Brief Description of Catalog Actions and Options
Public Infrastructure Technical Working Group

July 16, 2008

(Note: This listing is incomplete and will be fleshed out during the Technical Work Group process. Technical Work Group members are encouraged to provide input to the Technical Work Group facilitators on existing policies and programs, where relevant. Recently enacted policies and programs in Alaska are listed where relevant in the policy options catalog notes. Additional details will be added to this document under each of the option descriptions, as they are provided.)

PI-1 PUBLIC INFRASTRUCTURE -- Highways, Roads, and Bridges

1.1 Ensure Climate Change is considered as part of upcoming review of Alaska's State Transportation Plan

The issue of climate change and its impacts on transportation will be considered both as part of Alaska's long-range transportation policy plan as well as the smaller regional, multi-modal transportation plans developed for specific areas of the state.

1.2 Review Department of Transportation's Future Corridors Initiatives to insure it appropriately addresses climate change

TBD

1.3 Require/Enable Metropolitan Planning Organizations to take climate into account

Require / enable MPO's to consider climate change and its impact on transportation as part of their transportation plans and projects.

1.4 Integrate Transportation Land Use Planning

Transportation and land use planning each directly impact the other. By integrating the planning of both transportation and land use, greater efficiency can be gained in both sectors. This also allows for a smoother transition to more climate friendly types of development such as transit oriented development (TOD) and smart growth initiatives.

http://www.fhwa.dot.gov/Planning/ppasg.htm

1.5 Explore options for Community Planning Efforts, to address program for SLR (sea level rise) & other climate impacts

Consider what can be done at the local community level to address SLR and other climate impacts and determine the tools that would be necessary to initiate and develop these local community programs.

1.6 Establish Climate Change and Public Infrastructure Task Force (focused on adaptation)

Establish a climate change and public infrastructure task force to track the impacts of climate change and continue to identify and develop adaptation strategies on an ongoing basis at a statewide level.

http://www.investfairbanks.com/Taskforces/climate.php

1.7 Review public education funding criteria to address adapting behavior in light of climate risk

Initiate a program to teach the public about the impacts of their behavior and how their behavior ban be adapted to minimize their impact on the environment and to help reduce the impacts of climate change.

1.8 Re-evaluate evacuation Routes and modify as necessary

As climate change continues to modify the landscape, a periodic reevaluation of evacuation routes will allow for the consideration of new evacuation routes which may be better suited to the current environment.

Ex: Thawing permafrost or flooding may make a previously identified evacuation route unable to be traversed and therefore a new route will need to be identified.

1.9 Evaluate and address damage to highways, roads, and bridges from thawing permafrost

As climate change destabilizes infrastructure due to thawing permafrost, an evaluation of the damage caused by climate change to this infrastructure may become necessary to determine if the infrastructure needs repairs, updates, or possibly replaced earlier than would typically be scheduled or anticipated.

If it is determined that action must be taken to repair, update, or replace a portion of infrastructure, a plan must be in place on how to best address the issue in light of the anticipated impacts from climate change.

Highway, road and bridge damage from thawing permafrost: Current impacts --costly (ADOT's estimate is at least $10 million/year) and potentially dangerous damage (e.g., highways surrounding Fairbanks); larger construction costs (e.g., need embankments at least 4 feet thicker, and air convection embankments); damage to the highway's surface, road bed, and integrity. *Future projections – degrading permafrost predicted to double in next 50 years, leading to additional damage; substantial rehabilitation, reconstruction and/or relocation will be needed; road slope sloughing may fill ditches and plug culverts; overall $0.9 to $1.5 billion additional damage costs by 2030 (ISER estimate). Stratus Consulting – 2/28/08*

1.10 Evaluate and address damage to highways, roads, and bridges from temperature changes

As climate change destabilizes infrastructure due to thawing permafrost, an evaluation of the damage caused by climate change to this infrastructure may become necessary to determine if the infrastructure needs repaired, updated, or possibly replaced earlier than would typically be scheduled or anticipated.

If it is determined that action must be taken to repair, update, or replace a portion of infrastructure, a plan must be in place on how to best address the issue in light of the anticipated impacts from climate change.

Highway and road damage from temperature changes: Current impacts – more freeze/thaw cycles from milder winters, with accelerated road damage (e.g., in Anchorage). *Future projections – accelerated damage from milder winters and more freeze/thaw cycles; pavement damage from higher temperatures, resulting in softening asphalt and rutting. Stratus Consulting – 2/28/08*

1.11 Evaluate and address damage to and loss of roads from coastal and river erosion

As climate change destabilizes infrastructure due to coastal and river erosion, an evaluation of the damage caused by climate change to this infrastructure may become necessary to determine if the

infrastructure needs repaired, updated, or possibly replaced earlier than would typically be scheduled or anticipated.

If it is determined that action must be taken to repair, update, or replace a portion of infrastructure, a plan must be in place on how to best address the issue in light of the anticipated impacts from climate change.

Damage to and loss of roads from coastal and river erosion: Current impacts – coastal roads have been lost (e.g., Shishmaref); need to rebuild roads (e.g., Nome "Council Road") and increased costs associated with activities to avoid loss of roads (e.g., Kotzebue "Shore Ave" and Unalakleet "Beach Road"). *Future projections – greater loss of roads from coastal and river erosion; greater costs to avoid erosion; loss of roads from sea level rise. Stratus Consulting – 2/28/08*

1.12 Evaluate and address buckling and submersion of boardwalks in village communities

As climate change destabilizes infrastructure, including boardwalks in village communities, an evaluation of the damage caused by climate change to this infrastructure may become necessary to determine if the infrastructure needs repaired, updated, or possibly replaced earlier than would typically be scheduled or anticipated.

If it is determined that action must be taken to repair, update, or replace a portion of infrastructure, a plan must be in place on how to best address the issue in light of the anticipated impacts from climate change.

Boardwalks: Current impacts – buckling and submersion of boardwalks in village communities (e.g., Newtok). *Future projections – greater buckling and submersion of village boardwalks. Stratus Consulting – 2/28/08*

1.13 Evaluate and address damage to highways, roads, and bridges, from glacier melting, flooding, avalanches, and debris flows.

As climate change destabilizes infrastructure due to glacier melting, flooding, avalanches, and debris flows, an evaluation of the damage caused by climate change to this infrastructure may become necessary to determine if the infrastructure needs repaired, updated, or possibly replaced earlier than would typically be scheduled or anticipated.

If it is determined that action must be taken to repair, update, or replace a portion of infrastructure, a plan must be in place on how to best address the issue in light of the anticipated impacts from climate change.

Damage from increased glacier melting, flooding, avalanches, debris flows, etc.: Current impacts – highway and bridge damage from glacier melting, flooding, avalanches, debris flows, etc. (e.g., Richardson Highway and One Mile Creek). *Future projections – more glacial melt and more flooding may require larger culverts and/or bridges; more maintenance needs from increased precipitation events, debris flows, avalanches and floods. Stratus Consulting – 2/28/08*

1.14 Evaluate and develop a management plan for vegetative growth along infrastructure (highways, pipelines, etc.) where vegetation has not previously been (North Slope)

Due to a warming climate and melting permafrost, vegetative growth has been happening more rapidly and in places where vegetative growth has not traditionally occurred. This policy would propose a management plan to address how to deal with this vegetation.

1.15 Evaluate infrastructure design standards/codes associated with retrofitting activities for existing infrastructure to address lower probability events and to recognize SLR and potential increased severity of storms and storm surges

As climate change causes melting permafrost, coastal erosion, and flooding, infrastructure design should be reexamined to determine how future infrastructure can be built to adapt to this changing environment and how current infrastructure can be retrofitted to address these impacts.

1.16 Minimize the installation of paved surfaces as a strategy for flood runoff control

Paved surfaces prevent stormwater from being absorbed back into the ground, instead causing the quick runoff of this water either into a storm sewer or into area with the potential to become quickly inundated with water. Minimizing paved surfaces or utilizing such options as permeable pavement will minimize the impact.

1.17 Add additional planning scrutiny to future infrastructure investments in undeveloped hazard-affected coastal areas

Examine more thoroughly the investment into transportation infrastructure in areas which are both undeveloped and identified as being hazard-affected coastal areas. As climate change and SLR continue to impact coastal areas, infrastructure investments in these areas should be more closely examined both concerning their need and their design and construction requirements in light of the impacts anticipated from climate change.

1.18 Strengthen design codes for bridges, roads, and highways, to account for climate impacts

As climate change continues to impact transportation infrastructure, design codes for bridges, roads, and highways should be reexamined to determine how future infrastructure can be build to adapt to this changing environment and how current infrastructure can be retrofitted to address these impacts.

1.19 Implement strict maintenance regulations for existing infrastructure in acute sea level rise hazard zones

Impacts from SLR will cause additional maintenance issues with the transportation infrastructure located in these areas. This policy option proposed the development of new maintenance regulations to address these impacts.

1.20 Develop an inventory of potentially impacted infrastructure and maintain this database relative to emerging projected sea level rise findings

Impacts from SLR will negatively impacts existing infrastructure. This policy option proposes the maintaining of a database to track the impacts to transportation infrastructure in these areas.

1.21 Evaluate the need for redeveloping structures to raise first floor elevations some distance above base flood elevation

As flooding becomes more common the need to redevelop structures to minimize and / or avoid the impacts associated with this flooding may become necessary. This policy option proposed evaluating the need to redevelop structures to minimize or avoid the impacts associated with flooding, such as raising first floor elevations above the base flood elevation.

1.22 Evaluate the vulnerability of existing and future unprotected reaches of shoreline with respect to existing infrastructure.

Shoreline erosion due to increased storm intensity and SLR are likely to negatively impact existing infrastructure along the shorelines. This policy option proposes evaluating the vulnerability of this

infrastructure to shoreline erosion and SLR to determine what steps may be necessary to protect and / or replace this infrastructure.

1.23 Develop and evaluate a public repurchase program for vulnerable lands and public/private infrastructure

Climate change impacts will cause additional maintenance issues as well as increased costs associated with the repair, replacement, or adaptation of existing infrastructure. This policy option proposes funding a public repurchase program whereby the state would purchase back vulnerable lands as well as public / private infrastructure eliminating the cost of maintenance, repair, replacement, or adaptation of this existing infrastructure.

1.24 Plant trees and other vegetation to reduce flooding and erosion

Trees and other vegetation can minimize soil erosion associated with flooding and increased storm intensity.

1.25 Require that counties act on comprehensive planning requirements

Counties which have comprehensive plans in place will be required to abide by those plans, particularly as the requirements in these plans relate to impacts associated with climate change.

1.26 Integrate critical area planning requirements with comprehensive planning laws, including emergency planning, emergency evacuation routes, and infrastructure planning requirements

In preparation for emergency situations created from impacts associated with climate change, this policy proposed integration critical area planning requirements with comprehensive planning laws for the further development of emergency planning, emergency evacuation routes, and infrastructure planning requirements.

1.27 Develop and emergency evacuation plan – (evaluate infrastructure for emergency preparedness)

This policy option proposed the development of a statewide emergency evacuation plan to provide appropriate planning for the need to evacuate areas of the state during emergencies brought on specifically by climate change. As part of this plan, infrastructure would be evaluated to determine both the most efficient and safest evacuation route for various climate events.

1.28 Develop a strategy to regularly update floodplain maps

As climate change modifies the landscape through SLR, rising rivers, and erosion along the sea and rivers floodplain maps will need to be updated more frequently.

1.29 Establish a coordinating mechanism to assure that local governments act in concert with the state to reduce future impacts from SLR and associated hazards

This policy will ensure that local governments coordinate with each other and with the state to reduce the impacts from SLR and associated hazards.

1.30 Synchronize future design with emergency planning and evacuation infrastructure requirements

This policy ensures that the design of future transportation infrastructure meeting the necessary emergency planning and evacuation requirements.

1.31 Investigate opportunities and innovations with potential to benefit the economy, public services, and business sectors

The impacts associate with climate change are likely to develop new markets and opportunities for new products and innovations. This policy option promotes the exploration of these options to develop state benefits as a result of adaptations to climate change.

1.32 Create inventory of infrastructure vulnerable to future SLR and associated hazards

Identify infrastructure that will be vulnerable to future SLR and other hazards associated with climate change and keep a database of this infrastructure and its needs.

1.33 Create on-line mapping capability for multiple audiences including local governments

The development of on-line mapping for multiple users to assist in identifying climate change hazards.

1.34 Create visualization tool for SLR and associated hazards

This tool would help people to see the potential impacts associated with SLR and other hazards associated with climate change.

1.35 Establish structures training and vocational support for trades and others involved in implementation of new design standards

As public infrastructure evolves to adapt to the changes presented from the impacts of climate change, additional training and vocational support will become necessary to ensure a workforce capable of meeting the design and construction needs of this new infrastructure.

1.36 Integrate climate change and adaptation issues into advanced training in university, community college, and technical training programs

As climate change and adaptation issues come more into focus for a wide variety of local, state, regional, and federal agencies as well as businesses throughout numerous sectors, a workforce that is educated on these issues will become critical. This policy option promotes the development of training programs at the university, community college, and technical institution level to further facilitate the discussion surrounding climate change and to train tomorrow's experts in this field.

PI-2 PUBLIC INFRASTRUCTURE -- Airports, Landing Strips, and Air Transportation

2.1 Evaluate and address the impacts on airports and landing strips related to thawing permafrost

As climate change destabilizes infrastructure due to thawing permafrost, an evaluation of the damage caused by climate change to this infrastructure may become necessary to determine if the infrastructure needs repairs, updates, or possibly replaced earlier than would typically be scheduled or anticipated.

If it is determined that action must be taken to repair, update, or replace a portion of infrastructure, a plan must be in place on how to best address the issue in light of the anticipated impacts from climate change.

Current – damage to airports and landing strips (e.g. Bethel and remote communities in Y-K Delta); more difficult and expensive airport and landing strip construction conditions due to melting permafrost. *Future – degrading permafrost expected to double in next 50 years, leading to additional damage from melting/warming permafrost; substantial rehabilitation, reconstruction, and/or relocation may be necessary; increasingly difficult and expensive construction. Stratus Consulting 2/28/08*

2.2 Develop new standards for developing airport and landing strips in light of climate change impacts

As climate change continues to impact airport and landing strip infrastructure, design codes for airports and landing strips should be reexamined to determine how future facilities can be build to adapt to this changing environment and how current infrastructure can be retrofitted to address these impacts.

2.3 Evaluate and address the need to relocate, re-align or repair airstrips due to coastal and river erosion and flooding

As climate change causes melting permafrost, coastal erosion, and flooding, the design of airports and landing strips should be reexamined to determine how future airports and landing strips can be built to adapt to this changing environment and how current airports and landing strips can be realigned, relocated, or repaired to address these impacts.

Current – have relocated (e.g. Allakaket, Barrow) or planning to modify or relocate (e.g. Alakanuk, Shishmaref) airport landing strips due to coastal or river erosion and flooding; airports have been covered by water (e.g., Pt. Hope, Newtok, Shishmaref) requiring emergency repairs and protection (e.g., Kivalina). *Future – greater modification and protection needs (e.g. Kotzebue, Kaktovik) and more relocation needs, especially with sea level increase. Stratus Consulting 2/28/08*

2.4 Develop a comprehensive airstrip maintenance plan to address issues associate with climate impacts (thawing permafrost, ice, heavy precipitation, flooding, vegetative growth, etc…)

Impacts from thawing permafrost, ice, heavy precipitation, flooding, and vegetative growth will cause additional maintenance issues with airports and landing strips located in these areas. This policy option proposes the development of new maintenance regulations to address these impacts.

Future – increasing maintenance needs for vegetation management (especially on the North Slope) and increased precipitation events (e.g. ice, heavy precipitation) Stratus Consulting 2/28/08

2.5 Evaluate and address dangerous flying conditions, associated with icing, coastal fog, and non-traditional storms

Impacts from climate change are likely to make flying conditions increasingly dangers due to additional ice formation, coastal fog, and non-traditional storms. This policy option proposes evaluating the likely impacts of climate change upon flying conditions and evaluating how these conditions should best be addressed, including the introduction of new pilot and ground crew training and better navigational systems.

Current – problems with icing (e.g. dangerous icing currently occurring in fall and winter along coasts of Beaufort, Chukchi and Bering Seas from Seward Peninsula Northward from clouds of supercooled water), more coastal fog, more hazardous flying due to untraditional storms, and other dangerous conditions when flying. *Future – likely additional problems with icing, fog, and untraditional storms*. *Stratus Consulting 2/28/08*

PI-3 PUBLIC INFRASTRUCTURE -- Buildings

3.1 Survey existing building damage and loss due to shoreline erosion, less shorefast ice, melting permafrost, storms, realignment of rivers and flooding and identify the need to relocate buildings (e.g. Koyukuk) and plan for future siting

This policy options proposes identifying existing building damage and loss due to shoreline erosion and evaluating the possible need to relocate these buildings. Additionally, a plan for future siting would be incorporated into this plan.

Loss of and damage to buildings due to shoreline erosion, less shorefast ice, melting permafrost, and storms (e.g. Shishmaref and Barrow/Browerville have lost buildings to the ocean); relocation of buildings (e.g. Shishmaref, Kivalina); need for emergency shelters in new sites (e.g. Newtok and Shishmaref). *Future – increased sea level rise, permafrost melting, and loss of shorefast ice will lead to greater loss of buildings and more individual building relocation needs; need to relocate entire communities (e.g. Shishmaref, Kivalina and Newtok in next 10 - 15 years) – Stratus Consulting 2/28/08*

Building damage from thawing permafrost: Current impacts – there has been damage to non-coastal buildings from thawing permafrost (e.g., structural damage to buildings in Fairbanks) and land subsidence (e.g., increased flood risk to sinking homes in Kwigillingok). *Future projections – degrading permafrost expected to double in next 50 years, leading to additional structural damage from thawing permafrost; substantial rehabilitation, reconstruction, and/or relocation needs; and increasingly difficult and expensive construction. – Stratus Consulting 2/28/08*

3.2 Evaluate wild fire risk to buildings due to increased wild fire intensity and frequency and increased threat from diseased/dead trees (e.g. Caribou Hills fire in 2007)

More damage to buildings from increased fire frequency and intensity and increased threat from diseased/dead trees (e.g. Caribou Hills fires in 2007 destroyed 94 structures). *Future – greater threat from increased fires and diseased/dead trees – Stratus Consulting 2/28/08*

3.3 Strengthen existing building codes for new infrastructure and incorporate an increase in building inspection effectiveness as part of the strengthened codes as well as setback zones and phased-out or no development in areas vulnerable to sea level rise

As climate impacts thaw permafrost and SLR increases, the design and construction of new buildings and structures will need to be adapted to these changes. This policy promotes the development of new design standards and building codes for these new structures.

3.4 Improve hazard preparedness of residential homes and commercial entities by providing operational assistance or incentives

Develop a program to assist residential and commercial properties in being prepared for the potential hazards associated with climate change.

3.5 Assess sea level rise hazard insurance for businesses as part of standard operations

Evaluate making SLR hazard insurance mandatory for businesses.

3.6 Assess sea level rise hazard insurance for home owners in inundation hazard zones

Evaluate making SLR hazard insurance mandatory for homeowners.

3.7 Develop and use insurance policies to drive and support retreat activities

Develop insurance policies which promote and support homeowners and businesses in moving their homes and businesses out of areas deemed hazardous in light of impacts associated with climate change.

3.8 Implement standardized community education materials on hazards that addresses the relationship between climate variability and climate change

Public education program that would inform the public of the potential impacts resulting from climate change.

3.9 Conduct a comprehensive vulnerability assessment for all public and private properties

A statewide evaluation of properties, both public and private, assessing their vulnerability to the impacts of climate change.

3.10 Increase construction protocols/conventions for piers and wharves for wave strength

Develop new construction protocols that would take the impacts associated with climate change into account when developing piers and wharves.

3.11 Evaluate the riparian rights / property rights in the contact of SLR

As SLR and erosion begin to wash away shoreline areas riparian / property rights disputes are likely to become more prevalent. This policy option proposes a thorough evaluation of these property rights which could serve to develop a policy which would more clearly define these rights in light of SLR.

3.12 Relocation of threatened structures - Evaluate presence and significance of threatened historical structures and develop plans for their relocation and/or protection

Historical structures which are threatened as a result of SLR and coastal erosion would be evaluated and plans for their relocation could be developed.

Building damage, loss and relocation near rivers: Current impacts – building damage and loss due to realignment of rivers, thawing permafrost, and flooding; need to relocate buildings (e.g., Koyukuk). *Future projections – greater building damage and relocation needs as more permafrost melts and flooding occurs. – Stratus Consulting 2/28/08*

3.13 Guide future development out of areas vulnerable to sea level rise and associated hazards

Work with state, local, and regional planning agencies to developing zoning regulations that would serve to guide development away from areas vulnerable to SLR and other associated hazards.

3.14 End permitting of new homes in areas vulnerable to sea level rise and associated hazards

State, local, and regional governments would no longer provide building permits in areas identified as being vulnerable to SLR and other associated hazards.

3.15 Buy out unused properties in areas vulnerable to sea level rise and associated hazards

Develop a fund that would be used to purchase properties in areas determined to be vulnerable to SLR and other associated hazards.

3.16 Develop retreat strategies for the management of existing structures or conditions that may become submerged hazards to navigation or public health (e.g. effluent outfalls, water intakes, septic fields, rockwalls, docks, and piers)

Develop strategies to move existing structures out of harms way from hazards due to the impacts of climate change or to attempt to manipulate conditions to prevent such hazards from occurring.

3.17 Develop strategies to address situations of changing ingress/egress to structures as support for access roads in areas vulnerable to sea level rise and associated hazards is withdrawn

Part of an emergency plan to evacuate and / or reach residents / businesses located within hazardous zones.

3.18 Modification of land use, agricultural , and landscape practices including aquaculture, saline-resistant crops, depending on location and purpose

Modify the use of land is hazardous locations so that the properties are better adapted to the mpacts of climate change. Adjust agricultural practices to crops that are more saline-resistant or adopt aquaculture practices. Additionally landscaping can help to prevent erosion and slow winds and storms depending upon location.

3.19 Raise shoreline structures

Shoreline structures that will be impacted by SLR and / or shoreline erosion could be raised to prevent many of these impacts. As part of this policy these structures should initially be identified and evaluated to determine if raising these structures would sufficiently remove them from harm and if the structures are capable of being raised.

3.20 Establish a mechanism to evaluate and recommend new design standards for structures (and placement of mechanical and electrical equipment) that may be vulnerable to SLR and associated hazards

As climate impacts thaw permafrost and SLR increases, the design and construction of new buildings will need to be adapted to these changes. This policy promotes the development of new design standards and building codes for these new structures.

3.21 Require all municipalities to have written and operational disaster response plans that are updated at least every 5 years, and that include consideration of likely changes in the frequency and intensity of extreme events due to climate change

These disaster plans could include evacuation plans as well as emergency coordination between agencies.

PI-4 PUBLIC INFRASTRUCTURE -- Sea Walls and River Shoreline Protection

4.1 Re-evaluate current icing and ice control methods due to more ice from longer seasonal transition periods

XXXXX

4.2 Evaluate the effectiveness of hard structural options such as dikes, levees, floodwalls, saltwater intrusion barriers and install these options based upon effectiveness and feasibility

XXXXX

4.3 Review construction standards for piers and wharfs for wave strength

New design and construction standards should address the impacts to piers and wharfs associated with climate change.

4.4 Increase flood protection, e.g., dams, reservoirs, sea walls

New dams, reservoirs, sea walls and other flood protection mechanisms could be developed and utilized to control flood waters.

4.5 Limit infrastructure investments in hazard-affected coastal areas

XXXXX

4.6 Develop an early warning system (i.e., enhance hazard preparedness) through incorporation of sea level rise in hurricane and storm-surge evacuation planning.

XXXXX

4.7 Develop an inventory of potentially impacted infrastructure and maintain this database relative to emerging projected sea level rise findings

This is an essential first step in scoping relevance/viability of potential adaptation options

4.8 Evaluate the vulnerability of existing and future unprotected reaches of shoreline with respect to existing infrastructure.

Determine need for and type of shoreline protection appropriate to these reaches.

4.9 Develop operational protocols that specify disclosure requirements for coastal hazards

Develop operational protocols that identify coastal hazards. This will become more important due to shoreline erosion, SLR, and flooding.

4.10 Evaluate shoreline erosion buffers for zones subject to flooding in which significant infrastructure is located

Develop buffer zones to minimize the impacts of flooding, particularly in areas where there is significant infrastructure.

4.11 Develop and implement a tree planting program along vulnerable coastal areas as a flooding control strategy

Trees and other landscaping treatments will help to prevent shoreline erosion.

4.12 Add additional planning scrutiny to prevent new development from infringing upon sensitive shoreline areas subject to sea level rise hazards

XXXXX

4.13 Increase erosion and hazard planning focused on all coastlines, especially sheltered coastlines

XXXXX

4.14 Evaluate structural and non-structural options for beach protection (flood walls, dune restoration and creation, and periodic beach nourishment)

XXXXX

4.15 Develop and/or strengthen a system for the comprehensive surveillance, monitoring, documentation, and dissemination of rates and locations of sea-level rise.

XXXXX

4.16 Develop a system for the regular monitoring of sea level rise and updating of flood inundation mapping from changes due to sea level rise

XXXXX

4.17 Initiate a study that examines the replacement of soft protection options with hard structural options such as dikes, levees, floodwalls, saltwater intrusion barriers (this presupposes a solution)

As a first step, this option calls for a pre-feasibility study to evaluate the pros and cons and potential applications of hard, structural options to large estuaries.

4.18 Enhance public education programs aimed at informing the public about sea level rise and coastal hazards

XXXXX

4.19 Develop a strategy for managing the retreat of (Small and large) ports and associated infrastructure, such as rail and roads

XXXXX

4.20 Develop a strategy to assure long-term public access to water

XXXXX

4.21 Evaluate the effectiveness of soft structural options such as dune restoration and creation Wetland restoration, periodic beach nourishment, temporary barriers and other options and implement the best options based upon effectiveness and feasibility

XXXXX

4.22	**Design industrial systems to reduce vulnerability to future sea level rise and associated hazards.**

XXXXX

4.23	**Investigate potential and limitations of eminent domain, vesting, grandfathering, and amortizing strategies to support retreat activities**

XXXXX

4.24	**Assess financial impact of property value changes**

XXXXX

4.25	**Evaluate existing shoreline protection structures to determine their effectiveness under varying sea level rise and the need for modification/ replacement/ abandonment**

Should include a review of available Federal, state, and local shoreline protection programs; provide recommendations on how each could be modified to address future changes in seas level rise with respect to infrastructure and other land assets

PI-5 PUBLIC INFRASTRUCTURE -- Utility and Fuel Infrastructure

5.1 Develop a mechanism that requires utility companies to relocate existing overhead utility wires underground and require new wires to be placed underground.

XXXXX

5.2 Site industrial systems away from areas vulnerable to changes in sea level rise and associated hazards

XXXXX

5.3 Address impacts of sea level rise and coastal and river erosion on buried or above-ground utility and oil pipelines

XXXXX

5.4 Address impacts of thawing permafrost on existing buried or above-ground pipelines

An evaluation of the anticipated impacts of thawing permafrost on above-ground pipelines would need to be conducted as the first phase of this policy option. Options for how to address these impacts would then need to be developed and evaluated.

Pipeline damage and relocation: *Future projections – sea level rise and coastal and river erosion may impact buried or above-ground utility and oil pipelines; thawing permafrost may undermine support for existing buried or above-ground pipelines. – Stratus Consulting 2/28/08*

5.5 Develop appropriate standards for the future development of buried and above-ground utility and oil pipelines taking into account sea level rise, coastal and river erosion, and thawing permafrost.

New design and construction standards would need to be developed, taking into account the impacts of climate change.

5.6 Address the impacts of thawing permafrost and erosion on shoreline and river-side fuel delivery, storage, and piping.

An evaluation of the anticipated impacts of thawing permafrost and shoreline erosion on river-side fuel delivery, storage, and piping would need to be conducted as the first phase of this policy option. Options for how to address these impacts would then need to be developed and evaluated.

5.7 Develop new standards for the future development of shoreline and river-side fuel delivery, storage, and pipeline facilities.

New design and construction standards would need to be developed, taking into account the impacts of climate change.

5.8 Engage Utility Siting Board in incorporating SLR and climate risk factors

This would likely involve the formation of a committee to discuss the impacts of SLR and other climate impacts on where utility plants and lines can be sited.

PI-6 PUBLIC INFRASTRUCTURE -- Landfills

6.1 Address the impacts currently occurring in landfills such as failures and losses associated with shoreline erosion and river erosion resulting from sea level rise and more intense storms

An initial evaluation of landfill sites would be the first step in this process. The development of possible options to address these impacts would also be necessary.

6.2 Develop new standards for the future development of landfills that will address impacts associated with climate change such as sea level rise, thawing permafrost, and more intense storms.

New design and construction standards would need to be developed, taking into account the impacts of climate change.

There have been land fill problems, failures and losses associated with shoreline erosion and river erosion (e.g., Newtok). *Future – greater land fill problems and failures, especially with sea level rise and more intense storms (e.g. US Air Force Long Range Radar Site near Kaktovik at risk); also land fill problems with melting of permafrost and warmer temperatures – Stratus Consulting 2/28/08*

PI-7 PUBLIC INFRASTRUCTURE -- Sewage and Septic Systems

7.1 Provide incentives for the development of septic systems that can better operate under the conditions associate with climate change.

Climate impacts area causing septic tanks to malfunction. This policy option would provide incentives for the further development of new septic systems that are not as susceptible to the impacts of climate change.

7.2 Develop new standards for sewer and septic systems that address having less snow cover, thawing permafrost, sea level rise, and increased organics

New design and construction standards for sepctic tanks could be implemented to eliminate many of the impacts upon septic systems.

Current – some septic systems are freezing because of less snow cover; *Future – sewage system problems and failures, especially with melting permafrost and sea level rise (e.g. US Air Force Site near Kaktovik); increased organics adversely affecting treatment processes; ultimately significantly warmer temperatures could result in less damage to septic systems – Stratus Consulting 2/28/08*

PI-8 PUBLIC INFRASTRUCTURE -- Water Systems

8.1 Evaluate and improve capacity of storm water infrastructure for high intensity rainfall events

This policy would involve the re-development of storm sewer systems to accommodate larger amounts of rainfall and flooding.

Increased volume of stormwater: *Future – larger or new stormwater management systems needed to address increased precipitation and possible flooding in many locations – Stratus Consulting 2/28/08*

8.2 Increase water system design standards to address lower probability events (e.g. some cities are protecting to the 500 year event rather than the 100 year event because of the increased vulnerability)

New design and construction standards could be implemented to address future lower probability events and the additional capacity associated with these increases in stormwater.

8.3 Enhance existing storm water infrastructure capacity in zones subject to increasing high intensity rainfall events

XXXXX

8.4 Identify public and private systems and facilities at serious risk from sea level rise and initiate a system for siting such facilities away from vulnerable areas

Above Ground Water Systems: Current – melting permafrost, shoreline erosion, and drying of lakes leading to diminishment of community water source (e.g. in statewide study, between 5 and 54% of ponds disappeared in last 50 years; in NE Alaska of 23 lakes studied, 21 decreased in size); water quality compromised from storm surges, etc. *Future – increased above ground water system problems and failures; potential decrease in available non-community based water sources as more lakes, ponds, and streams dry and shrink - Stratus Consulting 2/28/08*

8.5 Identify the causes of drying lakes and diminished community water sources

XXXXX

8.6 Develop policies for the conservation of community water sources

XXXXX

8.7 Develop methodologies to stop or minimize the drying of lakes

XXXXX

8.8 Provide incentives for the development of well-based water system technologies that avoid freezing due to increased deep frost levels

XXXXX

8.9 Develop new standards for the development and deployment of new well-based water systems, taking into account deep frost levels.

Subsurface water systems: Current – low interior snowfall causes deep frost levels which freeze well-based water systems. *Future – loss and reduction of permafrost to have major impact on subsurface hydrology; loss of some confined aquifers and domestic artesian water wells; increased risks of contamination – Stratus Consulting 2/28/08*

8.10 Provide incentives for the development of increased efficiency of hydroelectricity facilities. (ability to operate with less water)

Hydroelectricity impacts: Current impacts – potential impacts on water availability and reduced energy production in some areas (e.g., current reductions in southeast may be due, in part, to climate change). *Future projections – potentially greater impacts on energy production from reduced or modified water availability and greater evaporation; potentially greater precipitation in southeast Alaska would mitigate these impacts. – Stratus Consulting 2/28/08*

8.11 Develop new, or expand current stormwater management facilities and systems to address increased precipitation and possible flooding

XXXXX

PI-9	PUBLIC INFRASTRUCTURE -- Ocean Transportation

9.1	Evaluate the potential risks from climate impacts to a ferry system (incl. public transportation and emergency planning)

XXXXX

9.2	Develop an emergency evacuation plan for the ferry system

XXXXX

9.3	Create new standards for floating piers to accommodate both higher water levels and flooding events

XXXXX

9.4	Evaluate the potential opportunities, risks, and needs associated with new shipping lanes opening up in the Artic Ocean and Bering Sea, associated with less ice.

Current - Less ice in Arctic Ocean and Bering Sea, opening up summer shipping lanes and opportunities (a 10% decline in sea ice per decade since the 1970s) and a decline in ice in the Bering Sea; some increase in traffic already observed, including cruise and recreational traffic, as well as offshore oil and gas exploratory traffic; rapidly melting glaciers causing navigation problems (such as Columbia Glacier during the first part of its retreat), more activities resulting in higher risk of marine accidents and oil spills in Bering Sea, Chukchi Sea, and Arctic Ocean; lack of Coast Guard and other infrastructure for emergency response. *Future – even greater opening of Arctic Ocean and Bering Sea for longer periods for shipping and marine activities; increased navigation and safety issues and concerns – Stratus Consulting 2/28/08*

9.5	Identify navigation problems associated with melting glaciers

XXXXX

9.6	Develop new shipping lanes through the Artic Ocean and Bering Sea.

XXXXX

9.7	Monitor shipping lanes through the Artic Ocean and Bering Sea for ice melt, glacier melt, and security.

XXXXX

9.8	Study the impacts of increased siltation in harbors stemming from glacier melt and flooding events.

XXXXX

9.9	Develop measures to minimize the impacts of siltation in harbors stemming from glacier melt and flooding events.

XXXXX

9.10	**Provide incentives for the development of mechanisms that can minimize the levels of and impacts from siltation in harbors**

XXXXX

PI-10 PUBLIC INFRASTRUCTURE -- Rural Non-Ground Transportation

10.1 Develop rural infrastructure to supplement lost rural routes due to thinner winter ice, insufficient snow, and ground that does not freeze

Current impacts – winter ground transportation by snowmachine and dog sled less available and reliable because ground not frozen and insufficient snow; shorter ground transportation season; less reliable and available river and shoreline transportation in the winter because of thinner ice and shorter freeze-up period. *Future projections – increasing problems with winter ground transportation by snow machine and dog sled, and on frozen water bodies. – Stratus Consulting 2/2808*

10.2 Provide incentives for the development of new modes of transportation that can travel across the altered rural landscape

XXXXX

10.3 Identify new rural transportation routes

XXXXX

10.4 Provide rural public transportation across new and existing rural transportation routes to more efficiently move people and freight across the altered rural landscape.

XXXXX

10.5 Develop new regulations for traveling across ice roads, taking into account thinner ice and shorter season length

XXXXX

10.6 Identify alternate routes to accommodate for the shortened ice road season

Ice road impacts: Current impacts – season length for ice roads and travel over permafrost has been significantly reduced. *Future projections – even greater reductions in season length for travel over frozen surfaces. – Stratus Consulting 2/28/08*

10.7 Further develop rural airstrips to accommodate larger planes with greater cargo capacity to compensate for the shortened ice road season

XXXXX

PI-11 PUBLIC INFRASTRUCTURE -- River Transportation

11.1 Create new standards for floating piers to accommodate both lower water flow and flooding events

XXXXX

11.2	**Further develop river transportation routes to accommodate lower water flow as well as flooding events.**

River transportation: Current impacts – river transportation is less available and reliable during some summers and early autumns because of lower water flow (e.g., Newtok, Porcupine River). *Future projections – increased problems with river transportation impacting fuel and material deliveries, interaction among communities, and subsistence activities. – Stratus Consulting 2/28/08*

11.3	**Provide incentives for the development of nautical vessels capable of navigating rivers during times of low water flow and flooding events.**

XXXXX

11.4	**Provide incentives for the purchase of nautical vessels capable of navigating rivers during times of low water flow and flooding events.**

XXXXX

PI-12 PUBLIC INFRASTRUCTURE -- National Defense Infrastructure

12.1 Address national security concerns associated with new shipping lanes opening up due to less ice in the Artic Ocean and Bering Sea.

XXXXX

12.2 Promote the new development of Early-Warning-Radar Sites capable of withstanding thawing permafrost and erosion.

Damage and closures: Current impacts – three Early-Warning Radar Sites (including Point Lonely) closed or slated for closure due, in whole or part, to erosion and thawing permafrost. *Future projections – may be more closures of defense infrastructure. Stratus Consulting 2/28/08*