

IMPROVE YOUR PROJECT'S SUCCESS:

Consider Climate Change and Adaptation



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Above, Far Right: Steven Huyser-Honig ~ November Gale

Section 1: CLIMATE VARIABILITY AND CHANGE IN THE GREAT LAKES REGION

What's the Buzz... Word?

There are many terms and phrases bandied about in discussions on climate change adaptation, for example:

- Safeguarding against climate change
- Being climate-smart, climate-savvy, or climate-ready
- Building resilience
- Coping with climate change
- Preparing for a warmer world

No matter how you talk about climate change and what you think is causing climate change; we are already experiencing the effects.

This publication contains the basics to help you get familiar with the topic and terminology.

What is Climate Change?

Climate change is a significant and lasting change in weather patterns over periods ranging from decades to millions of years. Climate change is caused by both natural (e.g. volcanic eruptions or changes in solar activity) and human activities (e.g. burning fossil fuels or cutting down lots of forests). The Earth's climate is changing.

Adapting to climate change means understanding what sorts of changes are happening already and may happen in the future. Changes happen both in the climate system itself and in the human and natural systems. Detailed reviews of observed and projected climate related changes for the Great Lakes region are available.

However, the purpose of this publication is to give you a basic overview of climate impacts and help you get started reducing the vulnerability of places and species you care about to climate change. So let's get started!





Above, Far Right: Storm The Prelude © Robert de Jonge

Changes in the Physical and Chemical Environment

Higher concentrations of greenhouse gases in our atmosphere, whether from natural or human causes, trap more heat near Earth's surface, leading to global warming. Although Earth's climate has been slowly warming for several thousand years, in the past two centuries greenhouse gas emissions from human activities have skyrocketed, atmospheric concentrations of these gases have also skyrocketed, and temperatures have likewise been increasing much more rapidly than before.

Increasing concentrations of greenhouse gases in the atmosphere affect the world around us in all kinds of ways. The most direct effects are on the climate system itself, that is, on the weather patterns that we experience over the years. A changing climate means changes in how hot the summers are, how much rain we get, how commonly we experience severe droughts. These climate changes influence many of the basic characteristics of our environment: how thick the lake ice gets or if there's any lake ice at all; how much oxygen the water in lakes and ponds can hold; when leaves on trees emerge in the spring. Some of the trends related to physical and chemical changes as a result of climate change in the Great Lakes are shown in the table on page 5. Check out our website, www.freshwaterfuture.org/climate for more detail.





Cathy Haverdink ~ Lake Michigan Icebergs

WHERE DO THE PROJECTIONS OF THE FUTURE COME FROM?

Scientific projections about the future, such as statements about how much warmer it will get by a certain date or how a particular species will respond to hotter summers, are based on models. The climate models that scientists use are made up of mathematical equations representing our current understanding of how all the factors controlling the climate system interact with each other. These models start with the basic physical laws of the universe, such as Newton's laws, and bring in observations and hypotheses to explore elements of the climate system that are not explained just by basic physical laws. There are some parts of the climate system, such as how the concentration of greenhouse gases in the atmosphere affects average global temperature, that we understand fairly well. Scientists are pretty confident about the projections the models give for temperatures. For other parts of the climate system, where scientific understanding is still evolving, scientists are less certain about their projections. These include changes in precipitation, and temperature changes near big lakes. No model is perfect, but even imperfect models can still be useful. They provide a framework for making sense of and communicating the information that's out there about the world around us. Models also help clarify what we do and do not understand so that we can better test ideas about how the world works. Models are not crystal balls—they don't give answers, but they do let us see range of possibilities.

Some regional groups engaged in climate-related modeling include:

NOAA's Great Lakes Ecological Research Laboratory
(modeling focuses on lake dynamics)

<http://www.glerl.noaa.gov/>

Great Lakes Integrated Sciences and Assessments

<http://glisa.umich.edu/index.php>

The Wisconsin Initiative on Climate Change Impacts

<http://www.wicci.wisc.edu/index.php>

The amount of ice cover on the Great Lakes has declined 71% since 1973 according to National Oceanic and Atmospheric Administration's Great Lakes Environmental Research Laboratory. Data indicates that lakes are freezing later in the season and that ice is thawing earlier—resulting in a much shorter ice fishing season.



Photo: Courtesy of Michigan Travel Bureau

Jack Deo



GREAT LAKES CLIMATE VARIABILITY TRENDS

The table below summarizes what computer models indicate will be the trends and impacts of climate change in the Great Lakes.

CLIMATE FACTOR	TREND	CERTAINTY	FAST FACTS
Air temperature	Increasing	Very high	Summers warming faster than winters
Rainfall	Increasing	High	Up overall, but variable by season: Fall and winter much rainier, summers drier
Snowfall	Unclear	Medium	Increase in lake effect snow, likely decrease in snowfall otherwise
Wind	Unclear	Low	Average wind speeds declining, but may have more high intensity wind events
Heat waves	Increasing	High	Heat waves are likely to be more frequent, longer-lasting, and more severe
Growing season length	Increasing	High	Likely to increase by 3-6 weeks by the end of the century
Extreme rains	Increasing	High	Frequency of heavy rainfall events increasing year-round
Evaporation/drought	Increasing	Medium	Increase larger in summer; loss of winter lake ice will increase evaporation off lakes
Lake level	Unclear	Medium	Decrease likely, but increase also plausible; lake level variability to continue regardless
Runoff	Increasing	High	Up overall, but variable by season
Lake temperature	Increasing	High	Lake Superior warming fastest; warmer water hold less oxygen for fish and other animals
Lake ice cover	Decreasing	High	Variable by lake; Lake Michigan likely to become ice-free soonest

Note: There will be variability in climate trends across the region, and that overall year-to-year variability is likely to increase.

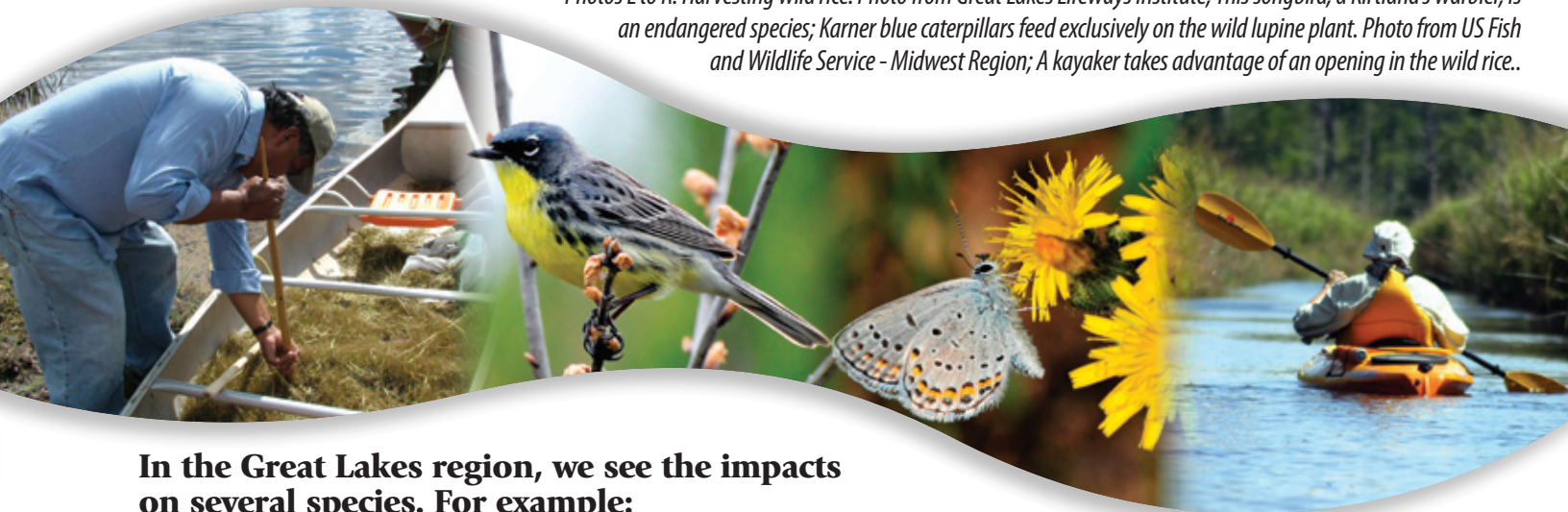
Section 2: CLIMATE CHANGE IMPACTS: PLANTS, ANIMALS, AND PEOPLE

Changes in Plants and Animals

Changes in the physical world lead to changes in the biological world, such as which species live where, when particular flowers bloom or birds breed, and where we can find a particular type of habitat. Looking at the geological record, we can see that plants, animals, and ecosystems have responded in many ways during past periods of change. Some species went extinct while others thrived; some species evolved and changed, some saw their ranges shrink, expand, or move, and many experienced some combination of evolution and range changes. Plants and animals today are exhibiting the same types of changes in response to the current period of rapid warming.

Scientists have also documented changes in seasonal events, including when plants bud, bloom, or lose their leaves; when birds migrate and how far they go; when birds reproduce, and in some cases how many broods they can hatch out in a single season; when frogs chorus or change from tadpoles to frogs; when insects reproduce, and how many generations they go through in a season. Our facts sheets, found at www.freshwaterfuture.org/climate provide more detail about what changes in air and water temperature, precipitation, and lake levels mean for species and ecosystems in the region.

Photos L to R: Harvesting wild rice. Photo from Great Lakes Lifeways Institute; This songbird, a Kirtland's warbler, is an endangered species; Karner blue caterpillars feed exclusively on the wild lupine plant. Photo from US Fish and Wildlife Service - Midwest Region; A kayaker takes advantage of an opening in the wild rice..



In the Great Lakes region, we see the impacts on several species. For example:

- Wild rice, a culturally significant plant for a number of tribes in the Great Lakes Region, is threatened by climate change in a number of ways. It needs cold winters to stimulate seed germination, so warmer winters can reduce the number of new plants in the spring. Warmer summers increase the risk of disease. Intense flooding can drown rice beds, while drought can dry the shallow wetlands the rice needs to grow.
- Karner blue butterflies need enough snow in winter to keep their eggs from freezing and drying out, and warmer winters mean less snow. They also depend on a particular habitat that incorporates the right climate and the right soil. Because soil types do not move or change as readily as the Karner blue butterflies can, it makes it harder for them to find their optimal habitat.
- Sea lampreys in the Great Lakes are getting bigger and more numerous thanks to warmer water temperatures and high populations of lake trout (their preferred prey). These invasive pests, already a threat to Great Lakes fisheries, are poised to become even more problematic and costly to manage. The Great Lakes Fisheries Commission has allocated \$20 million on sea lamprey control measures alone for 2013. Adding in the costs of research and assessments, the budget grows to \$25.9 million.



What do these Changes Mean for People?

It's not just species and natural systems that are being affected by and responding to climate change: humans are too.

The effects of both severe drought and severe flooding on agriculture have been all too clear in recent decades, and such extreme weather conditions are likely to become increasingly common. Changes in farming methods in response to changing climate conditions could affect how much and what types of pollutants get into lakes, streams, and groundwater. If lake levels go down significantly, contaminated sediments could be exposed and get into air, water, fish, birds, and even people.

We are seeing increases in numbers of pests, such as mosquitoes, ticks, and stinkbugs, and some of the invasive species we've been fighting for decades, such as sea lamprey and phragmites, are benefiting from warming conditions and falling lake levels.

According to the Detroit Wastewater Treatment Plant, in the past few years over 30 billion gallons of partially treated and raw sewage were dumped into Lake Erie each year. That is enough sewage to create a lake, four square miles and 100 feet deep! And with warmer water thanks to a changing climate the resulting growth in harmful algae and bacteria that sickens people and harms fish and wildlife becomes even worse. Adding "fuel to the fire" is the likelihood of more intense storms that threaten water infrastructure and increase combined sewage overflows.

Eric Andre ~ Apostle Islands Sunset



Section 3: CLIMATE ADAPTATION: GETTING STARTED

There are four basic steps to getting started on a climate adaptation project.

1. Determine the focus of the project.
2. Assess vulnerability of targets/project approaches to climate change.
3. Develop an adaptation strategy.
4. Implement your adaptation strategy.

People come at the issue of adapting to climate change in a variety of ways. Some create a climate focused project such as a community adaptation plan while others stay focused on existing goals, but do a broad assessment of what climate change means for their goals, objectives, and strategies. On a smaller scale, some might simply retrofit a few of their methods or educational materials to integrate climate considerations or use climate change to strengthen existing arguments for tighter environmental protection. All these approaches are valid; the key is to do the work to make sure you're really adapting to climate change rather than simply paying lip service to it. You can find case studies illustrating the range of approaches and worksheets at www.freshwaterfuture.org/climate. To reflect the different thought processes behind some of these approaches, we've created a handful of slightly different worksheets. Pick the one that works for you!

For community groups working to protect waters and natural resources, often the best place to start is to ask yourself....

1. What changes are going to happen as a result of climate change and what can I do about them?
2. What do I currently do, and how can I adapt that to incorporate the reality of a changing climate in such a way that I continue to achieve my goals?

Brenda Jones ~ Glowing Rocks, Lake Superior





John Dykstra ~ Miner Beach Falls

Step 1.

Determine Focus of the Project

Start by reviewing the problem you're trying to address and the goal of your work. The problem you want to tackle may be directly and clearly related to climate change—for example, “We want to restore floodplains in an area thought to be particularly vulnerable to flooding as a result of the increasing frequency and intensity of rainstorms that’s likely for our area”. Other projects may seem unrelated to climate change: “We want to build a boardwalk and interpretive signs to help people access and learn about our restored wetland.”

Your existing goals, targets and strategies may include:

- Advocacy or activism to stop something from happening (e.g. mining) or make something happen (e.g. water conservation)
- Doing or helping people to do on-the-ground restoration, conservation, low-impact development, or something else in your community
- Helping to create a plan (shoreline management, community development, comprehensive plan, etc...)
- Protecting a particular place or species
- Education or building awareness around a particular issue
- Decreasing the vulnerability of a particular resource, such as:
 - Making sure fish will be able to move freely up and down a river during both floods and droughts
 - Reducing inputs to your wastewater treatment system in order to prevent combined sewer overflows

Consider the Climate Lens

Projects that aren't clearly focused on climate change are no less important than the ones that are. However, these projects will benefit from considering how changes in climate may impact the project, allowing development of ways to reduce their vulnerability to these changes. In the end, your set goals and targets will include methods for achieving them that already consider these changes.

Step 2.

Assess Vulnerability of Targets/ Project Approaches to Climate Change

Once you've got an overall goal and target for your project, the next step is to understand the possible effects of climate change on the projects, place, or species in question. While people often gravitate towards considering the specific impacts of climate change—how much change will happen—it is also important to consider how projects, places, or species might be able to respond in ways to those impacts, which is referred to as adaptive capacity.

If you're working to reduce negative effects of climate change on a particular place or resource such as a lake or wetland, you'll want to identify what makes your resource vulnerable to climate change. Likewise, if you want to build climate change into existing work, anything from restoration to low-impact development to creating management plans to litigation, you'll want to assess the vulnerability of that work's strategies, activities, and targets to climate change.

Vulnerability to climate change is determined by three primary components:

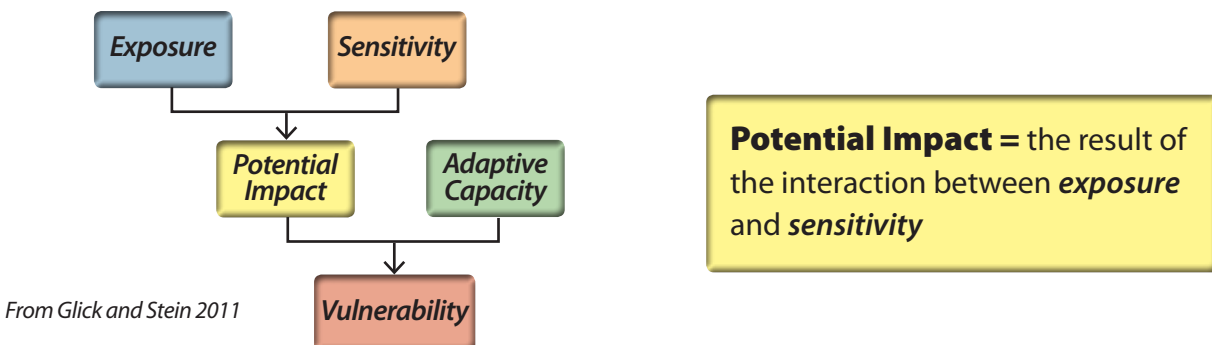
$$V = E + S - AC$$

V = Vulnerability to climate change

E = Exposure is how much change occurs, including changes outside the project area that affect the target (e.g. loss of glaciers loss of water supply)

S = Sensitivity is how much the target is affected by a given amount of change

AC = Adaptive Capacity is the ability of an individual, community, or ecosystem to adapt to change; this reflects intrinsic traits (behavioral flexibility that allows individuals to respond to new situations) and extrinsic factors (e.g. degree of habitat fragmentation)



Objectives of a vulnerability assessment could include:

- Deciding whether to call for tighter environmental controls on a mining or fracking operation as a result of changing rainfall and temperature patterns.
- Helping an agency, land trust, or other organization prioritize land for purchase or conservation.
- Developing a management plan for a park, reserve, or other management unit.
- Informing the design of a restoration project so that it can continue to succeed in a changing climate.



Step 3: Develop Adaptation Strategy

Once you understand the sources of vulnerability, you can begin to develop approaches to reducing vulnerability. These may include:

- **Decreasing exposure.** This could include replanting shoreline vegetation to help keep waters cooler, thus limiting their exposure to increasing temperature. Another example is reducing exposure to increases in drought and flooding by creating, restoring, or enhancing wetlands that can absorb water during floods and slowly release it during dry periods. A strategy to reduce the vulnerability of wild rice to increased water level variability might be to consider a using a water control structure to regulate water levels.
- **Decreasing sensitivity.** Some pollutants make plants or animals more sensitive to higher temperatures (and vice versa); reducing the levels of such pollutants would decrease the sensitivity of those plants and animals to climate changes. You could decrease the sensitivity of a restoration project to increasing floods and drought by making sure to use a mix of species that can cope with a range of climate conditions.
- **Increasing adaptive capacity.** During past periods of climate change, some plant and animal species underwent range shifts; you can increase their ability to do the same thing now by supporting ecological connections across the landscape (this is frequently called “connectivity”).



Dealing with an uncertain future, or “Should I bring my umbrella?”

Uncertainty about possible future climate changes leads some to think that we needn’t take action. In reality, the future is full of uncertainty about all kinds of things—the economy, employment, illness, and more—yet we make decisions anyway. Here’s an example of the sort of decision commonly made in the face uncertainty: whether or not to take an umbrella when you leave your house on the way to a meeting.



First, there’s the issue of what the weather might do. You could see if it “looks like rain” outside or listen to the weather forecast, but you still wouldn’t know for sure whether it was going to rain or how hard it was going to rain. Yet you almost certainly wouldn’t sit inside waiting for that uncertainty to disappear. You’d still go to your meeting, and you’d either end up taking an umbrella or you wouldn’t.

Then there’s the issue of convenience or cost. Maybe you have a nice compact umbrella you can slip in your briefcase, so bringing it along isn’t particularly inconvenient. But if you have a large, heavy, ugly umbrella or an expensive umbrella you’re worried you would forget, you wouldn’t bring it unless you were pretty sure you’d need it.

Finally, there’s the issue of consequences. What happens if you don’t bring an umbrella but it ends up raining? Maybe you’re meeting friends who won’t care if you’re wet and will lend you an extra sweater if you’re cold, so the consequences of not bringing your umbrella are small. If you’re meeting an important business connection and carrying sensitive materials that would be ruined if they got wet, getting caught in the rain without an umbrella could be trouble.

The same umbrella considerations can be applied to decisions about climate change adaptation:

- **What might the climate do?** We don’t have complete certainty, but we do have a good sense for the range of what might happen.
- **How costly or inconvenient are various adaptation options?** Some actions provide enough benefits regardless of climate changes or are easy or inexpensive enough that we’re unlikely to regret them regardless of what happens.
- **What are the possible costs or consequences of not taking action?** Not taking action may seem safer, but it has its own set of risks. If you don’t plan for a flood but it happens anyway, you could lose your livelihood, your home, or worse!





Yellow Dog Watershed Preserve Staff and the Salmon Trout River.

Photos by Cheryl Nenn.

Converting a Vulnerability Assessment into an Adaptation Strategy Example: Salmon Trout River

The Yellow Dog Watershed Preserve in Marquette, Michigan wants to protect the Salmon Trout River from potential pollution from a new copper-nickel mine that will be under the River. The Yellow Dog is concerned that the mines permit does not accurately assess higher runoff and pollutant loads that may be increasing due to larger storm events in recent years. The objective is to get stronger permit standards based on the outcome of the vulnerability assessment.

A Vulnerability Assessment for the Salmon Trout River could address the following:

1. **Exposure:** Higher temperatures, greater runoff, greater volumes of sulfide and other related pollutants
2. **Sensitivity:** Salmon Trout provides habitat for cold water fish that suffer in warmer water; higher pollutant levels might increase temperature sensitivity and potentially harm aquatic insects and fish; warmer water may make aquatic insects and fish more sensitive to pollutants and disease
3. **Adaptive Capacity:** Many aquatic insects can fly as adults and may be able to find other cold-water streams with better water quality. Coaster brook trout have limited capacity to move to new streams or adapt in others ways. Also, Salmon Trout River hosts the only breeding population of coaster brook trout along the south shore of Lake Superior, so the loss of this population would represent the final disappearance of this fish from this part of the Lake.

Using the results of the Vulnerability Assessment, it would provide the following potentials for an Adaptation Strategy:

1. **Decreasing Exposure:** Assessing the size of retention ponds at the mine to insure it can hold adequate runoff from increased runoff volumes so that it does not enter the River.
2. **Decreasing Sensitivity:** Preserve or plant extra vegetative buffers to collect and treat runoff to keep other pollutants out of the River.
3. **Increasing Adaptive Capacity:** Monitor water quality and aquatic insects as indicators of river health for the coaster brook trout population.



When Great Lakes levels dropped in recent years, shoreline wetlands started to emerge in locations that had formerly been underwater. In Traverse City, MI on the shores of Grand Traverse Bay, a hotel owner decided to bulldoze the wetland to “improve” the beach. Thanks to the pushing of citizen and community groups, the Army Corps of Engineers and Michigan Department of Environmental Quality enforced wetland regulations against the hotel owner and required restoration. As our climate changes and our natural habitats adapt, our regulatory system must keep up and regulatory agencies must enforce the laws to protect our resources.

Step 4: Implement Your Adaptation Strategy

When working on resource protection efforts, we tend to think that if only people knew the real facts about climate change, they would change their behavior and do “the right thing.” While knowing the facts or undertaking the reality of climate can help, it doesn’t necessarily lead people to change their behavior. Now that you have gone through the steps of getting started to work on climate adaptation, the real fun begins. One of the keys is to focus on the outcome you want to achieve with your project (e.g. reducing greenhouse gas emissions, supporting tighter water quality regulations, or building rain garden). For example, if you determine that trout in the stream are more vulnerable due to increasing temperatures, you can share the importance of keeping waters cool, providing increased vegetation cover, or protection of ground water inputs to a stream. You can put your efforts and hard work into a project you believe in and make our resources and communities more resilient to climate change.

Onondaga Creek Conservation Council is restoring vegetation in a community park and planting species that are tolerant of fluctuating water levels. The hope is that this vegetation will protect the stream corridor as the climate changes and still provide a green haven for residents in Syracuse, New York.



Case Study

This Case Study demonstrates how to get started working on climate adaptation. The West Grand Boulevard Collaborative in Detroit, Michigan recognizes that as citizens and a community group, they can play an important role in the solution to reduce stormwater pollution to the Detroit River. They secured funds from Freshwater Future and others to create a demonstration project at their neighborhood library in downtown Detroit that is creating awareness of the pollution caused by excess runoff from storm events, how our changing climate is making the problem worse, and what solutions exist. The Collaborative's project directs stormwater runoff into bioswales, rain gardens and onto porous pavement. This green space allows the water to soak into the ground as it is naturally cleansed by carefully chosen plants and cools water down as it enters the groundwater system.

PLANNING STEPS – Using Case Study

1. *Determine Focus of the Project*

To reduce pollution related to combined sewage overflows from stormwater runoff and provide examples of how green infrastructure can achieve this for replication elsewhere.

2. *Assess Vulnerability of Targets/Projects Approaches to Climate Change*

The size of the bioswales and rain gardens needed today for the site could be too small for the site if the frequency and size of storm events increase. Plants may not thrive over the years with permanent changes in temperature and rainfall patterns.

3. *Develop Adaptation Strategy*

Increase the size of the bioswales and raingardens beyond what is needed today to accommodate anticipated capacity for increased frequency and size of storm events. Identify plants that would most likely continue to thrive today and in climates several degrees warmer.

Identify size of the bioswales based on anticipated expanded capacity needs. Identify plants most likely to survive today and in the future with a changing climate. Prioritize plant options based on their ability to perform in the green infrastructure and thrive in a changing climate.

4. *Implement Your Adaptation Strategy*

After gathering expertise, permits, volunteers, the rain gardens are now installed and a focus of the neighborhood. Follow-up activities include monitoring the green infrastructure's performance by measuring runoff from the site and plant survival. If needed, revising the green infrastructure to bring in alternative or additional plants or if changes need to be made to the design such as how the stormwater is directed into the bioswales.





TIME FOR ACTION

Congratulations! Now that you've finished this introduction to climate change and adaptation, you're ready to move on and start adapting to climate change. You have all the knowledge you need to do a good adaptation project. No one has perfect knowledge, and even adaptation experts didn't know much when they first started working on this issue. The best way to develop knowledge, skills, and confidence around climate change adaptation is to start doing it.

If you're still wondering if adaptation is really worth the cost, or feeling paralyzed by worry about not doing adaptation the "right" way (or if you find your ability to act is being hampered by people with these worries), here are a couple of thoughts for you.

First, **adaptation isn't always costly, and not taking adaptation action often is.** Going through the exercises in the workbook (can be found at www.freshwaterfuture.org/climate) can help you get a better sense for both the costs of action and the costs of inaction. Whether you discover that a small, inexpensive change to a project will make a big difference for your long-term success, or that reducing vulnerability to climate change will take a significant and sustained influx of resources, you'll be better able to make informed and effective decisions.

Keep in mind that climate change has been underway for decades now. The question is not so much how you will respond to climate change and whether you'll do it "right," but how you have responded to it, and whether you can improve on this by taking a more conscious and strategic approach.

As you move through the process of developing and implementing an adaptation project, you'll ask questions, get the chance to explain and explore the issues with others, build a network of climate-savvy supporters, and deepen your understanding of what this adaptation stuff is all about.

Don't wait—get started on your adaptation project today.



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