptive Capacity for Existing Infrastructure is Low**
  - Public infrastructure is fixed, doesn't lend itself well to revised alignment, elevation, or structural foundation.
  - When modification is possible it is typically very expensive.
- **New Construction Provides More Opportunity to Incorporate Adaptive Techniques**
  - High potential for adaptive capacity in new infrastructure and construction through planning for projected climatic changes and updated design and siting.
  - However, these techniques increase project cost.

# Thank You



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