CLIMATE IMPACTS RESEARCH CONSORTIUM

# The Vulnerability Assessment Workbook

## Assessing Your Community's Vulnerability to Climate Risks

Oregon State University

# About the Vulnerability Assessment Workbook

***The Vulnerability Assessment Workbook*** is the second volume in the Climate Impact Research Consortium's three-volume ***Climate Resilience Workbook*** series.

The series includes:

> ***The Climate Toolbox Workbook (Volume 1, Modules 1 and 2)***
> ***The Vulnerability Assessment Workbook (Volume 2, Modules 3 and 4)***
> ***The Resilience Actions Workbook (Volume 3, Modules 5 and 6)***

**The Climate Resilience Workbook Series:** ***The Climate Resilience Workbook*** series helps users to access and apply global climate information at a local scale to develop relevant resilience actions. The series begins with an introduction to climate data analysis through ***The Climate Toolbox Workbook***. ***The Climate Toolbox Workbook*** is a user's guide to the Climate Toolbox, providing a road map for users to analyze climate information and communicate *climate data stories*, data-driven narratives about climate impacts and trends relevant at the community level. Then, ***The Vulnerability Assessment Workbook*** provides a framework to integrate those data analyses with judgement and choices. And finally, ***The Resilience Actions Workbook*** provides tools to help understand the human landscape of a community and plan resilience actions that integrate the outputs from the first two workbooks.

Questions around climate information and climate change are far-reaching and can be overwhelming. ***The Climate Resilience Workbook*** series seeks to help users develop skills in manageable chunks; learn how to analyze, integrate, and use information from a range of sources; and develop plans that are actionable at a local scale. We hope that by investigating discrete issues, the holistic picture becomes clearer.

***The Vulnerability Assessment Workbook*** **Goals:** Assess and catalog your community's vulnerabilities to climate change.

**About the Modules:** This workbook covers ***Module 3*** and ***Module 4*** of the CIRC ***Climate Resilience Workbook*** series. Each module contains multiple exercises designed to help organize and synthesize your data investigations and your judgement calls. This information will populate the ***Vulnerability Assessment Table (VAT)*** found at the center of this workbook. Each ***VAT*** column has a worksheet or table associated with it, and each worksheet provides instructions explaining the information for the corresponding column. Every result from ***Module 3*** and ***4*** is an input to the ***VAT***.

***The Vulnerability Assessment Workbook*** **Instructions:** Use this workbook to build on the climate data analysis and climate data stories you previously created using the Climate Toolbox and ***The Climate Toolbox Workbook***. ***The Vulnerability Assessment Workbook*** differs from ***The Climate Toolbox Workbook*** in two key respects:

- **A Step-by-Step Guide:** While ***The Climate Toolbox Workbook*** could be used in any order, the exercises in ***The Vulnerability Assessment Workbook*** build upon one another as you move through. Please work through ***The Vulnerability Assessment Workbook*** from front to back.
- **Transforming Quantitative Data into Qualitative Judgements and Actions:** ***The Climate Toolbox Workbook*** was created to help you acquire the quantitative information necessary to determine how climate stressors are likely to affect your community in the future. ***The Vulnerability Assessment Workbook*** is intended to connect that *quantitative* information with *qualitative* judgements. Making these judgement calls — and making them systematically — will help you and your community assess how best to respond to the climate impacts you collectively face.

**Tip:** Literally go through each step. By completing each step, you will document where you found your information and how you arrived at certain judgements and conclusions.

**Workbook Exercises, Examples, and Worksheets:** The exercises in this workbook provide step-by-step instructions for assessing current and projected future climate impacts faced by your community. To illustrate how our worksheet exercises could be used, CIRC referenced the work with the community of Spokane, Washington, as part of the Spokane Community Adaptation Projection to provide an example throughout (written in italics). The example worksheets throughout show how a community could develop a climate vulnerability assessment tailored to their local needs. Blank worksheets are provided in ***Appendix 5***.

**About RISA and CIRC:** The mission of the National Oceanic and Atmospheric Administration (NOAA) Regional Integrated Sciences and Assessments (RISA) program is to put climate science to work for stakeholders. The Pacific Northwest Climate Impacts Research Consortium (CIRC) is the NOAA RISA team for Washington, Oregon, Idaho, and western Montana. CIRC aids climate adaptation efforts by Pacific Northwest communities, policymakers, and resource managers through individual resilience efforts with community groups, online climate tools, communication of climate science, and the advancement of climate and social science. This work is possible under NOAA grant NA15OAR4310145.

**Another Shout-Out to the Community of Spokane, Washington:** ***The Climate Resilience Workbook*** series was originally created for the community of Spokane, Washington, as part of the Spokane Community Adaptation Project (SCAP). CIRC would like to thank everyone who participated in the SCAP effort. Your dedication and hard work made these documents and their community application possible. Thank you!

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# Contents

# Big Concepts

This workbook is as much about big ideas (the forest, if you will) as it is about completing individual exercises (the trees). *Most* concepts and definitions in this workbook are introduced as needed. However, there are some big concepts to familiarize yourself with before getting started. These concepts get at the core of ***The Vulnerability Assessment Workbook:***

***Vulnerability Assessment:*** Documentation describing how you identified and prioritized climate and non-climate stressors and impacts, and information for your community's plan for responding

***Climate Impact:*** An effect on human communities and natural systems that results from weather and/or climate events (e.g., drought, wildfire, floods)

***Non-climate Impact:*** An effect on human communities and natural systems that results from stressors other than climate (e.g., land-use changes, economic recessions, pandemics)

***Climate Stressor:*** A broad category containing multiple climate impacts (Example: a projected future increase in temperature is a climate stressor that contains several climate impacts, including a rise in heat-related illnesses, droughts, and increased wildfire risk)

***Non-climate Stressor:*** A broad category containing multiple impacts to your community that are not related to climate (Example: population growth is a non-climate stressor associated with multiple non-climate impacts, including land-use changes and changes to the tax base)

***Resilience Action:*** An action or set of actions designed to help make your community more resilient in response to both climate and non-climate stressors

***Synthesizing Information:*** In this workbook, you will combine data related to climate stressors and impacts with data related to non-climate stressors and impacts. Your goal is not merely to add the two types of data together but to see how the two data types interact with one another as part of a larger system with multiple moving parts. In other words, you will synthesize the data you have acquired in order to add richness and complexity to a big picture. Keep this idea of synthesis in mind as you assess the ramifications associated with the combined impacts and stressors your community faces and how you might respond.

***Using Your Judgement:*** As you combine and synthesize climate and non-climate data, you will use this *quantitative* information to make *qualitative* judgements. Ultimately this is all about choices, particularly making hard choices when faced with critical decisions in a constrained and changing environment.

**Tip:** Take notes. We've pointed out places where it's particularly important to take notes, but really, take notes on everything. You might forget how you assigned a set of values, where you found information, or why you made one choice instead of another. Notes will help you discuss your conclusions and inform your choices later.

# Module 3 — Synthesizing Data

**About Module 3 — Synthesizing Data:** This module will help you practice asking and answering questions about climate and non-climate data. You will practice organizing and managing your data and findings, and integrating those data into a vulnerability assessment framework. The information you use to populate the worksheets in this module will go into the ***Vulnerability Assessment Table*** (***VAT***) found in the center of this workbook.

In this module, you will be asked to think about climate and non-climate data as individual pieces of a larger puzzle. Because many of us tend to think about systems holistically, the step-by-step exercises in this module may feel counterintuitive. In the next module, ***Module 4 — Incorporating Judgement***, you will go back to thinking holistically when you examine the intersections between climate and non-climate data. However, to get back to the whole, you first need to consider the parts — by examining climate and non-climate data separately.

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**Module 3 Goals:**

- **Practice identifying and asking questions**
- **Identify components of your questions**
- **Identify and manage information sources that address your question**
- **Synthesize your findings into clear and concise statements**

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**Module 3 at a Glance:**

- **Synthesizing Climate Data**
- **Synthesizing Non-Climate Data**
- **Setting up the Vulnerability Assessment Table (VAT)**

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**Tip:** You will likely go through the steps in this module several times. You might also have to completely reframe how you ask questions. Be patient and run through the steps as often as you need.

## Synthesizing Climate Data

**About Synthesizing Climate Data:** In this section, you will use the information you collected to create your climate data story (or stories) using the Climate Toolbox and ***The Climate Toolbox Workbook*** (Volume 1 of ***The Climate Resilience Workbook*** series). Complete your climate data story before tackling the exercises in this section. You will use this information in the section, ***Building the Vulnerability Assessment Table (VAT)***.

***Climate Data*** — data related to climate research and monitoring that have a direct relevance for your community

***Climate Data Story*** — a narrative outlining climate facts and impacts specific to your community

**Goal for Synthesizing Climate Data:** Use your climate data story to write concise statements about climate impacts relevant to your community.

**Instructions for Worksheet 3: Synthesizing Climate Data:**

- Step 1. Identify a question you are interested in investigating. We recommend that you use a question you researched when creating your climate data story.
- Step 2. Use the climate impacts you investigated while creating your climate data story to synthesize your climate data into concise conclusion statements in ***Worksheet 3: Synthesizing Climate Data*** below.
- Step 3. Use these statements in ***Worksheets 5*** and ***6*** a little later on.

## Worksheet 3: Synthesizing Climate Data (Example)

| | |
|---|---|
| **Question**: *Was the summer of 2018 weird?* | |
| **Your climate question**:<br><br>*During the summer of 2018 (June–Aug), was the maximum temperature in Spokane, Washington, different from the expected normal temperature?* | |
| **1. Identify the component(s) of your question.**<br><br>*Maximum temperature in 2018*<br>*Mean historical maximum temperature* | **2. Identify what information might help you answer your question.**<br><br>*Understanding what "normal" summer temperatures are in Spokane and how the summer 2018 temperatures compare to the historical baseline* |
| **3. Identify the variables that are relevant to each component of your question.**<br><br>*Maximum temperature*<br>*Historical temperature* | **4. Identify the timeframe(s) that are relevant to each component of your question.**<br><br>*Summer (June–Aug) 2018*<br>*Historical June–August 1979-2018* |
| **5. Describe the outputs of your research in a short summary.**<br><br>*Maximum temperature averaged over June–August in Spokane, Washington was 83°F. This was 1.1°F above the historical baseline (1979–2018 average), that is, "above normal." However, I wouldn't say 2018 was "weird" in terms of Spokane maximum temperature averaged over June–August because there were many other past years in which June–August maximum temperature was higher than in 2018. For example, in 2015, June–August maximum temperature was 87.3°F, which was 5.4°F above the historical baseline.* | **6. Determine if your outputs answered your question. Determine if you need additional information to answer your question. Identify your next steps.**<br><br>*Yes. I was able to answer my question using the Toolbox.* |
| **Conclusion Statement:**<br><br>*While the summer of 2018 might not be considered "weird" for Spokane, Washington, there is strong evidence that mean annual temperatures are rising, and are projected to continue to rise under both RCP 4.5 and RCP 8.5, with the hottest days under RCP 8.5 topping out well over 100°F, compared to historical hottest days of 99°F. Under both scenarios, days where the heat index reaches or exceeds 90°F, 100°F, and 105°F are all expected to rise as well, likely corresponding to an increase in heat-related illnesses.* | |

**Tip:** We talk a lot about the Climate Toolbox (it's a CIRC and partners product, so, why wouldn't we?). However, we are not requiring you to use the Toolbox exclusively. There are multiple free climate tools available online, and many of them are very useful. We provide a list of additional online climate tools in ***Appendix 2*** of ***The Climate Toolbox Workbook***. Check out these other resources, especially if the Toolbox doesn't have the information you need.

## Synthesizing Non-climate Data

**About Synthesizing Non-climate Data:** In this section you will investigate non-climate data and synthesize them for use in the next section, ***Building the Vulnerability Assessment Table (VAT)***. We recommend choosing a subset of non-climate concerns to start with. You can add more later, but start with a constrained list.

***Non-climate Data*** — data that are not directly climate related and have a direct relevance for your community.

**Goal for Synthesizing Non-climate Data:** Investigate and write concise statements about non-climate data and their impacts in your community. You will use these statements later in ***Worksheets 7*** and ***8***.

The Spokane community chose the following to represent their top five non-climate concerns:

- Emerging health issues (smoke, high temperatures)
- Vulnerable populations (elderly, young, homeless)
- Changes in outdoor recreation (snow sports, water sports, hiking)
- Forest management for fires (forest thinning, prescribed burning, etc.)
- Land-use changes (housing developments, transportation patterns, employment)

**Instructions for Worksheet 4: Synthesizing Non-climate Data:** ***Worksheet 4*** will help you organize your non-climate data research and conclusions.

- Step 1. Choose a few non-climate data concerns that are important to your community.
- Step 2. Ask your question.
- Step 3. Refine your question and repeat (if necessary).

**Note:** ***Worksheet 4*** has space for two rounds of questions. You may need more than two rounds to synthesize your non-climate data into a concise conclusion statement; use as many as you need. Blank worksheets can be found in ***Appendix 6***.

The following example looks at how you may choose to analyze information through the lens of non-climate impacts using the example question from ***The Climate Toolbox Workbook,*** "Was the summer of 2018 weird?"

## Worksheet 4: Synthesizing Non-climate Data (Example)

**Question**: *Was the summer of 2018 weird?*

**Your non-climate question**: *Did the summer (July–Sept) 2018 have more unhealthy air quality (PM 2.5) days than other summers in Spokane, Washington?*

| | |
|---|---|
| **1. Identify the component(s) of your question.**<br><br>*Particulates in the air (less than PM 2.5),*<br>*Year 2018 and PM 2.5* | **2. Identify what information might help you answer your question.**<br><br>*EPA Air Quality Now*<br>*https://www.epa.gov/outdoor-air-quality-data* |
| **3. Identify the variables that are relevant to each component of your question.**<br><br>*Air particulate matter with size less than 2.5 microns* | **4. Identify the timeframe(s) that are relevant to each component of your question.**<br><br>*Year 2018*<br>*Historical particulate measures (1999–2018)* |
| **5. Describe the outputs of your research in a short summary.**<br><br>*All sensitive group categories are shown.* | **6. Determine if your outputs answered your question. Determine if you need additional information to answer your question. Identify your next steps (if any).**<br><br>*This shows all the sensitive group categories; we need to define what we mean by "unhealthy air" to refine our search parameters.*<br>*The geographic location combines Spokane and the Spokane Valley on the EPA site.* |
| **1. Identify the component(s) of your question.**<br><br>*How many days did Spokane/Spokane Valley have where sensitive groups would be impacted by unhealthy air quality (35.5–55.4 micrograms/$m^3$)?* | **2. Identify what information might help you answer your question.**<br><br>*Sensitive groups are impacted starting at 35.5–55.4 micrograms/$m^3$.* |
| **3. Identify the variables that are relevant to each component of your question.**<br><br>*Number of days with unhealthy air quality in 2018*<br>*20 days*<br>*Number of days with unhealthy air quality 1999–2017 (19 years):*<br>*All 0 days except:*<br>*2001: 1 day*<br>*2003, 2012, and 2019: 2 days*<br>*2006 and 2014: 3 days*<br>*2015: 5 days*<br>*2017: 19 days* | **4. Identify the time frame(s) that are relevant to each component of your question.**<br><br>*Year 2018*<br>*Historical particulate measures (1999–2018)* |
| **5. Describe the outputs of your research in a short summary.**<br><br>*There were 20 unhealthy air quality days in Spokane in 2018, whereas in all years 1999–2017 (except 2014, 2015, and 2017) there were < 5 days annually except for 2017, which had 19 days. Therefore, 2018 had significantly more unhealthy days than other years, except 2017, which was also weird.* | **6. Determine if your outputs answered your question. Determine if you need additional information to answer your question. Identify your next steps (if any).**<br><br>*Yes, the outputs helped to answer the question.*<br>*The year 2018 had significantly more smoky days (17) than all the years from 1999 onward. The year 2017 had 19 days. This led us to conclude that 2017 and 2018 were weird in terms of the number of unhealthy air quality days impacting sensitive groups.*<br>*(By comparison, the year 2019 had just two unhealthy days.) The years 2017 and 2018 were weird.* |
| **Conclusion Statement:** *In 2017 and 2018, there were 19 and 20 unhealthy air quality days for sensitive groups, roughly the same as adding up the 18 preceding years' unhealthy days (where the mean was one unhealthy day)! That IS weird.* | |

## Building the Vulnerability Assessment Table (VAT)

**About Building the Vulnerability Assessment Table (VAT):** To build the ***Vulnerability Assessment Table (VAT)***, you will use the climate data stories you completed using ***The Climate Toolbox Workbook*** and the synthesis statements you prepared in the previous exercises (***Worksheet 3: Synthesizing Climate Data*** and ***Worksheet 4: Synthesizing Non-climate Data***). Use the information you've already compiled to help constrain your assessment.

The next series of worksheets align with the columns of the ***VAT***.

**Goal for Building the VAT:** Using synthesis statements from ***Worksheets 3*** and ***4,*** fill in ***Columns A, B***, and ***C*** of the ***Vulnerability Assessment Table (VAT)*** using ***Worksheet 5 (Columns A*** and ***B)*** and **Worksheet *6 (Column C)***.

### Instructions for Worksheet 5: Building the VAT Columns A and B:

1. Write your chosen climate impact (or impacts) in ***VAT Column A.*** Write just one climate impact per row under ***Column A***.
2. Write one or two sentences synthesizing your climate impact (or impacts) in ***Column B*** of ***Worksheet 5***. Use your conclusion statement from ***Worksheet 3: Synthesizing Climate Data***. (Note: Be sure to include the observed or projected change and the severity and/or magnitude of that observed or projected change.)
3. Repeat this process for each climate stressor you identified. If you need to, use multiple rows to discuss multiple impacts associated with each climate impact.
4. Transfer your information from ***Column A*** and ***Column B*** of ***Worksheet 5*** to ***Column A*** and ***Column B*** in the ***Vulnerability Assessment Table*** (***VAT***).

### Worksheet 5: Building the VAT Columns A and B (Example)

| A. Climate Stressor | B. Synthesize the data describing the climate impact |
|---|---|
| *Temperature* | *There is strong evidence that mean annual temperatures are rising and are projected to continue to rise under both RCP 4.5 and RCP 8.5, with the hottest days under RCP 8.5 topping out well over 100°F, compared to historical hottest days of 99°F. Under both scenarios, days in which the heat index (a combined measure of heat and humidity) reaches or exceeds 90°F, 100°F, and 105°F are all expected to rise as well, likely corresponding to an increase in heat-related illnesses.* |

### Instructions for Worksheet 6: Building the VAT Column C:

Using the information you researched and synthesized in your climate data story (or stories), write one or two sentences describing the climate impact (or impacts) each climate stressor has had or is projected to have on your community. Repeat this process for each stressor. (Note: You can use multiple rows to tease out multiple impacts if you need to.) Transfer your summary statements from ***Worksheet 6: Building the VAT Column C*** to ***Column C*** in the **VAT**.

### Worksheet 6: Building the VAT Column C (Example)

| A. Climate Stressor | C. Summarize how the climate impact may be felt by your community |
|---|---|
| *Temperature* | *More heat-related illness, especially for vulnerable populations.* |
| | *Outdoor events may need to be rescheduled and/or require plans to respond to heat-related illness.* |

# Module 4 — Incorporating Judgement

**About Module 4 — Incorporating Judgement:** This module will provide a framework for how to apply your best judgement to support conclusions based on quantitative data. The sections use the stressors you identified in ***Module 3*** to determine the ***likelihood*** that impacts from those stressors will occur in your community; assess the ***consequences*** of those stressors occurring; combine the likelihood of your problem occurring with the consequences of that problem occurring (***risk***); assess your community's ability to respond to that problem (***adaptive capacity***); and assess your community's vulnerability to your problem (***vulnerability level***). In other words, ***Module 4 — Incorporating Judgement*** will help you translate quantitative findings into qualitative metrics that you will use to assess your community's adaptive capacity and vulnerability to a changing climate.

From here on out, you will work with estimates and descriptive words and associate them with numerical values (and vice versa). To keep things straight, keep a record of how you arrived at your assessed numerical values.

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**Module 4 Goals:** Help inform your community's future decision-making strategies by:

- **Determining the *likelihood* of a climate impact happening**
- **Assessing *consequences* by examining the cumulative effects of the intersection between climate and non-climate stressors**
- **Integrating likelihoods and consequences to assess *risk* levels for climate stressors**
- **Assessing your community's *adaptive capacity* based on the social relationships in your community**
- **Assessing the *vulnerability level* of you community by using risk and adaptive capacity**

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**Module 4 at a Glance:**

- **Column D Likelihood**
- **Column E Assessing Consequences**
- **Column F Assessing Risk**
- **Column G Assessing Adaptive Capacity**
- **Column H Assessing Vulnerability Level**

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**Tip:** You are navigating the world of judgement calls. Be prepared to communicate the steps you took to arrive at your judgement and conclusions. Take good notes — they will help you to explain your positions if necessary.

## Column D. Likelihood

**About Likelihood:** Previously, we summarized how a given climate impact may be felt by a community. Now it is time to use your best judgement to determine how likely that impact is to occur. There are many ways to measure likelihood, from very simple to very complicated. It's up to your community to develop a likelihood scale that will define and communicate likelihood to your community members. ***Table 4*** below illustrates an example of a likelihood scale whose terms and estimates were determined by a community. We'll continue to use this scale to develop the ***VAT*** here, but you should feel free to develop your own.

**Goal for Likelihood:** Use your judgement to determine how likely it is that a climate impact will be felt by your community.

**Instructions for VAT Column D. Likelihood:** Working directly in your filled-in ***VAT***, use the likelihood scale found below to show how likely the climate impacts identified in ***Column C*** are to happen. Use your best judgement.

***Likelihood*** — a judgement call that estimates how likely it is that a given impact will come to pass.

**Note:** This section is not meant to be a debate or discussion about the likelihood that climate change is happening, nor is it intended to be a discussion about the likelihood of a given projection or set of projections.

For instance, in our Spokane example about future rising temperature, temperature projection uncertainty has already been discussed in the climate data story process. The likelihood we're interested in now is how likely it is that outdoor events, including Bloomsday, will be affected by a rise in heat-related illnesses if the dates of the event continue unchanged.

### Table 4: Column D. Likelihood (Example)

| Level of Evidence | Term | Likelihood | Common Phrasing Defined by Spokane Community Members |
|---|---|---|---|
| **High** | *Very Likely* | *95–99%* | *"Beyond a reasonable doubt"* |
| | *Likely* | *65–94%* | *"Pretty much convinced, clear and convincing evidence"* |
| **Some** | *About as Likely as Not* | *34–66%* | *"Increasingly supporting evidence (possible/probable)"* |
| | *Unlikely* | *5–33%* | *"Unlikely, not a lot of supporting evidence"* |
| **Low** | *Improbable* | *1–5%* | *"Pretty much not gonna happen, little evidence"* |

**Notes on Likelihood:** Record thoughts and/or justification for the likelihoods you assigned.

*Impacts felt by increased summer temperatures are very likely to happen; nothing else is needed in order for high-heat impacts to be felt.*

*Wildfire requires an ignition source (manmade or natural), so impacts ascribable to fire are not necessarily a given, and therefore could be assessed as less likely by a community.*

**Tip:** This is *your* vulnerability assessment. It is built upon your judgements based on your and your community members' investigations. Take ownership. Keep good notes to help you explain your logic and reasoning, keep an open mind, and be ready to incorporate new information and adjust your assessment.

## Column E. Consequences

**About Consequences:** In this module, you will refer back to the exercises completed in ***Module 3.*** For this vulnerability assessment, ***consequences*** are defined as the cumulative effects of a community's examined climate stressors and impacts interacting with a community's examined non-climate stressors and impacts.

While ***consequences*** are logical conclusions based on your judgement and knowledge, it is important to complete this step so that you are able to support your conclusions.

***Stressor*** — a broad category containing multiple impacts

***Impact*** — an effect on human communities and natural systems

***Consequences*** — the cumulative effects of a community's examined climate stressors and impacts interacting with a community's chosen non-climate stressors and impacts

**Goal for Consequences:** Catalog the interactions between climate and non-climate stressors and impacts in your community.

**Tip:** As with the likelihood scale, modify your assessed consequence levels to suit your local context. Be sure to provide a basic definition of each assessed consequence level so the values work for you and your community.

**Instructions for VAT Column E. Consequences:** Using the following ***consequences*** worksheets, catalog interactions between climate and non-climate stressors in your community. The cumulative effect will become the assessed value input into ***Column E: Consequences*** of the ***VAT.*** There are three steps you will need to complete to determine the consequences of the climate stressors you are examining:

- Step 1. Complete ***Worksheet 7: Establish Impacts.***
- Step 2. Complete ***Worksheet 8: Assess Intersections.***
- Step 3. Transfer Assessed Consequence Levels from ***Worksheet 8*** to the ***VAT.***

**Step 1. Complete Worksheet 7: Establish Impacts**. Establish the impacts of non-climate stressors. (Repeat this process for each of your chosen non-climate stressors.)

- **Column 1, Non-climate Stressor:** Write an examined non-climate stressor in each row. (**Note:** We chose to examine five stressors related to non-climate impacts. You can choose to investigate more or fewer, depending on your community's needs.)
- **Column 2, Synthesize the Impact of Examined Non-climate Stressors:** Write one or two sentences synthesizing the impacts that each non-climate stressor is projected to have on your community. Note whether the impacts will have a positive or negative effect on your community. Use the information you recorded on ***Worksheet 4: Synthesizing Non-climate Data***.
- **Column 3a - 3e, Intersection with Climate Stressors**: Label the column headings with your chosen climate stressors, identified by your climate data stories. Next, write one or two statements about how your non-climate stressor (***Column 1***) and the climate stressor you wrote in the heading intersect.

## Worksheet 7: Establish Impacts (Example)

| 1. Non-climate Stressor | 2. Non-climate Impact | 3. Intersection with Climate Stressors | | | | |
|---|---|---|---|---|---|---|
| | | 3a *Temperature* | 3b *Precipitation* | 3c *Wildfire* | 3d *Streamflow* | 3e *Snow* |
| *Smoke* | *More unhealthy air quality days* | *Temp can already be stressing sensitive groups, adding unhealthy air compounds issues* | *If it's smoky then starts to rain, that's helpful, but with less rain in summer, the air doesn't get washed* | *More fires, more smoke* | *N/A - stream metrics don't apply* | *N/A - indirect inferences can be made about fire with the snow variables, but the fire variables are a better indicator* |

**Step 2. Complete Worksheet 8: Assess Intersections:** Focusing on the vertical columns, ***Column 3a - 3e***, you will summarize the information in the vertical column, describing the intersection between your non-climate stressors and your climate stressors. This will allow you to assess the consequence level of your climate stressors.

**Discussion Point:** You and your community determine how many stressors and impacts to include in your assessment. The climate data stories may be a subset of the climate impacts that could affect your community, rather than all of them. If you determine that there are gaps in knowledge of how climate may affect your community, develop more climate data stories. Similarly, there may be more non-climate impacts than the original subset you chose.

**Row 1. Synthesizing Climate Stressor Effects:** Write one or two sentences synthesizing the entire column designated for each climate stressor. Write your synthesis in ***Row 1*** (***Overall Impact of Climate Stressor***) ***Column 3a***. Synthesis statements should clearly illustrate how a climate stressor will affect your community. Repeat this process for ***Columns 3b - 3e***.

**Row 2. Assessing Consequence Level:** Re-read what you wrote in columns ***3a - 3e***. Decide the cumulative impact of each climate stress and write down an assessed consequence level using the following scale:

- ***Catastrophic:*** Community will cease to exist or have functions permanently altered
- ***Major:*** Functions of the community may be dramatically altered, such that value is undermined
- ***Moderate:*** Function of the community may be diminished, such that it is degraded but still present
- ***Minor:*** Community will continue to function but specific activities may be impaired
- ***Negligible:*** Community will not be visibly or functionally affected

## Worksheet 8: Assess Intersections (Example)

| | 3a *Temperature* | 3b *Precipitation* | 3c *Wildfire* | 3d *Streamflow* | 3e *Snow* |
|---|---|---|---|---|---|
| Synthesis Statement of Inputs Columns 3a - 3e | *Increases in temperature add a level of stress to any other non-climate impacts* | | | | |
| Assessed Consequence Level | *Major* | | | | |

**Note:** CIRC filled this out considering ONLY temperature and smoke. Even if you're looking at temperature, you may have a different statement that synthesizes how all of the various inputs come together. Remember, CIRC only looked at two factors in this example, while you may be looking at more.

**Step 3. Transfer Assessed Consequence Level from Worksheet 8 to the VAT:** Transfer the assessed consequence levels to the ***VAT Column E*** row that corresponds to the climate impact.

# Vulnerability Assessment Table

Reference Sections A–H in this workbook for instructions that correspond to each column and tell you what information goes into them*

| A. Climate Impact | B. Summarize the Climate Impact | C. Summarize how the climate impact may be felt in your community |
|---|---|---|
| *Temperature* | *There is strong evidence that mean annual temperatures are rising and are projected to continue to rise under both RCP 4.5 and RCP 8.5, with the hottest days under RCP 8.5 topping out well over 100°F, compared to historical hottest days of 99°F. Under both scenarios, days in which the heat index (a combined measure of heat and humidity) reaches or exceeds 90 °F, 100 °F, and 105 °F are all expected to rise as well, likely corresponding to an increase in heat-related illnesses.* | *More heat-related illness, especially for vulnerable populations* |
| | | *Outdoor events may need to be rescheduled and/or require plans to respond to heat-related illness.* |
| | | |
| | | |
| | | |

*Please reference them

| D. Likelihood | E. Consequences | F. Risk | G. Adaptive Capacity | H. Vulnerability level |
|---|---|---|---|---|
| *Very Likely* | *Major* | *Extreme* | *Moderate* | *High* |
| *Very Likely* | | | | |
| | | | | |
| | | | | |
| | | | | |

## Column F. Assessing Risk

**About Assessing Risk:** Risk combines the likelihood of an event with the degree of severity of that event's consequences should it occur. Risk is subjective; it can change depending on who is assessing it and their priorities. Above all, assessing risk is a conversation, a difficult conversation, and a necessary one. In ***VAT Column D: Likelihood***, you used a scale to determine the likelihood of the impacts of the chosen climate stressor on your community. In ***VAT Column E: Consequences***, you assessed the interactions between your chosen climate stressors and non-climate stressors and evaluated the potential significance of the consequences. Combining these two assessed values will help you to assess the ***risk*** level of the climate stressor to your community.

***Likelihood*** — a judgement call that estimates how likely it is that a given impact will come to pass

***Consequences*** — the cumulative effects of a community's chosen climate stressors and impacts interacting with a community's chosen non-climate stressors and impacts

***Risk*** — the likelihood of an event happening combined with the severity of that event

**Goal for Assessing Risk:** Assign/assess a ***risk value*** to a climate stressor by using the likelihood and consequence values assessed in the previous ***likelihood*** and ***consequences*** columns (and described in the previous sections).

**Instructions for VAT Column F. Assessing Risk:**

- Step 1. Using the likelihood and consequences you previously assessed, use ***Table 5: Column F. Assessing Risk*** to combine the two values. Where the ***likelihood*** row and the ***consequences*** column meet is your assessed ***risk value***.
- Step 2. Repeat for all your chosen climate stressors.
- Step 3. Transfer this assessed ***risk value*** into ***column F*** *of the* ***VAT*** for each climate stressor.

If the level of ***risk*** that your assessed ***likelihood*** and ***consequence*** value reveals seems off to you, go back to the notes you took while assessing those values. If your logic makes sense, perhaps the ***risk*** level is merely surprising but not wrong.

### Table 5: Column F. Assessing Risk

| Likelihood | Consequences | | | | |
|---|---|---|---|---|---|
| | Negligible | Minor | Moderate | Major | Catastrophic |
| Improbable | Low | Low | Low | Low | Low |
| Unlikely | Low | Low | Moderate | Moderate | Moderate |
| About as Likely as Not | Low | Moderate | Moderate | High | High |
| Likely | Low | Moderate | High | High | Extreme |
| Very Likely | Low | Moderate | High | Extreme | Extreme |

**Notes on Risk:** Record your thoughts for the risks you assessed. Do they make sense? Why or why not? What needs adjusting?

*Temperature: Likely + Major = High Risk*
*(Likelihood + Consequence = Risk)*
*Makes sense given the concluding statements from the climate data story and smoke investigation.*

**Tip:** If after discussion with your peers, one or more of your assessed values looks off, you can re-evaluate your assessed value(s) based on the new data.

## Column G. Adaptive Capacity

**About Adaptive Capacity:** ***Adaptive capacity*** of a system combines ***community adaptation potential*** with ***social constructs***, shining a light on a community's strengths and areas needing improvement. To determine ***vulnerability***, it is critical to determine what capacities exist in a community, where weaknesses might be, and how well the community is poised to respond to change from multiple stressors and impacts.

**Goal for Adaptive Capacity:** Assess your community's ***adaptive capacity*** in relation to your identified climate stressors (identify where you are already strong and where you might improve).

**Instructions for VAT Column G. Adaptive Capacity:** Use your judgement, existing knowledge, or conversations with others to assess the social, organizational, and management capacity to respond to the climate impacts you've identified. Make notes about why you ranked them the way you did.

Use the following scale to assess each of the factors and their statuses:

***5*** = ***Superior*** (This is the ideal condition)
***4*** = ***Good*** (Better than adequate, but could use improvement)
***3*** = ***Fair*** (Could easily be improved)
***2*** = ***Poor*** (Not adequate, but provides modest function)
***1*** = ***Nonexistent*** (Not functional or does not exist)

***Community Adaptation Potential*** — connections in a community based on existing relationships as well as evidence of past collaborative efforts and actions. This information is typically something you can learn about in news stories or by soliciting input from local residents with experience in the region.

***Social Constructs*** — social rules and governance structures that a community operates within. These are usually unspoken and unwritten, although most everyone understands them through training, experience, and time in the community.

***Adaptive Capacity*** — ability (or lack thereof) of the community to utilize social relations, social constructs, and knowledge to adapt to changing conditions in the community and/or larger world.

***Social Potential*** — relationships between people that allow them to make collective decisions about the future.

***Organizational Capacity*** — individual employee capacity combined with others in the organization and the community to make organizational choices in the face of change.

***Management Potential*** — rules, regulations, and management styles that allow the organization and its employees to adapt to changing conditions.

- **Step1. Social Potential:** Using the scale above, assign numbers for the intersection of each social potential category and each climate stressor. Then average them. If the social potential categories and climate stressors don't interact, mark it as *N/A*.
- **Step 2. Organizational Capacity:** Using the scale above, assign numbers for the intersection of each social potential category and each climate stressor. Then average them. If the organizational capacity categories and climate stressors don't interact, mark it as *N/A*.
- **Step 3. Management Potential:** Using the scale above, assign numbers for the intersection of each social potential category and each climate stressor. Then average them. If the management potential categories and climate stressors don't interact, mark it as *N/A*.
- **Step 4. Average your Averages:** Take an average of all of your average values. (Note: Taking an average of averages is not always a good mathematical approach, especially when working directly with climate data. Because these are numbers assigned to words based on judgements, not data-driven mathematical derivations, it's OK here.)
- **Step 5. Translate Value:** Translate that value to an assessed **Adaptive Capacity** where *Low* = 1–2; *Moderate* = 2.4–3.6; and *High* = 3.7–5.
- **Step 6. Transfer adaptive capacity value**: Transfer the assessed value (Low, Moderate, or High) for each climate stressor into ***Column G*** of ***VAT.***

## Worksheet 9: Column G. Adaptive Capacity

| Community Adaptation Capacity to Climate Impact | Climate Impact Temp | Climate Impact | Climate Impact | Climate Impact | Climate Impact | Notes (why you ranked it this way) |
|---|---|---|---|---|---|---|
| **Social Potential** | | | | | | |
| Extent, distribution, and connectivity of social networks | *3* | | | | | *Temp response is a 3, there are cooling centers identified, just need to work out logistics* |
| Past evidence of responsiveness to disasters | *3* | | | | | |
| Community expertise | *4* | | | | | |
| Community participation and collaboration | *4* | | | | | |
| **Average Social Potential** | *3.5* | | | | | |
| **Organization Capacity** | | | | | | |
| Staff capacity (training/time) | *2* | | | | | |
| Responsiveness | *2* | | | | | |
| Relationships | *4* | | | | | |
| Stability/Longevity | *3* | | | | | |
| **Average Organization Capacity** | *2.75* | | | | | |
| **Management Potential** | | | | | | |
| Existing mandates | *1* | | | | | |
| Monitoring and evaluation capacity | *1* | | | | | |
| Ability to learn and change | *5* | | | | | |
| Proactive management | *3* | | | | | |
| Partner relationships | *3* | | | | | |
| Science and technical support | *3* | | | | | |
| **Average Management Potential** | *6.67* | | | | | |
| **(Average Social + Organization + Management Potential) /3** | *2.97* | | | | | |
| Translate to Adaptive Capacity | *Moderate AC to temp* | | | | | |

## Column H: Vulnerability Level

**About Vulnerability Level:** The ***assessed vulnerability level*** combines your ***assessed risk*** and ***adaptive capacity*** to help reveal the summation of your chosen stressors and judgement calls and how they relate to one another. The ***assessed vulnerability level*** also informs your community's prioritization of resources when facing a changing climate.

**Goal for Vulnerability Level:** Assess a ***vulnerability level*** to each chosen climate stressor to help prioritize a community's response to climate change.

**Instruction for VAT Column H. Vulnerability Level:**

- Step 1. Using the ***risk*** and ***adaptive capacity*** values you previously assessed, use ***Table 6: Vulnerability Level*** to combine the two values.
- Step 2. Where the ***risk*** row and the ***adaptive capacity*** column meet is your assessed ***vulnerability level***.
- Step 3. Repeat for all chosen climate stressors.
- Step 4. Transfer this ***assessed vulnerability*** level into ***Column H*** of the ***VAT***.

If the ***vulnerability level*** that your assessed ***risk*** and ***adaptive capacity*** values reveal seems off to you, go back to the notes you took while assessing those values. See if your logic makes sense. The ***vulnerability level*** may merely be surprising but not wrong.

### Table 6: Vulnerability Level

| **Risk** | **Adaptive Capacity** | | |
|---|---|---|---|
| | **Low** | **Moderate** | **High** |
| **Low** | Low | Low | Low |
| **Moderate** | Moderate | Moderate | Low |
| **High** | High | Moderate | Moderate |
| **Extreme** | High | High | Moderate |

**Notes on Vulnerability Level:** Record your thoughts for the vulnerabilities you assessed. Do they make sense? Why or why not? What needs adjusting?

*Adaptive capacity = moderate*
*Risk = extreme*
*Vulnerability level = high*

*High vulnderability to temperature stress makes sense given the climate data stories. Lots of opportunities exist to plan resilience actions.*

# Final Task and Concluding Thoughts

Now you have a catalog of the ***Vulnerability Levels*** for your region, along with sample climate stressors and how they may be ranked and prioritized.

By identifying and investigating specific climate impacts likely to affect your community, understanding how the impacts are projected to manifest at the local scale, and understanding important non-climate impacts in your community, you are able to clarify your community's vulnerability to those risks and begin to develop strategies and actions for adapting to climate change.

**Using the Completed Vulnerability Assessment Table**: Use the ***VAT*** to identify and inform critical conversations within your community. Do this by looking at the relationships between the various assessed values data and thinking through how they logically fit together.

Try comparing your assessed ***risk*** (***Table 5: Column F. Assessing Risk***) with your assessed ***adaptive capacity*** (***Worksheet 9: Column G. Adaptive Capacity***) to identify gaps and opportunities in your community's ability to respond to changing climate conditions. For instance, if your assessed ***adaptive capacity*** is lower than the assessed level of ***risk*** for a given climate impact, this shows a gap between your ability to respond to an impact and the ***risk*** level associated with that impact. Conversely, if the difference between your assessed ***adaptive capacity*** and the ***risk*** of a climate impact is moderate, this could illustrate a potential place to allocate resources or identify an opportunity to leverage existing ***adaptive capacity***, find ways to expand that capacity, and develop some strategies to respond. The next volume, ***The Resilience Actions Workbook***, is designed to help you understand the human landscape of your community and plan resilience actions. Thanks for working with us, and let us know how you do!

**Discussion Point:** If there is a big disparity between assessed capacity and assessed risk, consider how you came to your conclusions. Likewise, if you have multiple individuals or groups doing this exercise and they come up with vastly different results, discuss the steps that were taken to arrive at their conclusions. While it can be frustrating to go back and reexamine your work, it can also be a great starting point for dialog around choices and how to allocate resources, particularly when working with individuals and groups with different perspectives and motivations.

# Appendix 5: Blank Vulnerability Assessment Worksheets

## Worksheet 3: Synthesizing Climate Data

| | |
|---|---|
| **Your Climate Question:** | |
| **1. Identify the component(s) of your question.** | **2. Identify what information might help you answer your question.** |
| **3. Identify the variables that are relevant to each component of your question.** | **4. Identify the timeframe(s) that are relevant to each component of your question.** |
| **5. Describe the outputs of your research in a short summary.** | **6. Determine if your outputs answered your question. Determine if you need additional information to answer your question. Identify your next steps (if any).** |
| **Conclusion Statement:** | |

## Worksheet 4: Synthesizing Non-climate Data

| Your Non-climate Question: | |
|---|---|
| 1. Identify the component(s) of your question. | 2. Identify what information might help you answer your question. |
| 3. Identify the variables that are relevant to each component of your question. | 4. Identify the timeframe(s) that are relevant to each component of your question. |
| 5. Describe the outputs of your research in a short summary. | 6. Determine if your outputs answered your question. Determine if you need additional information to answer your question. Identify your next steps (if any). |
| 1. Identify the component(s) of your question. | 2. Identify what information might help you answer your question. |
| 3. Identify the variables that are relevant to each component of your question. | 4. Identify the timeframe(s) that are relevant to each component of your question. |
| 5. Describe the outputs of your research in a short summary. | 6. Determine if your outputs answered your question. Determine if you need additional information to answer your question. Identify your next steps (if any). |
| Conclusion Statement: | |

## Worksheet 5: Building the VAT Columns A and B

| A. Climate Stressor | B. Summarize the data describing the climate impact |
|---|---|
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## Worksheet 6: Building the VAT Column C

| A. Climate Stressor | C. Summarize how the climate impact may be felt by your community (1-2 sentences) |
|---|---|
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## Worksheet 7: Establish Impacts

| 1 Non-climate Stressor | 2 Non-climate Impact (+/-) | 3. Intersection with Climate Stressors | | | | |
|---|---|---|---|---|---|---|
| | | 3a | 3b | 3c | 3d | 3e |
| | | | | | | |
| | | | | | | |
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## Worksheet 8: Assess Intersections

| | 3a | 3b | 3c | 3d | 3e |
|---|---|---|---|---|---|
| Synthesis Statement of Inputs from Columns 3a - 3e | | | | | |
| Assessed Consequence Level | | | | | |

## Worksheet 9: Column G. Adaptive Capacity

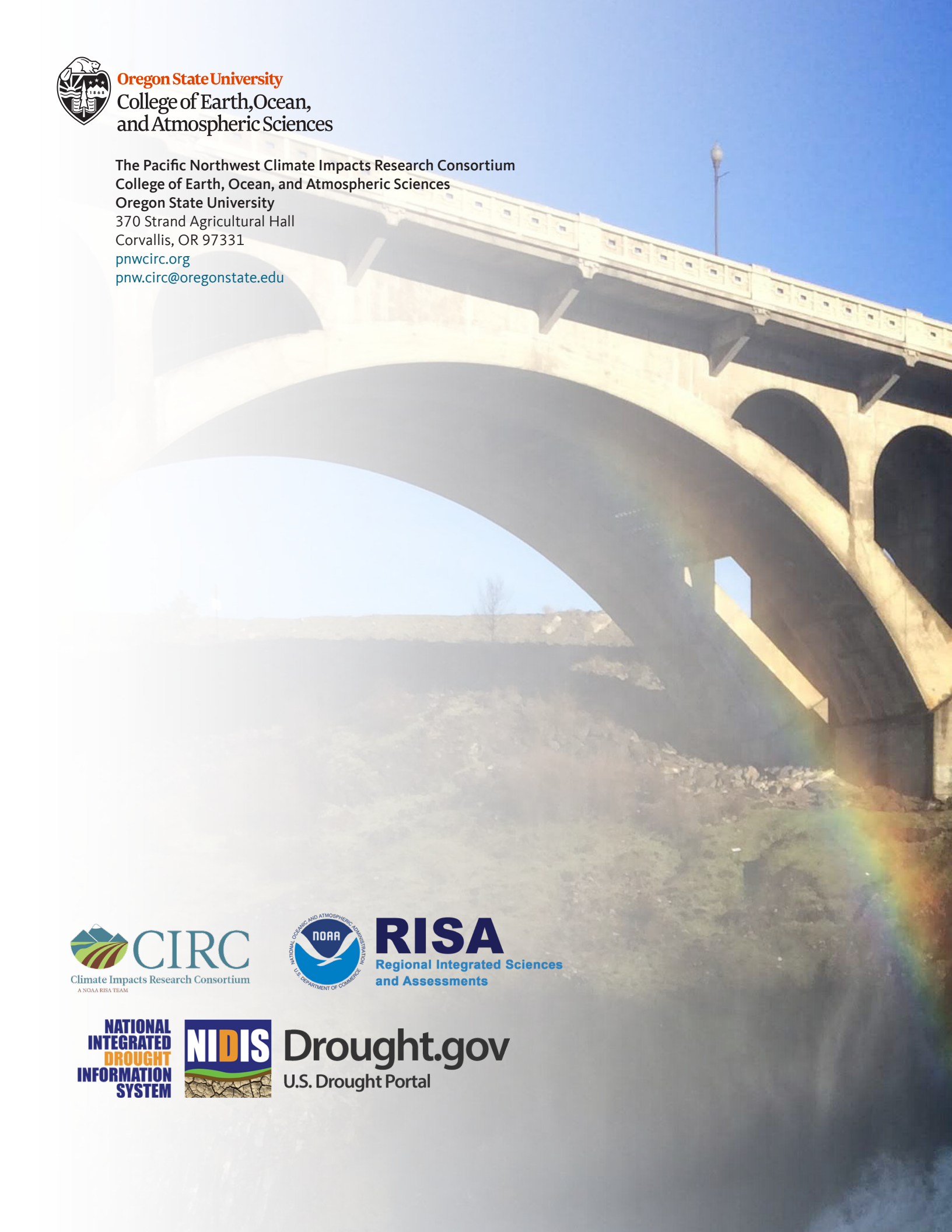
| Community Adaptation Capacity to Climate Impact | Climate Impact | Climate Impact | Climate Impact | Climate Impact | Climate Impact | Notes (why you ranked it this way) |
|---|---|---|---|---|---|---|
| **Social Potential** | | | | | | |
| Extent, distribution and connectivity of social networks | | | | | | |
| Past evidence of responsiveness to disasters | | | | | | |
| Community expertise | | | | | | |
| Community participation and collaboration | | | | | | |
| **Average Social Potential** | | | | | | |
| **Organization Capacity** | | | | | | |
| Staff capacity (training/time) | | | | | | |
| Responsiveness | | | | | | |
| Relationships | | | | | | |
| Stability/Longevity | | | | | | |
| **Average Organization Capacity** | | | | | | |
| **Management Potential** | | | | | | |
| Existing mandates | | | | | | |
| Monitoring and evaluation capacity | | | | | | |
| Ability to learn and change | | | | | | |
| Proactive management | | | | | | |
| Partner relationships | | | | | | |
| Science and technical support | | | | | | |
| **Average Management Potential** | | | | | | |
| **(Average Social + Organization + Management Potential) /3** | | | | | | |
| Translate to Adaptive Capacity | | | | | | |

## Resources Cited:

CEC 2017. *North American Marine Protected Area Rapid Vulnerability Assessment Tool*. Montreal, Canada: Commission for Environmental Cooperation. 30pp.

Mooney, Ann, Nathan Gilles, Katherine Hegewisch, John Abatzoglou, and Meghan Dalton. "*The Northwest Climate Toolbox Workbook: Discovering and applying your climate data story for climate adaptation planning*," Corvallis, Oregon: The Pacific Northwest Climate Impacts Research Consortium (CIRC), College of Earth, Ocean, and Atmospheric Sciences, Oregon State University, 2019.

# Notes



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