3.2 Community Assets at Risk

AGE RANGE
9th—12th grade

TIME REQUIRED
60 minutes

ACTIVITY OVERVIEW
Engage: Discussion Question
Explore: SLR 2-Pagers
Explain: Range of SLR Scenarios Discussion
Elaborate: Community Asset Worksheet
Evaluate: Discussion Questions

MATERIALS
Community Asset Worksheet
SLR 2-Pagers

BASED ON:
Material from the NOAA Adaptation Planning For Coastal Communities workshop.

LESSON TOPIC: Municipal decision makers

ACTIVITY SUMMARY: Students evaluate community resources and the risks those resources may face.

OBJECTIVES:

Students will be able to:
- Analyze their community assets.
- Make informed decisions for community resilience.

LESSON BACKGROUND: Sea-level rise scenarios show the range of possible outcomes. There are three major reasons for the scenarios:

1) We do not know how much carbon will be in the atmosphere.
    a. The rate of carbon emissions across the globe changes with policies put in place by different governments. Example: the Paris Agreement.
2) There is natural variability.
    a. Nature is dynamic; for example, each year it is not the same temperature on August 1st. That natural "wiggle" or range must be integrated into the scenarios
3) Scientists are still studying the ice sheet melt.
    a. Models used to measure the volume of ice sheets and their rate of melting is relatively new and constantly getting more accurate.

By understanding the possible outcomes of sea-level rise, communities can prepare for the future. Planning and implementing an adaptation plan is scalable and can start with a smaller project and lead to more. The integration of climate change adaptation planning into related policies and projects brings it into the mainstream.

VOCABULARY:

Assets	People, resources, ecosystems, infrastructure, and the services they provide. Assets are the tangible and intangible things people or communities value.
Built Infrastructure	Human-made buildings and structures such as bridges, roads, stormwater systems, wastewater treatment plants, buildings.
Climate Stressor	A condition, event, or trend related to climate variability and change that can exacerbate hazards or the impact of hazards.
Community Rating System (CRS)	The National Flood Insurance Program's (NFIP) Community Rating System (CRS) is a voluntary incentive program that encourages community floodplain management activities that go above and beyond standards required by the NFIP. In return citizens of that community receive flood insurance discounts.
Critical Facilities and Services	Man-made structures/improvements which, because of their function, size, service area, or uniqueness, are paramount to day-to-day function (e.g., hospitals, power plants, wastewater treatment facilities, emergency response, etc.).
Drinking Water	Water that is safe to drink or to use for food preparation without risk of health problems. Also known as 'potable water'.
Energy Infrastructure	Large-scale facilities allowing for the transport of energy (e.g., electricity, oil, and natural gas) from producer to consumer and for management and direction of energy flow.
Green and Blue Infrastructure	Plant- and water-based natural systems as infrastructure for communities (i.e., protection against flooding or improving soil, air, and water quality) in order to benefit both nature and people.
Managed Retreat	The purposeful, coordinated movement of people and buildings away from risks. At the same time, natural coastal habitat is enhanced seaward of a new line of defense. Also refered to as strategic relocation or managed realignment.

Mitigation	Processes that can reduce the amount and speed of future climate change by reducing emissions of heat-trapping gases or removing them from the atmosphere.
Natural Resources	Materials or substances that occur in nature and can be used for economic gain.
Non-climate Stressor	A change, trend, event, or action unrelated to climate that can exacerbate hazards (e.g., marine debris impacts on coastal habitats).
Probability	The likelihood of something occurring, in this case hazard events. Probabilities have traditionally been determined from the historic frequency of events. With changing climate and the introduction of non-climate stressors, the probability of hazard events also changes.
Projections	Potential future climate conditions calculated by computer-based models of the Earth system. Projections are based on sets of assumptions about the future (scenarios) that may or may not be realized.
Resilience	The capacity of a community, business, or natural environment to prevent, withstand, respond to, and recover from a disruption.
Risk	The potential total cost if something of value is damaged or lost, considered together with the likelihood of that loss occurring. Risk is often evaluated as the probability of a hazard occurring multiplied by the consequence that would result if it did happen.
Transportation	System (e.g., bus, roadways, subways, etc.) for moving passengers or goods from one place to another.
Uncertainty	A state of incomplete knowledge. Uncertainty about future climate arises from the complexity of the climate system and the ability of models to represent it, as well as the challenges with predicting decisions that society will make.
Utilities	Services (e.g., light, power, or water) provided by a public utility.
Vulnerability	The propensity or predisposition of assets to be adversely affected by hazards. Vulnerability encompasses exposure, sensitivity, potential impacts, and adaptive capacity.
Wastewater	Water that is adversely affected in quality by human influence (e.g., agricultural runoff, surface runoff, and most commonly sewage).

ENGAGE:

Open NOAA Sea Level Rise Viewer: https://coast.noaa.gov/slr/. Explore, with students, the area along the coast near your school. The slider bar with "MHHW" refers to Mean Higher High Water,

meaning that it is referencing sea-level rise impact on high tide. Some locations have blue map pins with water drops, these open photos and show simulations of sea-level rise.

Ask students who makes the choices for policies and ordinances in their town. Ask students what information would be helpful for these decision makers to have when they make plans for sea-level rise. This should set them up to explore the sea-level rise scenario projections and the days of future flooding and should call back to Module 1. *It is not necessary to have completed Module 1 for this activity.*

EXPLORE:

For this activity students will work in groups using a Sea-Level Rise 2-Pager for a local region of their choice. 2-pagers will be available with curriculum material for our local region. Students will examine their 2-pagers to familiarize themselves with the contents.

Alternative: teachers can prepare additional 2-pagers ahead of time or reference www.localSLR.org for students to view projections of sea-level rise in other locations in the U.S.

EXPLAIN:

With the class lead a discussion about what the scenario graph is showing.

Introduce the global scenario graph with multi-colored lines for future sea-level rise projections.

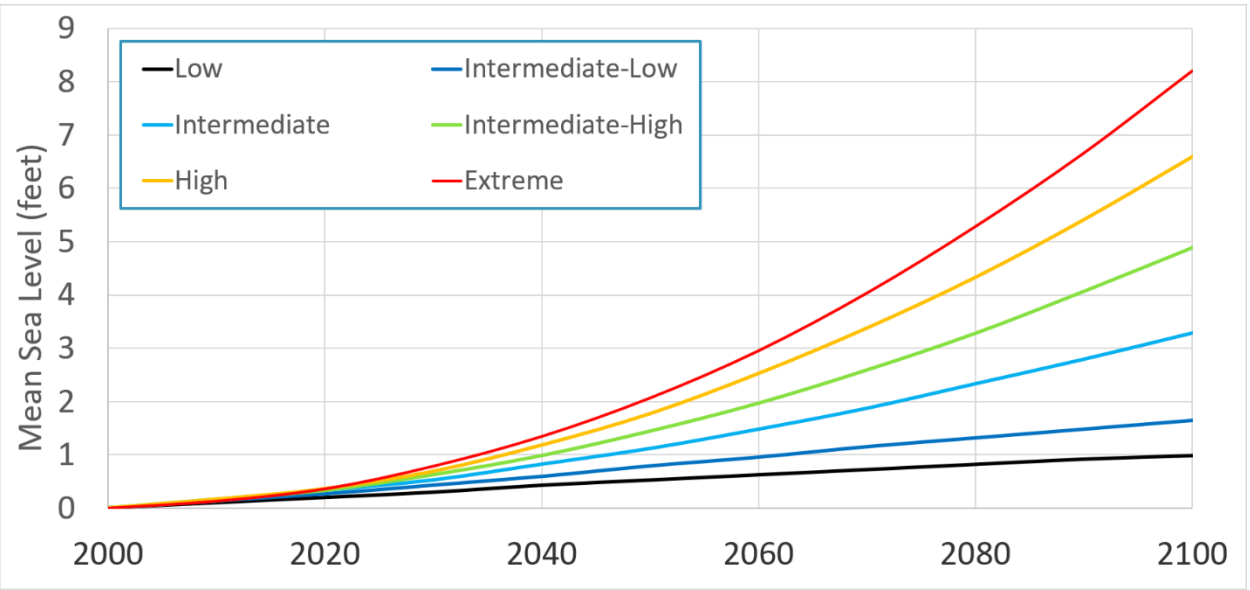


Image: global scenarios for sea-level rise. Source: Collini et al. 2018

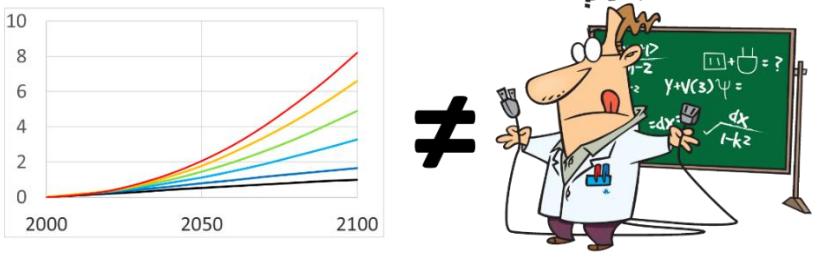


Image: Having a large range of sea-level rise scenarios does not mean that scientists do not know what they are doing. It shows the range of possible outcomes. Source: Northern Gulf of Mexico Sentinel Site Cooperative

There are three major reasons for the scenarios:

1) We do not know how much carbon will be in the atmosphere.
    a. The rate of carbon emissions across the globe changes with policies put in place by different governments. Example: the Paris Agreement.
2) There is natural variability.
    a. Nature is dynamic; for example each year it is not the same temperature on August 1st. That natural "wiggle" or range has to be integrated into the scenarios
3) Scientists are still studying the ice sheet melt.
    a. Models used to measure the volume of ice sheets and their rate of melting is relatively new and getting more accurate constantly.

With those three reasons in mind, the graph shows the range of scientifically possible scenarios for future sea-level rise. Low scenarios follow a low-end range of natural variability and the extreme scenario follows catastrophic ice melt.

To plan for sea-level rise it is helpful to narrow down the scenarios by understanding probabilities. Looking at the scenario likelihood chart, the greater the percentage the more likely that scenario will occur based on change in carbon emissions. As you can see in the chart, the likelihood of an extreme sea-level rise scenario occurring is very low – 0.1%-0.05%.

Global Sea Level Rise Scenario	RCP8.5 no change in carbon emissions
Low	100%
Intermediate-low	96%
Intermediate	17%
Intermediate-high	1.3%
High	0.3%
Extreme	0.1%

Image: likelihood of sea-level rise scenarios. Source: modified from Collini et al, 2018

Once you understand the probability of a scenario occurring you can identify your risk tolerance. Risk tolerance is the degree of uncertainty that you are willing to accept in respect of negative impacts to your community, structures, and people. This level will change based on considerations such as the location, cost or value, function served, adaptability, and length of time.

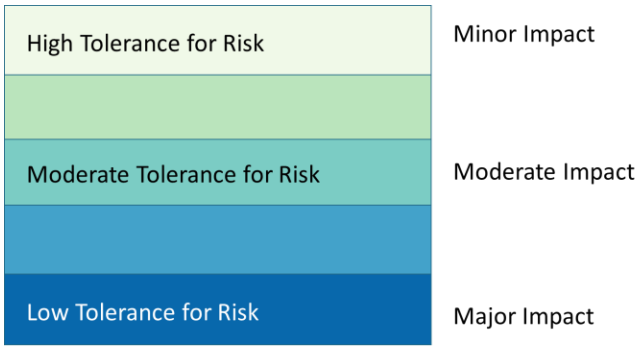


Image: Flood risk tolerance compared to impact level. Source: Northern Gulf of Mexico Sentinel Site Cooperative

Thinking in terms of building a new structure in your community:

If you are building a new hospital, this will require a large expense, its function is critical for providing care in your community. The hospital cannot be easily moved or adapted once it is built, and you want the hospital to be present for a long time. Building a hospital has a low tolerance for risk, meaning that you have a lot put into the building, do not have the flexibility to let anything negative happen, and cannot easily move it out of harm's way. Because of these considerations, a hospital would have a low tolerance for risk. To minimize the likelihood that your hospital would be impacted by sea-level rise over the course of its life, you would want to plan to the higher sea-level rise scenarios. This does not mean that the hospital will never experience flooding, but greatly reduces the likelihood that it will flood under any of the possible sea-level rise scenarios.

Sea level rise scenario	Likelihood
Low	100%
Intermediate-low	96%
Intermediate	17%
Intermediate-high	1.3%
High	0.3%
Extreme	0.1%

Low chance of happening, but would have a big impact

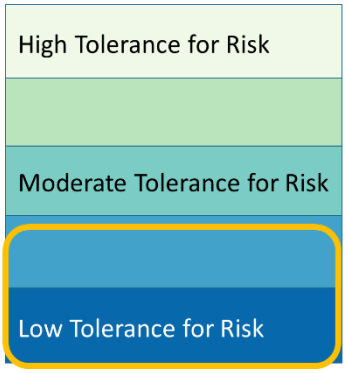


Image: Structures and areas with a low tolerance for risk should plan for high or extreme sea-level rise scenarios. Source: Northern Gulf of Mexico Sentinel Site Cooperative

If you are buying a new home there is a moderate expense required compared to something like a new power plant or hospital, it is critical for one family, other facilities are not dependent on the home, and you would want the home to be present for a mid-term length of time. Buying a home has a moderate tolerance for risk. You would not want a negative impact on the structure, but it does not support a wide community and the cost is not millions of dollars. In this case, this would be considered a moderate tolerance for risk. A person would want to plan for sea-level rise scenarios that are still less likely to occur but would not be as costly to adapt to as the higher sea-level rise scenarios.

Sea level rise scenario	Likelihood
Low	100%
Intermediate-low	96%
Intermediate	17%
Intermediate-high	1.3%
High	0.3%
Extreme	0.1%

Moderate chance of happening, would have a moderate impact

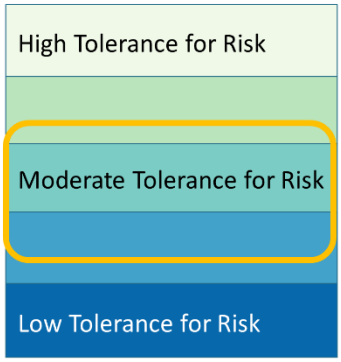


Image: Structures or areas with a moderate tolerance for risk should plan for the intermediate or intermediate-high sea-level rise scenarios. Source: Northern Gulf of Mexico Sentinel Site Cooperative

If you are building a shed there is a minor expense, the structure does not provide a critical function, it is relatively easy to move, and it is only needed for the short-term. The shed has a high tolerance for risk, meaning that not a lot of functionality or cost would be lost if something negative occurred. In a case like this your risk tolerance is high and you would only want to plan for the amount of sea-level rise that you are certain is going to occur. The low and intermediate-low scenarios are very likely to happen.

Sea level rise scenario	Likelihood
Low	100%
Intermediate-low	96%
Intermediate	17%
Intermediate-high	1.3%
High	0.3%
Extreme	0.1%

High chance of happening, would have a low impact

Image: Structures or areas with a high tolerance for risk should plan for the low or intermediate-low sea-level rise scenarios. Source: Northern Gulf of Mexico Sentinel Site Cooperative

The next step to narrowing down sea-level rise scenarios is to link the flood risk tolerance with probabilities.

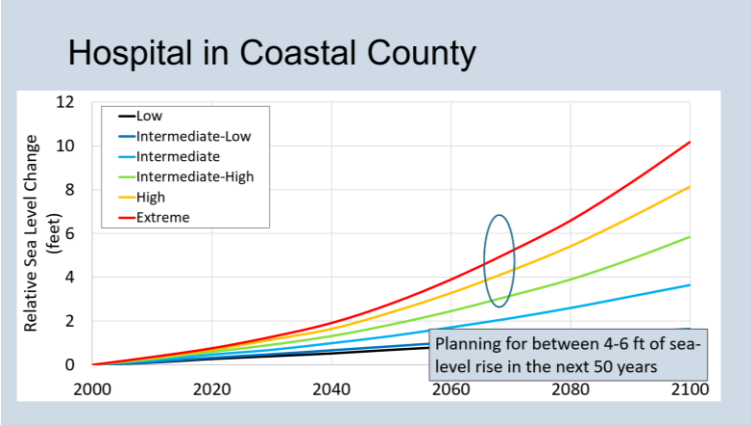


Image: Using the sea-level rise and likelihood scenarios to focus on how much sea-level rise to plan for. In this example a coastal county will build a hospital to last longer than 50 years. This structure has a low tolerance of risk, so they plan for the high or extreme scenarios. Following the x-axis to approximately 2070 (50 years in the future), then looking at the y-axis for feet of sea-level rise change on the high (yellow) and extreme (red) trend lines shows that the hospital should plan for 4-6 feet of sea-level rise. Source: Northern Gulf of Mexico Sentinel Site Cooperative.

ELABORATE:

Students will work in small groups and use the information from the sea-level rise projection graphs to work as community decision makers to plan for sea-level rise resilience. This chart is the same tool that is used by resilience professionals through the Adaptation Planning Framework. Working through this activity, models to students how professionals work through adaptation planning in our communities. In this activity students are thinking of assets as separate components. Eventually the individual assets need to be thought of in a holistic view because they fit together to create a whole community. Set up the "why" of the activity: communities have limited resources, personnel, and funding - unfortunately it is not realistic for communities to immediately upgrade all vulnerabilities. Thinking critically about all the stresses on valuable infrastructure allows resilience professionals to strategically plan the most needed resilience adaptations first.

EXTENSION:

The first chart "**Identifying Community Assets**" can be completed as a class through group discussion. Additionally, the lesson can be extended by having students complete a "Climate Issue Statement" using their responses from their assessment chart.

Climate stressors are conditions or trends that are related to climate variability and can exacerbate hazards.

- Increasing frequency and intensity of drought conditions can be a climate stressor for forests and crops. Rising sea level is another climate stressor.

Non-Climate stressors are changes or trends that are unrelated to climate but that can exacerbate hazards.

- Altering drainage patterns and replacing open land with roads and buildings are non-climate stressors for flooding hazards. Population growth along exposed coasts is another non-climate stressor.

EVALUATE:

Students complete reflection questions about the asset related to the sea-level rise projections from the first part of this activity.

How will future flooding impact your community asset?

How will the sea-level rise projections impact your asset? Is there a difference in impact between low and intermediate projections?

EXTENSION: Students present Climate Issue Statements.

STUDENT PAGE | Assets at Risk

As decision makers it is important to understand the assets that strengthen and support your community. In the following chart **list two assets in each sector and for each category**. Be as specific as possible for your community. Rather than "bridge" use "Pascagoula River High Rise Bridge." Keep in mind that your assets might fit in more than one category.

Identifying Community Assets		
	High Value	**High Consequence if Impacted**
Built Infrastructure Bridges, roads, stormwater systems, wastewater treatment plants, buildings, etc. 		
Natural Resources Beaches, rivers, wetlands, parks, etc. 		
People, Commerce, and Culture Citizens, health services, historical landmarks, economy, recreation and tourism, etc. 		

Decision makers need to narrow down their focus. **Choose <u>one</u> asset**. Use the following chart to describe characteristics of the assets.

Characterizing an Asset		
Asset:		
Circle the sector your selected asset belongs in **Built Infrastructure** 	**Natural Resources** 	**People, Commerce, and Culture** 
Circle the area that best applies to your selected asset **Site (small)**	**Region (medium)**	**Extensive (large)**
Characterize Stressors		
Non-climate Stressors	**Climate Stressors**	**Top climate Stressor Trend**
List all:	*List all:* *What is the top climate stressor?*	*Is the top climate stressor already occurring?* **Yes** or **No** *Circle the expected trend of the top climate stressor?* **Increase** **Decrease** **Stay the same**

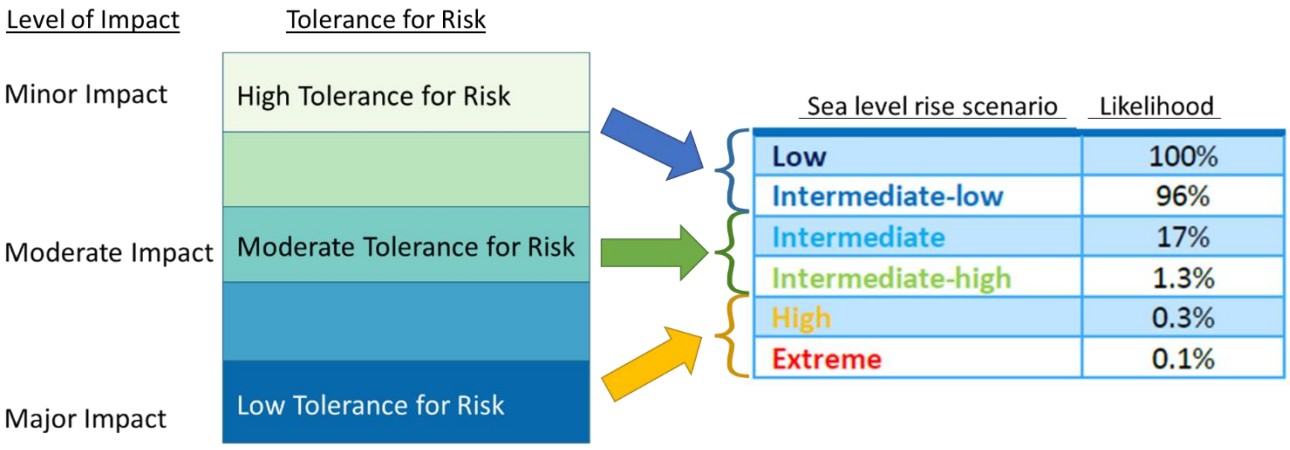
Now that you have the list of stressors to your asset, think about what consequences there may be if your asset was damaged or lost. If you think of consequences not listed write them in under "Other." **Circle all potential consequences if your community asset is damaged or lost.**

Potential Consequences		
Circle all potential consequences if your community asset is damaged or lost.		
Economic	**People & Society**	**Environmental**
Movement of goods impaired	Damage to housing and displacement of people	Biodiversity or species loss
Movement of people impaired	Loss of recreation opportunities	Habitat fragmentation and/or loss
Employment centers disrupted	Residents unable to obtain key services	Loss of flood protection benefits
Disproportionate impacts on certain business sectors	Disproportionate impacts on certain community members	Water quality decline
Lost revenue	Loss of cultural or historical resources	Loss of carbon absorption function.
Increased maintenance or repair costs	Personal injury or loss of life	*Other:*
Other:	Overall decline in quality of life	
	Other:	

If your asset is damaged the consequences will fall in a range of minor to severe impact. Think about your asset and how much relies on it functioning. **Circle the overall potential level of impact.**

Severity of Consequences Using the descriptions below, identify the overall potential level of impact	
Rating	**Description**
Minor	Financial costs to the community are possible but would be minimal. No expected loss of life, minimal decline in quality of life, and little disruption to livelihoods. Property and ecosystem damage might occur, but could be repaired without substantial cost or time.
Moderate	Some financial costs to the community are possible and would be moderate. No expected loss of life, but there could be a decline in the quality of life and some disruption to livelihoods. Recovery of property and ecosystem damage would take longer and be more costly.
Major	Large financial costs or significant inconveniences would be incurred the community. The possibility of loss of life or livelihood exists. Significant, and potentially permanent, property or ecosystem damage might occur.

Using your selected "Severity of Consequences" **circle the level of impact, the tolerance for risk, and the sea-level rise scenario and likelihood you should plan for.**



EXTENSION:

As a decision maker at the community level, you need to convince the other members of your community and other leaders why it is important to protect an asset from the climate change risks you have identified. Using the information you collected throughout the lesson, add them into the template below. This will be your Climate Issue Statement.

Climate Issue Statement		
Tell the story of why this is important to address. Use the information from the lesson.		
Insert value statement for asset – why should people care		
_____ *Asset*	is already experiencing	_____ *Non-climate stressor(s)*
and is susceptible to	_____ *Top climate stressor*	.
Consequences would likely be	_____ *Severity of consequences*	and could include
Economic _____ *environmental*	, *people and society*	and
. Therefore, we should consider strategies and actions that		
Summarize risk tolerance approach.		

STUDENT PAGE | Assets at Risk

DO NOW:

How does your local government address sea-level rise and flood resilience?

EXIT TICKET:

What are the three main reasons for sea-level rise scenarios?