

AK LEGISLATURE SPECIAL COMMITTEE FILES SCOMM 145 3129 3

Representative Samuels
January 31, 2008
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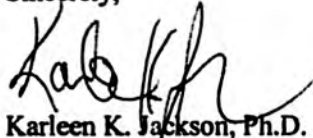
An increase in waterborne, skin, respiratory, and other illnesses resulting from the collapse of sanitation infrastructure and changes in access to quality drinking water due to melting permafrost melts, eroding shorelines, changing waterways and disappearing watersheds. These changes in rural Alaskan villages could result in the loss of the most basic public health service, quality drinking water. Response to disease outbreaks in these areas poses serious financial implications in the form of epidemiologic surveillance, provision of medical treatment, and implementation of prevention strategies.

Increased mental illness (e.g., depression, anxiety) and social stress due to changes in the physical environment and lifestyles.

All of these changes will require increased DHSS staff time and resources for surveillance, outbreak response, and public education efforts. At this time, DHSS does not have financial information on current or potential public health impacts due to climate change.

Please don't hesitate to contact me if you would like additional information regarding this issue.

Sincerely,



Karleen K. Jackson, Ph.D.
Commissioner

cc: Jay Butler, M.D., Chief Medical Officer,
Beverly Wooley, Director, Division of Public Health
Joe McLaughlin, M.D., Chief, Section of Epidemiology

STATE OF ALASKA

DEPARTMENT OF MILITARY AND VETERANS AFFAIRS

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February 15, 2008

Representative Ralph Samuels
AK Climate Impact Assessment Commission
State Capitol #204
Juneau, AK 99801-1182

Re: Request for Information Relating to Climate Change

Dear Representative Samuels:

In response to your letter of December 20, 2007, the Department's Division of Homeland Security and Emergency Management (DHS&EM) has examined Legislative Resolve No. 49 and prepared an analysis describing actual and potential effects upon the division's roles and responsibilities related to events which may be associated, in part or whole, to a changing climate.

DHS&EM is observing an increase in community fuel shortage incidents. While not considered disasters or emergency events, DHS&EM maintains a high level of awareness of these issues in the event the shortages result in life, safety, or public infrastructure damage issues. The primary concern is the ability for riverine, coastal, and island communities to receive bulk fuel deliveries via barge. For riverine communities, the issue involves water levels and the ability for barges to travel upriver and make landings. For coastal and island communities, the issue involves the ability for bulk fuel deliveries to be made prior to the fall sea storm season. Although not disaster related, the economic impacts to communities that must fly fuel in when timely bulk fuel deliveries cannot be made are a recurring issue. In order to improve intergovernmental synchronization DHS&EM along with DCCED are developing an annual coordination program, to be conducted in the June timeframe, to allow communities, bulk fuel providers, and state agencies that provide energy and fuel assistance to assist in the development of a coordinated approach to bulk fuel deliveries, and to develop a system of indicators and warnings as a result of bulk fuel delivery disruptions due to seasonal and climatic events.

Trends show a significant increase in costs for disasters over the last 16 years along with a rising number of repair projects. These rising trends may indicate potential increased response and recovery costs to DHS&EM. A list of potential disasters appears below:

- **Coastal Erosion:**

Coastal erosion is the wearing away of land resulting in loss of beach, shoreline, or dune material and is effected by waves, currents, wind, coastal storm surge, coastal storms, and flooding. The most dramatic erosion often occurs during storms, particularly because the highest energy waves are generated under storm conditions. Sea / shore ice serves as a

barrier and protection for coastal land from adverse weather. Climate change that diminishes the sea /shore ice thickness or longevity can dramatically effect costal erosion. Climate change that results in sea-level rise can also effect coastal erosion.

- **Storm Surge or Coastal Floods:**

Storm surge occurs when the sea is driven inland above the high-tide level onto land that is normally dry. Often, heavy surf conditions driven by high winds accompany a storm surge adding to the water's destructive-flooding force. The conditions that cause coastal floods can also cause significant shoreline erosion as the flood waters undercut roads and other structures. Winds maintained from roughly the same direction over a long distance across the open ocean (fetch) contribute to storm surge. Thin or absent shore and sea ice significantly contribute to the costal erosion and damage from coastal storm surge.

- **Flooding:**

Flooding may be related to climate change when waterways are altered due to ice jams or erosion changes when there is a change in rainfall-runoff, snowmelt, lake levels, ground water tables or glaciers, when there is storm surge flooding (see above):

- **Ivu:**

Ivu, also called an ice override, occurs when floating sea ice is pushed ashore by wind. The ice usually over-rides the beach a few tens of feet inland. Ivu may be related to climate change because the sea ice thickness, age and longevity are influenced by changes in climate. The latest Ivu occurred in January 2006, where 400 miles of sea ice started to move inland near Barrow. This developed a wall of ice 20 to 40 feet high that stopped just short of destroying a major road and adjacent power lines.

- **Severe Weather:**

Climate change could possibly increase storm frequency and intensity including wind, thunderstorms, lightening and precipitation.

- **Permafrost:**

An increase in temperature from climate change could result in areas of permafrost melting with the result of unstable ground. Inland permafrost thaw could affect the State transportation and infrastructure with collapsed roads, shifted railroad tracks, and building supports constructed on melting permafrost.

- **Wildland Fire:**

Should climate change result in an increase in temperature, decreased rainfall and drought there could be a corresponding increase in wildland fire activity.

All of the potential disasters listed above have current and potential effects on the citizens, natural resources, public health, and the economy of our state.

Since 1978, Alaska has declared over 226 disasters totaling a cost of over \$378 million. Below is a list of the natural disasters and the total cost from 1978-2007:

- Flood, storm, landslide, and avalanche – over \$250 million
- Wildland fire – over \$42 million
- Earthquakes accounts – about \$30 million
- Freezing Cold/Wind – over \$22 million

Of the over \$378 million expended, individual assistance accounted for over \$35 million while and public assistance accounted for over \$294 million. Refer to the attached document **Summary Data.pdf**.

The rapid warming Alaska is already experiencing is bringing substantial ecological and socioeconomic impacts, many of which result from thawing permafrost or melting sea ice. Permafrost underlies most of Alaska, and the recent several decades of warming have been accompanied by extensive thawing, causing increased erosion, landslides, sinking of the ground surface, and disruption and damage to forests, buildings, and infrastructure. Warming is also likely to impair transport by shortening the seasonal use of ice roads.

Retreat of sea ice allows larger storm surges to develop, increasing the risk of increasing erosion on coasts that are also made vulnerable by permafrost thawing. In some regions, shorelines have retreated more than 1500 feet due to erosion, over the past few decades.

The most current disaster with the specific circumstances of flooding and erosion that have affected life, property, economic and resource development in the state is the 2007 Kivalina fall sea storm. In this disaster the community was evacuated, sustained damage to the sea wall, and imperiled the loss of structural integrity for the fuel storage tanks owned by Alaska Village Electric Cooperative (AVEC) – all due to rapid erosion. Since 2002 this community alone has been involved in four other declared disasters.

- 2002 Northwest Fall Sea Storm (AK Disaster 03-201) – funds provided to the Community of Kivalina through the Northwest Arctic Borough (NWAB) for emergency protective measures.
- 2004 Bering Strait Sea Storm (FEMA Disaster DR-1571-AK) – funds provided to AVEC, the Community of Kivalina, and the School District for emergency protective measures, power line repairs, and movement of the principal's home. Permanent repairs to the sea wall were not approved.
- 2005 West Coast Storm (FEMA Disaster DR-1618-AK) – funds provided to DOT&PF, AVEC, the Community of Kivalina, and the School District for emergency protective measures, airport runway repairs, and relocation of the principal's home.
- 2006 October Kivalina Sea Wall Damage (AK Disaster 06-222/AO 231) – funds provided to NWAB, AVEC, and the Community of Kivalina for emergency response and emergency protective measures, not to include permanent repairs to or replacement of the seawall.

Other than Kivalina, the Village of Alakanuk has experienced recurring ice jam flooding. On June 13, 1984 Alakanuk experienced ice jam flooding which damaged the village road system. The State of Alaska funded a public assistance disaster grant to repair the damaged road. Since then, Alakanuk received in 2004 a grant for \$278,530 to relocate and elevate 15 residential structures and one city structure to locations that were less susceptible to the seasonal flooding from the Alakanuk slough of the Yukon River. Although we enumerate but a few communities, there have been many disasters possibly related to climate change that have affected numerous cities and villages in the interior and coastal regions of Alaska.

State of Alaska DHS&EM has already taken steps to prevent and mitigate climate warming trends by: being involved in emergency and disaster response to flooding, sea storms, tidal surges and other natural and man-made emergencies; involvement with coastal erosion community relocation workgroups, planning and taskforces, training and education for climate change related emergencies including flooding, evacuation, storms surge, fuel spills; and involvement in Congressional and State Legislative and Executive Branch cabinets and working groups on climate change.

Local hazard mitigation plans, developed between Alaskan communities and the DHS&EM is also an alternative measure that is mitigating the effects of flooding and erosion within the State of Alaska. All communities with local adopted FEMA plans will qualify for federal grant money under the Hazard Mitigation Grant Program, and the Pre-Disaster Mitigation Program. Currently Alaska has 24 approved FEMA plans, and 50 plans that are under development through various communities and contractors. From Alaska Federal Disaster Declarations, Hazard Mitigation Grant Program (HMGP) a total \$302,958 has been awarded. These funds have been split between mitigation projects and planning (Projects: \$245,942/ Planning: \$57,016).

- Examples of HMPG projects and plans:
 - May 2002 Interior Flood Disaster HMGP Grant:
 - Alakanuk: \$200,000 to relocate homes and elevate foundations
 - April 2004 Denali Earthquake Disaster HMGP:
 - Alakanuk: \$7,500 to develop local hazard mitigation plan
 - Kotlik: \$7,500 to develop local hazard mitigation plan
 - November 2004 Bering Strait Sea Storm Disaster HMGP Grant:
 - Shishmaref: \$45,942 to relocate Computer Center Cottage
 - Northwest Arctic Borough: \$34,516 to develop local hazard mitigation plan
 - January 2005 North Slope Borough Sever Winter Storm Disaster HMGP Grant:
 - Nunam Iqua: \$7,500 to develop local hazard mitigation plan
- Examples of PDM plans
 - PDM 2007 Planning
 - Shishmaref, Skagway, Craig, Tok, Kwethluk, Akutan, Cold Bay, False Pass, King Cove, Sand Point, Saxman, Port Alexander
 - Aleutians East Borough
 - Ketchikan Gateway Borough
 - City and Borough of Sitka
 - PDM 2008 Planning
 - Galena, Kaltag, Anvik, Nulato, Ruby, Huslina, Alatna, Allakaket, Bettles, Evansville, Hughes

Our public assistance section within the division is also engaged in preventing and mitigating the effects of flooding and erosion. The Public Assistance (PA) program under a state or federal declared disaster provides state, local and Alaska native village governments and certain private non-profit agencies (applicants) funding for permanent repair to infrastructure damages and reimbursement for Debris Removal and Emergency Response costs. State declared disasters are treated the same as federal declared disasters with a few exceptions.

- Disaster Assistance under the PA program for Federal Declared disasters:
 - Separates small and large projects with different requirements for each.
 - Allows for improved projects
 - Allows for alternate projects
 - Provides funding for disaster related mitigation efforts through the 406 Mitigation Program.
- Disaster Assistance under the PA program for State Declared disasters:
 - Does not separate small and large projects (all projects are treated the same),
 - Allows for improved projects
 - Does not allow for alternate projects
 - Does not provide funding for disaster related mitigation efforts

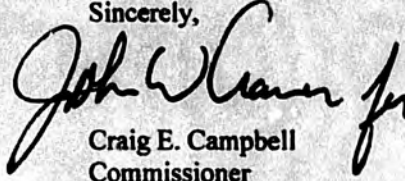
DHS&EM's role in response to climate change issues is limited due to FEMA Stafford act, federal coordination, and federal funding. These policies decrease the negative effect on climate change issues, allowing the state limited funding due to a lack in coordination efforts of mutual concern with federal agencies. Below is a list of these policies.

- FEMA Stafford Act limitations:
As currently legislated, the Stafford Act, on which all FEMA mitigation activities are based, is primarily limited to actual disasters or imminent threats to life and property. For example, relocation of properties and infrastructure to entirely new community sites is not an activity which FEMA would consider eligible under the Stafford Act.
- Federal Coordination limitations:
FEMA mitigation grant funding is limited to activities for which another federal agency is not responsible. Therefore, FEMA mitigation funds can not be used for projects that are primarily the domain of the US Army Core of Engineers or Natural Resource Conservation Service.
- Federal Funding limitations:
FEMA mitigation grant funding is limited to either a small percentage of a federally declared disaster (HMGP) or a yearly nationally competitive grant program (PDM). Both these grant programs have many more eligible projects from around the State and Nation than they have funds for.

Rep. Ralph Samuels
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Since 1978 Alaska has experienced 226 disasters, and not until those disasters take place is the Division able to respond. This is due to the current Stafford Act, federal coordination, and federal funding limitation making DHS&EM unable to provide pre-disaster mitigation (other than planning) to communities that may be affected by climate change disaster. Until an amendment is made to the Stafford Act, the DHS&EM is unable to provide any protective solution, but rather wait until the disaster strikes.

Sincerely,

A handwritten signature in dark ink, appearing to read "Craig E. Campbell for". The signature is fluid and cursive, with a long horizontal stroke at the end.

Craig E. Campbell
Commissioner

Improved Projects, Alternate Projects and 406 Hazard Mitigation Procedures for Federal and State Disaster Assistance

(Provided by DHS&EM, State of Alaska)

- A. The Public Assistance (PA) program** under a declared disaster, whether State or Federal declared, provides State, Local and Alaska Native Village Governments and certain Private Non-Profit agencies (applicants) funding for permanent repair to infrastructure damages and reimbursement for Debris Removal and Emergency Response costs. State declared disasters are treated the same as Federal declared disasters with a few exceptions.
- B. Disaster Assistance under the PA program for Federal Declared disasters:**
- (1) Separates small and large projects with different requirements for each.
 - (2) Allows for improved projects
 - (3) Allows for alternate projects
 - (4) Provides funding for disaster related mitigation efforts through the 406 Mitigation Program.
- C. Disaster Assistance under the PA program for State Declared disasters:**
- (1) Does not separate small and large projects (all projects are treated the same),
 - (2) Allows for improved projects
 - (3) Does not allow for alternate projects
 - (4) Does not provide funding for disaster related mitigation efforts.
- D. FEMA's Definitions for:**
- (1) Small and Large Projects**
- i. Projects are divided into small and large projects based on the monetary threshold established in Section 422 of the Stafford Act. The threshold is adjusted each fiscal year to account for inflation and published in the Federal Register.
 - ii. Small Project – is based on estimated costs, if actual costs are not yet available. Payment is made on the basis of the initial approved amount, whether estimated or actual. Even if not all funds are expended on the project, the Federal share amount is not changed.
 - iii. Large Project – is based on documented actual costs. When all work associated with the project is complete, the State performs a reconciliation of actual costs and transmits the information to FEMA for consideration for final funding adjustments.
- Note:* Under a State Disaster, reconciliation of actual costs is done for all projects regardless of dollar amount. All projects are treated the same.
- (2) Improved Projects**
- i. When performing permanent restoration work on a damaged facility, an applicant may decide to use the opportunity to make improvements to the

facility while still restoring its pre-disaster function and at least its pre-disaster capacity. For example: FEMA has written a project worksheet for the applicant to repair a 2 mile stretch of gravel road, the applicant decides that now would be a good time to pave that road. This change would constitute an improved project and the Project Worksheet would be changed to reflect the applicants' decision.

- ii. Funding for such a project is limited to the Federal share of the cost that would be associated with repairing or replacing the damaged facility to its pre-disaster design, or to the actual costs of completing the improved project, whichever is less, if the funding for the improvements cannot be separated from the costs for the original repair work.
- iii. If the original facility is being repaired and improvements are being added, FEMA may provide assistance with hazard mitigation under Section 406 of the Stafford Act. These funds must be applied to the original facility. If the improved project involves a complete new facility on the same site or on a different site, FEMA cannot approve Section 406 Hazard Mitigation funding that may otherwise have been eligible for the original facility. For example: If floodwaters inundate a sanitary sewer, block manholes with sediment and damage some of the manholes, cost-effective mitigation to prevent blockage of the damaged manholes in future events may be eligible; however, work to improve any undamaged manholes that are part of the system is not eligible.

Note: Under a State Disaster, improved projects are allowed and the requirements are the same as FEMA's.

(3) Alternate Projects

- i. An applicant may determine that the public welfare would not be best served by restoring a damaged facility or its function. In this event, the applicant may use the PA grant for that facility for other eligible purposes. Funds may also be used on more than one alternate project, and an applicant may request an alternate project in lieu of either a small or large project, but only on permanent restoration projects. The alternate project must serve the same general area that was being served by the originally funded project. The original facility must be rendered safe and secure, sold, or demolished. If an applicant opts to keep a damaged facility for a later or another use, it will not be eligible for FEMA funding in a subsequent disaster unless it is repaired to meet codes and standards, and mitigation measures that would have been approved are applied.

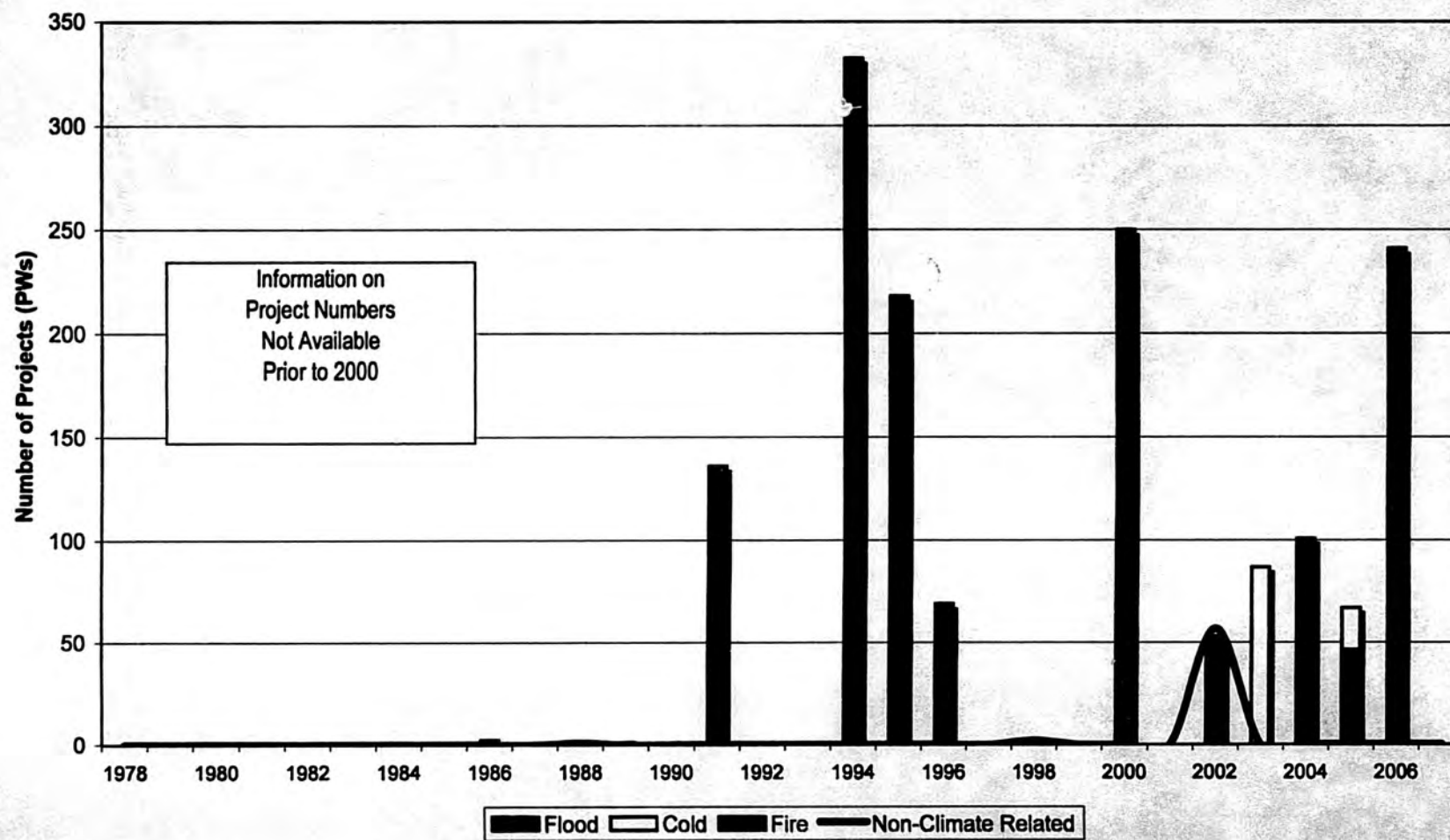
Note: Under a State Disaster, alternate projects are not authorized. DHS&EM is currently writing Regulations that could allow applicants to do alternate projects.

(4) Section 406 Hazard Mitigation

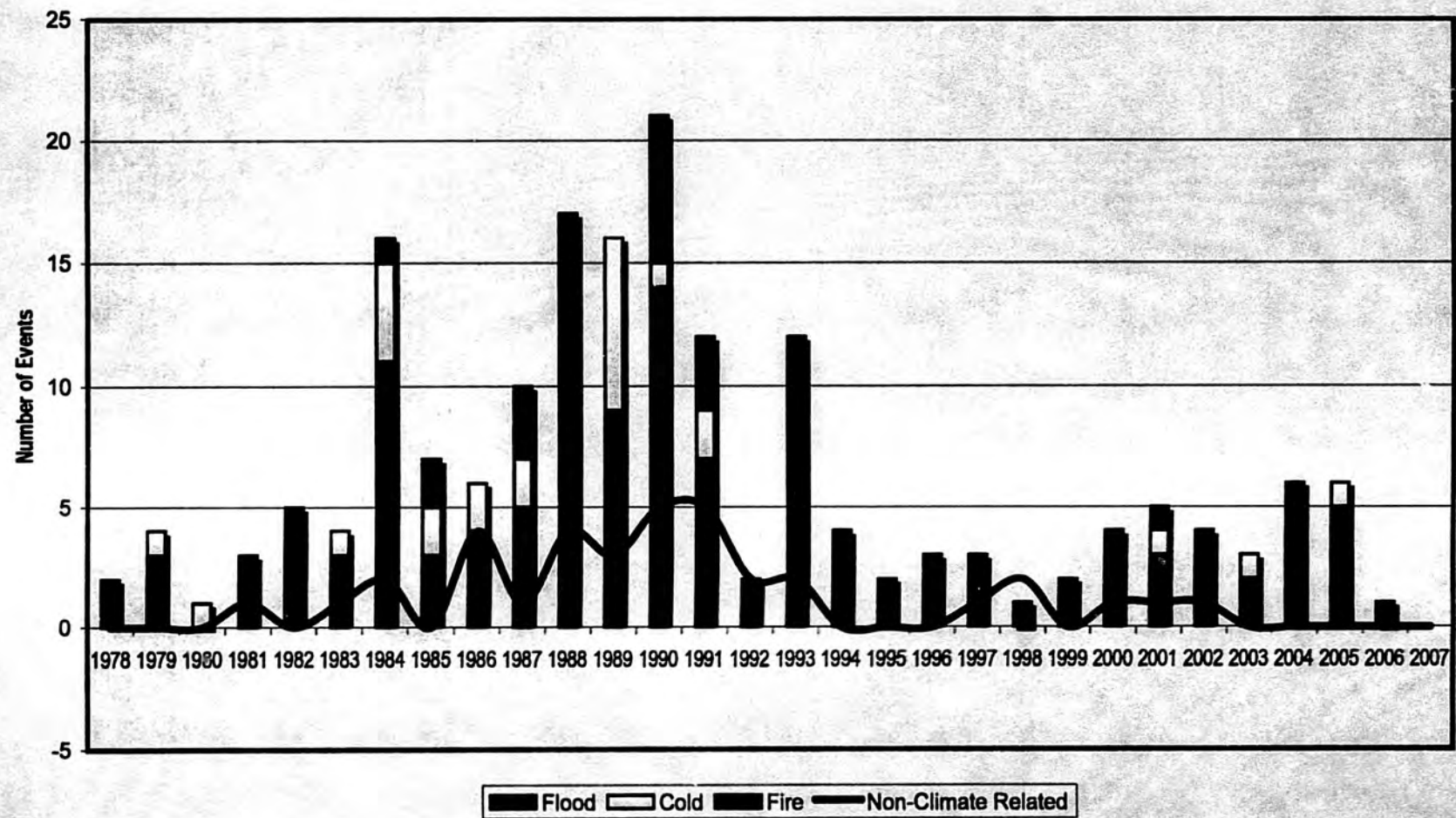
- i. Hazard mitigation is defined as cost-effective action taken to prevent or reduce the threat of future damage to a facility. The applicant, FEMA, or the State may recommend that hazard mitigation measures be included in a Project Worksheet (PW). The costs of eligible hazard mitigation actions will be included in the overall funding of a project.
 - 1. To be eligible, Section 406 hazard mitigation measures:
 - 2. Must be appropriate to the disaster damage and must prevent future damage similar to that caused by the declared event.
 - 3. Must be applied only to the damaged element(s) of a facility.
 - 4. Cannot increase risks or cause adverse effects to the facility or to other property.
 - 5. Must consist of work that is above and beyond the eligible work required to return the damaged facility to its pre-disaster design.
 - 6. Cannot be applied to replacement buildings.
 - 7. Applies only to structural measures and does not apply to buyouts.
 - 8. No program-wide limits on funds, but each project must be cost-effective and approved by FEMA.

Note: Under a State Disaster, there are currently no provisions that allow for hazard mitigation measures.

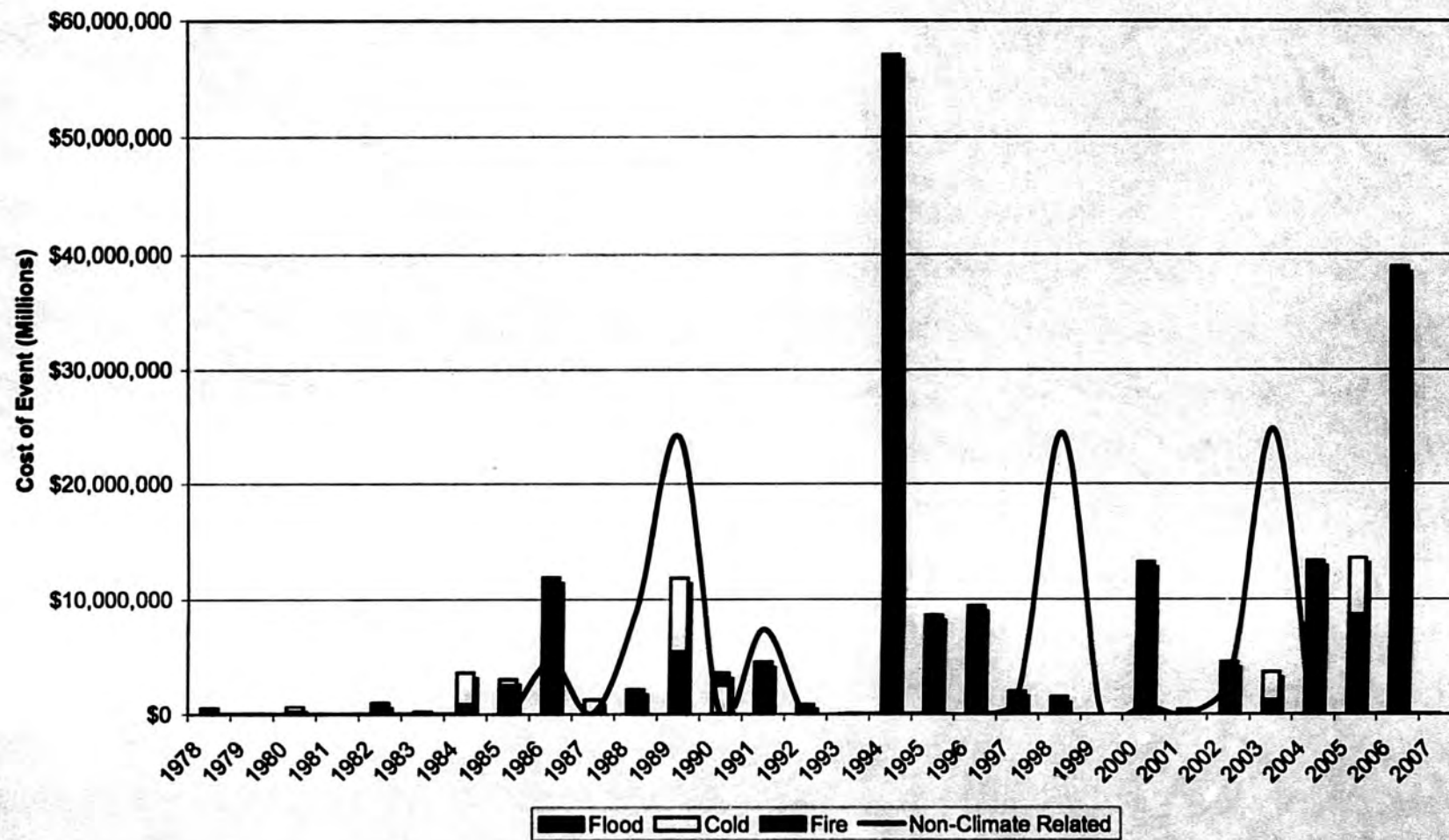
**Comparison of Types of Climate-Related Public Assistance Project Numbers Totals to Other
Projects:
Federal Declarations from 1978-2007**



**Comparison of Types of Climate-Related Disasters
to Other Disasters:
State Declarations from 1978-2007**



**Comparison of Types of Climate-Related Disaster Costs
to Other Disaster Costs:
State and Federal Costs from 1978-2007**



STATE OF ALASKA

DEPARTMENT OF NATURAL RESOURCES

OFFICE OF THE COMMISSIONER

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February 29, 2008

Representative Ralph Samuels
Chair, Alaska Climate Impact Assessment Commission
State Capitol #204
Juneau, AK 99801-1182

Dear Representative Samuels:

In response to your letter dated December 5th, 2007, the Department of Natural Resources (DNR) has put together a bulleted list of potential natural resource impacts associated with climate change. As you are aware, the northern latitudes may experience dramatic environmental alterations, and as is the case with all change, there will be both positive and negative impacts experienced in Alaska. It is important for the state to identify what mitigation measures are possible and feasible.

The Department of Natural Resources is working with the Governor's Sub-Cabinet on Climate Change, led by the Department of Environmental Conservation (DEC) and Commissioner Hartig, to identify both current and future impacts. The following list of bullets outlines our understanding of potential impacts. Identifying future costs associated with possible impacts will be a complex undertaking because of interdependent variables and significant uncertainty in forecasts.

Potential Near-Term Impacts to Natural Resources affecting DNR

• Data Collection Needs

- **Baseline data** is required in all sectors to enable identification and monitoring of change. Most areas have limited quantitative information. Increased data collection and interpretation could require additional funding to acquire initial data sets and imagery (depending on resolution, coverage needed, and federal partnerships) and for site-specific mapping efforts and identification of local climate impacts/hazards
- **High resolution LIDAR imagery and satellite data**
 - High resolution Digital Elevation Models (DEM) for select developed areas, or areas of potential development
 - We need better tools to track changes in the geomorphology, such as an accurate statewide digital elevation model, and high-resolution imagery that require regular updates. This information will enable us to identify trends in coastal and non-coastal erosion. The imagery will enable tracking of vegetation changes. The State is already leading an effort to develop a statewide digital base map, and this effort needs to be supported.

Representative Ralph Samuels

2/28/2008

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- For example, the Forest Inventory and Analysis (FIA) program in the U.S. Forest Services Pacific Northwest Research Station just acquired a LIDAR dataset for the Kenai Peninsula at the cost of \$3 million.

○ **Hazards mapping**

- Detailed geologic mapping in order to identify areas requiring hazards designation
- Derivative mapping of potential hazards areas for use in planning and permitting activity
- Detailed mapping of permafrost conditions to identify areas susceptible to thaw settlement under warming conditions
- Mapping of vegetation fuel types and infrastructure around communities to development risk maps for wildland fire threats

○ **Wildland Fire Risk**

- Warming trends are causing both a longer and more intense fire season across Alaska. Changes in permafrost conditions and weather patterns, particularly precipitation, which can have a large impact on both the long and short term impacts to vegetation across the state.
- The 2004 and 2005 fire seasons burned over 11 million acres of land in Alaska with the 2004 season setting a record for acreage burned in one season, 6.5 million acres. The combined State fire costs for FY04 and FY05 were \$95 million. How much can be attributed to climate change can't be determined.
- While the 2007 fire season was one of the lower years for total acreage burned, a late season wildfire on the North Slope caused problems until late September. The Anaktuvuk Pass fire reached 256,000 acres in size and caused air quality (smoke) issues from both a health and safety viewpoint. (Figure 1) Is the fire regime changing in the Arctic?
- Earlier fire season length and implementation of the program would substantially increase the fire preparedness budget.
- An increase in large project fires over the next 10 years would also considerably increase the State's costs for fire suppression.
- Deployment of DNR's Incident Management Teams (IMT's) that respond to natural disasters and associated emergencies will have budget impacts

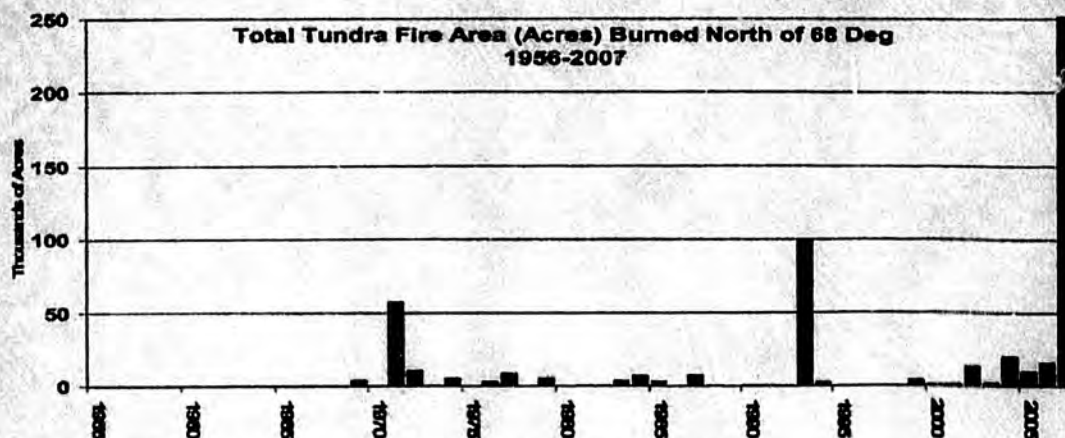


Figure 1- Acreage burned in Alaska North of 68 Degrees for the years 1956 to 2007, source Alaska Fire Service.

- Large fires in the tundra may have impacts on summer and winter range of caribou and affect migration routes.
 - Smoke issues associated with large wildland fires can cause disruptions in economic activities for communities. Road closures and other travel restrictions can cause short-term economic hardships for communities such as the Taylor Highway closures in 2004. The communities of Chicken, Tok and the surrounding villages were all affected.
- **Changes in Regulatory Framework**
 - *Permitting exploration and infrastructure development activities* in an ever changing environment require increasing the number of regulatory staff and associated staff costs.
 - Physical environment changes may require permit modifications and re-assessment of development activities to ensure safe operations
 - Fine-tuning our ability to predict likely change and, where possible and feasible, mitigate it,
 - Potential surface condition changes could include upland to marine, wetlands to upland, frozen soils to thawed soils or wetlands, fresh water to salt water. Any change in surface conditions will result in changes to appropriate resource permitting.
 - **Energy Development Issues**
 - Tundra travel limitations and reduced operational windows for exploration and development of resources during the winter season
 - The possibility of new carbon dioxide emission standards and carbon taxes suggest that the State should actively promote the development of larger-scale renewable energy resources. The same reasons suggest that the State should consider the development of alternative energy projects, such as tidal power in Southeast

Alaska. The department is beginning research to develop a more robust model for permitting alternative energy projects.

- Moving buildings or facilities related to the oil and gas industry could result in a change in regulatory oversight. Especially if the relocation results in an ownership change from state to federal.
- Biomass opportunities, particularly sustainable wood energy projects for space heating may be implemented in many rural and urban locations. Wood fuel is "carbon neutral" in regard to CO₂ emissions because the new young forest sequesters carbon as it grows and thus no net gain in CO₂ emissions is realized by the harvesting and burning of wood fuels.
- Using alternative energy, such as hydro, wind, solar and biomass to replace fossil fuels, like coal and oil produces an "offset" credit. Because these projects do not use a fuel source that creates additional CO₂ emissions, the amount of CO₂ that would have been released by the burning of the fossil fuel can be calculated in tons of carbon "offset". This "offset" tonnage may be sold into a carbon trading market if one is available.
- Pipelines
 - Existing facilities near or at existing sea level may experience additional erosion if sea levels continue to rise. In some cases, this could result in redesign of miles of pipelines from vertical support members (VSMs) to burial in a marine environment.
 - A large number of existing VSMs that do not have thermal couplers or heat pipes could become unstable and the resulting movement could produce sufficient stresses to damage existing pipelines.
 - Existing buried pipelines potentially could experience the loss of support beneath the pipe due to thermal degradation.

○ *Energy Consumption Issues*

- Carbon Dioxide emission standards
 - New federally mandated carbon emission caps, including credits for carbon sequestration, may put significant regulatory burden at the state level.
- CO₂ Capture and Storage
 - CO₂ injection in subsurface could create a complicated regulatory burden due to minerals ownership and CO₂ migration liabilities
 - There is some potential of an injected plume migrating onto adjacent acreage and towards the surface into aquifers.
 - Depleted oil and gas reservoirs may become feasible sites for long-term sequestration of CO₂, however this could affect revenue streams if producible amounts of oil or gas remain in these reservoirs.
 - Potential need to develop a certification body to verify carbon mitigation projects and the tonnage of atmospheric carbon being captured or stored. A third party certification is required before a project can be sold on a carbon exchange, such as the Chicago Climate Exchange. Often a governmental agency fulfills this role. Alaska has no private or public certification body at this time.

o ***Mining Issues and Regulatory Challenges***

- Mining projects are energy intensive. If energy costs experience additional increases due to carbon regulation issues, those cost increases may disproportionately impact mining projects which already face numerous hurdles in Alaska due to remoteness, seasonality, lack of transportation infrastructure, etc.
- Mining projects in permafrost areas sometime look to "freezeback" in tailings dams and tailings disposal sites. "Freezeback" is the idea that permafrost will expand into the dam of tailings disposal site, helping to stabilize and seal the facilities and minimize seepage. Reliance on freezeback may become increasingly difficult. Tailings dams must be engineered and monitored to recognize permafrost changes.
- Alaska has significant quantities of coal and most is substantially cleaner than much of the coal in the lower 48. We are currently in the permitting process for a proposed surface coal mine (the Chuitna Coal Mine) in the Beluga area. If permitted, it will be a large project with an approximate 25 year mine life. Global warming concerns often cite coal as being a significant CO₂ emitter, and we are hearing this in relation to the Chuitna project. Commentors appear to be seeking to link CO₂ and global warming to the permitting process and to expand the cumulative impacts analysis under NEPA to include global warming, even for coal to be shipped to foreign markets. Climate change concerns could have a significant impact on the development of Alaska's coal resources.
- Changing patterns in precipitation should be analyzed to ensure that mine tailings dams are constructed with sufficient freeboard and adequately sized emergency spillways for anticipated future storm events; particularly where dams must be maintained in perpetuity.
- With the thawing of permafrost over the past several decades, and the continued placer mining activity in areas of frozen loess, the State of Alaska may need to scrutinize future placer mining activities in these regions in order to minimize man-made erosion of these silts.
- "Carbon taxes", depending upon how they are applied, have the potential to stifle future development of Alaska's coal resources and close existing operations.
- Shortened winter travel seasons will adversely affect mineral and energy exploration and development programs, requiring the agencies to monitor the freeze-up and breakup periods ever more closely.

o ***Infrastructure and Development Zoning Issues***

- It may be appropriate for zoning laws to reflect potential environmental change
- Strict scrutiny, 'retooling', and enforcement of permit requirements (both existing and newly developed)
- Increased focus on engineering and design activity to ensure appropriate development in hazardous areas
 - It is important to evaluate changes in coastline to understand potential changes. Permitting agencies need to have and use this information in order to make good permit decisions on proposed development activities on the coast.

- Local government authorities should also be vigilant in permitting development in erosion and flooding prone areas to ensure the activities are sited, designed, and constructed to mitigate potential.
- ***Pipeline and Energy Infrastructure***
 - There has been hundreds if not thousands of heat pipes or thermal piles installed for schools, airports, jails, and numerous other public and private buildings in Alaska. The state may want to consider a monitoring program similar to that used by the Alyeska Pipeline Service Company (APSC) for the 1,222,000 individual heat pipes along the Trans Alaska Pipeline (TAPS), for the other existing heat pipes or thermal piles found throughout Alaska.
 - The state may want to look to the lessons learned on TAPS for surface, slope stability and geotechnical maintenance on other projects.
 - Difficult problems often occur after construction. The trend is towards greater stabilization each year after construction. While construction disturbs thermal regimes of an area, the area does reach a new thermal equilibrium if properly restored.
 - A change in the Mean High Water level could result in a change in the interface between salt and fresh water. This change could result in a pipeline designed for contact with fresh water or air now being in contact with more corrosive salt water.
 - The degree and direction of the movement of contamination resulting from spills could change.
 - In some cases permafrost has been a barrier in the movement of groundwater and surface water and associated contaminants. Changes in permafrost could result in flooding of gravel pads and contaminants from the gravel pads migrating into the environment.
- ***Land Ownership Issues***
 - Possible change to property boundaries due to sea level rise (change in Mean and Ordinary High Water Mark) or increased river erosion (not a new threat).
 - Increased ownership disputes, most will involve the state as the owner of the tidelands and submerged lands
 - Moving villages or buildings because of erosion; new sites required and vacated land ownership issues
 - The marine or off-shore boundary of state land could change. In some cases, there is a possibility that regulatory oversight could change from state to federal for existing facilities.

Potential Long-Term Impacts to Natural Resources affecting DNR

- **Residential, Commercial, and Infrastructure Development**
 - ***Loss or damage of Public Owned Facilities*** could impact replacement, maintenance and mitigation of state assets.
 - Parks Infrastructure
 - Schools
 - Other public facilities
 - Increased Maintenance costs
 - New cost only if originally built in hazardous area

- Increased Energy Costs
- Change in coastal zone hazard determination based on environmental changes
 - Loss of fast-ice and sea ice protection during storm events that creates increased erosion
 - Change in permafrost and drainage patterns
 - Thermokarst and land subsidence and elevation changes
 - Prediction of future water inundation areas due to sea level rise and river erosion / migration
- Changes in stream regimens could result in increased siltation of harbors and estuaries that will require more frequent dredging and increased costs.
- Ice-rich permafrost that is close to melting temperature could thaw, resulting in failure of even properly designed structures
- Distinguish between potential negative impacts that are the result of natural changes and those that are the result of faulty planning or design

• **Water and Hydrology**

- All aspects of water within the hydrologic cycle will be affected under climate change scenarios.
- **Precipitation Issues**
 - Precipitation patterns may change (including changes in timing). These changes may vary according to season and location. Some areas may receive greater precipitation annually, some may receive less. Some may receive more in a single season, and that same location may receive less in another season.
 - Precipitation amounts may change (change in quantity). As with pattern change, the amount of precipitation received at any one site may be greater or lesser dependent upon location. Amounts received may also vary from historic norms on a seasonal basis.
 - Precipitation form may change. What had previously been snowfall may now be rain.
- **Surface Water**
 - Changing precipitation patterns (timing, quantity and form) may change seasonal surface flow patterns. There may be more water available at times of year, or less.
 - Change in surface storage. Change in water form and quantity may alter available snowpack, and the release of water from that snowpack. A possible result is release of water from snow pack earlier, reducing stream flows during the summer periods. Also, a "flashier" response would be expected to most rainfall events; in essence a lowering of base flow.
 - Change in evapotranspiration patterns. Increased temperatures would, in theory, result in increased evaporation. This change may be partially offset, or conversely exacerbated, by a change in plant life that may result in greater or less transpiration. Surface storage in reservoirs may be reduced, resulting in lesser release of water during warm/dry periods, effectively reducing base flows.
- **Ground Water**
 - Loss or reduction in permafrost will have a major influence on subsurface hydrology
 - What had been confined aquifers may be effectively changed to unconfined.
 - Perched aquifers and/or lakes resulting from permafrost may disappear.

- Local melting of permafrost in regions with artesian domestic water wells that puncture a permafrost layer acting as a confining layer may experience sufficient melting around well casings to allow for discharge outside of the casing.
- Possible increase in infiltration of surface water to the subsurface, reducing streamflow.
- Possible change in pattern of release of storage from the subsurface, resulting in change to surface water patterns.

• **Changes in Subsistence Practices**

- Traditional means of winter travel could be impacted if there is less ice on lakes and rivers or shorter seasons when the ground is frozen or has adequate snow cover for winter travel
- Gradual changes in habitat and species diversity will change what subsistence foods are available for harvest
- Increased fuel costs will change harvest practices

• **Arctic Offshore**

- Possible impacts to shipping and from increased shipping
- Changes to near-shore habitat
- Changes to fisheries and northern migration of habitat in all sectors
- Change in climate pattern because of increased open seaway and different times of year

• **Flora & Fauna Habitat Changes**

- There is a great deal of unique plant genetic resources in the coastal areas. This is especially true of plants on islands, which by the nature of isolation will have the highest probability of evolving unique genetic characteristics. Additionally, changing temperature will also change habitat with some species totally disappearing.
- The state should take an active lead in collecting and storing these resources. The Plant Material Center already has a large collection of seed from the resources. However, more needs to be collected and the collections need to be sent to other facilities for backup storage in case the Alaska facility is damaged or rendered useless. We have a good start and actually lead the world in the collections of high latitude species.
- Increased listing petitions of Endangered Species under ESA
 - Dramatic affect on resource management
 - Changes in habitat results in changes in the species found in a given area. For example, on a coastal plain with rising sea levels, the existing threatened upland species may then relocate. This could result in additional permitting issues and compliance with new ESA requirements
- Changing climate can provide opportunities for increased agriculture; however, this may be coupled with the increased incidence of "pests". The Division of Agriculture could assist in off-setting increased transportation costs of food in both urban and rural areas by encouraging local sustainable food production.
- Increased need for monitoring invasive species (weeds, insects, & plant diseases such as: potato late blight, Canada thistle, hawkweeds, amber-marked birch leaf miner, large yellow underwing moth, etc.)
- In addition to invasive species, endemic species may also cause significant problems to forest and agricultural ecosystems. A case in point is the unprecedented spruce bark beetle outbreak on the Kenai Peninsula that began in 1989 and devastated the spruce forests of the region. The epidemic peaked in 1996-97 and continued into 2000. Pockets of activity still exist and on the Kenai Peninsula Borough over 1 million acres of spruce forests were

Representative Ralph Samuels

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attacked by the insect. Many areas have 90% tree mortality and fire risk has increased substantially due to the dead trees and understory grass that has taken over many of the sites. The risk of catastrophic wildfire is at a historic high on the Kenai and untold economic impacts have resulted from this ecosystem replacement event. The Caribou Hills fire this past summer burned 56,254 acres and destroyed 94 structures.

If you have any questions regarding the information provided above, or other concerns, please feel free to contact Robert Swenson at (907) 451-5001.

Sincerely,



Thomas E. Irwin
Commissioner

cc: Larry Hartig, Commissioner, Department of Environmental Conservation
Tom Chapple, Director, DEC Division of Air Quality
Robert Swenson, Director, DNR Division of Geological and Geophysical Surveys

STATE OF ALASKA

**DEPT. OF TRANSPORTATION AND
PUBLIC FACILITIES
OFFICE OF THE COMMISSIONER**

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February 13, 2008

The Honorable Ralph Samuels, Chairman
Alaska Climate Impact Assessment Commission
State Capitol, Room 204
Juneau, AK 99801-1182

Dear Representative Samuels:

This is in response to your December 14, 2007 letter requesting department input regarding budgetary impacts and engineering and construction considerations from perceived climate changes involving flooding, erosion, and permafrost degradation.

The Department of Transportation and Public Facilities (DOT&PF) manages the State's transportation infrastructure in a very challenging environment with many of the State transportation facilities in the Alaska's interior, northern, and southwest region's underlain by ice-rich permafrost. The department has been battling the effects of warming/melting permafrost for decades. Our Maintenance and Operations Divisions spend an average of \$10 million annually to combat melting permafrost on our highway system. The \$10 million annual figure realistically represents only a fraction of the actual need and therefore this cost may need to increase, perhaps dramatically, if the recent warming trend continues. However, at this point, the department does not have or collect the data necessary to accurately account for permafrost mitigation costs for our entire transportation infrastructure or predict supplemental costs associated with the future impacts of climate change. Doing so would require changing the department's current practices and a significant investment in additional resources. Damages to the public infrastructure could be large, but there is little reliable information detailing the degree and location of impacts.

As part of our mission to manage the State's transportation infrastructure, we have assessed the potential future effects of climate warming trends. Provided below is a list of potential impacts to department's transportation infrastructure and our operations if the climate warming trend continues.

- 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.
- The longer seasonal transition may lead to changes in weight restriction policies - both in terms of weights allowed and the length of time the restrictions will be in place.

- An increase in the rate of degrading permafrost is likely to increase highway and airport surface distress requiring an increase in both maintenance and capital expenditures to address the resulting safety problems. In some cases this may require the reevaluation of current design, construction and maintenance practices.
- The majority of roads in the interior, particularly around Fairbanks and north of Fairbanks, traverse areas underlain by ice-rich permafrost and will likely require substantial rehabilitation/ reconstruction and/or relocation if the warming trend continues.
- Increased Active Layer Detachments (slope sloughing and failures) on slopes adjacent to the highway system that result from the thawing of ice-rich surface layers. The thawing of these ice-rich slopes leads to a form of mass wasting. The potential for damage to the highway infrastructure is high and will require a pro-active geotechnical approach to prevent impacts to the transportation system. Even in less extreme instances, the mud-flow sloughing of cut banks fills ditches and plugs culverts, which will result in higher maintenance costs.
- A significant percentage of our airports in northern, western and interior Alaska are built over permafrost that will require significant rehabilitation/reconstruction and/or relocation if their foundations thaw.
- A number of our public buildings in northern, western and interior Alaska are built over permafrost that will require significant rehabilitation/reconstruction and/or relocation if their foundations thaw. These facilities include the majority of M&O maintenance stations.
- Embankments built over permafrost will need to be thicker to prevent the underlying ground from thawing. This will add to the cost of rehabilitation and reconstruction as more fill materials will be required.
- 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.
- Glacial fed rivers and streams will likely experience increased flows with the potential for flooding and the cutting of new, unanticipated stream channels. Highways such as the Copper River Highway and segments of the Richardson Highway may experience increased flooding requiring larger culverts and/or larger bridges.
- 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.

- If the timing, frequency, form and/or intensity of precipitation change in the future, then related natural processes, including debris flows, avalanches and floods, would likely increase with the resulting effect of increased repair costs.
- 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. As the climate continues to warm, coastal erosion will increase as sea ice retreats and coastal storms become more frequent.
- Coastal communities and their infrastructure are vulnerable to a rise in the sea level. A rise in the sea level could result in the required relocation on many public facilities as well as entire communities.
- As the Geophysical Institute has determined, warming temperatures are altering the blend of vegetative growth on the North Slope of Alaska. Extending this affect to all of Alaska leads to the conclusion that we may well face increased vegetation throughout our more northern areas, and face increasing demands for vegetation management that have never cropped up before.
- The slowly increasing temperatures being forecast by scientists will allow a variety of invasive plants to prosper in Alaska, which will pose new challenges and demands on our maintenance forces.
- The climatic warming trend, combined with an increase in transportation energy costs, will probably lead to alterations in the current vehicle "mix" (i.e., personal automobiles versus mass transit; buses and trains). Our transportation system is not well adapted to a dramatically different vehicle mix than has been experienced over the previous 50 years.
- The maintenance and operations fleet is totally dependent on the combustion of diesel - now shifting to ultra-low sulphur diesel. When viewing these vehicles in the sense of their carbon footprint, we are considering what tomorrow's fleet will be comprised of.

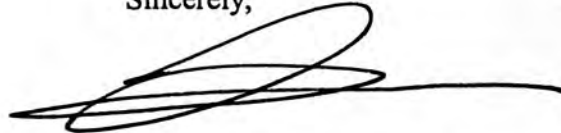
The department is currently assisting several communities that have already been affected by changing climate conditions. The department is actively involved in planning for designing and/or constructing shoreline protection, facility relocation, drainage improvements, and permafrost protection measures. We have active projects in Kivalina, Newtok, Kotzebue, Nome, Unalakleet, Shishmaref, Noatak, Allakaket, and Alakanuk.

To date, the department has not systematically studied the need for or implemented specific changes, policies or regulations to address the potential effects of climate change. At this point in time, we do not have the available data to accurately assess and determine required policy or procedural changes. As stated above, climate change can potentially impact the transportation infrastructure in a multitude of ways – melting/warming permafrost, sea level rise, increased river and shore erosion, increased scour of bridge foundations, increased storm frequency and

intensity, and increasing temperatures. We need to increase the collection and density of data ranging from stream flow records, precipitation and other weather related data records, geotechnical and foundation information, hazards mapping, and other hydrologic data. Our engineering staff needs the appropriate level of data to predict and determine more effective approaches for adapting to changes in climate. As an example, increased precipitation and runoff, storm intensities, and sea-ice conditions will potentially require new and/or revised hydrologic calculations for sizing culverts, designing bridges and their foundations, and erosion control structures. However, at this stage, we are lacking sufficient meteorological information to recommend changes in our planning and engineering processes.

The department will continue to address the impacts of climate change as they occur and will continue to investigate alternative design, construction, and maintenance techniques to address the changing environment that we work in. Right now we need accurate data to be able to design for future impacts to our transportation assets. By partnering with the University of Alaska and other State and Federal agencies we are addressing the most immediate needs for communities already being impacted and identifying the critical information we need to gather to be able to address future impacts of climate change.

Sincerely,

A handwritten signature in dark ink, appearing to read 'Leo von Scheben', with a long horizontal line extending to the right.

Leo von Scheben, P.E., L.S., M.B.A.
Commissioner

cc: Larry Hartig, Commissioner, Department of Environmental Conservation
Frank T. Richards, P.E., Deputy Commissioner of Highways & Public Facilities, DOT&PF
Mary Siroky, Legislative Liaison, DOT&PF