Climate Change Adaptation Planning Manual

For Coastal Alaskans and Marine-Dependent Communities

Alaska Sea Grant Marine Advisory Program

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Community Adaptation Planning

"Climate is what you expect; weather is what you get."—Robert A. Heinlein

Alaska is changing before our eyes. Some changes are dramatic, others subtle, some rapid and some gradual, but there is no question that our physical environment is undergoing change, much of it related to temperature, weather and climate. People who live close to the land or depend on the sea for sustenance and income are reporting many observations of a changing environment. For example:

- Storms apparently are becoming more frequent and severe.
- Disastrous floods are occurring more often.
- Spring is coming earlier and freeze-up later.
- Permafrost is thawing in places where it never did before.
- Some parts of the state are getting more snow, and others less.
- Sea ice is thinner, forms later, and retreats farther from land.
- Glaciers are melting.

People are observing these trends and research is confirming the observations.

What's more, scientists who study the environment believe that even greater change is coming to coastal Alaska between now and the end of the century:

- Sea level is expected to rise enough that some low-lying parts of the Alaska coast will be under water.
- Ocean chemistry is expected to change so much that some kinds of sea life may not survive, including a few keystone species in the oceanic food web.
- Rising air temperatures are likely to raise water temperatures in many streams to the point that they will not support spawning and rearing salmon.

Not all change is harmful, and some may be beneficial. Milder winters may lower heating costs, longer summers may boost tourism and outdoor recreation, some kinds of fish and wildlife will prosper under milder conditions, ranges of commercially valuable fish stocks may expand, and a longer ice-free navigation season and larger ice-free areas of the sea may lower transportation costs and open up new economic opportunities in the north.

Why Adaptation?

The exact causes of these climate-related changes are not in all cases well understood, and discussion continues about what can be done in the long term to slow and eventually halt them. While many people are working on that problem, we have an important and urgent task: deciding how to respond to change. If we think it through and plan to respond in appropriate ways, we can minimize the harm to our communities, businesses and lifestyles that these changes are bringing, and in some cases we may find ways to benefit from them.

Human beings are adaptive creatures, and as a species we have adapted to many kinds of change—environmental, social, technological and economic—throughout our history.

The archeological record shows that ice ages have come and gone, sea level has risen and fallen, forests and plains have turned to deserts, and in turn people have turned deserts into farms,

orchards and golf courses. The climate that we think of as normal has only been this way for a few thousand years or less, and humans have experienced and adapted to an endless series of climate-related changes.

Humans have adapted by **developing technologies** and by **changing behaviors**. Relocation, for example from a flood-prone area to higher ground, has long been an adaptive response to environmental change, as has been channeling, constructing dikes, and building on pilings. Modern science and new technologies are making adaptation if anything less disruptive and easier to plan and implement.

Two factors set apart the current changes from many we have dealt with before. One is that they will be **long-term** (essentially permanent), unlike so many of the floods, droughts and other changes that have come and gone in the past. The other is that **we have the knowledge and capabilities** to plan for them and begin to adapt before the worst hits, rather than after.

Why Start Planning for Climate Change Adaptation Now?

- Some effects are already upon us, and others are coming soon.
- Proactive (planned in advance) adaptation is usually more effective, and less expensive, than reactive adaptation (responding after change has occurred).
- Planned adaptation can provide immediate benefits because measures designed to address future climate effects can help a community deal with more immediate weather events.

What do we mean by "adaptation"? The United Kingdom Climate Impacts Programme (UKCIP), a world leader in adaptation planning, defines it this way: *An adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.*

Adaptation is distinguished from *mitigation*, which involves measures to cut emissions of climate-altering "greenhouse gases" in order to slow or halt climate change itself. In some cases, however, *mitigating* **specific impacts** of change can be part of an overall *adaptation* strategy.

The purpose of adaptation is to develop a **resilient community.** This is one that takes proactive steps to prepare for the impacts of projected climate change. It results from deliberate decisions by members or representatives (called **stakeholders**) of the affected communities. As member of communities currently or likely to be affected by climate change, we are stakeholders.

Adaptation is a **collaborative process**. Stakeholders should work together to devise strategies for adaptation. Adaptation planning can be done in a series of steps, each of which is relatively simple to accomplish.

About This Adaptation Planning Manual

This manual is for extension professionals, community organizers, local planning officials, teachers, or anyone else whose task is to help individuals, families, businesses, communities, and local governments **think through** the meaning of climate change on the local scale, **assess vulnerabilities**, **devise strategies** for improving resilience, **locate tools and resources** that will help, and **develop and implement plans** for adaptation.

Appendices include an adaptation checklist, talking points for leading adaptation discussions, a checklist of items to take to a village meeting, a roughly-drafted sample community adaptation plan, selected resources, sample preparedness measures, and samples of goals, objectives and measures. The final appendix contains a set of worksheets with spaces for stakeholders to enter answers to questions about observed climate-related changes, adaptation measures, risks, and others.

This manual has a companion document called the *Alaska Climate Change Adaptation Planning Tool,* which is an abbreviated (7-page) version of the eight steps to adaptation planning outlined in this manual. The *Planning Tool* is intended to be used in community planning sessions and is the document stakeholders are likely to work with directly.

Also available as part of this climate change adaptation project are an Alaska-specific climate change introduction video, Alaska-specific climate change fact sheets, and a related website**.**

Notes:

Climate Change Adaptation Messages

1. **Climate change is real,** it's happening now, and it will become much more evident in the coming years.

- There is no real scientific debate about its existence. There is some debate about causes.
- Even if strict limits on greenhouse gases were to be put in place soon, climate change would continue to increase for decades.
- Not all extreme weather events result from climate change. Some climate change effects will develop subtly and over time will turn into major, long-lasting changes to our environment.
- Alaska already is experiencing more direct effects than most of the United States due to its northern location, and scientists predict the north will experience more extreme impacts than many other places.
- Many of those impacts are likely to affect residents' health, safety, comfort, and financial well-being. They may alter community structure, cultural traditions, business, recreation, and overall lifestyle.
- Not all impacts are bad, and some may bring new opportunities.

2. **It doesn't matter whether observed changes are direct results** of "global warming" or climate change or not.

- Many people—for political, philosophical, religious, social or other reasons—do not believe that observed changes result from climate. In some cases it may turn out that they are right.
- The focus of adaptation planning should be on the trends or events, not causes. Many weather-related events may or may not be intensified by climate change, but the preparation is the same in any case. Hazard mitigation is climate change adaptation.

3. **Human beings are adaptive**, and can understand, anticipate, and adapt to the inevitable changes that are coming and are now under way. Chances are you may already have begun to do so, possibly without realizing it.

- Adaptation comes in many forms, some dramatic, others subtle. Some are very expensive and disruptive, while others cost little time and effort.
- Some kinds of adaptation can only be done by government, but individuals and communities can take some adaptive measures on their own.
- Adaptation can be proactive or reactive. Generally, reactive adaptation is more expensive, more disruptive, and less effective. This project is directed at proactive adaption

4. **A great deal of scientific research and monitoring is under way,** and climate change data are piling up. Some of this information is helpful to individuals and communities trying to predict the impacts of climate change on them. However,

- Decisions regarding how to adapt must come from the people affected, and should be made with the best available information and through group effort.
- There is much to be gained in working cooperatively where possible.
- Adaptation methodologies are similar to those of other kinds of risk management and decision-making under conditions of uncertainty.

5. This manual lists some of the kinds of climate change impacts that **some Alaskans currently experience or are likely to experience in the foreseeable future**. Discussion is confined to the 21st Century, about 90 years or the potential lifetimes of children just being born and their children.

Notes:

Eight Steps to Adaptation

I. ***Define your community and specify your adaptation planning area.*** Determine boundaries for the geographical area, or combination of areas, or otherwise define the community for which you want to develop adaptation planning.

2. ***Determine your motives for adaptation.*** What do you want to achieve? Are you trying to avoid damage to property or community infrastructure, plan for the future of your business, foresee changes in traditional lifestyle, identify future business opportunities, or simply raise awareness in your community?

3. ***Identify categories of change to which adaptation may be needed.*** Many different kinds of change are now occurring, and many more are predicted. Some of these will have no impact on you, and some may be things that you can't do anything about. It's helpful to catalog kinds of change.

4. ***Conduct a climate change vulnerability assessment and a risk assessment.*** Determine what kinds of environmental change are likely to affect your community, business or family; how they will affect you; and how severe the impacts may be. Include not only those that you can directly attribute to climate change, but also other geographical, social, economic or technological changes that affect you and might be made more extreme by climate effects. Having identified your community's vulnerabilities, determine what are the greatest threats (and opportunities). Make a list of priorities for adaptation planning.

5. ***Set goals and objectives for preparedness.*** Spell out what you want to happen in response to current or predicted changes. Specify objectives for reaching those goals.

6. ***Identify Adaptive Measures for Meeting Goals and Objectives.*** List and classify actions that build adaptive capacity or produce adaptive benefits.

7. ***Begin implementing your plan.*** These actions may take time and money, and you may not see immediate results. But all adaption begins with initial steps, and some of those can begin immediately.

8. ***Evaluate your progress, and report and share your experiences with others.***

1. Defining Your Community

A community can be a town or village, a tribe, or a group of people with common interests, such as fishermen or property owners.

Step 1: Identify the community or communities of which you are a member. It can be as large or small as you wish. Explain in what way you are a stakeholder.

Notes:

2. Motivations

Decide what you want to accomplish by planning for climate change adaptation.

People in many different situations are thinking about adapting to change.

- Some are just **curious**. They're not sure climate change is really happening, or whether it has any real implications for them. They just want to learn what all the fuss is about.
- Some believe change is happening, and they want to **raise awareness** in their communities that might lead to action.
- Some are **concerned about their property or about community infrastructure**. If their land is eroding, they're worried their house will fall into the water, or be inundated by storm surges or sea level rise. They may be concerned about the town's seawalls, bridges or roads.
- Others may **wonder if the family's fishing or other business has a future**, given the threat of ocean acidification or changes in fish abundance.
- For some the big **concern is how to continue traditional subsistence** hunting, fishing and food gathering.
- Some business owners may **see new opportunities**. Tourism and farming may look forward to longer seasons and more outdoor activities in a milder climate. A changing environment may open up markets for new insurance or financial products or expand demand for technologies that don't currently exist in Alaska.

Step 2. Write one or a few sentences defining what your motivations are for doing this exercise, and what you plan to get out of it.

Notes:

3. Kinds of Change

"The future ain't what it used to be."—Yogi Berra

Many kinds of change challenge our ability to survive and prosper. We confront **social, political, economic and technological change** in our communities, state and nation. This manual can help you adapt to changes in the physical environment, especially those whose causes are related to climate change.

Weather describes meteorological conditions at a particular time and in a specified location. **Climate** refers to the average weather over a given time. Thirty years is sometimes used as the time interval for describing climate.

An important step to adaptation is to **identify which kinds of change** are most likely to affect each of us or our communities, and then to isolate the specific changes within those categories that present the biggest threats or opportunities.

Humans instinctively fear change. It can be profoundly disrupting to life; it usually produces winners and losers. Information is the best tool in preparing for change.

Categories of Changes

The Adaptation Advisory Group (AAG) to the Alaska Governor's Climate Change Sub-Cabinet has identified four broad categories of climate change effects that residents of the state are now experiencing or are likely to face in the future:

Natural Systems—Alaska's natural systems provide a range of goods and services that benefit people. For example:

- Waters that provide fish for commercial, subsistence and recreational users.
- Habitat for valuable game animals and birds
- Ice that provides a platform for hunters and their prey, and acts as a buffer that smooths winter seas to reduce shoreline damage

Public Infrastructure—This is known as the "built environment" and includes:

- Docks and boat harbors
- Seawalls to protect shoreline
- Municipal water and sewage systems

Health and Culture—This includes personal and public health, and factors relating to lifestyles, traditions and material culture, including:

- Disease and injury
- Sanitation
- Subsistence and traditional arts and crafts

Other Economic Activities—The Adaptation Advisory Group defines this as sectors of the Alaska economy not directly supported by living systems, including:

- Oil and gas
- Mining
- Recreation and tourism

Alaska's Changing Environment

Atmospheric temperatures all over the world have risen measurably in the last half century, and the increase is greater nearer the poles than at lower latitudes. Average annual temperatures in Alaska have increased twice as much as in other parts of the United States.

- Since 1949 the statewide annual average temperature has increased by 3.1 degrees F. Some communities have experienced minimal increase, others as much as 5 degrees F.
- Winter temperatures have increased more on average (6.0 F) than summer (2.1 F), and winter temperatures in the Arctic have warmed more than elsewhere in the state. Winter temperatures in the Arctic and Interior have increased by as much as 6 to 9 degrees F in winter and 1 to 3 degrees F in summer.

Scientists predict that over the next century, the **temperature increase will be twice as much over the long-term norm as it is now**. Statewide average annual temperatures could rise from current levels by as much as 5 to 13 degrees, and average winter temperatures could rise by as much as 22 degrees F in certain locations.

- In the north, rain and snowfall has increased during winter, spring and summer, and has decreased in autumn. Total Alaska **precipitation is expected to increase again by 20 percent**. Snowfall amount and distribution is changing, with greater snowpack (and greater potential for avalanches) in many areas, while in others higher temperatures and a shorter period of snow accumulation is causing reduced snowpack.
- Greater precipitation, compressed into limited periods in the year, will cause **more flooding** and more destructive **riverbank erosion**.
- Most of Alaska's **glaciers are retreating,** indicating that the amount of snowfall is not keeping pace with melting due to higher temperatures.
- **Permafrost is thawing** in places where it never did before. Roads and buildings tilt or settle, and there are more landslides. Thawing permafrost increases **river and coastal erosion**, which damages infrastructure.
- **Sea ice off the coasts of the Bering, Chukchi and Beaufort Seas is thinning and retreating**. Studies indicate that across the Arctic over the last few decades, the extent of annual sea ice has decreased by 5 to 10 percent and thickness has decreased by 10 to 15 percent.
- Weakening and retreat of sea ice **makes access difficult and hazardous** for subsistence hunters**.**
- **Ice-dependent species** like walruses, polar bears and some kinds of seals, are losing their platforms for resting, mating and foraging. Already there are signs that some of these species are headed for a steep decline.
- The buffering effect that sea ice has on shorelines hammered by storm waves is being lost in many areas, causing increased **coastal erosion**. At least six Alaska villages are already facing relocation due to loss of shoreline, and more than 30 are in danger of eventually being taken by the sea.

- On the other hand, **navigation** in Arctic waters may benefit from the retreat of sea ice, lengthening the shipping season, lowering costs, and opening new sea lane routes.
- **Global sea level has risen** about half a foot due to **thermal expansion** of the oceans' waters, increased runoff from the land, and melting of the Antarctic and Greenland ice caps. Scientists predict that by the end of this century the **average height** of the world's ocean will be about a foot and half higher than now. On most of the Alaska coast this isn't a problem because the land is still rising after melting of the ice caps following the end of the last ice age, and because of *tectonic deformation* caused by the earth's surface plates crunching together. But in **low-lying areas of western Alaska**, such as the Yukon-Kuskokwim Delta, a foot of sea level rise could flood large areas.
- Saltwater could infiltrate domestic water supplies and kill coastal vegetation, and **storm surges** caused by a common combination of high tides, low atmospheric pressure, and high winds (also an effect of a warming climate), could push the sea up into villages, causing significant damage.

Changes in diversity, abundance and distribution of species are likely to affect commercial, subsistence and recreational users of Alaska's fish and wildlife.

- In the Bering Sea, both **crab and pollock** stocks have expanded their range or shifted north.
- **Salmon** stocks have expanded their range northward and have become established in some Arctic coast systems where the local language doesn't even have a name for them.
- Some migratory birds, like the black brant goose, have increasingly **overwintered in Alaska rather than migrating** to Mexico. Biologists say this behavior renders them vulnerable to catastrophic die-offs if a temporary severe winter freeze catches them in a location where they can't feed.
- Many species appear to **benefit from slightly warmer temperatures, particularly in the winter**. Sustained periods of excellent salmon production may result from shorter ice-covered periods in freshwater habitat and better conditions for plankton blooms at sea.
- However, for every species and stock there is an **upper limit** for the temperatures and conditions in which those benefits are enjoyed. As one biologist puts it, "warm is good, warmer is bad."

Invasive and eruptive species are beginning to displace native species in some cases, and are causing harm to some ecosystems as well as to human health and well being. Some invasives are simply shifting their ranges northward in response to warming conditions; others have been intentionally or inadvertently introduced but are finding conditions hospitable.

- **Atlantic salmon** (fish-farm escapees from British Columbia) are showing up in Alaska waters, where they compete with wild fish for food and habitat.
- **Bacterial enteric** (digestive system) **diseases** are becoming more common where water sources are compromised due to warming.
- ***Harmful algal blooms*** are becoming more frequent and widespread, increasing the risks of people becoming sick or even dying from paralytic shellfish poisoning and domoic acid. A disease-causing bacterium known as *Vibrio parahaemolyticus* has shown up in samples of Alaska-grown shellfish.
- A warming Yukon River appears to be linked to a destructive **fish disease** caused by a fungus-like parasite known as *Ichthyophonus*.

Ocean acidification could have profound effects on all marine natural systems. Over the last 200 years ocean acidity has increased by 30 percent. Ocean acidification is a separate condition

resulting from the same cause as the warming climate—atmospheric carbon dioxide. About a third of the carbon dioxide released into the atmosphere falls into the world's oceans where it dissolves in seawater, lowering the pH. Acidification lowers the amount of saturated calcium available to shell-building organisms.

Corals, most shellfish, and many of the phytoplanktons that form the base of the oceanic food web build *calcareous* shells, structures made up of calcium carbonate. An important example is the *pteropod*, a tiny pelagic swimming sea snail that is a primary prey of juvenile salmon.

Step3: Examine the above list of environmental changes currently being reported or projected to occur in coming years. Note those that you or other members of your community have observed. Place them in the appropriate AAG categories listed above. Some may apply to more than one category. Look for positive as well as negative effects. Specify the consequences of each for your community.

Notes:

4. Vulnerability

Every community is vulnerable to the impacts of change, environmental as well as social and economic. A simple vulnerability assessment can help to identify impacts that stakeholders most need to address in adaptation planning. Vulnerability has four components:

- The projections for change at the local or regional scale. The previous section identified most of these.
- Exposure and sensitivity—the assets at risk and the potential for harm (or benefit in some cases).
- Risk.
- Adaptive capacity.

Vulnerability means "capacity to be harmed." It is the degree to which a system or entity is susceptible to—and unable to cope with—adverse impacts. It is a function of sensitivity (to variability or change), exposure to risk, and adaptive capacity. A vulnerability assessment indicates the subject community's **net vulnerability**.

The opposite of vulnerability—and the goal of adaptation planning—is **resilience**. Resilience is a community's ability to absorb disturbance while retaining its basic structure and function.

Exposure refers to the types of assets at risk. They can include property, infrastructure, natural resources, and the services those natural resources can provide (protection of health, provision of food or water, etc.).

Sensitivity is the degree to which a system (natural, human, or built) is likely to be affected by change, such as climate-related environmental change.

Risk is a measure of the consequence (severity or sensitivity) and likelihood (probability) of potential impact.

Adaptive capacity is the ability of a community or system to mitigate, cope with, or accommodate change.

A vulnerability assessment is composed of two parts: a **sensitivity analysis** and a **risk assessment**.

Sensitivity Analysis

A good proxy for future climate change is **past weather events**. Not all climate change is expressed as weather, and not all extreme weather is caused by climate change. But previous extreme weather events can present some idea of what impacts future climate change will impose.

Has your community suffered flooding following storms or storm surges? What about rapid and damaging erosion? If these events have been more frequent or severe in recent years, they may be indicators of coming climate-related change that warrant planning and preparation. Some changes will **not** have direct impact on your community, so select carefully to ensure that you are assessing threats that are realistic to your situation.

Try to identify **critical thresholds** for those climate/weather events that apply to your community. Critical thresholds are the points at which if a level of effect is exceeded, unacceptable

harm will occur. For example, if the river floods but the water does not reach any structures, flooding may not have exceeded a critical threshold, but if water enters buildings, the threshold has been reached.

There may also be **indirect climate effects.** For example, transport of supplies and materials to your location may be disrupted or made more expensive.

Past weather events probably do not encompass the full range of future weather/climate related changes. Review the list you made in Step 3 to see projected climate-related effects that have not yet occurred.

Not all threats are climate- or weather-related. It is important also to list non-climate threats, particularly those that may interact with climate threats. Some may have **synergistic** interactions that make climate effects worse, or climate effects may make non-climate threats worse. These could include, for example, non-climate-induced changes in fish abundance and local or even global economic shifts.

Risk Assessment

A risk assessment considers potential hazards, estimating the likelihood or **probability** of those impacts actually occurring and the **consequences** or potential harm that would result.

A risk assessment can be *quantitative* (assigning numerical values; for example, low = 1, medium = 3, high = 5) or *qualitative* (assigning values in words, such as low, medium or high). Another quantitative approach is to estimate financial consequences (how much it would cost to repair the damages).

A **risk matrix** helps you express either qualitative or quantitative values. On the matrix the lowest values for both consequences and probability would go in the lower left-hand corner, and the highest would go in the upper right-hand corner (a blank matrix appears at the end of this manual). If a hazard has a higher probability or presents more severe consequences, it appears higher and more to the right, and those with the highest values (closest to the upper right-hand corner) present the greatest need for adaptation and should be considered **priority planning areas**.

Risk assessment outcomes may be modified by other factors, including:

- The **geographic scale** of the assessment. What is the size of the area that is being considered and what are the geographic **boundaries**?
- The **time frame** of the assessment; a decade, a century? An impact is less of a priority if it is expected to develop over a longer period because technological or other changes may overcome it. A 50-year time frame will be more helpful than one that extends out centuries.
- Your or your community's **risk tolerance**. People who live in unstable environments and who experience frequent extreme weather events, earthquakes or other kinds of rapid and dramatic change, may be more risk tolerant. Those in stable (especially urban) environments may place a higher priority on immediate action.

Adaptive Capacity

Your community may already have adapted to climate-related changes. If your community is susceptible to flooding, for example, but bulkheads in place are adequate to protect it, you have one kind of adaptive capacity. If you have a local planning committee that assesses the potential for problems and makes recommendations to agencies who can fund proactive protective measures, you have another type of adaptive capacity.

On the other hand, if local law, tradition or social factors prevent decision-making and action based on the best available science, adaptive capacity may be compromised. The same may be true if no money is available for implementing adaptive planning, or if local geographical, physical or biological barriers prevent effective action.

It's difficult to quantify adaptive capacity, but it should be factored in when assessing vulnerability and identifying priority planning areas.

Step 4: (**a**) Based on the list of effects noted in Step 3 or on predicted future effects, do a vulnerability assessment for each and prioritize them based on urgency. **(b**) Write out a short assessment that includes all of your community's vulnerabilities. The assessment can be qualitative or quantitative. Note where insufficient information is available.

Notes:

5. Goals for Preparedness

"It's not the strongest…that survives, nor the most intelligent…It is the one that is most adaptable to change."—a paraphrase of Charles Darwin

A key step in planning is to **determine what you want to accomplish**. State some goals you want to achieve, and some objectives to reach in pursuit of those goals, and then select some measures that will help you achieve the objectives that contribute to meeting your goals.

Goals are general statements about desired long-term outcomes. A goal should reflect a realistic accomplishment. A goal statement could be, "Prevent damage or loss of property to flooding or inundation resulting from heavier storm events and sea level rise."

One broad goal could be to make yours a **"climate resilient community,"** which is defined as one that takes proactive steps to prepare for projected climate change impacts. The King County/ICLEI guidebook (see Sources, Appendix F) recommends five guiding principles for resilience:

1. Increase public awareness of climate change and its community impacts.
2. Increase the community's technical capacity to prepare for climate change.
3. Incorporate climate change preparedness into policy decisions.
4. Increase the adaptive capacity of your community's systems (built, natural and human).
5. Strengthen community partnerships to reduce vulnerability.

Objectives are statements about specific accomplishments or outcomes that are important to achieve on the way to reaching a goal. Objectives should be quantifiable (they can be expressed in numerical terms) and limited to a particular time period for achievement. An objective statement could be, "Ensure that by 2020 at least 90 percent of residents' homes are safe from flooding and inundation."

Planners use the expression **SMART objectives** to describe objectives that are ***s**pecific, **m**easureable, **a**chievable, **r**esults-oriented, and **t**ime-bound.*

Some **measures**, or **preparedness actions**, can be taken only by governments, such as creating zoning laws to prohibit construction in flood zones, or moving whole existing villages out of flood zones. Individuals can take other actions, such as putting buildings on pilings to keep them above flood level.

First tier objectives can be planned and implemented in the current planning process. **Second tier** could be planned and implemented in the future but require additional information, resources or authority to implement. It may be good to start planning them soon, realizing that action will come later when more resources are in place. **Third tier** objectives are ones you probably can't address in the foreseeable future.

Sometimes goals, objectives and measures are easier to establish if they are measured against adaptation **strategies**. The UKCIP has outlined four strategies that may be appropriate for your community:

1. **Accept the impacts and bear the losses** of changes that are occurring or will occur. This may involve letting assets deteriorate and closing access to existing facilities. It includes what is known as the "managed retreat option."

2. **Offset losses by spreading or sharing the risks or losses.** Attempt to reduce financial loss and social disruption by using insurance or by establishing partnerships to spread the risk or share the losses.
3. **Prevent effects or reduce risks** with measures that reduce the community's exposure. It can include moving away from risk areas, improving technical standards for facilities, and implementing contingency and disaster planning. *This is the strategy that most of this adaptation planning manual is about.*
4. **Exploit positive opportunities** by introducing new activities, establishing new businesses or expanding existing businesses, developing new markets for goods or services, and putting into productive use areas, locations or resources that previously have been marginal or unproductive.

Step 5: (a) Based on exposure and risk assessments from the preceding section, select the highest priority potential impacts to address. Set an appropriate time frame. Address potential problems that can be solved through adaptation. (b) Write a one- or two-sentence goal statement for each one. (c) Write one or more objective statements for each one.
(d) Prioritize in terms of urgency and importance.

Notes:

6. Selecting Measures

There is likely to be a range of adaptive measures a community could take. A single measure alone probably won't achieve large-scale goals such as would relate to climate change adaptation. More likely, communities and their members will need to combine complementary measures.

Adaptive measures can be organized into two categories:

1. Those that **build adaptive capacity**. They create information (through research, monitoring and awareness-raising), support organizations including governments and partnerships, and back up adaptive actions.
2. Those that **deliver adaptation actions**. This could include improving management structures (such as creating buffer zones where building is not allowed), building or modifying infrastructure and other structures, or applying new technology that physically improves the community's climate resilience.

Each community has to find approaches that work for its situation. Creative thinking is needed. Guidance may be available from state and federal agencies, but ultimately the members of the community will have to make the hard decisions.

Adaptation measures should be considered in light of these criteria:

- Do they provide direct **benefits** such as protecting property, preserving health or lowering costs?
- How **effective** are they at solving the problems they are intended to address?
- How much do they **cost**, and who will pay? Do they show a positive benefit-cost ratio?
- Is **implementation practical**? Are they technically feasible in your location? Are they socially and culturally acceptable? Are they equitable; do they help at least some individuals without harming others?

No-regrets measures produce benefits that are independent of any climate change-related effects. The benefits exceed costs whether there is climate change or not. They make the community safer and more livable and clearly would increase the community's resiliency in the face of the predicted effects. They provide benefits now and in the future. An example would be reducing leakage from a community water supply facility.

Low-regrets options can produce big benefits for relatively low cost and produce a high return on investment or benefit-cost ratio. An example would be several communities getting together to build a larger water storage facility.

Win-win measures enhance adaptive capacity or have other social or economic benefits. They address climate impacts while helping to solving other community problems. An example would be creating a community reservoir that would enhance water supply capacity in case of future drought while providing immediate opportunities for recreational fishing, boating and skating.

Flexible or **adaptive management** options can be applied **incrementally**, one step at a time rather than all at once. Adaptive management means not committing all resources to a fixed project but instead designing the response so that different approaches can be taken as new information or resources become available. Choosing to delay or take incremental steps can buy time to get more complete information and can reduce the risk of taking inappropriate or ineffective measures.

A final option is to **do nothing**, which may be appropriate for low-priority impacts or where other factors clearly outweigh climate-related risks. However, doing nothing shouldn't be the default response whenever there isn't enough information.

Step 6: (a) Make a list of potential measures for current or anticipated climate change effects that may concern your committee. Focus on the four that you identified in previous sections. (b) Note which categories (capacity building or delivering actions), and which strategies they include. (c) Write a brief statement for each about their benefits, costs, effectiveness and practicality.

Notes:

7. Implementation

Implementation means putting into place the measures identified for meeting goals and objectives. You probably won't be able to implement all your measures at once or over a short period of time. Implementation is a **process that is likely to take years**.

Individuals or families can implement some measures. For example, they could adapt to the increased risk of occasional flooding due to storm surge by **putting their homes on pilings**. They could adapt to the threats to their fishing by **diversifying their operations**, or by preparing for supplementary or alternative occupations.

In most cases implementation requires the assistance of local governments, state and federal agencies, and other organizations whose mission it is to help communities deal with change. This means **building a team**.

Individuals and communities need to direct and motivate their governments and agencies. Even if stakeholders see themselves as "just" community members they still have an important role in helping to plan and ensure that governments or agencies see their vision and respond to their needs.

It may be useful to write up a brief **adaptation strategy document** to record the thinking on the strategy applied to each climate change impact issue addressed. Include a brief explanation of why each strategy is selected.

An effective adaptation strategy will guide adaptation efforts for years. It may be some time before you know how effective it actually is. Here are some questions you can ask members of your community to help decide whether they are on the right track:

- Does the adaptation strategy fit the purpose; will it help you lessen the negative (or enhance the positive) impacts of climate change?
- Does it address the goals and objectives of your program?
- Is it financially viable; does it have a positive benefit/cost ratio?
- Does it contribute to meeting other social, economic or environmental goals?
- Is it practical; can it be implemented with existing or available resources?
- Is it flexible enough to allow you to adjust to changing circumstances or new information?
- Is it understandable and equitable to all the stakeholders?

Implementation is best accomplished where measures are integrated into normal planning and operations, rather than set apart and acted upon as part of a separate climate change related action.

The implementation plan will reflect the stakeholder's or agency's role. Stakeholders planning for their personal, family, or community preparedness will produce a simple and more general plan. A local government or agency may have to meet more complex and rigid criteria. In either case, the plan should address:

1. The specific threats (or opportunities) being considered
2. The strategies for dealing with them
3. The proposed measures to be applied.
4. The legal, administrative, or bureaucratic structure involved (if any)
5. Sources of funds or financial basis

6. Partners, collaborators, other individuals or groups that may be involved
7. Sources of technical assistance (if needed)
8. A timeline
9. A method of evaluating progress
10. A method for modifying the project if and when appropriate

Step 7: Write up a brief implementation plan for your community's climate change adaptation program. Try to include a statement on each of the ten points listed above. Feel free to include more detailed explanation or justification if you think it would be helpful.

Notes:

8. Evaluation, Reporting and Sharing

Evaluation is a formal or informal process of reviewing and analyzing a project to determine whether it is effective. It is **systematic collection** of information about the activities and outcomes of a project. For government and agency programs, evaluations may have to be done in accordance with a specified and detailed format. Funders may require evaluations for projects they support. Individuals and communities can do informal evaluations. In either case, the purpose is **to determine whether the adaptation measures are meeting expectations**, and to guide changes if warranted.

Because most climate change effects occur over time, and adaption measures show results over years, it is difficult to do a meaningful evaluation after just a brief period. However, **planning for evaluation should begin immediately**, and some measures may be evaluated for early effectiveness soon after implementation.

For guidance on doing a formal evaluation, consult any of several guides to project management and follow the sequence of steps outlined. (See, for example, pp. 65–68 in *Adapting to Coast Climate Change: A Guidebook for Development Planners,* published by USAID; Chapter 12, "Measure Progress and Update Your Plan," in the King County/ICLEI guidebook *Preparing for Climate Change*; or pp. 119–136 in *Project Design and Implementation,* published by the NOAA Coastal Services Center.)

The process of informal evaluation is simple:

1. Review your adaptation goals and objectives.
2. List all adaptation measures applied. Include any that address indirect effects of climate change or effects of other kinds of change (social, economic, environmental) that could affect or be affected by climate.
3. Compare 1 and 2 above, looking for measurable indicators of adaptation.
4. Assess whether measures had identifiable effect toward achieving goals and objectives. If not, or if effects were inadequate, note the problems and how they can be solved. Look for unintended consequences, good or bad.
5. Record results, and write up a report that can be shared with others. Communicate results to partners and other communities with similar issues.

Do not confuse **correlation** with **causality.** Determine whether a change that occurred was the direct result of your adaptation measures, or simply occurred at the same time.

The desired effect of a goal or an objective may be that **nothing changes**. It is hard to demonstrate that no change is the result of adaptation measures taken. This points out the advantage of setting objectives that are measureable or observable.

If your initial evaluation indicates a need for changes in your strategies and measures, determine whether the **poor results are due to flaws in design or implementation or both**. If the flaws are in the strategy or planning, you need to determine whether current measures can be adjusted to obtain the desired results or if new measures are required. If new or modified measures are needed, you will probably need to **revise the strategies and implementation plan**. This approach is an example of "adaptive management" as outlined in the USAID publication *Adapting to Coastal Climate Change.*

Follow-up and Sharing Results

Follow-up includes further actions taken after an adaptation plan is developed and implemented, and an initial evaluation is done. ICLEI recommends four steps:

1. **Measure your progress.** Attempt to quantify or characterize progress.
2. **Periodically review assumptions** about the community's vulnerability, risks, goals, and the rest of the adaptation plan.
3. **Update plans and actions regularly**, based on new information and developments in your community's social, economic and environmental status.
4. **Share your learning** with other communities with situations similar to yours.

Step 8: Jot down ideas for evaluating your adaptation measures, and for sharing climate change adaptation information with other similar communities. What kinds of information might your stakeholders want to share and how would it be presented? Will it include written reports, multimedia presentations, in-person visits, working through governments or agencies? How will you get other communities to share with you?

Notes:

Appendix A:
Adaptation Checklist

The United Kingdom Climate Impacts Programme, a leader in adaption planning, offers the following checklist of characteristics of effective adaptation processes:

- ☐ Work in partnership and ensure that partners are well informed.
- ☐ Understand risks and thresholds, including associated uncertainties.
- ☐ Frame and communicate SMART objectives/outcomes (specific, measurable, achievable, results-oriented, and time-bound).
- ☐ Manage climate and non-climate risks using a balanced approach.
- ☐ Focus on actions to manage priority climate risks.
- ☐ Address risks associated with today's climate variability and extremes as a starting point toward taking actions to address risks and opportunities presented by long-term climate change.
- ☐ Use adaptive management to cope with uncertainty, and recognize the value of a phased approach to deal with uncertainty.
- ☐ Recognize the value of no/low regrets and win-win adaptation options.
- ☐ Avoid actions that foreclose or limit future adaptations or restrict adaptive actions of others.
- ☐ Review the continued effectiveness of your adaptation decisions by adopting a continuous improvement approach that includes monitoring and re-evaluations of risk.

Appendix B:
Talking Points for Village Climate Change Meetings

Climate change is unavoidable, it's already under way, and the observable effects are likely to increase with time.

Climate is always changing, but recent decades it's been **changing too quickly.**

Show a map of Alaska indicating the annual average temperature increase of 3 degrees F, greater in winter and in the north.

In the next century, predicted changes of 3 to 10 degrees F are predicted. Small changes in temperature will cause big changes to life on earth

People are adaptable. With planning we can minimize the potential harm from coming changes, and in some cases even find opportunities.

Planned adaptation is usually more effective and less costly that reactive adaptation.

It is important to work together, within your community and with other communities.

Many resources are available to help.

Focus on reducing your community's vulnerabilities and risks by reducing sensitivity or by building adaptive capacity.

Remain flexible and don't be surprised when the unexpected occurs.

Most planning for future climate change adaptation is simply a matter of addressing current effects of weather extremes.

As they say in the field, "Hazard mitigation is climate adaptation."

What are you observing?

- Wear and tear on roads? Mild winters = thawed ground.
- Threats to your village water system?
- Reduced or less predictably safe travel on winter travel routes, hunting on ice, river ice?
- Storms, strong winds? Less productive (or more productive) berry crops?

Other Strategies for Community Discussion

Use maps, get good background information on local environment, conditions, use "community story."

Do brainstorming on chart paper. Bring chart paper, different color markers, and tape or sticky tack for posting ideas on the wall.

Hold an informal discussion, or roundtable discussion, or hand out index cards:

- Ask people to think about changes observed in winter, spring, summer and fall.
- Ask how these changes have impacted the things people do in the community in the categories of environment, economy, society and culture. Create a matrix by season and impact categories.
- Be inclusive of all individuals, and be sure everyone can speak. Record all observations.
- Emphasize the input of elders.

Discuss the community's vulnerability:

- Review the list of impacts.
- Prioritize vulnerabilities—sensitivity (severity of impact) x risk (probability or duration) minus adaptive capacity. Consider in light of environment, economy, society and culture.

Discuss building adaptive capacity, taking adaptive measures:

- List vulnerabilities and impacts
- Refer back to community vision—ask what do you want your community to be? List adaptive measures. Are they feasible here?

Ask what kind of help do you need to take these measures, and to achieve the community in your vision?

Appendix C:
Preparing for Village Climate Change Workshops

Items To Bring to Workshops

- ☐ This manual for reference in planning.
- ☐ Copies of the condensed adaptation planning tool.
- ☐ Fact sheets—acidification, sea level rise, subsistence, and permafrost—that are appropriate to the audience.
- ☐ Other area-specific climate observations, data.
- ☐ List of resources participants can go to for technical or financial assistance.
- ☐ A good map of the area, camera, business cards.
- ☐ Computers, projector (or check to ensure one is available), large tablets, pens and tape.
- ☐ Sample climate change adaptation plan.
- ☐ Workshop evaluation survey.

To Prepare Before Workshop

- ☐ A draft survey form for participants to use to record/document observations of changes in their environment, to express concerns, and to write questions.
- ☐ Get websites for resources mentioned in the planning tool. Augment that list.
- ☐ Get a clearer idea of hosts' expectations for the session(s).
- ☐ Talk to school principal, figure out what grade(s) to visit, how much time in each class, and what you are expected to accomplish. Ask whether any teachers are already on the subject, and if they have any tools (videos, PowerPoint presentations, curricula) that the students haven't already seen that could be used.
- ☐ Door prizes, or other enticements?

Sample Agenda for an Evening Meeting

1. Introductions.
2. Why we're here.
3. What is climate change?

4. Ask participants if they have noticed changes in their environment.
5. What the scientists say, and how that squares with local observations.
6. How are these changes affecting participants and their community?
7. What threats do they see coming from these or other anticipated climate-related threats?
8. Why adapt?
9. How do they perceive the risks? (Likelihood and severity minus adaptive capacity.)
10. What would they like to happen? Describe a vision of their community in 10 years.
11. Brainstorm some adaptive measures.
12. What kind of help is needed? Who has the funding, technical expertise?
13. What can we do to help?
14. Do you want to continue this process (tomorrow, or in the future)?

Appendix D:
Sample Climate Change Adaptation Plan

1. Community

Primary community is the southern Kenai Peninsula, including Homer and other small towns on lower Cook Inlet. Total area population is about 12,000.

2. Motivations

This adaptation plan is intended to help residents avoid physical damage to homes and property, to survive and prosper financially, and to adjust psychologically to alterations to a physical environment and lifestyle they treasure. The desire is to foster a resilient community that supports an attractive quality of life and a sustainable economy.

3. Observed, Measured and Predicted Changes

- Increased frequency of storms (marine navigation hampered, wind damage)
- More frequent flooding of Anchor River, local creeks (property loss due to bank erosion, disruption of travel, possible loss of salmon, trout rearing)
- More bluff erosion and coastal low-area damage from storm surges (property loss)
- Forest and timber loss to spruce bark beetle (fire threat), (but possibly improved understory growth, improving habitat for moose, other wildlife)
- Invasive invertebrates in Kachemak Bay (impacts unknown)
- Decreasing snowpack (possibly reducing reservoir water storage), (but improved road transportation during winter, possibly less winter kill of moose)
- Projected decrease in key commercial fisheries species (impacts unknown)
- Harmful algal blooms (possible paralytic shellfish poisoning, *Vibrio parahaemolyticus,* domoic acid events which could damage the aquaculture industry, and endanger health of recreational harvesters
- Higher stream water temperatures in summer (possibly too high for instream survival of salmonids, at least during summer droughts)

4. Vulnerability

Exposure Rank	Sensitivity	Risk	Adapt. Capacity	Vulnerability
1. Increased storm frequency	3	3	1	**8**

Fishermen/boaters and some outdoor workers and recreationists likely to suffer from increased storm activity. More blowdown of beetle-killed spruce. Towns not likely to be greatly affected other than possibly power lines down. Adaptive capacity limited because not much to be done about increased frequency of storms.

Exposure Rank	Sensitivity	Risk	Adapt. Capacity	Vulnerability
2. Bluff, bank erosion, inundation	2	5	3	**7**

Bluff erosion of waterfront properties occurring in some locations, though consequences limited to specific sites. High adaptive capacity through land use zoning and in some cases uses of seawalls or bulkheads.

Exposure Rank	Sensitivity	Risk	Adapt. Capacity	Vulnerability
3. Forest loss to beetle	2	5	4	**6**

Most of the mature spruce forest already beetle killed but spread has slowed. Considerable timber lost, with some damage to watersheds. Biggest threat now is wildfire. Clearing firebreaks, improving fire response systems can improve adaptation.

Exposure Rank	Sensitivity	Risk	Adapt. Capacity	Vulnerability
4. Higher anadromous stream temperatures	2	4	2	**6**

Already frequently recorded. So far limited impacts observed, but streams highly vulnerable to loss of productive capacity if temperature maximums exceeded. Communities have little ability to increase adaptive capacity.

Exposure Rank	Sensitivity	Risk	Adapt. Capacity	Vulnerability
5. Harmful algal blooms	2	4	3	**5**

Few reported to date, but impacts can be sickness or death to persons who eat infected shellfish, and diminished value of farmed shellfish, so risk is high. Adaptive capacity can include increased monitoring, developing technologies/methodologies for reducing farmed shellfish exposure.

Exposure Rank	Sensitivity	Risk	Adapt. Capacity	Vulnerability
6. Stream flooding	3	3	5	**4**

Numerous streams in the area are susceptible to bank erosion. Cause bridge, road and property damage and loss. Effects likely to be fairly common, though consequences limited to part of the population. Communities have high adaptive capacity because potential for strengthening bridges, bulk-heading stream banks.

Exposure Rank	Sensitivity	Risk	Adapt. Capacity	Vulnerability
7. Decreasing snowpack	2	3	3	**3**

Decreased snowpack should make life easier for most residents, making roads less hazardous, reducing snow damage to homes and structures. However, communities have limited storage capacity for domestic water so may need to develop new water storage reservoirs. May improve moose survival. Recreational skiers and winter recreation businesses could suffer reductions in revenues and shorter seasons. They might be able to adapt by developing more "shoulder season" activities.

5. Goals for preparedness

Priority 1 – Increased storm frequency

Goal: Protect life and property from effects of more frequent storms

Objectives:

Bring storm-related boating fatalities to zero over five years.

Eliminate storm damage to structures, infrastructure.

Priority 2 – Bluff erosion, coastal inundation

Goal: Safeguard homes, personal property, infrastructure.

Objectives:

In 5 years, ensure no losses to bluff erosions.

In 5 years, ensure homes, infrastructure protected from inundation.

In 5 years have area plans in place to prevent future losses.

Priority 3 – Forest and timber losses to spruce bark beetle

Goal: Adjust to forest loss, safeguard property from wildfires. Exploit opportunities.
Objectives:

Beginning immediately, safeguard property from wildfire damage.
Develop information/education on causes and effects of beetle attack.
In 5 years, find productive uses of formerly spruce-forested areas.
In 3 years, develop strategies for combating future insect infestations.

Priority 4 – High water temperatures in anadromous fish streams

Goal: Expectations for stream productivity reconciled with a changing environment.
Objectives:

In 1 year, development of monitoring focused on stream temperature impacts.
In 3 years, develop understanding of likely long-term stream temperature impacts.
In 5 years, develop a plan for mitigating productivity losses due to temperatures.
In 5 years, have a stream temperature plan that includes new or improved opportunities for rearing more heat-tolerant stocks of native fish.

Priority 5 – Harmful algal blooms

Goal: Continuing prosperous shellfish industry, safe shellfish use for recreation.
Objectives:

Within 1 year, monitoring program in place to detect HAB blooms.
In 3 years, research conducted on ways to prevent HAB contamination.
In 4 years, develop production insurance program for shellfish farmers.
In 5 years, management program operational that protects farms, users from HABs.

Priority 6 – More frequent flooding, bank erosion, road and bridge damage

Goal: Safeguard homes, personal property and infrastructure from damage.
Objectives:

In 5 years, ensure no flooding, erosion damage to homes or property.
In 5 years, ensure no road, bridge or infrastructure losses.
In 5 years have plans, zoning in place to prevent future losses.

Priority 7 – Decreasing snowpack

Goal: Secure water supply, continuing recreation and tourism industry.
Objectives:

Within 5 years develop sufficient water storage to meet demand.
Work cooperatively with other communities to write water supply plan.
In 3 years, help rec and tour operators develop "shoulder seasons."
Within 2 years, identify savings resulting from lower road maint. costs.
In 3 years develop operating strategies to adjust to stock dislocation.

6 – Adaptation Measures

Priority 1 – Increased storm frequency

- Review of boat harbor and other waterfront facilities for storm resiliency
- Utilities department review of power lines, structures for resistance to storms
- Review of low areas of Spit and other parts of the shoreline for storm vulnerabilities, and "hardening" of those sites to improve resilience
- Removal of dead spruce from locations where windfall trees could cause damage to structures, power lines, etc.
- Review of buildings for vulnerability of roofs, sidings, etc., to wind damage
- Review and if necessary enhance storm water runoff system

Priority 2 – Bluff erosion and inundation

- Review bluff and other low areas for developing hazards
- Introduce zoning to prevent new construction in vulnerable areas
- Engage engineers to determine if beach "hardening" would save bluffs
- Investigate ecological buffers such as planting vegetation at bluff base
- Enhance protection and reestablishment of wetlands as protective buffer

Priority 3 – Forest loss to spruce bark beetle

- Most forest already damaged. Contract study to predict any further spread
- Encourage salvage of dead timber for firewood, mulch, stream or upland habitat improvement, crafts, etc.
- Clear firebreaks around homes, structures, facilities, as recommended by state Dept. of Forestry and local fire departments
- Review ways to improve wildland fire response
- Replant beetle-killed property with young or beetle-resistant trees to improve storm protection.
- Convert formerly forested area into agriculture to capitalize on longer growing season

Priority 4 – Higher stream temperatures

- Continue and intensify stream temperature monitoring
- Attempt to correlate to changes in stream fish productivity
- Minimize stresses to fish in stream by voluntarily limiting angling, minimizing use of machinery and other disturbances
- Assess impacts to recreation, tourism, commercial fisheries and other quality-of-life issues should anadromous fish production decline in the future

Priority 5 – Harmful algal blooms

- Encourage enhanced scientific monitoring for harmful blooms
- Develop response plan for shellfish mariculture in case of HAB outbreaks
- Develop technologies for mariculture response to HAB outbreaks
- Develop alert plan for recreational clam diggers in case of HAB outbreaks
- Develop education programs on HABs, including their possible health threats

Priority 6 – Stream flooding

- Begin to design more flood-resistant bridges and structures
- Put in place zoning that restricts future building in flood zones
- Plant natural vegetation bank protection
- Provide for emergency evacuation means, such as helicopter pads

Priority 7 – Decreasing snowpack

- Implement domestic and business water conservation program
- Plan to expand municipal water storage capability
- Hold community discussions regarding impacts of shorter skiing seasons, longer snow-free outdoor recreation seasons.
- Encourage water conservation

7. – Implementation Plan

This plan offers guidelines to members of southern Kenai Peninsula communities to adapt to current and anticipated future environmental changes brought on by a changing climate and related influences, as listed above.

Partners and sources of technical assistance:

1. Increased storm frequency

- Local harbor authorities
- Public works departments
- State DOT
- Local and borough planning departments
- University inundation specialists
- Public utilities including power company
- Civil engineers associated with public works or borough

2. Bluff erosion and inundation

- Public works departments
- Local and borough planners
- Engineers specializing in coastal stabilization
- Neighbors who might participate in cooperative stabilization projects

3. Forest loss to spruce bark beetle

- State Dept. of Forestry
- University agriculture and forest pest specialists
- State emergency response wildfire specialists
- Small business consultants who could advise on business opportunities
- Neighbors who may want to collaborate on fire protection measures
- Cooperative Extension for advice on agriculture potential of former forests

4. Elevated stream temperatures

- Cook Inlet Keeper, ADFG
- Angling groups, ATV groups
- Tourism business consultants

5. Harmful algal blooms

- Sea Grant Marine Advisory Program aquaculture specialist
- State Dept. of Environmental Conservation
- Local shellfish mariculture associations, neighbor shellfish growers
- ADFG public information office, local press, local educators
- Regional sea temperature and current modelers, such as AOOS, university scientists

6. Stream flooding

- State DOT
- Local and borough planners
- State Dept. of Forestry, agriculture specialist about vegetation planting
- Local and borough planning offices

7. Changing precipitation patterns, including decreasing snowpack

- Local municipal utilities (water departments)
- State Dept of Health and Social Services
- Hydrological engineers, to develop expanded water storage systems
- Local and borough public works departments for informational campaigns
- Neighbors who may want to participate in joint water projects
- Tourism consultants to conduct meetings on implications of shorter skiing seasons, longer summer recreation seasons

Costs and sources of funding:

These are impossible to predict for each adaptation measure until more details are available.

Many costs eventually will be paid with federal grants or state general fund monies. Costs of some kinds of technical advice will be borne by the agencies performing the work, but private consultants, consulting engineers and business specialists will have to be paid by the recipients of the services or with grant money from targeted programs.

Steps to Implementation:

Initially:

1. Name a project coordinator and a steering group to oversee the effort.
2. Make prioritized list (based on Step 4 above) of vulnerabilities to begin addressing immediately.
3. Starting with the most urgent—or the most solvable—vulnerabilities, prioritize adaptation measures.
4. Identify partners and sources of assistance. Include contact information and make note of any special conditions, time constraints they may have.
5. Contact them and make appointments or applications for their assistance.
6. Contact prospective funders, get application forms and deadlines.
7. If partners are neighbors, family members or other community members, schedule a face-to-face meeting to discuss the project. Contract a facilitator if needed.

Within six months or sooner if possible:

8. Confirm participation of partners, technical assistance, and consultants.
9. Confirm participation of neighbors, family and community participants.
10. Complete all applications for funding and agency assistance.
11. Hold community meetings to make sure the community understands the project(s) and is in agreement. Look for and attempt to resolve potential conflicts or disagreements. Structure so that there is a two-way flow of information and all participants have an opportunity to express their concerns, and look for ways of addressing any objections.
12. Re-draft any parts of the plan that were raised as problems in the community meetings, or as result of other feedback received.

As soon as funding and/or technical assistance is available:

13. Begin implementing measures. This could include conducting studies or monitoring, building structures, or drafting zoning or management plans.

Within one year of project initiation:

14. Engage steering committee or community meeting process to comment on early progress
15. Ensure that all bills are paid, required reports filed, etc.

Within five years or planned project duration:

16. Conduct project evaluation. Make changes as needed.

8 – Followup

- Plan evaluation of adaptation projects. If necessary, seek assistance from an agency with expertise in program management and evaluation.
- Check the directory of sources for assistance on climate change adaptation for links to help with evaluation as well as technical assistance, legal and political issues, and funding. Included is contact information on programs that will help build a network with other communities involved in adaptation with whom experiences and results can be shared.

Appendix E
Selected Alaska Resources for Adaptation Planning

A multitude of resources are available to Alaskans who want to build their capacity for adaptive action in response to climate change. The list below is a starting point and will provide some examples of the kinds of resources you can find.

Building Adaptive Capacity

Agencies

Alaska Center for Climate Assessment & Policy (ACCAP) assesses social-economic and biophysical impacts of climate variability in Alaska and makes that information available to local and regional decision-makers. www.uaf.edu/accap

Scenarios Network for Alaska Planning (SNAP) provides quick and easy access to a wide range of climate projections for the state at a 2km resolution. Data and maps are available for download in web-based and Google Earth formats. www.snap.uaf.edu

NOAA Climate Program Office comprises five divisions and provides a number of services on the national level, including an Arctic Research Program and climate observation and prediction programs. www.climate.noaa.gov/cpo_pa/

Alaska Dept of Natural Resources – Division of Forestry has forest expansion and wild lands fire information. http://forestry.alaska.gov/fire/current.htm

Adaptation Advisory Group of the Governor's Sub-Cabinet on Climate Change is made up of industry and government officials from around the state who met and collaborated to produce several studies and reports on various aspects of climate change adaptation in Alaska and to make recommendations to the Governor. www.climatechange.alaska.gov/aag/aag.htm

Alaska Native Tribal Health Consortium studies public health issues in rural Alaska and assists communities in solving health problems. http://www.anthc.org/chs/ces/climate/index.cfm

Publications

Ecological Impacts of Climate Change booklet by the National Academies, 30 pp

Preparing for Climate Change: A Guidebook for Local, Regional and State Governments a joint publication of ICLEI Local Governments for Sustainability, King County Washington, and the University of Washington, 172 pp.

Adapting to Coastal Climate Change: A Guidebook for Development Planners published by U.S. Agency for International Development for use in developing countries, 146 pp.

Alaska's Climate Change Strategy: Addressing Impacts in Alaska The final report submitted by the Adaptation Advisory Group to the Alaska Climate Change Sub-Cabinet, 78 pp plus introduction.

Towards Predicting the Impact of Climate Change on Tourism by ACCAP, discusses impacts of weather and temperature on the industry. 8 pp.

Final Commission Report Alaska Climate Impact Assessment Commission Alaska Sate Legislature, 2008. 44pp. plus extensive attachments.

Global Warming: Alaska on the Front Line is a small booklet published by the Alaska Conservation Foundation. 14pp.

Delivering Adaptive Actions

Agencies

Alaska Sea Grant Marine Advisory Program is the extension division of the School of Fisheries and Ocean Sciences, UAF, and has developed a climate change adaptation support program. www.marineadvisory.org

Alaska Cooperative Extension is the agricultural and home extension program of the University of Alaska Fairbanks and provides climate change adaptation assistance. www.uaf.edu/coop-ext

Alaska Dept. of Commerce, Community and Economic Development Division of Community and Regional Affairs, Alaska Riverine and Coastal Community Stewardship assists communities to protect themselves from effects of flooding and erosion. www.commerce.state.ak.us/dca/planning/arccs/ARCCS.htm

Rural Alaska Community Action Program, Inc. does rural housing and planning and hazard assessments. www.ruralcap.com

Alaska Division of Homeland Security and Emergency Management provides planning and response to natural and human-caused disasters including coordination of evacuations and other immediate actions and has an "Imperiled Communities project in northwest Alaska. www.ak-prepared.com

Federal Emergency Management Agency (FEMA) is responsible for planning to respond to extreme weather and climate events. www.fema.gov/plan/mitplanning/resoures.shtm

U.S. Army Corps of Engineers does much of the mitigation planning and is responsible for much of the infrastructure and protective measures that deal with flooding, erosion, inundation and other impacts. www.poa.usace.army.mil/en/cw/fld_haz/communities.htm

Publications

Local Government Climate Change Adaptation Toolkit A manual for adaptation planning intended for use by small island nations in Oceania, published by ICLEI Local Governments for Sustainability, 61 pp.

Identifying Adaptation Options – A short publication of the United Kingdom Climate Impacts Programme for use in Great Britain but including suggestions that could be useful in Alaska. 34 pp.

2009 Fall Sea Storm Preparation Guide – a publication of the State of Alaska Department of Military and Veterans Affairs – Homeland Security & Emergency Management. Contains emergency actions checklist and community resource contact lists. 39 pp. plus appendices

Working Together to Make Changes: Plan of Action Checklist A folder of seven fact sheets and checklists on organizing to take action. Published by Alaska Cooperative Extension.

Climate Witness Community Toolkit A publication of the World Wildlife Fund South Pacific Programme, it is intended for use in small island communities to help residents document climate change impacts in their villages. 18 pp.

Café Design Principles is a small publication by The World Café that offers an integrated set of design principles for hosting conversations in important issues. 5 pp. Available at www.theworldcafe.com/principles.htm

Local Strategies for Addressing Climate Change published by NOAA Ocean Services Center. 22 pp.

ICLEI Resource Guide: Outreach and Communications Published by ICLEI Local Governments for Sustainability, has tips on outreach objectives, examples, and best practices. 39pp.

Project Design and Evaluation published by NOAA Coastal Services Center, details how to design and evaluate projects. 163 pp. plus appendices.

Appendix F:
Sample Measures

Vulnerability Area	***Preparedness Goal***	***Preparedness Measure***
More frequent and severe high wind events (storms)	Safety, property protection	Convert fishing fleet to larger, more seaworthy vessels.
		Require new buildings to be set back on higher ground.
		Inspect buildings for susceptibility to wind damage.
Decreased snowpack	Maintain water supply year round	Increase storage reservoir capacity, build new reservoirs.
		Develop alternate sources of water (pipeline interties, wells, rainwater harvesting with storage tanks, etc.).
		Change building codes to require low-flow fixtures.
		Meter water use, raise fees.
		Provide financial (tax) incentives for efficiency.
		Inform public of climate change impacts on water supply.
		Actively monitor snowpack.
	Protect winter recreation and tourism business	Transition from primarily skiing to ecotourism, with greater emphasis on spring and autumn activities.
Loss of forests	Maintain sources of heating fuel and building materials.	Install alternative technology heaters (pellet, passive solar).
		Plan building to use non-wood or imported wood.
		Use harvest and burning to create mosaic of size and age.
		Attempt reforestation with temperature-tolerant species.
		Actively monitor trends in forest conditions.
Permafrost thawing	Protect property, infrastructure	Engage engineers to study, make recommendations.
		Impose, apply stability standards on new construction.
		Hire inspectors to examine existing buildings and infrastructure for vulnerability, make structural changes.
		Investigate new technologies for keeping ground cold and preserving permafrost where possible.
		Relocate structures and plan new building only on sites approved for permafrost thaw resistance.

Diminishing sea ice	Hunter safety	Access updated ice map source, disseminate in community.
		Develop weather and ice prediction training.
		Develop and promote use of lightweight vessels (such as Pack rafts) by hunters for routine or emergency use.
	Maintain game availability	Work with ADFG, NMFS to develop harvest management that preserves stocks of ice-dependent animals.
		Where feasible, encourage use of subsistence game (such as caribou) to take pressure off ice-dependent species.
		Study possibility of expanding hunting range farther out to take pressure off local stocks.
	Adjust to more open water	Take measures to prevent impacts of erosion (see below).
		Take advantage of longer navigation season in ordering supplies and materials.
		Look for business opportunities in servicing increasing vessel traffic that is likely to develop.
		Start process of developing harbors, facilities to support additional vessels that will use more open sea lanes.
		Study impacts of polar bear critical habitat designation on community economy. Look for opportunities such as threatened-species tourism.
Coastal erosion	Protect property	Engage scientists, engineers to predict future erosion.
		Preserve wetlands, enhance natural buffers.
		Consider armoring rip-rap, bulkheads if deemed effective.
		Investigate feasibility of moving existing structures to locations deemed safe.
		Prohibit new construction in vulnerable locations.
		Consider complete community relocation to safe site.
Changes in fish abundance and distribution	Ensure continued viability of commercial fisheries and survival of subsistence lifestyle	Engage fish scientists to provide projections of changes.
		Begin diversifying fishing operations into new stocks, species that are becoming abundant, away from those not.
		Start direct marketing, custom processing, look for other ways to get higher value from lower volume.

Appendix G:
Sample Goals and Objectives

Vulnerability	Goal	Objective	Measure	Govt or Pvt	Capacity or Action	Sources of Assistance
Frequent and severe high winds	Safety and property protection	Reduce fishing casualties	Convert fleet to larger and more seaworthy vessels	Pvt	action	Ak Div of Investments, CFAB, NOAA CCF
		Protect coastal property	Require setbacks for new construction	Govt	action	Municipalities, DCCED, HUD
			Inspect buildings for susceptibility to wind damage	Govt	capacity	Municipalities, DCCED, HUD
Decreased snowpack	Maintain water supply	Ensure communities have enough domestic water	Increase storage reservoir capacity	Govt	action	
			Develop alternative sources (wells, interties, etc.)	Pvt and Govt	action	
			Change codes to require low-flow fixtures	Govt	action	
			Meter water, raise fees	Govt	action	
			Financial incentives for efficiency	Govt	action	
			Inform public of climate impacts on water supply	Govt and Pvt	capacity	

Appendix H:
Worksheets

This adaptation manual contains a number of tasks for stakeholders as part of the process of planning good climate change adaptation. The following set of worksheets offers a place to enter the answers to some of the questions raised in those tasks. You may also want to use the **"Adaptation Plan for this Community"** template file, a Microsoft Word document. Replace the text in brackets in that document with your own information.

Step 1. Defining Community

Define your community.

Step 2. Motivations

(a) What are your motivations for doing climate change adaptation planning?

(b) What do you expect to get out of doing this planning? What results are you hoping for?

Step 3. Kinds of Climate-Related Changes

Make a list of reported or projected environmental changes you are concerned about. Refer to the list in Section 3. But also rely on your own observations and those of people you know or have read about. Describe past weather events that have impacted your community. **Specify anticipated consequences.**

Change	Group Affected	Consequences

Step 4. Vulnerability Assessment

Use additional pages if necessary to address each of the threats you have identified.

Vulnerability Risk Matrix

Total = (Sensitivity × Risk) – Adaptive Capacity

Exposure	Sensitivity	Risk	Adaptive Capacity	Total
Example: Homes damaged	5	3	4 (e.g., can rebuild; alternate homesites are available)	**11**

Step 5. Goals and Objectives

For each priority impact, write a brief goal statement and some objectives, and prioritize in terms of urgency and importance.

Impact	Goal	Objectives	Priority
1			
2			
3			
4			
5			
6			

Step 6. Adaptive Measures

Take the highest priority impacts and propose adaptive measures. Note whether they build capacity or deliver action, and write statements about benefits, costs, effectiveness and practicality.

Impact	Measures	Capacity or Action	Benefits, Costs, Effectiveness, Practicality

Table of Adaptation Measures

Vulnerability	Goal	Objective	Measure	Govt or Pvt	Sources of Assistance

Write a brief overall adaptation strategy.

Step 7. Implementation

Write a brief implementation plan for your community's climate change adaptation program.

Step 8. Evaluation and Follow-up

Briefly outline an evaluation plan for your program. How will you compare results with original goals and objectives? How can results of this evaluation be used to guide future changes to the plan? Record ideas or share climate change adaptation tips, techniques, strategies and experiences with other communities.