Adaptation Options to Reduce Impacts on Public Infrastructure

Component #	Title	Leads
Vision	Sustainable Infrastructure that supports Communities in an Uncertain Environment	**Steve Weaver,** Greg Magee, Mike Coffey
PI-1	Mandate Systematic Key Data Collection, Analysis, Monitoring, and Access	**Vladimer Romanovsky,** Patricia Opheen, John Warren, John Madden
PI-2	Promote "No regret" Improvements	**Greg Magee,** Steve Weaver, John Madden
PI-3	Build to Last	**Billy Connor,** Mike Coffey, VladimerRomanovsky, Patricia Opheen

Public Infrastructure are the essential facilities and utilities under public, cooperative or private ownership that deliver goods and services to communities.

Increased temperatures in Alaska due to climate change are having the **following effects on public infrastructure** (there is significant regional variation):

- Increased or decreased flooding and erosion;
- Decreased duration and extent of sea ice;
- Increased or decreased wind and precipitation;
- Increased storm frequencies and duration; and
- Thawing permafrost; and
- Increased or decreased fire risk.

The Public Infrastructure Technical Work Group (PIWTWG) is taking a systems approach to the climate change challenge.

We have established an overarching vision that Alaska must strive to meet. This vision can be achieved by enacting a comprehensive program with three components.

This system is adaptive in its nature; a continuous feedback and communication loop must occur among its program areas so information gained is continually used to update and inform the system.

Vision: Sustainable Infrastructure that supports Communities in an Uncertain Environment

Infrastructure is the platform on which our society functions. Reliable and sustainable infrastructure is the foundation on which the future of Alaska will be built. To ensure that Alaska is prepared to optimize investment opportunities and demonstrate that the return on investment for Alaska's current and future infrastructure provides good value for the state and the nation, an on-going, aligned statewide effort to monitor, analyze and proactively adapt to our changing environment is required.

The infrastructure of Alaska is particularly vulnerable to the effects of climate change. It is predicted that climate change will bring warming temperatures that will cause sea level to rise and increase precipitation and storm intensity. With some 6,640 miles of coastline, and an estimated 47,300 miles of tidally effected shoreline, Alaska will be at the forefront of such change. Warming temperatures will likely also destabilize much of the permafrost across Alaska adding a uniquely Alaskan challenge to the climate change issue in America.

Coupled with these climate change effects is the overall dismal reality of the current condition of our infrastructure. The American Society of Civil Engineers recently reported that because decades of underfunding and inattention have endangered our nation's infrastructure, $2.2 trillion in repairs and upgrades are needed over the next five years to bring infrastructure back to adequate conditions. As the United States prepares to reinvest in its infrastructure, Alaska is faced with both a challenge and an opportunity.

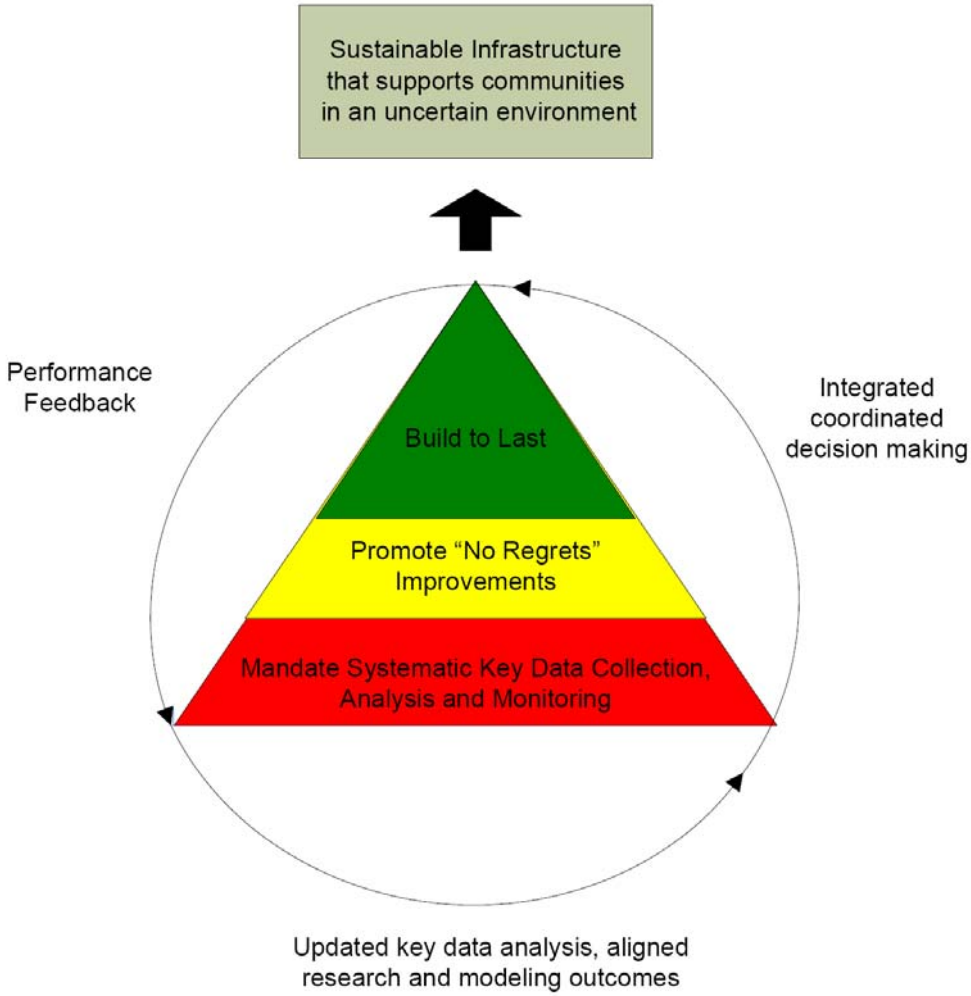
It is expected that as climate change unfolds and our understanding increases, predictions will change and interventions become more effective, therefore an integrated statewide plan that incorporates cycles of improvement and is well coordinated both nationally and internationally is essential to build the resiliency necessary for meeting the challenges ahead.
A three component approach is recommended:

1. Mandate Systematic Key Data Collection, Analysis, Monitoring, and Access – Baseline data needs to be established. We need to know where and what the problems are. We need to know what is working and what is not working. We need to be able to accurately characterize our problems, scope solutions, and estimate the funding needed to implement selected alternatives. Based on the best science and collected empirical data we need to predict our future. The resulting information needs to be available to all interested parties.

2. Promote "No regret" Improvements - Promoting sustainability, reducing operating costs, and protecting/extending the service life of existing infrastructure is always worthwhile. In parallel with component I, create and fund improvements to existing infrastructure that are worth doing regardless of climate change effects.

3. Build to Last – Based on components I and II, new/replacement facilities need to be planned, designed, and built to be resilient and sustainable in an uncertain environment. A systematic performance review/analysis feed-back loop needs to be integrated into the public infrastructure development, construction, and facilities operations process, so that planners

and builders use “what works” and codes and standards are assessed and improved as needed to achieve the best results.



A. Build to Last
1. Meet or exceed design service life
2. Best in class life cycle costs/asset management practices
3. Able to withstand disasters and changing environment
4. Based on the best science and appropriate building codes & engineering standards

B. Promote "No Regrets" Improvements
1. Provides benefits regardless of future climate changes
2. Enhances Sustainability
3. Protects investments/increases return on investment

C. Mandate Systematic Key Data Collection, Analysis and Monitoring
1. Baseline inventory and current conditions
2. Conduct hazard and vulnerability assessments
3. Analyze to identify future conditions and vulnerabilities
4. Identify adaptation measures and tools to assess and adopt options
5. Prioritize and coordinate research /computer modeling

PI-1. PI TWG POLICY COMPONENT ONE: ACCOMPLISH SYSTEMATIC KEY DATA COLLECTION, ANALYSIS, USE AND MONITORING

Component Description

Establish a coordinated and integrated system to observe, collect, catalog, and disseminate data on the existing condition of public infrastructure and the environmental conditions where it is located. Use this information and trend data to systematically assess the vulnerability of Alaska's public infrastructure to establish the level of risk, and to better coordinate project planning and development within communities in this environment of uncertainty. Disseminate this information among the members of the local communities to provide them with better understanding of environmental changes and how these changes may affect their lives. Five points to achieve:

1. Standardize information to be gathered. Establish a baseline and benchmarks, so data comparison and analysis is possible over time and across agencies/parties.
2. Conduct hazard analysis based on up-to-date climate data for Alaska's regions. Produce vulnerability assessments to rank the risk level or vulnerability of existing infrastructure. Create an actionable format to facilitate sharing and use of this data by local, tribal, borough, state and federal users.
3. Gather and review planning documents for proposed public infrastructure; analyze and eliminate conflicts for renovation, retrofit, replacement, or relocation of existing infrastructure.
4. Identify sustainability criteria and correlating adaptation measures for public infrastructure and tools to assess which measure to use with long term intent to update code requirements as necessary.
5. Prioritize and coordinate research /computer modeling so that environmental data and modeling as well as the engineering needs are as up to date and as accurate as possible

A new entity is needed to coordinate efforts of all involved local, borough, tribal, state and federal agencies in achieving these goals. This entity should also guarantee an active involvement of scientists and academia in this process. This involvement is minimal up to date.

Component Design

Structure/design

Establish a network of professionals across government and academia to identify key data needs and link available data on infrastructure, plans, and potential changes to the environment. Identify 'key' data based on three criteria: only data needed to adapt to climate change effects – not all data- should be gathered and linked under this program's auspices; key or critical data should be prioritized since realistically not all desired data will be able to be gathered and linked; and agencies must agree on the key data parameters and protocol so that data can be compared and linked.

A. Standardize information to be gathered. Establish a baseline and benchmarks, so data comparison and analysis is possible over time and across agencies/parties. Identify key data needs, mechanisms to share and link databases, and fill data gaps where possible.

Targets/Goals

Improve dissemination of already existing and new data, trend analysis, and assumptions bearing on effective planning, e.g. flood plain mapping, climate predictions, demographics, permafrost conditions. This is where we should state what data specifically to gather and link for the purpose of adapting infrastructure. It doesn't have to exhaustive or complete, but we should be specific here. What data should be gathered to prepare a baseline inventory of the current condition of public infrastructure and local environmental conditions? (VR - it should be one of the first priority when this option will be implemented, I don't think we should include here a complete list, maybe just some examples. As an example, permafrost temperature should be monitored, data on permafrost ice content are also crucially important, any data on development of surface processes (as thermokarst, thermal erosion, ponding, slope processes) in adjacent to the infrastructure of interest areas should be collected.)

Timing

This can begin immediately upon approval. It is scalable to begin with existing resources but could contribute to significant improvements in project effectiveness with a small professional cadre and more active involvement of academia.

Participants/Parties Involved

There are several government agencies and academic databases already in use but not integrated. Each has a database manager or monitor. Examples of climate databases: Alaska Climate Research Center (http://climate.gi.alaska.edu), SNAP, permafrost databases: UAF Geophysical Institute Permafrost Lab (www.permafrostwatch.org), CALM (www.udel.edu/Geography/calm/) This component can begin with as a proof of concept and expand as needed.

Evaluation

Evaluation can be based on answering several questions: e.g. 1) if all the data that are needed are being collected? 2) if these data are being collected at all needed locations? 3) if representation of data are good enough to be understood and easily used? etc.

Research and Data Needs

VR – on climate: what are the recent trends in air temperature, wind velocity and duration, and precipitation at the locations of interest, what are the best available at this time projections of the future change in this parameters, what are the projected changes in other environmental parameters and first of all in permafrost. The trustful projections could be made only based on data mentioned in i) and iii) and additional modeling research. The possibility of use of the remote sensing products should be researched and recommendations should be made.

B. Conduct systematic hazard analyzes for public infrastructure, based on up-to-date climate data that takes regional variation into account. Produce vulnerability assessments to rank the risk level or vulnerability of existing infrastructure. Create an actionable format for this system to facilitate sharing and use of this data by local, tribal, state and federal users.

Targets/Goals

Potential climate change impacts to infrastructure vary based on site specific conditions such as ice rich permafrost, erosion or flooding. These conditions must be evaluated for each specific location to determine the types and levels of risk each community will face. Information derived from this analysis should then be used to focus initial efforts on those communities determined to be at greatest risk from environmental factors.

Timing

Ideally, up-to-date input on local environmental and infrastructure conditions is needed before a hazard analysis and vulnerability assessment is completed. However, because establishing this baseline will take place over several years, and because the public infrastructure in some areas is clearly highly vulnerable this effort should begin immediately with best available data in high risk areas. This would include erosion, melting permafrost and flooding, coastal areas in the north, uplift areas in southeast, areas of discontinuous or warm permafrost that are most vulnerable to change.

Participants/Parties Involved

Those involved in this effort would include government agencies, professionals, academia and local participants. There is a need for a lead agency for village relocations, possibly tying this in with being the integrator for work in existing villages. PO- I thought we said we'd use the DCCED data base to keep track of proposed projects.

Evaluation

Information necessary to complete vulnerability assessments is readily available in many cases. Geotechnical conditions, erosion or flooding events have already been evaluated for most communities

Research and Data Need

VR **–** The possibility of much more intense use of the remote sensing products should be evaluated and an approach that combines remote sensing with ground monitoring and modeling should be developed.

C. Gather and review plans for public infrastructure; analyze and eliminate conflicts for renovation, retrofit, replacement, or relocation of existing infrastructure.

Targets/Goals

Proper planning is a critical component in ensuring infrastructure improvements are resistant to the site specific forces that will be imparted on facilities as a result of climate change. Through knowledge of future environmental conditions, structures can be designed to accommodate the environment throughout the design life of the facility without the need for costly overdesign. Agency oversight of public infrastructure design efforts can be used to protect public investment through code enforcement based on the best available information

Timing
This work can begin immediately. This can occur simultaneous with the other programs that are part of this Component.

Participants/Parties Involved
State regulatory agencies such as the Department of Environmental Conservation can integrate protection of infrastructure from climate change into the regulatory plan review process. Code enforcement can be extended to smaller communities to address climate related threats to infrastructure.

Evaluation

Research and Data Needs
Regulations and codes will need to be updated and plan reviewers trained.

D. Identify adaptation measures for public infrastructure and tools to assess which measure to use. Improve quality of data, scenarios, and assumptions for policies and plans for future infrastructure. VR – are these data, scenarios, and assumptions different from what was discussed in a)?

Targets/Goals

Timing

Participants/Parties Involved

Evaluation

Research and Data Needs

E. Prioritize and coordinate research /computer modeling so that inputs and modeling for (2) above - as well as the engineering needs discussed in PI TWG Component Three - are as up to date and accurate as possible.

Targets/Goals
Critically evaluate performance of existing models, improve predictive capabilities of these models, develop mechanism/procedure how to best use the outcomes of these modeling efforts, and establish system for identification and tracking of modeling efforts.

Timing

Participants/Parties Involved

Evaluation
A retrospective evaluation of models predictions could be used to evaluate the models performance. I am not sure how to evaluate the success of the entire Task. PO- possibly a demonstrated source listing of on-going and published model data?

Research and Data Needs

Improvement in models performance will be needed. It could be achieved by improving the models themselves, by improved parameterization used in these models, and by better assimilation of remote sensing and ground observational data

Implementation Mechanisms

What steps need to take place to make Component One happen? Is there anything critical that must happen before this option can be implemented? (Examples: Does a feasibility study need to be done first? Is new legislative authority needed? Does a new agency or group need to be formed?) VR – I believe all three above will be needed PO- Agree first two, and a new mission in an existing agency or group if not a new agency

Related Policies/Programs and Resources

Do current governmental, non-governmental, or private programs exist that are relevant to this policy option? If so, list and describe briefly. Are there potential synergies with other efforts being undertaken in other sectors, states, or otherwise? PO- Yes- NSSI, AOOS are examples but none of them cut across the full spectrum.

What resources already exist to address the programs described in Component One? Are there funding mechanisms in place to institute this policy? Is the necessary expertise available? Does an existing governmental body have the necessary authority and/or practical ability to implement this policy option? Are there unconventional resources available, such as indigenous knowledge or social networks? PO- Denali Commission potentially as an integrator/lead agency for projects; Arctic Research Commission may be aligned well for data collection and trend analysis, NOAA is particularly adept at collecting and collaborating requirements.

Benefits and Costs

Implementing the programs described and a communication and decision-making network will significantly improve coordination between projects involving one or several state, federal, local or tribal agencies. There is a potential for significant savings through a common set of planning assumptions and the timing and sequence of otherwise disparate projects. The costs will vary with the scale of implementation from low (network of existing planners and database managers) to moderate (small professional cadre for analysis and a standing resource for policy makers).

PLEASE SEE BENEFITS/COSTS TEMPLATE. We should develop narrative to address at least the 1st two of the four points.

Feasibility Issues

The coordinated network approach described here is similar to that instituted by the State of Iowa to rebuild or repair 8000 elements of public infrastructure damaged or destroyed by the 2008 floods. The Rebuild Iowa Office, with a small cadre under the Lieutenant Governor and a network of public and private sector, coordinates, prioritizes, and monitors the rebuilding effort of dozens of state and federal agencies with many funding sources.

TWG Approval and Deliberations

What is the level of approval within the PI TWG for this Component? Are there any minority views, as well as caveats or ideas to keep in mind as this component of the PI TWG system to adapt public infrastructure to the effects of climate change.

PI-2. Promote "No Regret" Improvements

Description

There are many uncertainties as to the impact of climate change on public infrastructure in Alaska. How we deal with these uncertainties will determine how we adapt to a changing climate. For sure, our predictions on future climate change would be more accurate if we reduce the uncertainties by meeting the expectations of Component #1 (Systematic Key Data Collection, Analysis, Monitoring and Access). Also, by forecasting future climate change and its effects better, we can protect our existing infrastructure and plan and design new infrastructure, thus resulting in infrastructure that can better withstand climate change.

Managing the risks and/or reducing the uncertainties will take time. Meanwhile, while data is being collected and analyzed, the focus should be on infrastructure improvements that will provide value added regardless of future climate change, i.e. no regret.. This focus is Component #2 (Promote "No Regret" Improvements) of the Sustainable Infrastructure Policy. "No regret" actions and "no regret" projects need to be incorporated into preparing our infrastructure to a changing climate. A "no regret" approach provides cost-effective and cost-saving benefits regardless of future climate changes. This approach promotes building resilience that does not overly depend on the potential consequences of future climatic events on infrastructure in Alaska.

Component Design

Structure/Design

An integrated statewide plan is necessary to achieve the best value in our future infrastructure development, which is Component #1 of the Sustainable Infrastructure Policy. The ability to accurately forecast the effects of climate change are critical to our long term success. However, our understanding today of climate changes processes and the associated impacts in Alaska are to a great extent incomplete, which makes it extremely difficult to adapt existing and new infrastructure to future climate changes. Due to these uncertainties, the overall infrastructure strategy will have to balance the short term need for agility with the long term need for durability and cost effective deployment of facilities designed and constructed to survive extreme events and the changing environment.

"No regret" projects provide the near term agility vital to an effective response. Utilizing existing data and technology, these projects focus on protecting the State's infrastructure investment by:

- Protecting/extending the design service life of infrastructure
- Reducing facility operating costs and complexity, and
- Promoting the systematic deployment of current best practices in the development, design and construction of new infrastructure

Implementing "no regret" measures that are sustainable would provide cost-effective benefits to communities even if the underlying climate change assumptions were incorrect. Also, "no regret" options will continue to build resilience that starts with Component #1 (Systematic Key Data Collection, Analysis, Monitoring and Access) and ends with Component #3 (Build to Last).

No regret actions include adaptation of infrastructure to better withstand climate change impacts or mitigation measures designed to address the vulnerabilities of existing infrastructure. Examples of "no regret" adaptations include protection of key facilities from erosion/storm damage, energy conservation upgrades, and enhanced water quality protection. "No regret" mitigation measures for public infrastructure include long term planning and preparedness, promoting energy–efficient technologies, using alternative energy sources, or building with better materials.

Targets/Goals/Timing

During the initial phase (first 3 -5 years) of the Sustainable Infrastructure Policy deployment, the "no regret" component will be ongoing concurrently with Component #1. As both efforts move forward, the Component #3 (Build to Last) will be introduced. This third component will overtake and replace the "no regret" component once the ability to accurately forecast the effects of climate change is firmly in place and the adaptation strategies for future infrastructure are created.

Participants/Parties involved

The "no regret" methodology can be readily integrated in current infrastructure prioritization methodologies. This will enable Federal and State agencies tasked with infrastructure development, construction and/or operation the opportunity for an orderly transition to the new "Build to Last" methodology. A new central coordination entity will be needed to coordinate the transition.

Infrastructure development, construction and operation are key responsibilities for all levels of government. Participation by Federal, State, Municipal and Tribal governments will be necessary for the successful deployment of this component.

Evaluation

Integrating cycles of improvement information sharing will enhance the effectiveness of this component. Opportunities for best practices information sharing and project administration/outcome feedback loops will need to be integrated into existing infrastructure award and follow-up processes.

Research and Data Needs

While research and data are critical to the other components of this option, the ability to proceed based on existing information provides the opportunity for agility that makes this component of the overall all Sustainable Infrastructure Policy Option so valuable.

Implementation Mechanisms

This Component of the overall Sustainable Infrastructure Policy Option can be implemented within the existing framework of State and Federal Agencies. Although greater efficiencies could be achieved if a central coordination entity was established to enable aligned deployment and clear communication horizontally among partner agencies and vertically between the various layers of government.

Related Policies/Programs and Resources

The other Components of the Sustainable Infrastructure Policy Option are integrally related to the long term success of this Component. All three components must be initiated as a system to ensure the State achieves the maximum return on investment for this Policy Option.

Existing resources of the agencies that currently fund the development, construction and operation of the State's infrastructure can be utilized to implement this component of the overall Sustainable Infrastructure Policy Option. For best results a centralized planning/coordination effort would be required.

Benefits and Costs

Adapting public infrastructure to a changing climate will be expensive. However, the cost of not adapting infrastructure will be greater. With a start up component utilizing "no regret" methodology, the State's investment in existing infrastructure will be better protected. Proven technology will be utilized that will extend infrastructure service life and potentially reduce or contain operating costs.

Feasibility and Constraints

The United States has the required technology and needed capacity to be successful in this endeavor. Component #2 can be initiated with minimal additional resourcing; to optimize its effectiveness would only require a central coordinating entity be established to ensure existing infrastructure funding, development, construction and operations agencies were better aligned.

Funding availability is lacking.

Sufficient Alaska specific scientific research capacity does not yet exist to assure the long term success of the overall Policy Option

A coordinated statewide database of key data and analysis displayed and readily available to decision makers in an understandable and actionable format does not currently exist

The ability does not yet exist for the various State and Federal Agencies to communicate among each other and establish aligned and connected policies, procedures, and information access that enable and empower local government with the ability to act.

G. TWG Approval and Deliberations

PI-3. BUILD TO LAST, BUILD RESILIENCY INTO ALASKA'S PUBLIC INFRASTRUCTURE.

Component Description

To adapt Alaska's existing and future public infrastructure to the effects of climate change we must build new infrastructure to last. This means either building it in locations outside of hazard zones (that have been updated and defined using climate change modeling) or in a manner that can withstand the expected forces at the location over the expected life of the infrastructure. This will require climate change modeling that yields updated hazard zone locations and revised data on expected forces and conditions for which infrastructure must be designed. This will also require modification of some engineering design standards, building codes, and operation and maintenance practices. Three points to achieve:

1. Meet or exceed design infrastructure service life.
2. Best in class life cycle costs/asset management practices.
3. Infrastructure is able to withstand disasters and changing environment. Infrastructure uses best science and appropriate building codes and engineering standards.

Component Design

A. Meet or exceed design infrastructure service life.

Structure/Design

Current building codes concern themselves with safety and performance of infrastructure under both manmade and natural forces. Indeed the concept of service life focuses on the ability of the structure to fulfill its intended function over the design life. The design life is often set not by the engineer but by the owner or public policy. For example, buildings for 'Box Stores' have a design life of 20 years. In contrast, dams for mining sediments have a infinite design life.

Highway, railroad and airport design considers not only structural design criteria but also natural forces such as erosion, flooding and thermal impacts. Erosion control features are commonly incorporated into the design. Buildings, on the other hand, are sited based on their function with little consideration of natural forces. Schools are sited close to housing, post offices are sited close to business areas, and power generation plants are located safely away from populated areas. Rarely do their design consider erosion control. Instead the designs focus on function, safety and sites which provide adequate foundation.

Indeed, it is these natural forces which are the focus of the impact of climate change. Coastal erosion, increased flooding, and thermal degradation threaten to shorten the life of infrastructure if not properly managed. Unfortunately, available information make it difficult for engineers to incorporate climate change in their designs. Further, since public policy or lack thereof related to inclusion of climate change in owner decision make it impossible for engineers to account for climate change impacts.

Targets/Goals

Two changes are required to ensure our public infrastructure achieve its service life. The first is to develop a policy which ensures public buildings be sited in locations which preclude damage by natural forces such as flooding or erosion. If that is found to be impractical, then appropriate measures should be part of the design including first floor elevations above flood level or including erosion control measures.

The second requirement is sufficient climatic data to include in design codes and procedures. At present, engineers use historical data to predict the future. Unfortunately, climatic models indicate this procedure may not adequately predict future natural forces. Without improved prediction models with adequate resolution and reliability, designs will be a patch work of speculation.

Timing

Implementation should begin immediately by requiring a vulnerability assessment of all public structures. Make plans on how these vulnerabilities will be addressed. In some cases action might be simple, in others we may have to accept the loss of the structure. In either case, we can avoid crisis management. The second part of the implementation is to require a vulnerability assessment for all proposed publicly funded infrastructure leading to policy and design requirements which limit or eliminate these threats. The third is to implement the development of usable climatic data for policy makers and engineers to use in making and refining criteria for locating, designing, constructing and maintaining infrastructure. This last requirement may take years to fully develop, but data can be implemented as soon as it becomes available.

Participants/Parties Involved

Federal, State and Local agencies responsible for planning, design, construction and maintenance of infrastructure are critical to the implementation of policies related to climate change. Agencies such as the Public Health Service, BLM, the Park Service, Alaska DOT&PF, DEC, and others must develop consistent policies concerning the issues discussed above. For example, if the Public Health Service ignores the increasing coastal erosion and state agencies choose to limit new construction in vulnerable areas, inconsistencies will arise which makes community planning difficult or impossible.

The engineering community must assess codes and engineering practices to ensure infrastructure is adequately addressed. The engineering community must also unite on these issues to provide feedback to the owners noted above about the consequences of their decisions. However, in the end, as long as no codes or regulations are broken, it is the owner that has the final say.

Evaluation

There are numerous examples of evaluation available. Bridges are evaluated every two years for structural and functional deterioration. Roadways are evaluated every two years to find deficiencies. Aircraft undergo regular inspections to ensure safety. Unfortunately, not all of our infrastructure undergo routine evaluation to assess how they are performing and encourage timely corrective action. The Navy is in the process of developing procedures to do exactly this. They assess how well each part of their inventory including civil structures are able to perform their intended mission and develop a plan to ensure the infrastructure continue to meet that mission. This approach, often termed Asset Management, provides tools to assess the condition and performance of the infrastructure and to suggest appropriate and timely corrective action. Unfortunately, many agencies have little information concerning the infrastructure under their jurisdiction especially the condition of those structures.

Research and Data Needs

There are two major data needs. First, climatic data which is at a resolution and accuracy to be useful to decision makers is needed. Statements like ‘an increase of 8 degrees over the next century’ provide little information to feed into the design process.

Agencies must institute a condition inventory and vulnerability assessment of their infrastructure so that they have the information to plan for improvements and replacement. At present, it seems we get to crisis mode before acting. This results in hasty decisions which are often less than efficient.

B. Life-cycle costs/asset management practices.

Structure/design

Life-cycle costing uses all costs including first costs, repair, maintenance and operating costs to select the best alternative. For example, if we base our decision solely on first cost, we will likely build the structure that minimally meets the need even though this option may have high heating or maintenance costs. In some cases, these structures become obsolete before they reach their design lives.

Asset Management provides a tool to evaluate all the agencies assets and develop a program that either maximizes the performance with a given budget or minimizes the budget for a set performance criteria. This process helps decision makers put their limited funds where it will do the most good. Asset management also allows decision makers to plan for upgrades and replacement over a 10 to 20 year time span. However, we must be careful to understand that political and social needs must be a part of the decision process. However, asset management techniques allow us to understand the impact of these decisions.

Targets/Goals

Implementing life cycle costing and asset management is really a decision of management. Both of these tools have been available for many years and when used have either improved the overall condition and performance of infrastructure or has reduced the budget or both. The complexity of these procedures is predicated on the desired outcomes and the size of the inventory. In most cases a consultant skilled in these processes is hired to guide the organization through the development. However, most agencies establish a small group to run the system. As an example, AK DOT&PF hired a consultant to develop a life-cycle cost process for pavement design. The University of Alaska Fairbanks has been hired to incorporate that procedure into the design software used by DOT&PF.

Timing

Work could begin as soon as management decides to accept this approach. The legislature has on occasion tried to push these concepts. Unfortunately, resistance by agencies stagnated the effort. The development and implementation would take three to four years. However, we can expect continued improvements as part of the feedback processes normally included.

Participants/Parties Involved

Development of life-cycle costing and asset management requires buy in from all decision makers including the agencies affected, the legislature and to a limited extent the engineering community. If it is to be accepted, the public must see the benefits. The major barriers are the feeling by decision makers and the public alike that they are losing control. While these procedures provide input about the impact of a decision, they do not dictate the decision. They do tend to force a more thorough discussion and rationalization of decision which go counter to life-cycle costing and asset management.

Evaluation

Both life-cycle costing and asset management require collection of cost data, condition inventories and performance data as inputs to the systems. Further, performance-life curves will be required as feedback into the process to ensure we learn from our experiences. One of the major benefits is that we can begin to truly document and understand the impacts of climate change on the performance of our infrastructure and to implement appropriate design changes.

Research and Data Needs

These techniques are well established. If the State of Alaska chooses to implement them, data collection and inventories will be required. These data may include, energy costs, structural deficiencies, vulnerabilities from natural forces including erosion, flooding and wind.

C. Infrastructure is able to withstand disasters and changing environment. Infrastructure uses best science and appropriate building codes and engineering standards.

Structure/design

The easiest and often the most cost effective means of coping with natural disasters is to locate the infrastructure outside the hazard zone. For example, locate the power plant beyond the anticipated 50 or 100 year coastal erosion zone. This requires that we develop models which are able to predict erosion over this time frame. Where it is impractical to locate the structure outside the hazard zone, we must design the structure to withstand the hazard or provide protection against the hazard. For example, designer of the power plant could include erosion control measures in the design of the plant. In the case of an existing structure, engineers and the owners must assess the structure and determine whether to move or protect. Each case is different, but the process is the same. Through the use of benefit/cost analysis, each alternative can be evaluated to determine the most attractive solution.

Targets/Goals

If we are to ensure the longevity of our infrastructure subjected to climate change, we must include those changes in our decision and engineering processes. This requires that we first have and understanding of the impacts of climate change and that we actively address them. Management must set performance standards which engineering codes do not and should not address.

Timing

The first step is to establish a policy which recognizes the impact of climate change. Agencies must recognize they have the opportunity and responsibility to locate public facilities in a safe location and that the design of the structure can include resiliency against climate change. Further, agencies must recognize that they have are responsible to establish the performance criteria for the infrastructure. Engineering codes will adapt to these new requirements. The time frame is really a function of urgency felt by the owners. That is to say many of the changes can occur almost immediately after the decisions are made.

Participants/Parties Involved

Federal, state and local agencies who own and operate the facilities are responsible for establishing the performance standards for their facilities. Engineers are responsible for ensuring these performance standards are met within the framework of engineering codes. As has been repeatedly stated, climate data required to carry out implementation of these decisions must be developed in a usable form.

Evaluation

Routine inventorying and inspection of our infrastructure provides invaluable insight into how well we are doing. For example, if we regularly see displacement of pile foundations in thawing permafrost, we need to alter our design procedures. Without collecting that information engineers can only assume the designs are adequate. Too often we have a build and forget attitude.

Research and Data Needs

Again we must obtain good climatic data. In addition we can evaluate our existing infrastructure looking for common failure modes which can then be fed back into the engineering designs and codes. The Canadian experience has shown in a review of foundation types that some foundations perform better in permafrost areas than others and that some are more resilient to climate change in others. Research can identify which designs are successful and which are not.

Implementation Mechanisms

The steps required to implement Component Three are:

1. Establish performance standards and policies which incorporate hazard vulnerability and climate change.
2. Revise engineering standards which implement these policies.
3. Obtain climatic and performance data to be incorporated into 1 & 2. This feedback process ensures improvements with time.

No new agencies or groups need be established although existing groups may be required to refocus their efforts.

Related Policies/Programs and Resources

Do current governmental, non-governmental, or private programs exist that are relevant to this policy option? If so, list and describe briefly. Are there potential synergies with other efforts being undertaken in other sectors, states, or otherwise?

What resources already exist to address the programs described in Component Three? Are there funding mechanisms in place to institute this policy? Is the necessary expertise available? Does an existing governmental body have the necessary authority and/or practical ability to implement this policy option? Are there unconventional resources available, such as indigenous knowledge or social networks?

Benefits and Costs

PLEASE SEE BENEFITS/COSTS TEMPLATE. We should develop narrative to address at least the 1st two of the four points.

Feasibility and Constraints

Can the state realistically implement the proposed component? Is this within state authority or is it more appropriately the role of the federal government, localities, individuals, etc? Do the necessary legal, administrative, financial, technical, and other resources exist, and are they available for use on this proposed state action?

Are there potentially limiting factors for implementing this component? Does it require public buy-in? Will there be a long delay between actions taken and benefits realized? Are there other potential logistical, geographical, financial, technical, or procedural constraints?

Approval and Deliberations

What is the level of approval within the PI TWG for this Component? Are there any minority views, as well as caveats or ideas to keep in mind as this component of the PI TWG system to adapt public infrastructure to the effects of climate change.