

# arrowsic climate action plan



DRAFT April 24, 2024

Developed by the Arrowsic Climate Resilience Committee



# land acknowledgment

The Town of Arrowsic begins this plan with recognition of the stewardship of the Abenaki people, part of the Wabanaki Federation, who lived here before the arrival of European colonizers. These lands are the unceded territory of the Abenaki people. We pledge to build a better understanding of those who came before us and to continue to repair the relationship between our peoples and the land. For one to thrive, all must thrive.

COVER PHOTO: BACK RIVER FOG  
CREDIT: JACK WITHAM

# appreciation

The Arrowsic Climate Resilience Committee dedicated hours of thought and energy to creating an actionable plan that accurately represents Arrowsic's strengths, vulnerabilities, and vision.

Thank you to all of the Town committees and volunteers who contributed their time, knowledge, and perspectives during the development of this plan. We also appreciate the community members who attended the public workshops in August 2022 and September 2023.

We are grateful as well for the generous support of the Governor's Office of Policy Innovation and the Future's Community Resilience Partnership. This project was made possible through funding from a Community Action Grant.

## Members of the Arrowsic Climate Resilience Committee

Jody Jones, Co-Chair  
Aleisha Khan, Co-Chair  
Jack Carr  
Dan Cassidy  
Jennifer Geiger  
Jenna Howard  
Jesse Nankin McMahon  
Karin Sadtler  
Mona Schlein  
Tom Spear  
Pam Wischkaemper

## Members of the Arrowsic Select Board

Walter Briggs, First Selectperson  
Jennifer Geiger  
DeeDee Jorgensen

## Members of the Arrowsic Conservation Commission

Phine Ewing, Chair  
Clarke Cooper  
Jenna Howard  
Jesse Nankin McMahon  
Karen Robbins  
Priscilla Tucker  
Carla Weeks

## Other Committees that contributed to the ACAP:

Arrowsic Fire Department  
Planning Board  
Recycling & Solid Waste Committee  
Road Commission  
Shellfish Conservation Committee  
Town Properties Committee

## Consultant Team

Judy Colby-George, Project Lead  
Madeline Tripp

# TOWN OF ARROWSIC

Settled 1630

January 29, 2024

We are fortunate to live in a place surrounded by three beautiful rivers, extensive coastal marshes, a cherished freshwater pond and over 1,500 acres of conserved lands that support a wide variety of wildlife. Our island's rich cultural history shows us we are only temporary stewards. We recognize the contributions of those who came before and feel an obligation to those who will come after.

Climate change is already affecting our lives today. The December storms of 2022 and 2023 couldn't have been more persuasive about the need to act now. More frequent and intense storms coupled with rising sea level are causing crucial roads to flood more regularly, limiting our ability to get off the island and stretching our volunteer emergency response team to the limit.

This Climate Action Plan represents a road map to make our community more resilient to these changes. So many of you contributed to this plan through your participation in community workshops and your work on town committees. Your feedback identified and prioritized the actions suggested in this document. As part of a Community Resilience Partnership with the Town of Arrowsic the Maine Governor's Office of Policy and Innovation funded the professional assistance needed to create this plan.

While climate change can make one feel powerless, we choose to take action now. As your select board, we will support this process and the recommendations laid out in this plan in every way we can.

Sincerely,



Walter Briggs  
First Selectman, Town of Arrowsic



Deedee Jorgensen  
Selectman



Jennifer Geiger  
Selectman

340 Arrowsic Road, Arrowsic, ME 04530  
www.arrowsic.org ~ 207.443.4609

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A photograph of a white lighthouse with a blue roof and red lantern room, situated on a rocky cliff overlooking the ocean. The lighthouse has a small green door and a wooden walkway leading up to it. The ocean is visible in the background, with waves breaking on the shore. The sky is a pale blue, suggesting a clear day.

# executive summary

Our climate is changing. Arrowsic residents are already experiencing the impacts. Most noticeably, storms are happening more frequently and at a greater intensity, leaving our island community increasingly susceptible to road flooding and power outages, among other issues.

This climate action plan represents our strategic response to the changes. It focuses on creating opportunities to address local effects of climate change and lower the community's greenhouse gas emissions. It identifies Arrowsic's assets and vulnerabilities related to climate change and prioritizes activities to reduce the risks. The plan also includes a practical implementation guide for individual and collective actions.

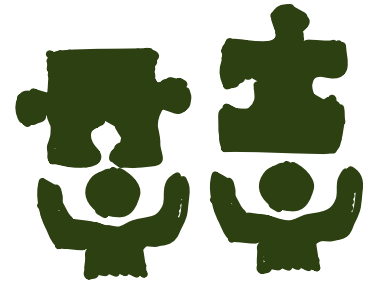
# PRIORITY ACTIONS



45 people attended the public meeting



250+ comments provided by committees



7 town committees & orgs contributed

The Arrowsic Climate Resilience Committee coordinated the process leading to this document which includes input from town officials and committees. Residents participated in two well-attended public workshops held in 2022 and 2023 and submitted comments to the draft plan. The following issues and actions rose to the top as the most significant and urgent.

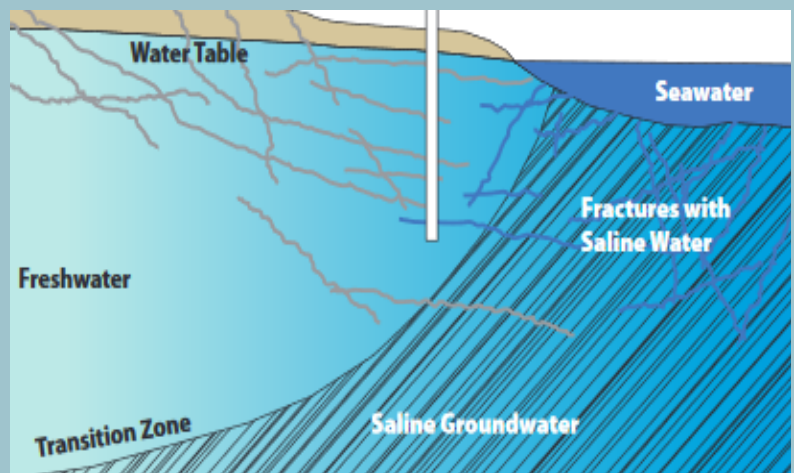


## Infrastructure

Arrowsic and Georgetown residents rely on Route 127 and the Wilder Memorial Bridge as the sole access point to the mainland, emergency medical services, healthcare, food supplies, electricity, and other necessary resources. This state road is intermittently blocked by tidal flooding. This disruption is expected to happen more often as sea level rises and the frequency of severe storm events increases. The town of Arrowsic is prepared to collaborate with Maine DOT, Georgetown and others to address this issue. It will be critical to participate in the development of road improvement plans far enough in advance to ensure that additional needs of the communities are met, such as considerations for Arrowsic's salt marshes, vehicle traffic and bike lanes, etc.

## Groundwater

Arrowsic relies exclusively on private wells for drinking water, which access groundwater stored in fractures in the bedrock. This valuable resource is under pressure by several climate change impacts, including sea level rise, periodic droughts, and severe precipitation events. Coastal Maine towns can collaborate to better understand how to preserve access to potable water by improving, updating, and sharing existing well data.



# PRIORITY ACTIONS

## Emergency Services

The volunteers of the Arrowsic Fire Department are the first to respond to emergency situations in town. As the department adapts to meet a growing number of climate-related incidents, it needs support to increase its capacity. This includes the recruitment of additional volunteers with a variety of skills and training, improved communications, updated mapping, and signage to facilitate emergency response, and additional support to apply for funding for equipment and training.



## Marsh Migration/Coastal Erosion

Marshes along the three rivers surrounding Arrowsic (Kennebec, Sasanoa and Back rivers) are nationally significant for their extensive wildlife and fisheries habitat. These marshes also provide crucial flood control by acting as sponges. Several are crossed by important stretches of roads in Arrowsic, including along Route 127, which may impact the health and resilience of these marshes. When in a compromised condition, marshes are more vulnerable to stress caused by sea level rise and increased wave action, which will impede their ability to provide flood and erosion protection for the island. Conserving land adjacent to vulnerable marshes will allow these ecosystems to better adapt and migrate inland, which will mitigate the negative impact to the ecosystem services these areas provide.





## COMPANION RESOURCES

In addition to this Climate Action Plan, the Arrowsic Climate Resilience Committee developed a Climate Resilience Handbook, describing actions individuals can take to reduce the impacts of climate change on their lives and increase their resilience to climate hazards. The handbook was modeled after the Arrowsic Stewardship Guide which helps community members care for Arrowsic's natural resources. These three documents (Climate Action Plan, Stewardship Guide and Climate Resilience Handbook) work together to create a cohesive plan for both the Town and individuals to participate in strengthening our community, creating a brighter future.

## DEVELOPING SUPPORT & CAPACITY

Implementation of the actions identified in this plan will require leadership from many parts of the community. It will be important to track progress towards goals, help coordinate between town committees, and to ensure the actions are implemented. While this plan provides guidance on which committees will take up the work of implementation, the work of addressing climate change is in each of our hands. We are a small town reliant on volunteers to keep the lights on, pay our bills etc. New volunteers were recruited to create this plan and it is our hope that we can tap into this enthusiasm in ways that will help the town achieve the goals within the plan.

An aerial photograph of a two-lane asphalt road with yellow dashed center lines and white edge lines, winding through a winter landscape. The ground is covered in snow, with patches of brown grass and small trees. A dense forest of evergreen trees is visible on the left side. A semi-transparent teal rectangular overlay is positioned horizontally across the middle of the image, containing the text 'community assessment' in a white serif font.

# community assessment

PHOTO CREDIT:  
EVAN D'SOUZA

# 1. INTRODUCTION

## 1.1 Why Arrowsic has a Climate Action Plan

Arrowsic, as a small island community, is vulnerable to climate change impacts from sea level rise and changing weather patterns. The community is already experiencing some impacts related to climate change, including more frequent droughts and periodic tidal and storm-related flooding. Arrowsic relies on the mainland for access to healthcare, food supplies, electricity, and other necessary resources. Any disruptions in access to the one road on and off the island impacts daily life for residents.

While there may be new challenges ahead, Arrowsic is an engaged community with a long history of taking collective action to protect the environment. For example, in 2016, the community developed a stewardship guide to help community members care for Arrowsic's natural resources in their daily lives.<sup>1</sup>

The community is building on this legacy of collaboration and care by working towards climate resilience. Reflecting the urgency of climate change, Arrowsic developed the following Climate Action and Outreach Plan to serve as a road map for the Town's adaptation and mitigation actions. It includes an assessment of the Town's assets and vulnerability, recommended actions, and a practical implementation guide. The Climate Resilience Handbook was developed as a companion document with guidance for individual action.

### What's the Cost of Inaction?

This term refers to the estimated losses if a community does nothing to adapt to climate change or reduce emissions, usually measured in terms of damage from climate-related hazards.

To see a cost assessment for Maine:  
<https://www.maine.gov/future/climate/reports>. Click on "Assessing the Impacts..."

## 1.2 State & Regional Context

### 1.2.1 Maine Won't Wait

In 2020, the state released Maine Won't Wait, a comprehensive plan to reduce the state's carbon footprint, avoid the costs of inaction (see inset), foster economic opportunity and prosperity, and advance equity through the climate response effort. This plan, based on an extensive scientific assessment of climate change in Maine, was also a call to action for communities across the state to create their own climate action plans. Strategy F, Build Healthy and Resilient Communities, includes measures to support towns like Arrowsic in "understanding, planning for, and acting to reduce their risk" related to climate change.<sup>2</sup>

### 1.2.2 Climate Resilience Partnership

To implement Strategy F of Maine Won't Wait, the Governor's Office of Policy Innovation & the Future established the Community Resilience Partnership (CRP). This program, which Arrowsic is enrolled in, provides funding and support to help communities take steps towards climate resilience and reduce emissions.<sup>3</sup> There are opportunities to collaborate with other communities in the CRP, particularly neighboring towns with similar concerns.

### 1.2.3 Coastwise Approach

In 2023, the State of Maine released the CoastWise Approach, a comprehensive set of practices and decision-making tools based on the latest science to encourage the resilience of coastal roads and adjacent tidal environments. CoastWise was developed over a six-year period with contributions from leading experts in Maine, across the U.S., and abroad. The Maine Climate Council and others recommended this tool as a means for road owners, engineers, ecologists, and local communities to achieve safe, cost effective, and climate-ready roads that also support the resilience of adjacent tidal environments, now and in the future.

# 1. INTRODUCTION

## 1.2.4 Arrowsic's Climate Action Plan Process

### Joining the Community Resilience Partnership

Arrowsic enrolled in the Community Resilience Partnership in 2022. As a part of this process, representatives from Arrowsic's Conservation Commission (ACC), Properties Committee, Fire Department, Planning Board, Selectboard, Recycling & Solid Waste Committee, and the Local Emergency Management Agency completed a Community Resilience Self-Assessment.<sup>4</sup> This process identified vulnerabilities and documented current Town activities that increase community resilience.

In August of 2022, the Town held a community workshop at the Fire Station to share the self-assessment and gather feedback from residents on the Town's resilience priorities. Following the workshop, the Selectboard adopted a resolution to participate in the CRP, designating the ACC to coordinate future resilience projects.<sup>5</sup>



*Community members during a discussion at the Community Workshop in August 2022 (photo credit: Karin Sadtler)*

### Arrowsic Climate Resilience Committee

Developing the Community Action and Outreach Plan is the first climate resilience project undertaken by the Town since joining the CRP. The ACC formed an ad-hoc committee, the Arrowsic Climate Resilience Committee (ACRC), charged with coordinating the planning process. Arrowsic received a CRP Community Action Grant to fund the development of the Climate Action Plan and Climate Resilience Handbook. The ACRC developed the following vision and mission to guide their decisions.

#### **Vision**

*We aspire to be a sustainable, resilient, and equitable community, acting to prepare our residents for the effects of the changing climate while reducing our greenhouse gas emissions.*

#### **Mission**

*We aim to identify actions and resources that support the island of Arrowsic and its residents in preparing for the changing climate and reducing the community's greenhouse gas emissions. We will work closely with the community to prioritize and implement effective strategies to help achieve these goals.*



*Community members gathered outside the Fire Station during the Community Workshop (photo credit: Karin Sadtler)*

## 2. EXPLORING RISK IN THE COMMUNITY

### 2.1 Climate Risk

A broad definition of climate risk is the potential for climate change to have adverse consequences for a community, from the people who make it up to the ecosystems and infrastructures they rely on. Developing a sense of the climate risk that a community is facing is an important part of climate action planning. One approach to understanding climate risk involves exploring the potential climate hazards, community exposure, and vulnerability.

Another consideration is how risk may **change over time**, as hazards, exposure, and vulnerability interact.<sup>6</sup> For example, the effects of sea level rise (SLR) and erosion can reinforce each other, resulting in increased rates of erosion as time passes. The occurrence of a hazard can change the exposure and vulnerability of a community over time, as those who are able to relocate or adapt. Evaluating climate risk should be an iterative process that takes this unpredictability into account.<sup>7</sup>

These concepts are used in the following sections to explore Arrowsic's climate risk. Risk, along with community values and concerns, will serve as the basis for prioritizing the implementation of this plan.

#### Components of Risk

**Hazards** can be defined as phenomena that have negative impacts, such as damage to infrastructure, ecosystems, property, livelihoods, or health.

**Exposure** encompasses all the people, livelihoods, resources, or assets that have the potential to be negatively impacted by hazards.

**Vulnerability** can be used to describe how susceptible a person, group, resource, or ecosystem is to harm, and the capacity to adapt to hazards.

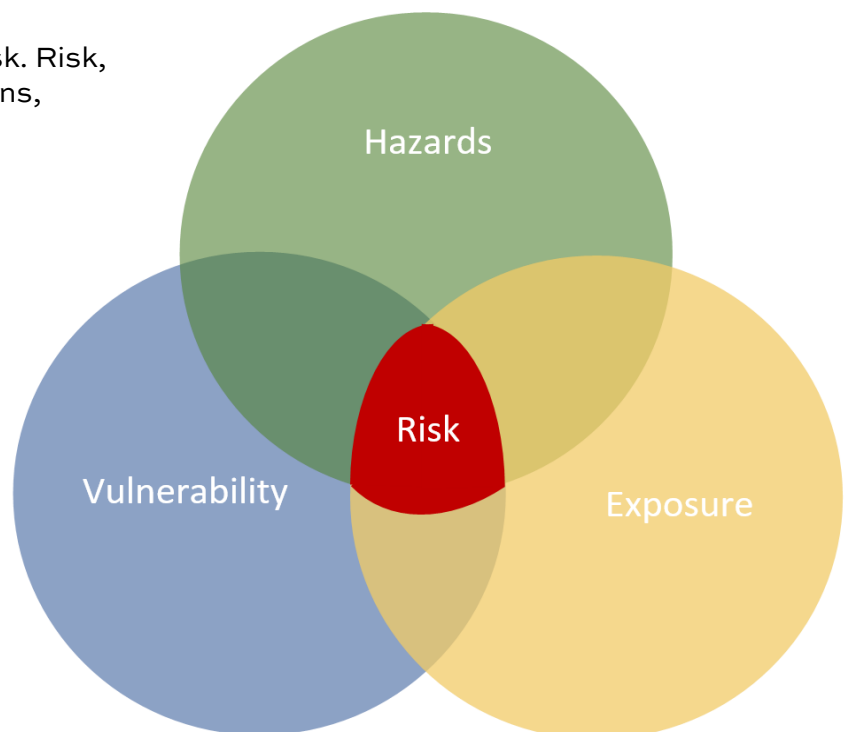


Figure 1: A diagram of climate risk, which is the intersection of hazards, vulnerability, and exposure.

## 2. EXPLORING RISK IN THE COMMUNITY

### 2.2 Hazards

Arrowsic is already experiencing the impacts of some climate hazards, and the intensity and frequency of these phenomena will increase as climate change progresses. Some of these hazards include flooding, more intense and frequent storms, greater variations in rainfall (drought and inundation cycles), high heat events, sea level rise, wildfires, warmer temperature trends, and poor air quality. The exposure and vulnerability of Arrowsic's assets will play a role in how these hazards affect the community.

In the coming years, Arrowsic is predicted to experience a **shift in precipitation patterns**, toward more **torrential rainfall**, interspersed with **periods of drought**. Already, Arrowsic is experiencing increased road flooding, which cuts off critical access to the mainland. Other effects could include water damage in buildings, impeded function of septic systems, and increased runoff, which can carry pollutants into nearby bodies of water and contaminate wells.



Figure 2: Flooding along Route 127, as viewed from Sirois Road (photo credit: Doug Kohring)

#### Most Critical Hazards in Arrowsic:



Road Flooding



Volatility in Precipitation Patterns



More Frequent & Severe Storms



Saltwater Intrusion

Pollution from runoff will be compounded by **higher ocean temperatures**, creating conditions that could increase algal blooms and harm freshwater and marine ecosystems.

**Periods of drought**, combined with high temperatures, causes more evaporation from vernal pools, freshwater wetlands, and transpiration from other vegetative habitats. The drier soils and loss of vegetation caused by this cycle of inundation and drought would increase runoff, which may decrease the potential for groundwater infiltration and recharge.

**Sea level rise (SLR)**, especially when combined with increased storm surge and flooding, poses a threat to the community as well. SLR could cause **saltwater intrusion** along the coast, pushing the salt front inland and increasing the salinity of groundwater in some areas.

Another effect of rising seas is increased **coastal erosion**, which could result in tidal marsh migration or loss, and the loss of the shoreline protection and other ecosystem services they provide. Depending on the rate of erosion, this could increase the risk of flood damage or inundation for buildings and septic systems on coastal properties. Erosion could also impact the functionality of infrastructure, destabilizing bridge pilings and utility poles.

## 2. EXPLORING RISK IN THE COMMUNITY



Figure 3: An example of erosion in Arrowsic (photo credit: Jack Witham)

More **frequent and severe storms** could contribute to infrastructure damage with high winds, erosion, lightning, or falling debris, which could affect the function of communication systems, broadband, electricity, and other services and pose a safety hazard for community members. Roads in low areas could be washed out, which may impede repair, evacuation, or access to emergency services.

There will likely be an increase in **high heat days** in Arrowsic, which could cause heat sickness in people and wildlife, while air conditioning could increase the strain on the electrical grid. The increase in storm events can trap people in their homes, making it difficult to access medical care, replenish medications, or power life-sustaining equipment in an emergency. Changes in temperature and environmental conditions may also increase existing pests like ticks, brown tail moths, and mosquitoes, and could lead to the introduction of new pests and diseases from warmer climates.

### 2.3 Community Exposure

Assessing the potential effect of such climate hazards requires taking into account the qualities, values, and needs of the community. The social network of the community and the values held by that community shape and inform the level of risk an event or hazard may pose. Arrowsic has a strong social network and a long history of volunteerism and civic engagement. These social connections make it easier for everyone to access information, share resources, and contribute their strengths to the whole. A functioning social network increases the community's resilience and helps to mitigate the risk that certain hazards may pose.

Along with social networks, community values play a role in understanding the impact of various hazards. A climate hazard that poses a risk to human life, like a flooded neighborhood, holds more weight than a washed-out dock. Assets include infrastructure like municipal buildings, roads, or the broadband network, or broader values like the health of local ecosystems. The level of exposure of these assets to climate hazards also influences the amount of risk. The risk posed by flooding is greater in residential areas that are in low-lying coastal areas of Arrowsic than houses along its steep coastal bluffs.

### 2.4 Vulnerability

Another factor to consider when discussing the risks associated with climate change is vulnerability. Vulnerability is used to describe how a climate hazard poses a disproportionate threat to certain members of the community. It can also refer to certain geographic, physical, or socio-economic aspects of a community that increase the threat of hazards, such as Arrowsic's limited access to the mainland. In the following section, vulnerability in Arrowsic is discussed in more depth, including a discussion of vulnerable portions of the population and factors that increase the vulnerability of the whole community. This assessment is organized into sections by hazard.

# 3. VULNERABILITY & RISK ASSESSMENT

## 3.1 Introduction

The demographic makeup and infrastructure in Arrowsic present significant challenges for the community as it prepares to manage the wide-ranging effects of climate change. Of particular concern are (1) the aging population and high number of single-person households, which may need extra support during storm events, heat waves, and flooding; and (2) single-road access (Route 127) to the mainland and a lack of on-island critical infrastructure, including medical care. When Route 127 is inaccessible, such as during flooding events, evacuations and access to supplies or emergency services are impeded. The town will need a strategy for how it will accommodate its most vulnerable community members, reduce the risk of road flooding on Route 127, as well as contingency plans for when Route 127 is impassable.

Social vulnerability describes the way that a population’s demographic characteristics can predict how that population may be impacted disproportionately by different natural hazards. These portions of the population may need more support, resources, or considerations when planning for the impacts of climate change.

Arrowsic’s population has a large proportion of older adults. Approximately 46% of Arrowsic’s population is over the age of 60, and about 34% are over the age of 65. Older adults, especially those with limited mobility or preexisting health concerns, may be disproportionately impacted by extreme temperatures, changes in air quality, and barriers to medical care access (such as during flooding or storm events). In addition, 22% of the population 65 or older also live alone, making it more difficult for them to access the care they need in the event of an emergency or evacuation.<sup>8</sup> As Arrowsic plans for climate related changes, considering the needs of older adults will be a key part of ensuring the wellbeing and resilience of the community.

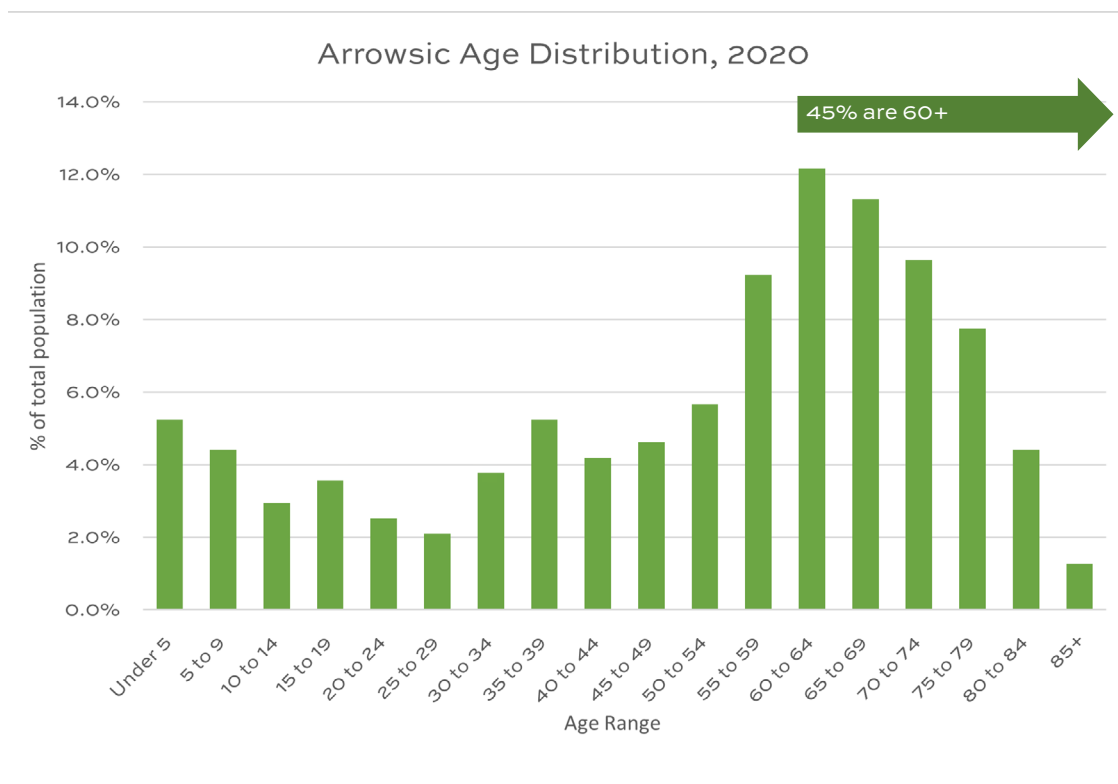


Figure 4: The age distribution of Arrowsic’s population in 2020.



### 3. VULNERABILITY & RISK ASSESSMENT

Disabilities can also impact how a person can access care and/or evacuate in the event of severe weather. There is limited current data on the number of individuals in Arrowsic with disabilities and the types of disabilities they live with, but the American Community Survey (ACS) estimates that 10% of the Town's population lives with some type of disability.<sup>9</sup> This reinforces the importance of considering a wide variety of abilities during the community's planning process, and making sure that resources, information, and help are accessible to all.

Managing the care of children requires additional resources and considerations. Younger populations, especially those under 18, may be more vulnerable to the effects of extreme temperatures, air pollution, infectious disease, and trauma from natural disasters. They may rely more on their caretakers as climate change progresses, putting more strain on parents and caretakers, especially if there are disruptions in school or childcare schedules. Households with children may need more support to navigate the impacts of climate change. Approximately 19% of households in Arrowsic have at least one child under 18 years old. Nearly 5% are single parent households.<sup>9</sup>

Those with lower incomes may be at a higher risk of many chronic health conditions, such as diabetes or heart disease.<sup>10</sup> High heat and storm events that cut off access to medical care will disproportionately impact those with chronic disease. A lower income may make it harder to access information or certain resources, such as the resources needed to adapt their home to withstand flooding or storms.<sup>11</sup>

The American Community Survey estimates that no households in Arrowsic are without vehicles, and that little to no households are without internet or telephone service.<sup>9</sup>

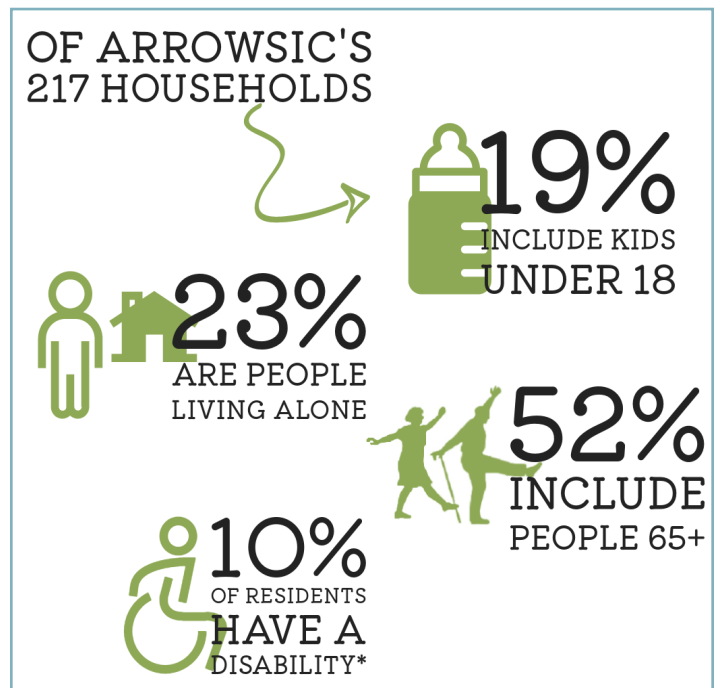


Figure 5: Portions of the population in Arrowsic that may be disproportionately impacted by climate change.

# 3. VULNERABILITY & RISK ASSESSMENT

## 3.2 Temperature Shifts & Heat Waves

On a county level, monthly temperature data is available as far back as 1895 from the U.S. Climate Divisional Database. For Sagadahoc County from 1895 to 2022, the average monthly temperature was 44.2 °F. However, the average monthly temperature from 2010 to 2020 is more than two degrees hotter, at 46.4 °F.<sup>12</sup> Even small changes in average temperatures can increase the odds of extreme weather events. All the warmest years in Sagadahoc County have occurred since 2006, and the coolest years occurred between 1904-1926. For the years since 2000, 75% of the monthly averages exceed the average for that same month between 1989-2022.

In addition to the trend towards warmer temperatures overall, climate change is predicted to increase the frequency of high heat days and heat waves. Heat can impact communities in different ways, depending on what temperature range is typical for an area.

High heat has the greatest impact on vulnerable populations, including older adults, children, low-income households, and those with chronic diseases, such as heart disease and diabetes. In 2019, 42% of households in Sagadahoc County lacked air conditioning, which can compound the impacts of extreme heat.<sup>13</sup> With the likelihood of more frequent heat waves as climate change progresses, hospitalizations are expected to increase for heat-related illnesses.<sup>14</sup>

The First Street Foundation is a nonprofit that produces peer-reviewed climate risk projections for the U.S. on their free website, Risk Factor, in partnership with several government agencies and universities.<sup>15</sup> On their Risk Factor site, they have calculated what a “hot day” means for different counties around the country. This is calculated using Coupled Model Intercomparison Project data, based on the 7 hottest days in that county.<sup>16</sup>

*Figure 7: Maine CDC’s Extreme Heat Plan advisories, compared to those set by the National Weather Service.*

In Sagadahoc County, a “hot day” was defined as 88°F or above. There have been 82 days reaching 88°F since 2011, with 40% of these occurring since 2020. This averages out to about seven hot days a year. The First Street Foundation predicts that this will increase to 17 days per year over the next thirty years.<sup>17</sup>

Temperature	Number of days
88°F or over	82
90°F or over	31
95°F or over	2

*Figure 6: Number of High Heat Days Since 2011*

A heat wave occurs when there are three or more days of high heat in a row. Multiple days of high heat can increase the risk posed to a community. When using the “hot day” temperature mentioned above, there have been 12 instances of heat waves recorded at the Bath weather station since 2011. The First Street Foundation calculated that the likelihood of a heat wave using the 88 °F threshold was 18% thirty years ago, 53% in 2023, and is expected to be 83% 30 years from now.<sup>17</sup>

In cooler climates like Maine, infrastructure may not be equipped to handle high heat (such as a lack of air conditioning) and individuals may have lower heat tolerance. This lowers the threshold for what qualifies as a heat emergency. The Maine Center for Disease Control and Prevention’s (CDC) Extreme Heat Plan sets Maine-specific criteria for heat alert levels. These lower thresholds (compared to the National Weather Service standards) may better represent the impact of high heat on Arrowsic.<sup>18</sup>

Alert Level	National Weather Service	Maine CDC
Heat Advisory	Heat index of 100-104 F for 2 or more hrs	Heat index of 95+ F for 2 or more days
Excessive Heat Warning	Heat index of 105+ F for 2 or more hrs	Heat index of 100+ F for 2 or more days
Heat Emergency	-	Heat index of 105+ F for 2 or more days

## 3. VULNERABILITY & RISK ASSESSMENT

### 3.2.1 Potential Effects

#### Spread of Disease

Milder winters and longer warm seasons contribute to the spread of vector-borne diseases, such as those carried by ticks and mosquitoes. In the Midcoast region, deer ticks have been known to spread Lyme disease, anaplasmosis, babesiosis, and Powassan encephalitis virus. In Sagadahoc County, the rate of Lyme disease increased from 5.7 cases per 100,000 in 2001 to 231.5 cases per 100,000 in 2019.<sup>19</sup> Already, patient treatment for vector-borne diseases has cost Maine over \$10 million annually, not including lost workdays and other individual costs of these diseases.<sup>20</sup>



*Figure 8: A browntail moth caterpillar, showing the tell-tale red dots that can help identify it (Maine Department of Agriculture, Conservation, & Forestry).*

#### Air Quality

Warmer temperatures also have impacts for air quality, creating conditions that can increase the potential for ground-level ozone (smog), pollen production, wildfires, and the spread of brown-tail moth caterpillars (which can cause skin and lung irritation).<sup>14, 20</sup> Large fires elsewhere, such as the Canadian wildfires in 2023, can also have an impact on local air quality.

This is particularly concerning for vulnerable populations, such as older adults and those with conditions that impact breathing, such as asthma. Maine has one of the highest rates of asthma in the country, with 12.5% of adults reporting a current diagnosis in 2021.<sup>21</sup> Air quality and environmental factors like pollen and brown-tail moth outbreaks can increase the frequency of asthma attacks.<sup>14</sup>

There is limited data on air quality in Arrowsic. The nearest Department of Environmental Protection air monitoring station to Arrowsic is at Popham Beach, which only started recording data in 2022.<sup>22</sup> Air quality can have a significant impact on quality of life, especially for residents with health concerns. As temperatures increase, Arrowsic will need to prepare for more variability in air quality.

### 3. VULNERABILITY & RISK ASSESSMENT

#### Habitat Changes

The Gulf of Maine is warming at a rate ninety-nine percent faster than the rest of the world's oceans, causing shifts in the ranges of many important species, such as lobster.<sup>23</sup> It has also increased ranges for some invasive species, such as European green crabs.<sup>24</sup> Data shows that warmer winters are associated with higher numbers of green crabs.<sup>24</sup> Green crabs can decimate shellfish populations and damage the root systems of salt marsh grasses. In Arrowsic, this threatens shellfish harvesting and the ecosystem services provided by salt marshes.<sup>25</sup>

Temperature shifts will also likely impact forest habitats. Maine is located at the intersection of the northernmost and southernmost ranges of several species. Some species may shift out of Arrowsic, following cooler temperatures, while other species may increase their range northward into Arrowsic.

As some diseases and species of parasites expand their range or reproduce faster, they are expected to have an increased impact on wildlife. Tree and plant diseases and pests may also spread, including insects like the Hemlock Woolly Adelgid or diseases like Oak Wilt Disease. Loss of trees will have an impact on forest ecosystems, driving changes to wildlife populations. The loss of trees will also result in a decrease in carbon storage these forests provide, further driving climate change.<sup>26</sup>



*Figure 9: Wetland researchers in the Holt Research Forest in Arrowsic (photo credit: Jack Witham)*

# 3. VULNERABILITY & RISK ASSESSMENT

## 3.3 Sea Level Rise

The rate of sea level rise (SLR) is increasing—about half of the total SLR that was observed in Maine over the last century occurred since 1990—and this will likely have impacts on the landscape of coastal and island communities.<sup>23</sup> Sea level rise will likely magnify the impacts of storm surge from increasingly frequent and severe weather events.<sup>27</sup> A sea level increase of one foot is predicted to increase the frequency of nuisance flooding by ten times.<sup>28</sup> The Intermediate SLR scenario projects 3-5 ft of SLR by 2100, though higher scenarios are plausible. In *Maine Won't Wait*, communities were advised to commit to manage for 1.5 ft of rise by 2050 and 4 ft by 2100, and to prepare to manage for 3 and 8 ft of sea level rise by 2050 and 2100, respectively.

### 3.3.1 Incorporating Risk

The CoastWise Approach, released in 2023, recommends using a risk-based approach to coastal flood management based on scientifically developed criteria.<sup>29</sup> The corresponding SLR scenarios recommended for each scenario for 2100 range from 3.9 ft for Low and Medium risk consequence to 6.1 ft and 8.8 ft for High and Very High risk consequence, respectively. Road stretches such as Route 127 at the north end of Arrowsic would be considered High or Very High Risk Consequence based on the critical functions of the assets to which this road provides a single point of access. Any upgrades to Route 127 should incorporate this risk-based approach.

Crossing Risk Consequence:	LOW	MEDIUM	HIGH	VERY HIGH
<b>CRITERIA:</b>				
<b>Value of assets to be accessed</b>	Low	Medium	High	Very High
<b>Ease or likelihood of adaptation</b>	Easy or likely	Moderately easy or somewhat likely	Difficult or unlikely	Very difficult or very unlikely
<b>Public function or safety implications</b>	Few to none	Moderate	Substantial	Critical
<b>Inundation/scour sensitivity</b>	Low	Moderate	High	Very high
<b>Examples of asset types served by the crossing</b>	Residential area (variable risk consequence)			
	Conserved or working lands, temporary/accessory structures, minor storage	Light commercial or industrial	School, community center, public gathering facility, care facility, childcare, commercial hub, sensitive storage, or industrial	Hospital, public safety, power generating facility, emergency shelter, drinking water supply, essential communications facilities, hazmat storage
<b>Corresponding Sea Level Rise Scenario:</b>	INTERMEDIATE	INTERMEDIATE	INTERMEDIATE HIGH	HIGH

Figure 10: Framework for determining risk and assigning corresponding sea level rise scenarios from the Coastwise Approach: *Achieving Ecological Resilience and Climate-Ready Road Crossings in Tidal Environments*, page 20.



Figure 11: A view across the Kennebec River (photo credit: Bart Chapin).

Vulnerability analysis conducted for Arrowsic in this section was done using Maine Geological Survey’s SLR projections, which were created using the highest annual tide (HAT) line. Due to a current lack of data on the lowest annual tide line in Maine, the effects of subsidence and erosion, and elevation variability, it is difficult to predict the effect of sea level rise on the low tide line.

### 3.3.2 Infrastructure Damage

As an island, one of Arrowsic’s biggest vulnerabilities is its limited connection to the mainland. Route 127 is the island’s only access point by car, providing access to emergency medical care, groceries and supplies, and an evacuation route. Under the Intermediate SLR scenario, it is predicted that by 2050, 355 ft of the north end of Route 127 would be expected to flood at the highest annual tide (HAT). By 2100, the Intermediate scenario predicts that 1,800 ft of Route 127 would be expected to flood at HAT. Higher SLR scenarios would flood considerably more road distance with increased frequency.

While the highest annual tide occurs only once per year, storm surge could cause similar flood levels to occur more frequently during normal high tides. Flooded sections of road cut off access for many properties to the mainland or to the rest of the island. In the map on the next page, the areas in light pink show sections that are predicted to be inundated with 1.6 ft of SLR above HAT, and the dark pink sections are those that are predicted to be inundated at 3.9 ft. of SLR above HAT.

At 1.6 feet of SLR above HAT, the entire island would be cut off from the mainland, due to the inundation of a section of Arrowsic Road (Route 127), between Sirois Road and Stone Tree Road. While this section of road may not be inundated at all tide levels, the culvert under this section of road (which is already a tidal restriction) has an increased chance of washing out. Land subsidence and erosion also have the potential to damage the road.

Road Class	1.6 ft Sea Level Rise +HAT	3.9 ft Sea Level Rise +HAT	6.1 ft Sea Level Rise +HAT
Secondary	0.23 mi	0.57 mi	0.77 mi
Local	0.37 mi	0.54 mi	0.68 mi
Private	0.06 mi	0.23 mi	0.41 mi

Figure 12: Miles of roads that will be inundated at high tide under different sea level rise scenarios, shown by road type.

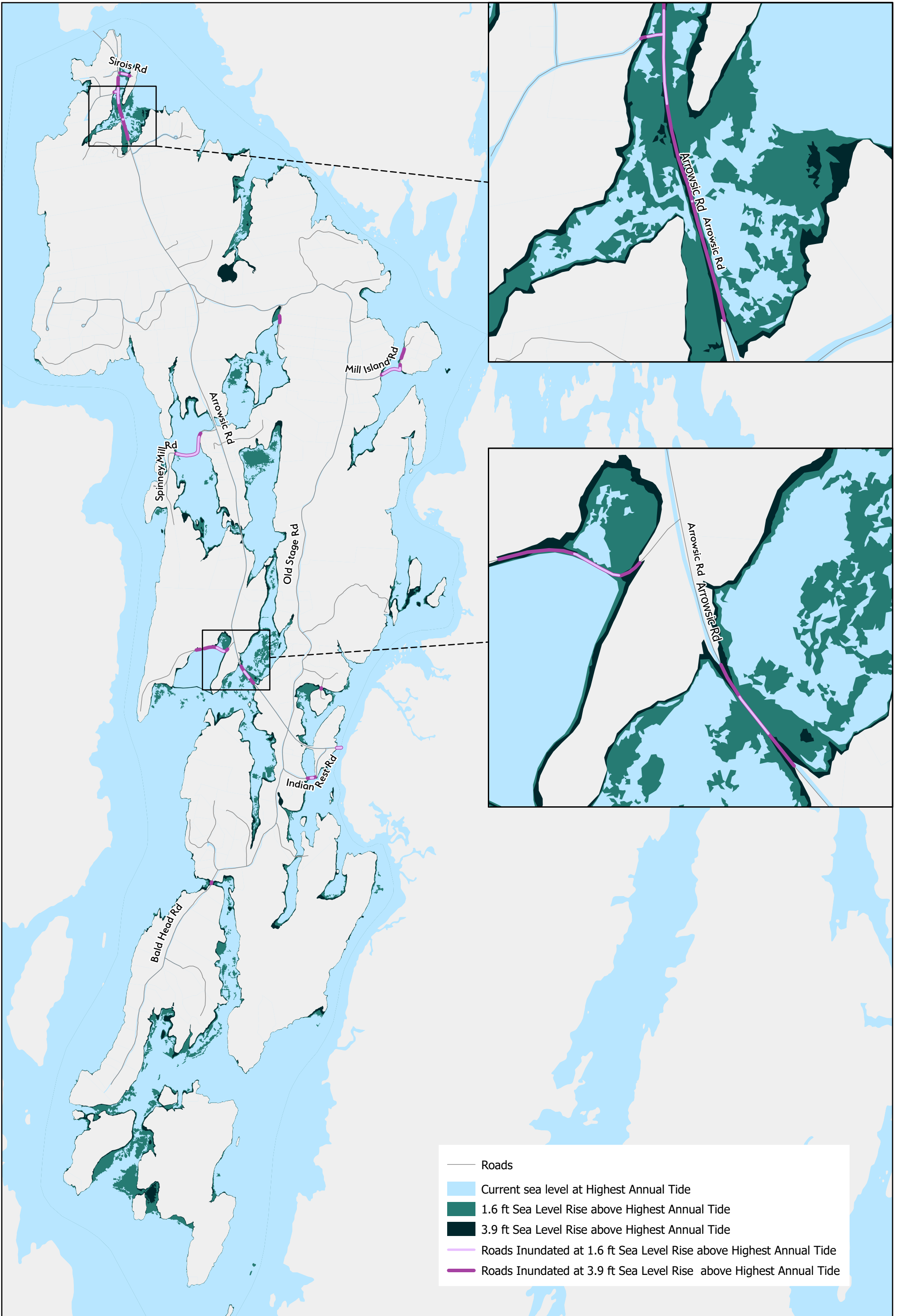


Figure 13: Roads in Arrowsic that are predicted to be inundated under a 1.6 ft (light pink) or a 3.9 ft (dark pink) sea level rise scenario.

### 3. VULNERABILITY & RISK ASSESSMENT

#### What is inundation?

The National Oceanic & Atmospheric Association (NOAA) defines coastal inundation as

*“the covering of normally dry land with water. This refers to the long term result of sea-level rise, as well as the shorter and more variable impacts of high-tide and storm surge flooding.”*

In Maine, SLR scenarios are calculated as the amount of SLR in addition to the current Highest Annual Tide level.

More information:

- NOAA Coastal Inundation Story Map: <https://storymaps.arcgis.com/stories/5086cdc8c33b-49919648f4142b0f6e1d>
- Maine Sea Level Rise Information: [https://www.maine.gov/dacf/mgs/hazards/slr\\_ss/index.shtml](https://www.maine.gov/dacf/mgs/hazards/slr_ss/index.shtml)
- The CoastWise Approach for Tidal Crossing Design is a resource for coastal road crossing best practices: <https://www.maine.gov/dmr/programs/maine-coastal-program/coastal-community-support/the-coastwise-approach>

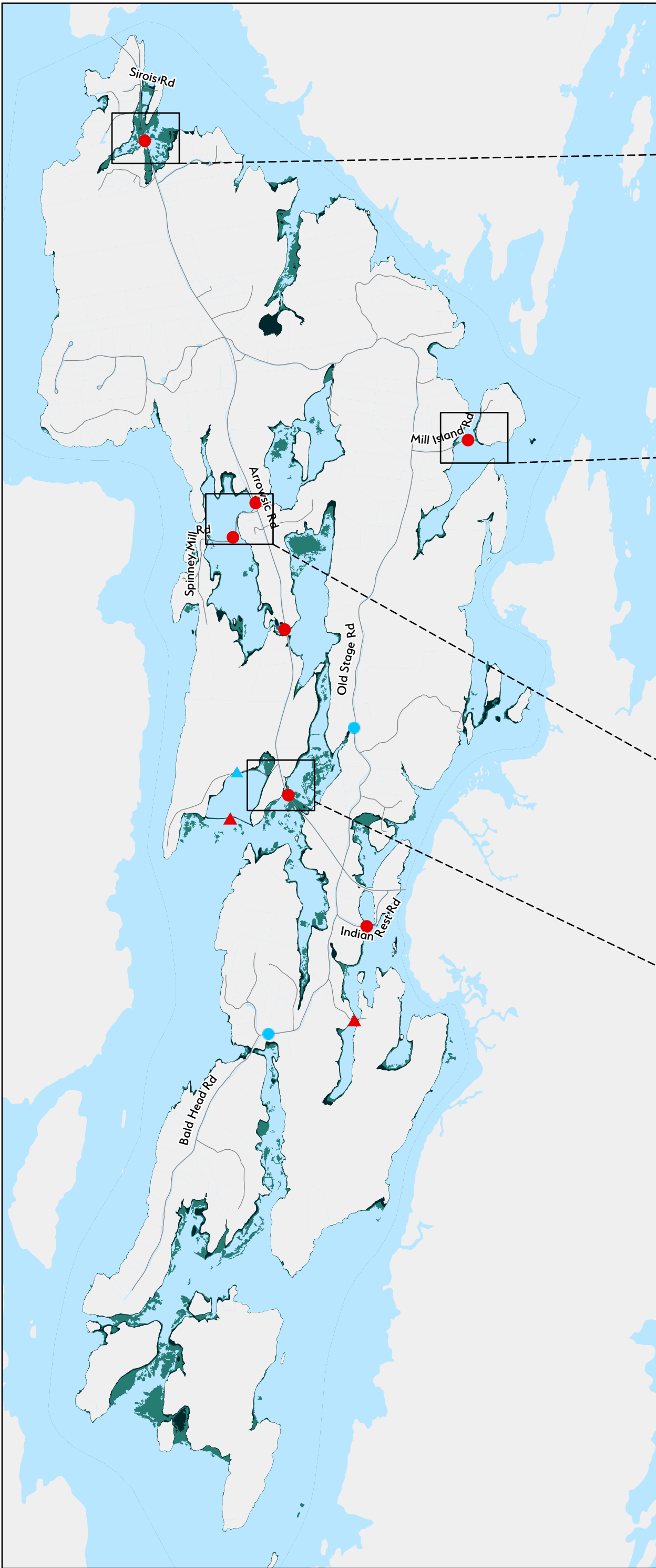
There are efforts underway to address the above section of Arrowsic Road. If this area is addressed, there are still an estimated 41 buildings that could be cut off from access to the mainland at 1.6 ft. of SLR above HAT and 84 buildings could be cut off at 3.9 ft. of SLR above HAT. This does not take into consideration several long private driveways that are not included in the state’s enhanced 911 data, so it may underestimate the total number of buildings impacted.

Access to certain areas of the island may also be impacted where there are tidal culverts that are improperly sized and unable to handle tidal flow. According to Maine’s Tidal Restriction Atlas, there are seven road crossings and two other culverts that are currently restrictive (shown in Figure 14 in red).

These restrictive crossings are areas where the tides are not able to flow to their natural extent, either from a too-small culvert or a culvert that is too high. In many cases, this restricted flow can change the marsh ecosystem and/or cause marsh erosion. This makes the marsh land less resilient to SLR. These culverts also wear out more quickly because there is greater flow than they were designed to handle. With the additional volume of water from SLR, restrictive crossings are more likely to fail or over top, causing increased maintenance costs and potentially limiting evacuation routes.

There are also three future tidal crossings in Arrowsic listed on the Atlas (shown in Figure 14 in blue). These are crossings that do not currently restrict tidal flow, but may become restrictive at a higher sea level. Sea level rise will increase the tidal flow at these culverts beyond what they were designed to handle. As with the current areas with tidal restrictions, these culverts will be more likely to wash out at a higher sea level. They could also hinder the ability of the marsh ecosystems upstream of the culverts from adapting to the changing sea level.





- Roads
- Light Blue Box: Current sea level at Highest Annual Tide
- Dark Green Box: 1.6 ft Sea Level Rise above Highest Annual Tide
- Black Box: 3.9 ft Sea Level Rise above Highest Annual Tide
- Red Circle: Tidal Restrictions (Road Crossings, Footpaths, etc.)
- Red Triangle: Other Tidal Restrictions
- Blue Circle: Future Tidal Road Crossings
- Blue Triangle: Future Tidal Other Crossings

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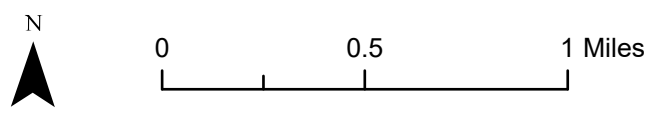


Figure 14: Tidal crossings in Arrowsic. (source: Maine Tidal Restriction)

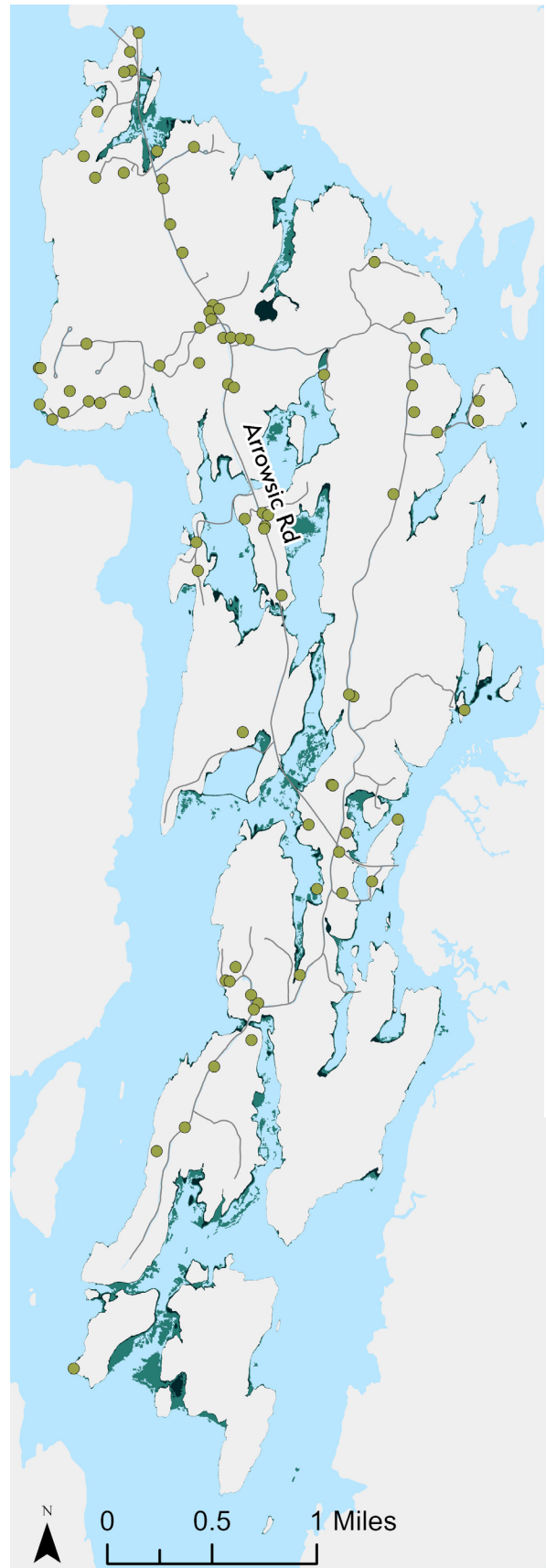
### 3. VULNERABILITY & RISK ASSESSMENT

Arrowsic relies on private bedrock wells for drinking water. SLR could cause saltwater intrusion and contamination of drinking water supplies.<sup>30</sup> This process is especially difficult to predict in bedrock wells, which access water located in fractures in the rock and vary in depth.

Our knowledge of Arrowsic’s wells is limited. A high school project from 1988 lists information for about 90 wells. The Maine Geological Survey provides partial data on 105 wells. Detailed information about changes in yield, static level and salinity could be useful in better understanding and predicting future risks to individual wells. In general, deeper wells closer to shore and at lower elevations are more likely to experience salt water intrusion as sea level rises.

The Town also relies on septic systems to treat wastewater, the function of which may be impeded by inundation from SLR or heavy rain events. Based on a survey of septic systems recorded in the Maine State Septic Permit Search Database, there are currently only four septic systems at risk of inundation in a 3.9-foot SLR scenario. This does not consider rising groundwater levels, which could affect infiltration and effectiveness of septic fields. Especially in areas with older, less effective systems, this could present an issue for water quality.<sup>31</sup>

Figure 15: Wells in Arrowsic that are recorded in the Maine Well Database, mapped by well depth.



- Maine Well Database
- Roads
- Current sea level at Highest Annual Tide
- 1.6 ft Sea Level Rise above Highest Annual Tide
- 3.9 ft Sea Level Rise above Highest Annual Tide

### 3. VULNERABILITY & RISK ASSESSMENT

#### 3.3.3 Property & Building Damage

Arrowsic has a total of 370 parcels in town, covering a total land area of 4,229 acres. When overlaying the Maine Geological Survey’s model of 1.6 feet of SLR above HAT, approximately 244 of these parcels will have at least some (if minimal) impact or inundation. This amounts to about 206 acres of inundation, or about 4.9% of the town’s land area. In a 3.9 foot SLR above HAT scenario, about 250 parcels would have some level of inundation, affecting about 321 total acres. However, no buildings are predicted to be inundated in these scenarios. Rather, most of the impacted area includes marshland and areas immediately adjacent to the shoreline.

The impacted area includes some marshland and conserved lands, which may result in decreased flood protection as these areas are less able to perform their ecological services. However, none of the island’s buildings are predicted to be inundated under a 1.6-foot or 3.9-foot sea level rise scenario, according to available data. This does not account for storm surge in addition to sea level rise.

Most of the impacted properties are privately owned, based on the data we have. Properties that are privately owned and have buildings on them were classified as “presumed residential.” These make up about 122 acres inundated at 1.6 feet of SLR and 143 acres impacted by 3.9 feet of SLR.

Only about 4.5-5 acres of town-owned property are expected to be inundated under 1.6-3.9 feet of SLR, and all these properties are either vacant or conservation areas. No properties with a municipal use or known cemetery are predicted to be impacted, since they are mostly in the upland areas of the island.

A quick method for estimating the value of property lost is by taking the assessed land value, dividing it by the assessed acreage, and then multiplying this value per acre rate by the acreage predicted to be inundated on that property. This is imperfect, because it assumes that all areas of a property would be valued at the same rate (even if, for example, the inundated area is unbuildable). However, it is a starting point for understanding the value that may be lost due to climate change. Based on this method, about \$2.5 million worth of property may be impacted by SLR in a 1.6-foot scenario, and about \$3.3 million worth of land may be impacted in the 3.9-foot scenario.

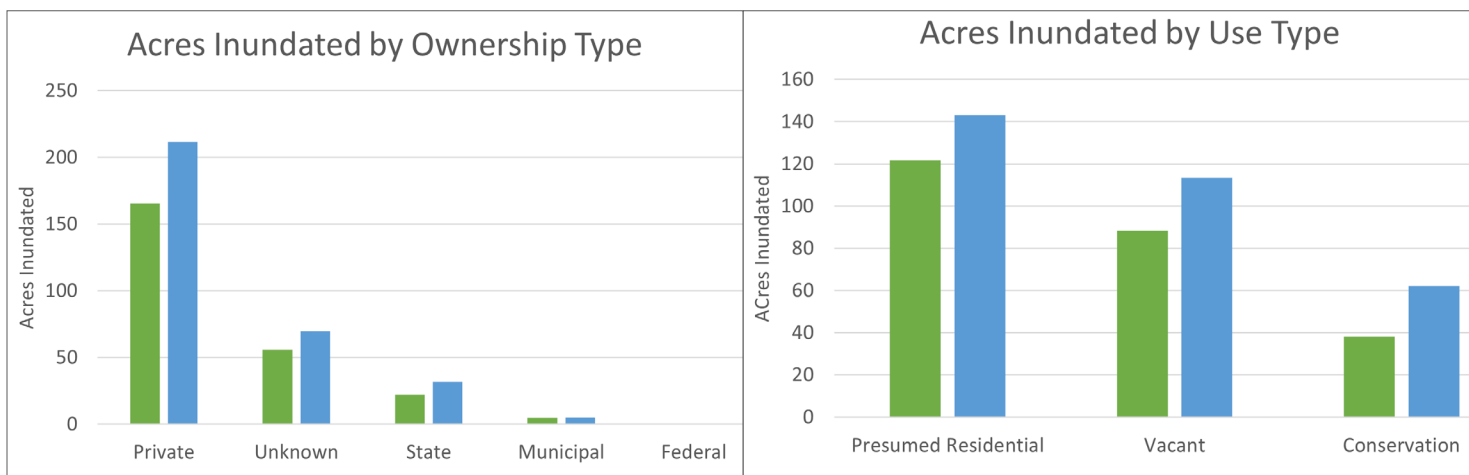
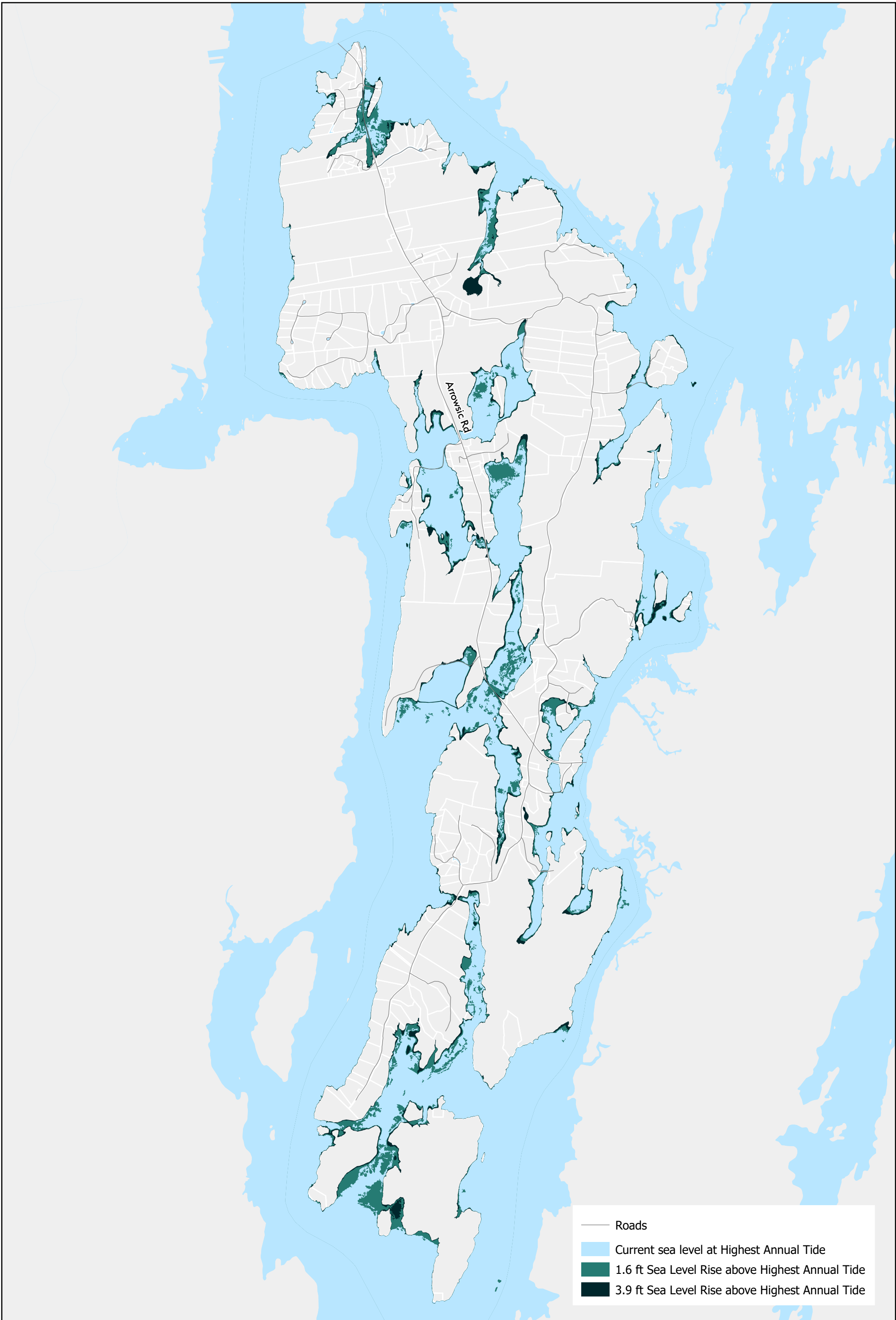


Figure 16: Charts showing the acres impacted by 1.6 feet (green) and 3.9 feet (blue) of sea level rise, broken down by ownership (left) and use (right).



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- Roads
- Light Blue: Current sea level at Highest Annual Tide
- Medium Green: 1.6 ft Sea Level Rise above Highest Annual Tide
- Dark Green: 3.9 ft Sea Level Rise above Highest Annual Tide

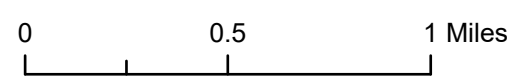
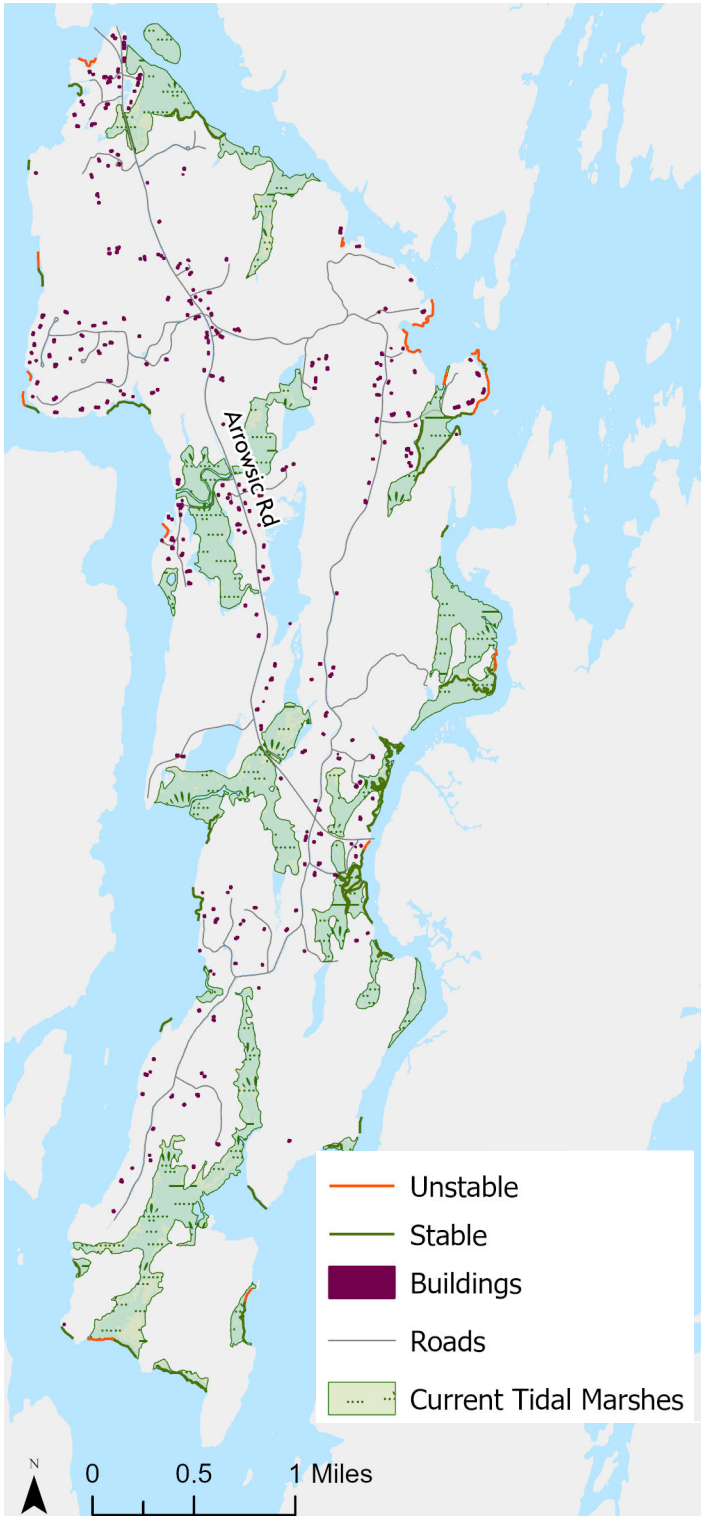


Figure 17: Level of potential inundation in Arrowsic based on a 1.6 ft and 3.9 ft sea level rise scenario. Parcel lines shown in white.

### 3. VULNERABILITY & RISK ASSESSMENT

Figure 18: Coastal bluffs in Arrowsic, mapped by the Maine Geological Survey, along with tidal marshes (green pattern) and buildings (purple). Green lines indicate stable bluffs, orange are unstable. Arrowsic does not have any bluffs classified as highly unstable.



Of greater concern are the number of properties and buildings that are likely to be cut off from access to the rest of the island or to the surrounding mainland. Based on a visual analysis, at 1.6 feet of SLR above HAT, the island will be cut off from the mainland at high tide. See Figure 13 for a map of roads affected by sea level rise. This threatens the ability of people to access services, medical care, and basic food and supplies. This does not consider additional flooding due to storm surge.

Arrowsic has almost 5 miles of bluffs out of about 50 miles of shoreline, three miles of which are classified as “unstable” by the Maine Geological Survey. Figure 18 shows a map of these bluffs, with those classified as stable shown in green and the unstable bluffs highlighted in yellow.<sup>32</sup> These unstable bluffs could represent areas where SLR increases the risk of rapid erosion. This is especially important in areas where buildings or infrastructure are near the bluffs and could be impacted.

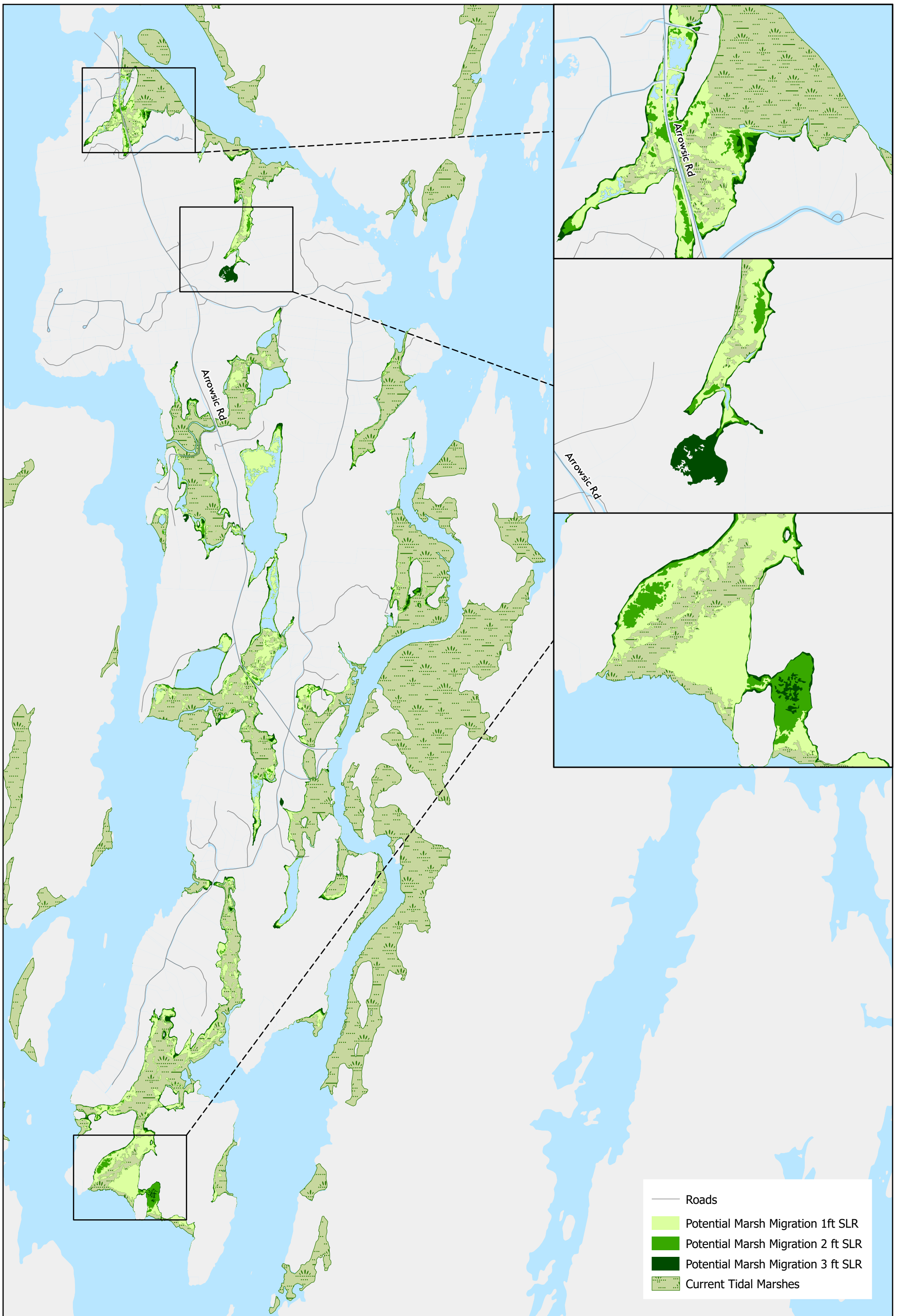
In areas with salt marshes adjacent to coastal bluffs, whether those bluffs are stable or not, there is a risk that the bluff could prevent the salt marsh from migrating inland as sea level rises. In areas with unstable bluffs, erosion could deposit sediment on the marshes. The effect of sedimentation is unclear, because while it could smother the marsh vegetation, it could also help elevate the marsh.<sup>33</sup>

#### What is a coastal bluff?

According to the Maine Geological Survey (MGS), “a bluff is defined as a steep shoreline slope formed [of loose sediment] that has [3+ feet] of vertical elevation just above the high tide line.”

Visit the MGS’s webpage for more info:

<https://www.maine.gov/dacf/mgs/pubs/mapuse/series/descrip-bluff.htm>



Map created by:  
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Figure 19: Predicted tidal marsh migration under 1, 2, and 3 ft sea level rise scenarios (source: Maine Geological Survey)

## 3. VULNERABILITY & RISK ASSESSMENT

### 3.3.4 Salt Marsh Migration

In tidal rivers and coves like those surrounding Arrowsic, SLR and storm surge are predicted to increase erosion in salt marshes. These valuable ecosystems serve as nurseries for many ecologically and economically important marine species in Maine, and these disruptions may impact their life cycles. Salt marshes are valuable ecosystems that serve as nurseries for many ecologically and economically important marine species. Any disruption to the marsh could impact the life cycle and population of these species. As SLR and storm surge increase, there is predicted to be increased erosion in and around salt marshes, which will impact this ecosystem.

The valuable habitat and ecosystem services of marshes may be impacted by increased inundation, which will negatively affect the ability of Arrowsic and its ecosystems to adapt to rising seas. In places where marshes are unable to migrate inland, they may be converted to open water, resulting in a loss of marsh land. The impacts of the eroded sediment on mudflat ecosystems are not well known.<sup>33</sup>

### 3.3.5 Economic Disruption

Power outages can be caused by extreme storm events and flooding. This has a negative impact on the ability to conduct business. For those engaged in remote work or businesses that are reliant on electricity and electronic communications, outages caused by extreme storm events and flooding will have a negative impact on the ability to conduct business as usual. Due to the small number of businesses in Arrowsic, the greatest economic disruption will include a reduced ability to work from home. The cost of repairs to homes and infrastructure, and the work time lost while managing repairs to damage will also have an economic impact on the community.

### 3.3.6 Limited Healthcare Access

Storm surge and SLR will impede access to emergency services when roads flood during extreme weather events or extremely high tides. An island community like Arrowsic that has limited connections to the mainland is especially vulnerable to this loss of healthcare access.



*Figure 20: An area along Spinney Creek during an extreme high tide. This area will likely experience the effects of marsh migration.*

## 3. VULNERABILITY & RISK ASSESSMENT

### 3.4 Precipitation Changes

In the last several years, Sagadahoc County has experienced periods of moderate to extreme summer drought every year except for 2019 and 2023 (2019 had a period of “abnormally dry” weather).<sup>35</sup> It is becoming more common for areas of Maine to experience snow drought, which can impact seasonal stream flows, vernal pools, and groundwater recharge.<sup>36</sup>

At the same time, Arrowsic has experienced more abnormally wet days and heavy precipitation events. According to data from NASA’s Earth Exchange Global Daily Projections, Arrowsic is currently experiencing 1-5% more extreme precipitation events than the average over 1980-2010. In the next 15 years, the town is predicted to experience 5-10% more precipitation.<sup>37</sup>

These swings between dry and wet periods may impact wildlife and vegetation, erosion, flash flooding, and water supplies. To prepare for this increasing pattern of extremes, an awareness of the risks posed by both extremes is needed in addition to understanding the impacts of swings themselves. The town will need increased flexibility and resources to manage the risks associated with each change.

#### 3.4.1 Public Health

Increased incidences of flooding and extreme precipitation will likely have impacts for water quality in Arrowsic, especially due to reliance on well water and septic systems. Swings between periods of inundation and drought may impair the ability of groundwater to recharge from rainfall, resulting in diminished drinking water resources. Flooding and rising water tables can increase septic failure, releasing pollution into surrounding water bodies and increasing the spread of diseases such as giardiasis.<sup>31, 38</sup>

#### 3.4.2 Environment

Increased drought and changes in seasonal runoff could impact freshwater communities like vernal pools, which rely on snow melt as an ephemeral water source for spawning amphibians.<sup>39</sup>

Flooding from nearby rivers and streams is also an issue for vernal pools, as this can wash predators into these protected ecosystems. Changes in precipitation and temperatures can also cause stress and damage to trees, which will have a negative impact on forest habitat. Species shifts will change the makeup of these ecosystems as well, which could harm existing species.



# 3. VULNERABILITY & RISK ASSESSMENT

## Resources

1. Arrowsic Stewardship Guide
2. [What's the Plan | Maine Climate Plan](#)
3. [Community Resilience Partnership | Office of Policy Innovation & Future \(maine.gov\)](#)
4. Town of Arrowsic Community Resilience Self-Evaluation
5. Arrowsic Community Workshop Summary
6. Viner D, Ekstrom M, Hulbert M, Warner NK, Wreford A, Zommers Z. Understanding the dynamic nature of risk in climate change assessments—A new starting point for discussion. *Atmos Sci Lett*. 2020;21:e958. <https://doi.org/10.1002/asl.958>
7. Tonmoy, F.N., Rissik, D. & Palutikof, J.P. A three-tier risk assessment process for climate change adaptation at a local scale. *Climatic Change* 153, 539–557 (2019). <https://doi.org/10.1007/s10584-019-02367-z>
8. Decennial Census 2020
9. [DPO5: ACS DEMOGRAPHIC AND ... - Census Bureau Table](#)
10. <https://health.gov/healthypeople/priority-areas/social-determinants-health/literature-summaries/poverty>
11. [https://www.epa.gov/system/files/documents/2021-09/climate-vulnerability-september-2021\\_508.pdf](https://www.epa.gov/system/files/documents/2021-09/climate-vulnerability-september-2021_508.pdf)
12. [NOAA Monthly U.S. Climate Divisional Database \(NCLimDiv\)](#)
13. [Heat Illness | Maine Tracking Network](#)
14. [Climate Change Harms the Health of Maine People | NRCM](#)
15. [Methodology - First Street Foundation](#)
16. [CMIP - Coupled Model Intercomparison Project \(wcrp-cmip.org\)](#)
17. [Sagadahoc County, Maine Heat Factor® | Risk Factor](#)
18. [mainecdcallhazheat.doc \(live.com\)](#)
19. [Tickborne Diseases | Maine Tracking Network](#)
20. [UMaine research connects rising temperatures with browntail moth resurgence - UMaine News - University of Maine](#)
21. [Most Recent Asthma State Data | CDC](#)
22. [Historical Data, Air Quality Forecast, Maine Department of Environmental Protection](#)
23. [MaineClimateScienceUpdate2021.pdf](#)
24. [European Green Crab \(Fact Sheet\) \(maine.edu\)](#)
25. [Measuring Impacts of Invasive European Green Crabs on Maine Salt Marshes: A Novel Approach \(epa.gov\)](#)
26. [The State of Maine and Climate Change \(umaine.edu\)\(forest research article\)](#)
27. [GOPIF SLR Factsheet 2021 05 06.pdf \(maine.gov\)](#)
28. [Maine Climate Office \(umaine.edu\)](#)
29. [https://www.epa.gov/system/files/documents/2021-09/climate-vulnerability-september-2021\\_508.pdf](https://www.epa.gov/system/files/documents/2021-09/climate-vulnerability-september-2021_508.pdf)
30. [CAGS 04 Drinking Water.pdf \(maine.gov\)](#)
31. [“Avoiding Septic Shock: How Climate Change Can Cause Septic System Fail” by Elena Mihaly \(maine.edu\)](#)
32. [Maine Geological Survey: Coastal Bluffs Maps](#)
33. [marshes-on-the-move.pdf \(noaa.gov\)](#)
34. [ERG MCC AssessingImpactsClimateChangeMaine Summary.pdf](#)
35. [Arrowsic, Town Of Arrowsic, Maine Conditions | Drought.gov](#)
36. [Maine | Drought.gov](#)
37. <https://doi.org/10.7917/OFSG3345>
38. [Climate Change Harms the Health of Maine People | NRCM](#)
39. [BiodiversityFlyer.pdf \(umaine.edu\)](#)

A photograph of a person standing in a field of tall, green grass. The person is wearing a light-colored jacket and is reaching out to touch a large, light-colored rock covered in moss. The background is a dense forest of green trees. A semi-transparent teal banner is overlaid on the left side of the image, containing the text 'action plan' in white, lowercase letters.

# action plan

PHOTO CREDIT: EVAN D'SOUZA

# HOW TO USE THE ACTION PLAN

This section of the plan lays out a course of action to address climate change in Arrowsic. Actions are organized by the community resource/value to be protected & strengthened. *These are not listed according to priority.*

These topics include the following:

- Infrastructure
- Groundwater Resources
- Surface Water Resources
- Environmental Resources
- Emergency Response
- Community Resilience
- Public Health
- Energy & Waste Efficiency
- Housing & Built Environments
- Governance

Each section includes:

**Discussion:** an introduction to the topic and why it is relevant to Arrowsic’s resilience

**Existing Policies & Projects:** summary of existing policies & projects addressing this topic

**Community Actions:** actions that would be most effective if undertaken on a community-level, such as through a Town Ordinance or committee activity

For the top three recommendations, extra guidance is provided, including:

**Why** this action is helpful & how it builds resilience

**How** this activity might be accomplished

**Resources & Examples** from other Maine communities or organizations

**Additional Options:** other potential actions that might be pursued, given the resources and capacity

**Individual Actions:** things that anyone can do to increase their resilience and contribute to the Town’s goals. These actions are prioritized in the Implementation Plan in the next section.

### 1.1 Discussion

Arrowsic is particularly vulnerable to sea level rise and flooding because it relies on a sole access point to the mainland, Wilder Memorial Bridge, at the north end of the island. Georgetown also relies on this bridge and the Islands Road Bridge over Back River for access to the mainland. A higher sea level and more frequent flood events may increase erosion and apply stress on the bridges. The stretch of Route 127 located on the Arrowsic side of the Wilder Memorial Bridge passes through a low-lying area that is predicted to be inundated at 3 feet of sea level rise or storm surge.

As sea level rises, Arrowsic should plan for flooding to become increasingly common in this area during storm or flood events, as well as sunny-day flooding. In the longer term, this road may become impassable if no action is taken. In addition, four segments of Town Ways are also vulnerable to regular flooding and at times are impassable. These include portions of Spinney Mill Road, Sirois Road, Bald Head Road, and Indian Rest Road.

### 1.2 Existing Policies & Projects

- **Town Way Criteria** The Town currently requires new subdivisions to meet general standards for roads that may be adopted as Town Ways.
- **Additional Subdivision Access** The Town has an optional provision for the Planning board to require two access points to a subdivision.

## 1.3 Community Actions

1.3.1 Adopt the CoastWise Approach and Stream Smart Crossing Guidelines as standard practice for culvert and bridge improvements. Identify vulnerable crossings and apply for DEP improvement funds.

### Why

Maine Audubon’s Stream Smart program provides best practices for designing road crossings that minimize disruptions to the flow of non-tidal streams and the species that rely on them. CoastWise provides a comprehensive set of science based practices for assessment and design of safe, cost-effective, and climate resilient tidal crossings. They also decrease the risk to public well-being during high tides, storms, and other events that presently exceed the capacity of road crossings in Arrowsic or are likely to, within their expected service life.

### How

CoastWise uses data collection, modeling, and design methods to effectively accommodate tidal flow and storm surge, anticipating SLR scenarios and present/projected conditions. Decisions are made using transparent and equitable community-involved processes based on collected data. Stream Smart guidelines encourage crossings that exceed channel width, line-up with the natural elevation of the stream, and have natural bottoms where possible to encourage habitat continuity. For tidal crossings, they determine how to incorporate SLR scenarios into project assessment/design.

Route 127 is maintained by the Maine Department of Transportation, and any changes will need to be in coordination with the state. Because of the importance of this road to the safety and access needs of Arrowsic and Georgetown residents, sections of the road are considered to have a high risk or very high risk consequence to coastal flooding scenarios, which inform crossing design criteria.

### Resources & Examples

- The Maine Audubon Stream Smart web page: <https://maineaudubon.org/projects/stream-smart/resource-library/>
- CoastWise: <https://www.maine.gov/dmr/programs/maine-coastal-program/coastal-community-support/the-coastwise-approach>

1.3.2 Incorporate resilience to sea level rise into the Capital Improvement Plan. This includes upgrading culvert sizes and bridge spans and adjusting road surface heights to effectively accommodate tidal elevations caused by sea level rise and storm surge under present and projected conditions. SLR scenarios will be selected based on the risk consequence (such as public safety and accessibility to critical services) for each site.

### Why

The Governor's Office of Policy Innovation and the Future recommends that municipalities commit to manage 1.6 ft of sea level rise by 2050 and 3.9 ft by 2100. However, the Council recommended planning for 6.1 ft and 8.8 ft by 2100 SLR for infrastructure with long lifespans and facilities that are critical for public safety and local economies (Maine Climate Council 2020).

While these improvements can be expensive, they could be more economical in the long run than not addressing sea level rise, and more importantly, are more likely to avert safety hazards. As the Town replaces or maintains road infrastructure, using undersized culverts are less expensive in the short term but risk failure, creating hazardous conditions and additional costs.

### How

As the Town plans for regular capital improvements, incorporate data on restrictive tidal crossings and sections of roads that have been flagged as vulnerable to sea level rise and storm surge flooding. If an area in need of repair or culvert replacement overlaps with an area vulnerable to sea level rise, explore options to address both the immediate repair needs and the long-term sea level rise resilience of this infrastructure.

Sections of roads that are the sole access for large portions of the community, including Route 127 at the north end of Arrowsic, should be designed and constructed to remain above water using the appropriate American Society of Civil Engineers High Risk and Very High Risk Consequence corresponding sea level rise scenarios of 6.1 ft and 8.8 ft by 2100, as well as incorporate storm surge flooding modeling.

Preparing the engineering plans for these improvements ahead of time can also make it easier to apply for grant funding.

### Resources & Examples

- The CoastWise Approach – Achieving Ecological Resilience and Climate-Ready Road Crossings in Tidal Environments: <https://www.maine.gov/dmr/programs/maine-coastal-program/coastal-community-support/the-coast-wise-approach>
- Maine Tidal Restriction Atlas – provides the known locations of road crossings throughout the state, sea level rise scenario overlays, and other information: <https://www.arcgis.com/apps/webappviewer/index.html?id=8f7fc-922c464482d8fe946ca5b17c7ea>
- KELT project with Woolwich: <https://www.kennebecestuary.org/2019-annual-report-res-toration>

1.3.3 Educate private road owners about sea level rise impacts and Stream Smart culverts and other best practices for resilient road design.

### Why

Sharing these resources with landowners is especially important in Arrowsic, since so many roads are privately owned and there are many driveways that cross large areas. Following these practices will lessen the burden on emergency services due to washed out roads and driveways and will also lower costly long term maintenance for landowners.

### How

Share these resources with Homeowner's Associations, at the Town Hall, and the Town website. Publicize when Maine Audubon holds a workshop. The Town could also require new private roads to follow the standards set by these programs.

### Resources & Examples

- The Maine Audubon Stream Smart web page and the Maine Department of Marine Resources page each provide design guidelines, resources for Stream Smart technical assistance, and sample presentations on the value of these practices:
  - <https://maineaudubon.org/projects/stream-smart/resource-library/>
  - <https://www.maine.gov/dmr/programs/maine-coastal-program/coastal-community-support/the-coastwise-approach>
- Maine Audubon also holds Stream Smart Workshops throughout the state: <https://maineaudubon.org/projects/stream-smart/stream-smart-workshops/>

### 1.3.4 Additional Options

- Coordinate with Georgetown and Maine Department of Transportation on state road improvement projects.
- Review standards for new roads that incorporate sea level rise in the design process (including culvert design) and update as needed.
- Encourage marsh restoration, both on Town lands (area near the Wilder Memorial Bridge) and on private properties.
- Create an emergency response plan for flood scenarios and incorporate sea level rise and the Federal Emergency Management Act's Flood Insurance Rate Maps (FIRM) into emergency planning.

## 2. INFRASTRUCTURE BROADBAND & ELECTRIC

### 2.1 Discussion

Sea level rise has the potential to submerge roads and other land access to electrical infrastructure, greatly increasing the difficulty of repairs. Sea level rise also destabilizes and/or washes away soil and other substrates that provide structural support to power lines, increasing their risk of falling or washing out.

As climate change persists, flooding and intense storms will only become more frequent and severe. With the increase of these events will come an increased risk of damage to electrical infrastructure in many forms. These could include power line damage due to high winds, falling debris, and erosion; conductor damage or failure due to slapping and galloping of power lines; the submerging of electrical infrastructure and building connections during flooding events.

Central Maine Power delivers power to Arrowsic. Grid adaptation to climate hazards will depend on the cooperation of the utility company. However, there are options to diversify local power supply through alternative energy sources like solar, as well as ways to prepare for outages.

Arrowsic recently installed a new fiberoptic broadband network, which uses existing telephone poles. This infrastructure is town-owned land and will face many of the same challenges posed by climate change and outages as the electrical grid. Damage to this network will incur repair costs for the town as well as the loss of a critical services for residents.

### 2.2 Community Actions

2.2.1 Consider diversifying energy sources through community solar initiatives, especially projects that enable “islanding” during an outage.

#### Why

Microgrids can decrease the impact of storm damage to power lines and decrease the reliance of a community on outside power sources.

#### How

Creating micro grids or “islanding” refers to the development of an electrical network that can operate self-sufficiently, as needed. This involves developing local sources of power, such as a community solar project, and creating redundancies so that the microgrid can operate when connected to the larger electrical grid and self-sufficiently when it is isolated by a downed power line. Microgrids can supply emergency power to a few key locations, such as an emergency shelter, or an entire neighborhood, depending on a community’s values, needs, and energy consumption. A few towns in Maine have pursued funding and technical assistance through the U.S. Dept. of Energy’s Energy Transitions Initiative Partnership Project.

#### Resources & Examples

- The Maine Office of the Public Advocate has info on community solar: [https://www.maine.gov/meopa/electricity/community\\_solar](https://www.maine.gov/meopa/electricity/community_solar).
- Islanding and micro grids explanation: <https://www.energy.gov/femp/articles/islanding-microgrid>
- Ongoing microgrid and hydropower project by the Department of Energy and the Town of Eastport: <https://www.energy.gov/eere/energy-transitions-initiative-partnership-project-eastport-maine>



## 2. INFRASTRUCTURE BROADBAND & ELECTRIC

### 2.2.2 Petition Central Maine Power to reinforce power lines in Arrowsic.

#### Why

Reinforcement measures increase the stability of power lines, and could decrease the probability of downed lines, snapping/galloping lines, and conductor failure.

#### How

This could include installing guy wires on poles, replacing wooden poles with metal, installing dampers, etc. Electrical lines are under the jurisdiction of CMP, but residents and municipalities can advocate for change through the Maine Public Utilities Commission (MPUC).

#### Resources

- General guidance from Audubon on how individuals can help improve the electrical grid: <https://www.audubon.org/magazine/fall-2019/how-you-can-help-fix-electric-grid>
- General guidance from Audubon on how to voice concerns with a Utilities Commission: <https://www.audubon.org/magazine/fall-2019/get-know-your-public-utility-commission-and>
- Keep track of cases being heard by MPUC and submit public comments here: <https://www.maine.gov/mpuc/home>
- There are federal grants, like Grid Resilience Utility and Industry Provider (GRIP) grants, that provide funding for power companies to increase the resilience of the grid in vulnerable areas: <https://www.energy.gov/gdo/grid-resilience-utility-and-industry-grants>.

### 2.3 Individual Actions

- Consider diversifying energy resources at home (battery storage, solar, etc).
- Tips to prepare for a power outage: <https://www.ready.gov/power-outages>

### 3.1 Discussion

Arrowsic relies exclusively on private wells for drinking water, which access groundwater stored in fractures in the bedrock. In addition to threats from pollution, this valuable resource is threatened by several climate change impacts, including increased drought frequency and increased intensity of storms.

Instances of drought are projected to increase, in addition to a general increase of average temperatures. This could cause more evaporation from vernal pools, freshwater wetlands, and other vegetative habitats that support the ability of freshwater to infiltrate and recharge groundwater. Drier soils and periods of torrential rainfall may cause rainwater to turn into runoff rather than being absorbed into the soil to replenish groundwater.

Saltwater intrusion is another threat to Arrowsic's groundwater resources. It occurs when the salt front (the line where fresh and saltwater meet) shifts vertically or moves inland, which can increase the salinity of the groundwater. Groundwater salinity level can be impacted by a variety of factors, including periods of drought, sea level rise, variations in the volume of water demand/use, rates of groundwater recharge, and the geological features of the groundwater source of a well. High salinity levels in groundwater can make the resource unsuitable for use as drinking water.

### 3.2 Existing Policies & Projects

- **Subdivision Hydrologic Study** In the Subdivision Ordinance Section 8.3.2.2.U, Arrowsic requires subdivisions to conduct a hydrologic study to determine the impact of a new development on groundwater resources. Subdivisions are required to show that under drought conditions (less than 60% average precipitation), the new development will not impact groundwater resources beyond the subdivision.
- **New Construction Requirements** In the Zoning Ordinance Section 3.24, the Town requires all new construction and development to minimize stormwater runoff caused by the development. Where possible, existing natural runoff control features, such as berms, swales, terraces, and wooded areas, shall be retained to reduce runoff and encourage infiltration of stormwater.
- **Water Conservation Tips** The Arrowsic Conservation Commission created a page for residents with suggestions to reduce water consumption.

### 3.3 Community Actions

3.3.1 Collaborate with regional efforts to understand impacts of saltwater intrusion.

#### Why

In several of the towns surrounding Arrowsic, there are similar bedrock groundwater resources. Studies of saltwater intrusion in these towns could increase the understanding of the process in Arrowsic. Collaborating on studies and projects to address saltwater intrusion could also increase the capacity and resources available.

#### How

Maintain the working relationship between committees in adjacent towns, like Georgetown. Communicate about needs and share information from studies or projects in Arrowsic. When a common need is identified, explore the possibility of a joint project or study.

#### Resources & Examples

- Eight towns on the Bluehill Peninsula have formed a partnership, Peninsula Tomorrow, to work on climate resilience and emissions (<https://www.hcpcme.org/environment/peninsulatomorrow/index.htm>). Within this group, Bluehill and Brooksville have partnered to receive a Community Action Grant to conduct a joint Climate Vulnerability Analysis.

3.3.2 Support research on current and future capacity of wells in Arrowsic.

#### Why

A modeling study conducted by Oak Ridge Laboratory in July 2023 found that if aquifer recharge rates continue to decline and saltwater intrusion occurs, groundwater availability may not be able to meet demand. This study also began the process of modeling sea level rise impacts on the depth of the freshwater lens, which could provide insight into saltwater intrusion risk in Arrowsic.

#### How

There are several data gaps that are barriers to a thorough study of groundwater in Arrowsic:

- Incomplete count and characterization of wells
- Number of people per lot is unknown
- Changes in annual well yield unknown
- Annual well salinity data not available

The Town could fill in these data needs by continuing to promote the online well survey started this summer and supporting data collection projects to document well yield and salinity. This could be accomplished by pursuing funding through a Community Action Grant, to pay for well water testing kits or a formal groundwater study.

#### Resources

- Assessing the Vulnerability of Coastal Aquifers in Arrowsic, ME, Aninditha Nair, July 2023. [https://www.arrowsic.org/climate/Assessing\\_Vulnerability\\_Aquifer\\_Arrowsic.pdf](https://www.arrowsic.org/climate/Assessing_Vulnerability_Aquifer_Arrowsic.pdf)
- Westport Island's Groundwater Study: [https://westportisland.us/images/site/body-images/Summary\\_report\\_on\\_Current\\_status\\_of\\_Westport\\_Island\\_Groundwater\\_Study.pdf](https://westportisland.us/images/site/body-images/Summary_report_on_Current_status_of_Westport_Island_Groundwater_Study.pdf)

### 3.3.3 Educate and encourage residents to adopt water conservation measures.

#### Why

It's difficult to understand how wells may be impacted by changes to drought and precipitation patterns, but there is anecdotal evidence that water supply may vary more in coming years in bedrock wells. The natural flow of fresh groundwater towards the sea keeps saltwater from migrating into inland water supplies. Drawing too much freshwater out of wells can allow the saltwater barrier to migrate inland and contaminate supplies. Water conservation measures could help decrease demand on wells and lower the risk of saltwater intrusion.

#### How

Community workshops on water conservation could encourage people to incorporate small measures into their lives. The existing materials on the Town's website could be updated to include information on how to take advantage of Efficiency Maine rebates on efficient appliances. Materials could be distributed at Town events, in the Arrowsic Arrow, or in tax bill inserts.

#### Resources & Examples

- ACC's Water Conservation Tips Document: <https://arrowsic.org/uploads/water%20conservation%20tips-041421.pdf>
- Maine's Emergency Management Agency has a webpage with techniques to conserve water at home: <https://www.maine.gov/mema/hazards/natural-hazards/drought/sensible-water-use>
- Arrowsic Stewardship Guide: [https://arrowsic.org/uploads/Stewardship\\_Arrowsic.pdf](https://arrowsic.org/uploads/Stewardship_Arrowsic.pdf)

### 3.3.4 Encourage homeowners to implement water recycling systems.

#### Why

Diversifying water sources can help create more resilience to water supply issues, while also decreasing water demand on wells.

#### How

Provide information on these water recycling options to residents, either on the Town website, spotlights in the Arrowsic Arrow, or handouts in the Town Hall. This could include systems that collect and purify water for household reuse, or the tried-and-true method of collecting water in rain barrels for irrigation and other outdoor uses.

#### Resources & Examples

- Monhegan Plantation: Alternative water supply feasibility study: <https://www.maine.gov/dacf/municipalplanning/casestudies/docs/70%20-%20Monhegan%20Island%20Alt%20Domestic%20Water%20Supply%20Study.pdf>

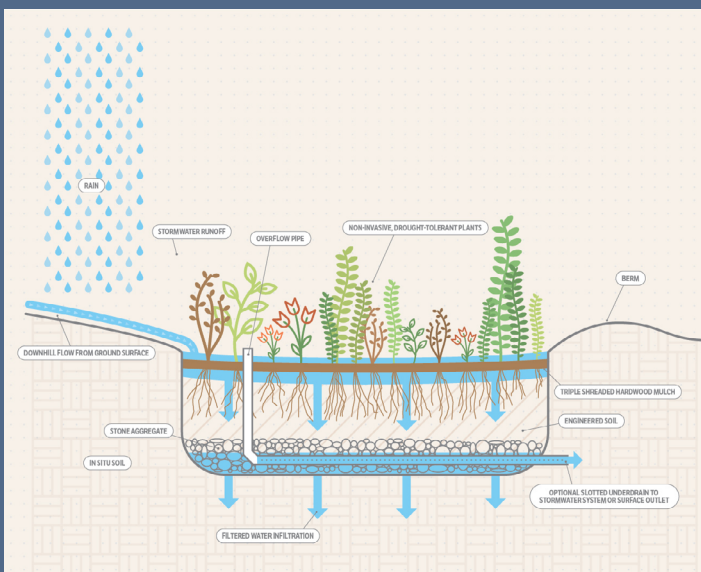
## 3.3.5 Additional Options

- Update the existing 1989 Wellhead study. Capture location, depth, recharge rate, mineral levels (at least potassium), well history (has it been redrilled, hydro-fractured, deepened, etc.).

## 3.4 Individual Actions

- Practice water conservation practices and install water efficient appliances and fixtures.
- Transition to low water use lawns and plant rain gardens and native vegetation to slow runoff and allow for infiltration.
- Install rainwater collection structures for outdoor water use.

## What is Low Impact Development (LID)?



These are techniques that help minimize runoff generated by development, such as permeable pavers, rain gardens, driplines, or swales. By reducing runoff, LID protects surface and ground water quality, maintains the integrity of aquatic living resources and ecosystems, and limits erosion.

For more info, visit: <https://www.maine.gov/dep/land/stormwater/stormwaterbmps/vol3/chapter10.pdf>

## 4. SURFACE WATER RESOURCES

### 4.1 Discussion

Surface water resources, such as streams, wetlands, and vernal pools, will also face threats associated with climate change. These include drought, increased temperatures, and runoff from flooding and heavy rainfall, which carry pollutants and sediment into nearby bodies of water. Sewall Pond already has a history of high phosphorus levels and pollution from runoff.

Pollutants can disrupt the function of aquatic ecosystems. A common example is nutrient pollution from fertilizer causing algal blooms, which block light and reduce oxygen in surface water. These conditions can cause plant die-offs, which would interfere with the ecosystem stabilization they provide, such as erosion control, flood protection, water filtration, and water cooling. This could cause increased runoff and sedimentation in streams, which would negatively affect water quality downstream.

Communities can make these ecosystems more resilient to environmental changes by reducing harm from pollution, sedimentation, and development.

### 4.2 Existing Policies & Projects

- **Shoreland Zone** Arrowsic has adopted a shoreland overlay district in line with Maine's Mandatory Shoreland Zoning Act, which restricts development within the shoreland zone (Arrowsic Zoning Ordinance, Section 2.3.1: Shoreland Zoning Overlay Districts). This zone includes any area within 250 feet of a great pond or river, and the upland edge of coastal and freshwater wetlands, as well as areas within 75 feet of perennial streams.
- **Foliar Herbicide Ban** The Town voted in 1984 to ban foliar herbicide application along Town roads, Route 127, and under power lines.

## 4. SURFACE WATER RESOURCES

### 4.3 Community Actions

4.3.1 Prioritize conservation and management of significant freshwater habitat.

#### Why

Arrowsic's freshwater ponds, streams, and wetlands are important wildlife habitat. They also provide ecosystem services to the community, such as aiding groundwater recharge and supporting vegetation that filters runoff and decreases erosion.

#### How

Arrowsic's freshwater resources include Sewall Pond, Newtown Creek, Lost Pond, and several wetlands and vernal pools. The Town has already identified these areas in the Special Protection Zone. There are 129 parcels adjacent to freshwater resources, and of these, 21 parcels are at least partially conserved. Eighty of these parcels are residential.

Where possible, surrounding lots could be identified for conservation through purchase or conservation easements, potentially with the support of a land trust, such as Kennebec Estuary Land Trust.

Expanding the Town's successful water quality monitoring and improvement program at Sewall Pond to additional waterbodies could help identify additional areas of focus for the Town.

#### Resources & Examples

- Beginning with Habitat, a program under the Maine Dept. of Inland Fisheries & Wildlife, has data and conservation strategies to inform Arrowsic's approach to prioritizing, conserving, and managing freshwater habitat: <https://www.maine.gov/ifw/fish-wildlife/wildlife/beginning-with-habitat/municipalities/conservation-strategies.html>

4.3.2 Educate community members on best practices for limiting runoff, including maintaining healthy native plant buffers.

#### Why

Private landowners, in a mostly residential town like Arrowsic, have the greatest impact on water quality and runoff control. If landowners limit runoff and erosion, it benefits not only freshwater habitat, but also protects their property from erosion and increases groundwater infiltration to their well.

#### How

There are many options to address runoff, including rain gardens, rain barrels, dripline trenches, and more. When incorporating vegetative measures, using native plants and maintaining the health of these buffers is important to their function. Landowners could be informed of these options by distributing the handouts created by the Maine Department of Environmental Protection at a Town Meeting or any other Town event. There could also be a series included in the Arrowsic Arrow, spotlighting different techniques.

#### Resources & Examples

- The Maine Department of Environmental Protection has a series of handouts about reducing runoff, including guidance on how to plant vegetative buffers and what plants to use, shoreline stabilization techniques, and other best management practices: <https://www.maine.gov/dep/land/watershed/materials.html>
- Arrowsic Stewardship Guide: [https://arrowsic.org/uploads/Stewardship\\_Arrowsic.pdf](https://arrowsic.org/uploads/Stewardship_Arrowsic.pdf)

## 4. SURFACE WATER RESOURCES

### 4.3.3 Consider increasing restrictions on pesticide use in the Town.

#### Why

Pesticides are chemicals used to control populations of certain organisms, most commonly plants and insects.

Pesticides are more likely to run off into surface water as precipitation becomes more intense and frequent. Increased pollution from runoff could contaminate groundwater supplies and will put stress on freshwater resources already under strain from other climate hazards. This could also harm aquatic ecosystems and reduce the flood protection, water filtration, groundwater recharge, and other ecosystem services they provide.

#### How

In 1984, Arrowsic banned foliar herbicide application along Town roads, Route 127, and under power lines. The Town could consider adopting restrictions on other types of pesticides, such as insecticides. The Town could also expand the area of the ban by restricting the application of certain pesticides on all Town properties, in an overlay zone, or the Town overall. Pesticide Ordinances can vary in restrictiveness. Some ban certain application methods (such as aerial) or types of pesticides (such as neonicotinoids) that cause the most harm. Others restrict the use of all pesticides, encouraging organic alternatives, or require a permit for pesticide use. All municipalities must notify the Board of Pesticides Control, which is attached to the Maine Department of Agriculture, Conservation, and Forestry (Maine DACF), at least 30 days prior to voting on an ordinance restricting pesticide use.

#### Resources & Examples

- The State maintains a list of all municipal ordinances on pesticide, as well as resources on best management practices: [https://www.maine.gov/dacf/php/pesticides/public/municipal\\_ordinances.shtml](https://www.maine.gov/dacf/php/pesticides/public/municipal_ordinances.shtml).
- Law relating to Municipal Pesticide Ordinances: MRS Title 38, Chapter 3, §§ 435-449
- Harpswell banned the outdoor use of insect growth regulators, as well as the aerial application of any pesticide that harms aquatic invertebrates.
- Brunswick created a groundwater protection zone and banned the storage or use of any pesticide, except for agricultural or indoor use.
- Amherst, Maine requires a permit for the application of pesticides in the Shoreland Zone.

### 4.3.4 Additional Options

- Review state standards for Low Impact Development to determine if we should limit the amount of impervious surfaces allowed in new development in Arrowsic.

## 4.4 Individual Actions

- Read the Arrowsic Stewardship Guide and incorporate best practices into your daily life: [https://arrowsic.org/uploads/Stewardship\\_Arrowsic.pdf](https://arrowsic.org/uploads/Stewardship_Arrowsic.pdf)
- Avoid disturbing vegetative buffers around freshwater habitats.
- Identify sensitive freshwater ecosystems on your property and monitor for changes.
- Participate in local community science initiatives:
  - Sewall Pond Water quality monitoring with the Arrowsic Conservation Commission
  - Kennebec Estuary water sampling with Kennebec Estuary Land Trust
- Use natural pest management practices and avoid pesticides.



# 5. ENVIRONMENTAL RESOURCES

## COASTAL EROSION & SALT MARSH MIGRATION

### 5.1 Discussion

Erosion is a natural process anywhere with water and high winds; Arrowsic has an abundance of both already. This process is accelerating due to climate change via increased intensity of storms and storm surge, sea level rise, and the loss of protective coastal vegetation. Salt marsh migration is predicted to occur as coastal wetlands are inundated by sea level rise and the leading edge of wetlands are eroded and converted into sediment. In areas where topography or development prevents wetlands from shifting inland, this may result in the loss of marshland and the habitat and ecosystem services it provides. When combined with the impacts of storms and sea level rise, this could have implications for coastal erosion rates, flood vulnerability of adjacent properties, species loss, and ecosystem resilience.

### 5.2 Community Actions

5.2.1 Consider adding a Climate Change Observatory Network site or a similar community science site to document change over time at priority wetlands.

#### Why

The Climate Change Observatory Network is a community science project run by the Southern Maine Conservation Collaborative (SMCC) to document environmental change in Maine, including sea level rise, vegetation change, restoration projects, etc. This can be an important source of information documenting the effectiveness of a restoration project, management practices, or localized impacts of climate change. It's also an easy way for residents to be engaged in community science and to fostering a sense of stewardship.

#### How

Signs at specific sites instruct users on how to take a photo and upload it to the project website. These photos create a timelapse of change at the site. This could be added to conservation land or to Town-owned lands. Reach out to SMCC to get started.

#### Resources & Examples

- Southern Maine Conservation Collaborative's Climate Change Observatory webpage: <https://southernmaineconservation.org/cco-network/>

## 5. ENVIRONMENTAL RESOURCES

### COASTAL EROSION & SALT MARSH MIGRATION

#### 5.2.2 Identify and conserve open land adjacent to priority wetlands.

##### Why

It is important to conserve lands adjacent to tidal wetlands, especially those predicted to migrate inland due to sea level rise. If a marsh is adjacent to developed land, the development will be at risk of erosion and flooding, as the marsh may not be able to naturally move inland. The flood protection and habitat this resource provides will be lost.

##### How

The Town could work with a land trust, such as Kennebec Estuary Land Trust, and landowners to either purchase or establish an easement on undeveloped lands adjacent to important tidal marshes. The Town could also partner with a land trust or technical resource provider like the Midcoast Council of Governments to conduct a restoration study.

##### Resources & Examples

- The Community Intertidal Data Portal's Sea Level Rise and the Nearshore Environment Story Map: <https://community-intertidal-data-portal-gpcog.hub.arcgis.com/apps/be4a2a7e272749428fa8bdcd083d3789>
- Woolwich and KELT partnered on a study of tidal marsh restoration along Route 1: <https://www.wiscassetnewspaper.com/article/kelt-will-facilitate-study-returning-woolwich-meadow-salt-marsh/110482>

#### 5.3 Individual Actions

- Participate in community science efforts to document change.
- Preserve undeveloped land adjacent to wetlands by creating a conservation easement.
- Participate in community efforts to restore or stabilize eroding wetlands.

## 6. ENVIRONMENTAL RESOURCES

### HABITAT PROTECTION & SPECIES CHANGE

#### 6.1 Discussion

Sea level rise will cause low lying areas to flood and lead to the transformation of dry land into clusters of islands, shrinking existing landmasses. This can cause habitat ranges to shift, pushing plant and animal species up in elevation and further inland. The reduction of dry land and creation of barriers in the form of water will reduce the carrying capacity of many species of plants and animals in the Arrowsic area. Smaller populations are more prone to local extinction by events such as natural disasters and disease.

Rising oceans will also change the groundwater and soil composition in coastal areas. These chemical changes affect the ability of certain plant and tree species to grow in these areas as well as the animals that rely on them. Sea level rise is likely to submerge much of what is now saltwater marsh, which serves as a huge breeding and feeding ground for many species of birds, fish, and insects. Changing temperature and rainfall patterns will likely impact the entire ecosystem, well beyond the boundaries of Arrowsic.

#### 6.2 Existing Policies & Projects

- **Cool Little Culvert** The Arrowsic Conservation Commission and Kennebec Estuary Land Trust partnered to install a wildlife culvert to replace the existing Sewall Pond Culvert, as a part of a project to restore the Alewife population in Sewall Pond.

## 6. ENVIRONMENTAL RESOURCES

### HABITAT PROTECTION & SPECIES CHANGE

#### 6.3 Community Actions

6.3.1 Compile available species inventories. Maintain data so it can be monitored, updated, and visualized over time.

##### Why

While there are state-level resources on habitat and wildlife readily available, there is also a need for local level habitat and wildlife data to inform management and conservation decisions on a local scale. Tracking this information would provide valuable insight into Arrowsic's natural resources, which could be inform future plans, policies, zoning, and conservation decisions.

##### How

Conducting a natural resources inventory usually involves conducting surveys and assessments of habitat types and conditions, wildlife ranges, invasive species locations, etc. These surveys should be tailored to the Town's interests and needs. This could be done by through partnerships with organizations or universities. Spatial data should be collected as a part of this process for incorporation into maps and the Town's GIS. The Town could solicit mapping/GIS assistance from the Midcoast Council of Government or could apply for grant funding to hire a consultant to develop a Town GIS. Arrowsic would need to maintain the GIS.

##### Resources & Examples

- The Maine Land Trust Network has resources for finding natural resource data, using GIS, and finding technical support that is relevant for municipalities: <https://www.mltm.org/resources/gis/>
- An example of a natural resource inventory application for Gardiner, NY: <https://tognri.maps.arcgis.com/apps/MapSeries/index.html?appid=316635524fec43afa6367b-b21c2c10c4>

6.3.2 Advocate for the Maine TREE Foundation to continue research on key datasets in Holt Research Forest.

##### Why

The town of Arrowsic and all of Maine is fortunate to have 38 continuous years of standardized data collected on wildlife and forest ecology, collected at the Holt Research Forest. This long-term forest ecosystem study was initiated by the University of Maine and conducted between 1983 and 2021. These data are rare in the longevity and detail of studies. However, UMaine is no longer involved in the project and wildlife data collection has not been conducted since 2021 at this site.

The Maine TREE (Timber Research and Environmental Education) Foundation owns the site and continues to conduct forest ecology and timber management research. Continuing the collection of ecosystem data could offer valuable insight into how the species in the forest continue to change and interact over time. This research is an opportunity to capture ecosystem change and the impact of climate change with a rare level of detail and duration.

##### How

Arrowsic could advocate that the Maine TREE Foundation continue the research on key data sets (e.g. birds, small mammals, species composition etc.) to document climate change impacts on the forest ecosystem.

##### Resources & Examples

- Holt Research Forest Information: <https://holtresearchforest.org/research/>
  - Species List: <https://holtresearchforest.org/research/#species>
  - List of Publications: <https://www.uvm.edu/femc/holt#projects>

## 6. ENVIRONMENTAL RESOURCES

### HABITAT PROTECTION & SPECIES CHANGE

6.3.3 Encourage participation in existing citizen science projects to monitor species changes.

#### Why

Documenting local knowledge and observations is an easy way to educate and engage community members, while also gaining valuable insight into the local habitat and wildlife. This information could make for better management decisions.

#### How

Arrowsic's Shellfish Commission participate in yearly green crab trapping events, and the Arrowsic Conservation Commission conducts monitoring and Alewife counts at Sewall Pond. The Conservation Committee launched a project in 2022 to collect citizen science data using iNaturalist. This effort should continue to be supported.

The Town could encourage resident or committee participation in community science projects like the bird monitor program with Kennebec Estuary Land Trust, and continue to encourage participation in Arrowsic Conservation Commission's iNaturalist activity.

#### Resources & Examples

- Arrowsic Nature Sightings: <https://www.inaturalist.org/projects/arrowsic-nature-sightings>
- Green Crab Trapping: <https://www.arrowsic.org/greencrabproject.html>
- KELT Bird Monitoring: <https://www.kennebecestuary.org/bird-monitoring>

6.3.4 Adopt Stream Smart culvert requirements in new road projects and subdivisions.

See recommendation 1.3.1 in the *Infrastructure: Roads & Bridges* section on 32 .

#### 6.3.5 Additional Options

- Prioritize conservation of the most vulnerable habitat types in Arrowsic, such as riparian areas and land adjacent to salt marshes.
- Understand implications of populations of particularly damaging species, for example green crabs, woolly adelgid, etc..

## 6.4 Individual Actions

- Maintain yards to protect native flora and fauna.
- Find and remove invasive plants from your property using recommended practices (see [https://www.maine.gov/dacf/mnap/features/invasive\\_plants/invsheets.htm](https://www.maine.gov/dacf/mnap/features/invasive_plants/invsheets.htm)).

# 7. EMERGENCY RESPONSE

## 7.1 Discussion

The volunteers of the Arrowsic Fire Department (AFD) are essential for our town's resilience. The AFD stops brush fires, supplies water to fight structure fires, provides aid and support as we wait for an ambulance, and keeps us safe from downed wires. In addition, the department is part of a regional mutual aid network, a system that has well-served our emergency response needs. Mutual aid partners will assist neighboring communities unless they must respond to calls in their own municipalities. Emergency medical services are provided under contract by ambulances and EMTs from the Bath Fire Department. Over the past twenty years, emergency calls have fluctuated between 24 and 54 yearly calls without a clear trend.

The AFD is adapting to meet greater climate-related emergency response needs. This is particularly true as it relates to severe weather events which increase the risk of:

- Road flooding due to tidal storm surge, extreme high tides, and stormwater runoff
- Brush fires due to extended periods of drought
- Blocked roads from downed trees, utility poles and/or electrical wires
- Vehicle accidents
- Damage from high winds, gusts and freezing rain or ice buildup

The need for traffic control during road flooding and power outages has increased the challenges to the AFD as storm-induced road blockages can last for hours or days while utility companies cope with outages state-wide. Extended events require more volunteers to cycle in and out of an emergency scene.

The AFD would benefit from expanded capacity to continue to keep the Town safe, including additional volunteers (with a variety of skills and training), improved communications, updated mapping and signage to facilitate emergency response, and additional support to apply for funding for equipment and training. Strengthening the AFD would help build community resilience and make Arrowsic better prepared for the next emergency.

The mission of the Fire Department is to respond to emergencies; however, when hazardous events become predictable and repetitive in scope and location, precautions should be taken in advance to mitigate adverse impacts on the community. The primary road to the mainland for both Arrowsic and Georgetown is state highway Route 127 which is the responsibility of the Maine Department of Transportation.

While it may take several years for the state to deliver a long-term solution that addresses the frequent predictable flooding of Route 127, interim measures such as automated signage and flood-activated warning lights can serve to ensure public safety. To achieve this goal with cooperation and support from State agencies, officials from Arrowsic and Georgetown will need to work together with elected state representatives and Department officials.

# 7. EMERGENCY RESPONSE

## 7.2 Community Actions

7.2.1 Identify priorities for investment and identify funding opportunities to support AFD.

### Why

Ensuring that the AFD has adequate funding will make sure that the department is equipped to manage public safety, especially as the frequency of disasters increase with climate change. These needs could include new equipment, communications tech, staffing, & training.

### How

Continue to regularly consider equipment, training, staffing, & other needs that the AFD may have during the annual budgeting process. For larger expenses, explore grant funding opportunities, such as the Preparedness grants offered by FEMA.

### Resources & Examples

- Federal Emergency Management Act's (FEMA) Preparedness Grants offering funding to help firefighters access fire protection resources and increase safety personal capacity: <https://www.fema.gov/grants/preparedness/firefighters>

7.2.2 Create a Community Emergency Response Team (CERT).

### Why

CERT is a program administered by the Federal Emergency Management Agency (FEMA) to train volunteers to provide critical support to first responders during an emergency and increase the capacity of the local emergency management agency. There are over 2,700 local CERT programs nationwide and more than 600,000 people have trained since CERT became a national program. Local CERT programs are tailored to the unique needs and capacity of the community.

This program provides a streamlined approach to engaging and training community members so that they can contribute to the safety of their families, neighbors, and community.

### How

CERT programs can be created on a local, regional, or county level. Sagadahoc County Emergency Management Agency (SCEMA) does not currently have a CERT in place. Arrowsic could create a CERT program as a Town, or collaborate with adjacent municipalities, or SCEMA.

### Resources & Examples

- CERT in Action: <https://www.fema.gov/emergency-managers/individuals-communities/preparedness-activities-webinars/community-emergency-response-team>
- CERT Training: [https://community.fema.gov/PreparednessCommunity/s/cert-trainings?language=en\\_US](https://community.fema.gov/PreparednessCommunity/s/cert-trainings?language=en_US)
- Maine's guidance on CERT program: <https://www.maine.gov/mema/maine-prepares/community-preparedness/emergency-response-teams/cert>
- How to register a CERT: [https://community.fema.gov/PreparednessCommunity/s/about-registering-a-cert?language=en\\_US](https://community.fema.gov/PreparednessCommunity/s/about-registering-a-cert?language=en_US)

## 7. EMERGENCY RESPONSE

### 7.2.3 Implement a standardized house addressing program.

#### Why

Emergency services must be able to find an address easily and quickly in the event of an emergency. Residents may display addresses in different locations, with different fonts and styles that are difficult to read quickly or may not display an address at all. Towns can require residents to display their address in a standardized way that minimizes confusion and helps emergency services quickly identify a household.

#### How

The Town could create and adopt an addressing ordinance to standardize the signage and location for addresses. See the model ordinance below. Arrowsic could also designate funding in the Town Budget for providing standardized/ approved address stickers/signs or create a program for residents to purchase signs from the Town.

#### Resources & Examples

- Maine's Emergency Services Communication Bureau guidance on addressing (model addressing ordinance linked at bottom of page): <https://www.maine.gov/maine911/community-addressing/addressing>
- Berwick, ME Fire Dept sells standardized reflective signs to residents: [https://www.berwickmaine.org/departments/fire\\_and\\_rescue/reflective\\_address\\_signs.php](https://www.berwickmaine.org/departments/fire_and_rescue/reflective_address_signs.php)
- Georgetown House Numbering Project: <https://www.agefriendlygeorgetown.org/house-numbering>

### 7.2.4 Consider Town Hall as a community emergency shelter.

#### Why

Severe weather events exacerbated by tidal flow causing road flooding or washout could isolate most of our island community and Georgetown residents from the mainland. A wildfire could destroy individual homes. Community members may need to shelter with neighbors or in a municipal building for the duration of the event.

#### How

The Arrowsic Town Hall could provide emergency shelter for residents during extended, severe, adverse events. The Fire Station is less suitable as its main purpose is the safe storage of the fire trucks and the department's equipment. During the cold season the fire trucks must be stored in a heated building to prevent the water from freezing. During power outages an on-demand propane-fueled generator provides electricity at the Fire Station and Little Barn.

The Town Hall is heated via propane furnace forced air, has a small bathroom with toilet and one sink, and an additional outdoor faucet, each with cold water only. Water is supplied from a well, though it is unknown whether the quality of the well water meets the guidelines for potable water during a public emergency. The well should have continuous testing to ensure it is potable, and a hand pump should be installed so that residents can access water during prolonged power outages. The Town Hall also has an external hookup only for a portable generator.

In conversations with community members, define the community's needs for an emergency shelter, appropriate equipment, and supplies. Plan with residents to provide blankets, cots, mattresses, food and water in case of an extended emergency situation.



## 7. EMERGENCY RESPONSE

### 7.2.5 Designate an emergency alert official to join the Integrated Public Alert and Warning System (IPAWS).

#### Why

The Department of Homeland Security maintains the Emergency Alert System or EAS (broadcasts to radios, cable, and other media) and the Wireless Alert System or WAS (broadcasts to cell phones) to notify communities in the event of a disaster or emergency. IPAWS integrates these two alert systems. These systems can also be used locally for emergency messages specific to a community. This could be an efficient way to reach residents and anyone in the area quickly and without having to maintain a Town database of contacts.

#### How

The EAS sends messages over media, like public radio, while the WAS sends alerts via text message within a certain radius. To sign up, these systems require a community to designate a liaison.

#### Resources & Examples

- General information for WAS and EAS alert systems: <https://www.ready.gov/alerts>
- How to become an Alerting Authority for IPAWS: <https://www.fema.gov/emergency-managers/practitioners/integrated-public-alert-warning-system/public-safety-officials/alerting-authorities>

### 7.2.6 Update the town road map for use by the AFD.

#### Why

Common road map apps (Google, Bing) do not consistently update their data to reflect changes. At times when cellular phone service is unreliable, a printed map can provide the geographic information needed to respond efficiently to the location of an emergency. The map currently used by AFD needs continual updating to include newly built and renamed roads. This project could also include mapping private driveways. (See recommendation 12.3.3 in the *Housing & Built Environment* on 64)

#### How

Options range from amending the existing document to creating a new map from E-911 Roads data available in the Maine Geographic Information System (GIS) library. An advantage to using GIS is the ability to map other natural and infrastructure features, such as topography and water supply resources.

It could also be a useful tool for other committee projects moving forward. Once a draft is created it is important to “ground truth” the information before finalizing the map.

#### Resources & Examples

- Maine’s guidance on updating E-911 Roads: <https://www.maine.gov/maine911/community-addressing/find-addressing-officer/data-map-maintenance>

## 7. EMERGENCY RESPONSE

### 7.2.7 Additional Options

- Develop a non-emergency communications plan to incorporate updates from the AFD into Town communications and generate community awareness of AFD's volunteer needs.
- Conduct a confidential survey of vulnerable households (e.g., older adults, people with life-sustaining medical equipment or impaired mobility) to inform emergency response.

### 7.3 Individual Actions

- Join or support the Arrowsic Fire Department.
- Reduce wildfire risk and protect your home from wildfire: (Wild-Urban Interface) <https://www.usfa.fema.gov/wui/what-is-the-wui.html>
- Arrowsic Burn permit: [https://arrowsic.org/fd/open\\_burning.pdf](https://arrowsic.org/fd/open_burning.pdf)
- Be prepared for extended power outages.
- Sign up for local emergency alerts:
  - New England 511 for travel updates (<https://newengland511.org/>).
  - Sagadahoc County Emergency Management Agency's CodeRED Emergency Warning Notification System for county-specific alerts regarding the safety of the community ([https://www.sagadahoccountyme.gov/departments\\_and\\_services/emergency\\_management\\_agency\\_and\\_board\\_of\\_health/understanding\\_codered%C2%AE.php](https://www.sagadahoccountyme.gov/departments_and_services/emergency_management_agency_and_board_of_health/understanding_codered%C2%AE.php)).

## 8. COMMUNITY RESILIENCE

### 8.1 Discussion

While there are many technical things that can be done to ensure that communities can move forward as we face climate change, the most important thing is how well community members communicate with one another and how connected people are to one another. Community is what helps people access the information they need, share resources/support, and pool their collective expertise to solve issues. Arrowsic already excels in this area due to the nature of the committee and volunteer-run Town government. Strengthening the existing ties with one another, ensuring that everyone has a chance to contribute to the community's journey toward resilience and has the support they need, will prepare Arrowsic for the climate of the future. This plan is an opportunity to create common goals and strategies to address climate change with input from the entire community. It's also a chance to take stock of under-resourced or over-burdened committees and issues related to climate change.

### 8.2 Community Recommendations

8.2.1 Maintain and strengthen channels of communication between committees. Consider implementing regular meetings or email updates between committee chairs.

#### Why

Arrowsic relies on the functioning of and communication between its committees to operate. Goals of these different committees overlap or intersect, and the ability to address shared concerns is bolstered by cooperation. Each committee has knowledge, skill, and capacity to contribute.

#### How

This could be as simple as setting up regular email updates between the chairs of each committee, summarizing their committee's significant updates or actions. Publishing committee meeting agendas a week prior in town's weekly meetings notices could also serve this purpose. Another option is to hold a quarterly meeting between committee chairs.

## 8. COMMUNITY RESILIENCE

8.2.2 Incorporate chances for public input and workshops into community planning and projects at every possible step.

### Why

Public engagement can help create community buy-in for a project, and it is important in gathering local knowledge to make a plan/project more effective, applicable, and successful.

### How

Public engagement should start early in the process and happen frequently. There should be a variety of ways to participate, including remote and in-person meetings or activities. Meetings need to accommodate a variety of schedules. When scheduling, check the school calendar, think about work schedules, holidays, and tides for shellfish harvesters. Events do not need to be formal! Organizers could hold smaller discussions or create simple activities that allow people to share their perspective and learn about others. One example is giving participants each a certain number of stickers and allowing them to “vote” for different ideas and then discuss.

### Resources & Examples

- This guide includes an introduction to public engagement, considerations, and ideas: [https://publicagenda.org/wp-content/uploads/PublicAgenda\\_StrengtheningAnd-SustainingPublicEngagement\\_2018.pdf](https://publicagenda.org/wp-content/uploads/PublicAgenda_StrengtheningAnd-SustainingPublicEngagement_2018.pdf)
- Maine Development Foundation hosted a workshop on public engagement, with resources available here: <https://www.mdf.org/event/maine-downtown-institute-engaging-communities-in-difficult-conversations/>

8.2.3 Develop a system to encourage neighbors to check in on neighbors during emergencies, and to provide aid to people who need it. This could include a phone tree or a “buddy program” to pair individuals in need with a check-in partner/neighbor.

### Why

During emergencies, communication redundancy is important. This can increase the chances of people receiving important information or accessing help if needed. Phone trees help neighbors check in on each other, even when other communication methods are down.

### How

Identify individuals to include on the phone tree, especially those who are isolated or more vulnerable. Identify key people to serve as the trunk of the tree, and coordinate with the AFD to make sure that these individuals are notified during emergencies. Keep numbers updated.

### Resources & Examples

- The Red Cross has a guide and template: <https://www.redcross.org.au/act/action-catalogue/preparedness/start-an-emergency-phone-tree/>

## 8.2.4 Additional Options

- Make public meetings more accessible by adjusting meeting times, spaces, and/or formats to accommodate working people, families, and people with limited mobility or immunity issues.
- Re-invigorate the Food Co-op.
- Have an annual up-cycle/recycle party.

## 9. PUBLIC HEALTH

### 9.1 Discussion

There are a variety of ways that climate change will impact public health. There will likely be more heat waves, which can create serious health issues, especially for those without air-conditioning, among older adults and very young children, and for those with chronic diseases. The increase in storm events can trap people in their homes, making it difficult to access medical care, replenish medications, or power life-sustaining equipment in an emergency. Finally, changes in temperature and environmental conditions will likely increase populations of existing pests like ticks, brown tail moths, and mosquitoes, and could lead to the introduction of new pests and diseases from warmer climates.

### 9.2 Community Actions

9.2.1 Coordinate with the AFD to ensure that vulnerable people are contacted during heat waves, power outages, or other emergencies.

#### Why

Vulnerable people, such as older adults, those who rely on electrical life-supporting equipment, and those with disabilities, may need more assistance during an emergency event. Understanding where these households are could help emergency services assist people sooner and check in on them more regularly.

#### How

The Town could create a survey of vulnerable households to create a database for emergency services to check in on during certain emergencies. This survey could ask for information to inform different scenarios, including whether the person relies on electricity for essential equipment, whether the person has an air conditioner, and whether the person has mobility issues.

There is an opportunity to boost AFD capacity by recruiting volunteers to join a resilience task force that would coordinate the survey and outreach activities.

## 9. PUBLIC HEALTH

9.2.2 Create a system for residents to report information about the spread of pests and disease in the community.

### Why

While the progression and movement of pests and disease is tracked on a state level by the Maine Center for Disease Control, understanding what is occurring on a local level can inform how the town and residents of Arrowsic prepare and respond. For example, the spread of brown tail moth caterpillars can vary from one town to another due to environmental conditions. Having local ways to track the spread could help residents take precautions, as well as help emergency services prepare to provide care (if this is necessary).

### How

Choose one pest or disease to track, such as brown tail moth, as a starting point. Some communities have created a hotline or a survey to collect reports/sightings for community science projects. Free applications, like Google Forms, are a low-barrier way to start.

### Resources & Examples

- Oregon State University's Extension Service has a Forest Pest Detector Program and hotline: <https://extension.oregonstate.edu/ofpd/forest-pest-resources>.

9.2.3 Understand various options for reducing populations of disease-carrying pests. Create programs to control the populations of these pests while balancing water quality standards.

### Why

Pests can impact the health of residents, but many pest control methods involve pesticides that may negatively affect aquatic ecosystems. Water quality and public health can be addressed by using best management practices or natural pest control methods.

### How

The Town could require best management practices on Town lands, and provide educational materials to residents on how to balance water quality and pest control on their property.

### Resources & Examples

- State Guidance on best practices: [https://www.maine.gov/dacf/php/pesticides/applicators/best\\_management\\_practices.shtml](https://www.maine.gov/dacf/php/pesticides/applicators/best_management_practices.shtml)

## 9.3 Individual Actions

- Check in on your neighbors during an emergency (heat wave, power outage, etc.). Create a neighborhood phone tree.
- Use low impact methods for pest control.
- Wear protective clothing when working outside.
- Check for ticks on people and pets.

# 10. ENERGY EFFICIENCY

## 10.1 Discussion

Due to the huge role conventional energy production plays in producing greenhouse gases and contributing to climate change, it is vital that buildings are built and renovated to be energy efficient. It is equally important that the community is mindful of its energy consumption and aware of the ways they can limit it. This includes: improving insulation and windows to minimize heat loss in the winter and unwanted warming during the summer; installing renewable energy generation such as solar panels; and education on the benefits of energy conservation measures. Using water efficiently can also reduce energy used by well pumps.

## 10.2 Existing Policies & Projects

- **Capital Needs Assessment** The Properties Committee completed a Capital Needs Assessment for Town buildings in 2019, which included a brief assessment of energy efficiency for each building.
- **Annual Inspections** of the Town Hall, Fire Station, and Little Barn are conducted by the Properties Committee.
- **Town Solar Array** Installation of a PV Solar array is planned on the Fire Station Roof.

# 10. ENERGY EFFICIENCY

## 10.3 Community Actions

10.3.1 Keep track of energy use in Town buildings to understand use and document impacts of future improvements.

### Why

Arrowsic has three Town buildings. Town Hall is over 170 years old and has single-pane windows with poor efficiency and an uninsulated attic floor. The Little Barn was built in 2003 as an unheated and uninsulated garage, but was later retrofitted with insulation and a heater. The Fire Station was built in 2010 to be energy efficient.

All three buildings are heated from a single propane tank and the Little Barn and Fire Station share an electric meter. As a simple way to track emissions and efficiency, the Town could keep annual records of the overall propane and electricity usage for the buildings. These data would provide a general baseline for consumption and be a way to document the effect of improvements on overall energy efficiency and the costs these updates are saving the Town.

### How

The Town already keeps track of bills for heating fuel and electricity consumption. As these bills are received (monthly), enter the gallons of fuel used or kilowatt hours (kWh) used. There are templates available, such as the one from the Environmental Protection Agency, that can be adapted to use for continuous tracking rather than a single greenhouse gas emissions inventory.

### Resources & Examples

- Local Greenhouse Gas Inventory Tool | US EPA: <https://www.epa.gov/statelocalenergy/local-greenhouse-gas-inventory-tool>

10.3.2 Consider adopting the IECC 2021 “Stretch” building and energy efficiency code.

### Why

The Maine Uniform Building and Energy Code (MUBEC) is the base building code in Maine and sets efficiency standards for new development for the entire state. However, municipalities under 4,000 people are not required to enforce this base code. While it may require more resources (in the form of capacity or staff time for the CEO) to adopt and enforce, this could have a significant impact on the town-wide carbon footprint. Simply enforcing the standard MUBEC code could save as much as \$200/year in energy savings per each building constructed to code.

There is also a “stretch code” option to allow municipalities to adopt more stringent efficiency requirements which is based off the 2021 International Energy Conservation Code (IECC). Municipalities that opt into this stretch code are required to enforce it.

### How

The Town would need to adopt MUBEC or the “stretch code” at Town Meeting. The Codes Enforcement Officer would be required to receive training and certification from the State to enforce these codes, and could increase the demands/time required for this role.

### Resources & Examples

- Natural Resources Council of Maine’s Building and Energy Codes web page: <https://www.nrcm.org/programs/climate/energy-efficiency/maines-building-energy-codes-2/>
- Efficiency Maine Resources on the baseline code (MUBEC): <https://www.energymaine.com/building-energy-codes/>



## 10. ENERGY EFFICIENCY

10.3.3 Provide information to residents about the savings available through Efficiency Maine credits for energy audits, insulation, and efficient appliance upgrades.

### Why

Efficiency Maine already keeps a table of resources for at-home efficiency upgrades and audits, as well as a list of certified providers, but many people do not know about these resources. Spreading the word about these opportunities and how to take advantage of them may help increase participation in these programs.

### How

The Town could add a web page on the municipal website with information on the opportunities available through Efficiency Maine and publicize this information at the Town Hall and in the Town emails. It may also be helpful to send this information out with the tax bills to each household.

### Resources & Examples

- Efficiency Maine home resources table: <https://www.energymaine.com/at-home/>

### 10.3.4 Additional Options

- Conduct energy audits of Town buildings with an Efficiency Maine approved contractor. Prioritize efficiency improvements to lower energy consumption and operating costs.
- Create guidance for weatherization of existing houses and structures and aid for weatherization for vulnerable households.
- Install EV charging locations at Town Hall/Fire Station.
- Developing bike lanes/paths to encourage non-auto travel.

## 10.4 Individual Actions

- Weatherize your home and increase energy and water efficiency by updating appliances as your old ones wear out. Install a heat pump, insulate your home, and get efficient appliances using Efficiency Maine incentives.
- Schedule an energy audit with an approved contractor listed on Efficiency Maine's website and receive a tax credit to cover part of the cost.
- Switch outdoor lighting to motion-sensor (direct downward if possible).
- Switch to LED lighting.
- Practice energy conservation. Unplug appliances and turn off lights when not in use.

# 11. WASTE EFFICIENCY

## 11.1 Discussion

Waste reduction is an area that could have one of the greatest impacts on Arrowsic's carbon footprint. As of 2021, solid waste accounted for 9% of the Town's total carbon footprint, or 224 metric tons of carbon. Waste disposal is also a regular cost for the Town, so increasing recycling (usually less cost per ton) and composting rates could save the Town money.

Arrowsic has a strong recycling program, with a recycling to trash ratio of 35% in 2022. However, Arrowsic has seen an increase in the total tons of solid waste produced (in line with the national trend of increasing solid waste). Arrowsic's Solid Waste & Recycling Committee (ASWRC) has also noted that not all households participate in the recycling program. Education of non-participating residents has not been very effective, so the ASWRC has redirected efforts to educating participating residents on recycling best practices.

While the Town does not collect compost, residents are encouraged to compost in their backyards. According to a yearly survey conducted by the ASWRC, about 23 tons of waste are diverted from the landfill each year through composting.

There is a need for education on composting best practices for residents to ensure that materials are not needlessly sent to the landfill. Increased education could also generate more participation. Composting is a net carbon sink, since compost helps soil store more carbon than is emitted through the composting process.

## 11.2 Existing Policies & Projects

- **Solid Waste Ordinance** was amended in 2000 to require participation in the recycling program to receive solid waste disposal services.
- **Arrowsic's Recycling Program** diverted approximately 35% of waste from the landfill in 2022.
- **Resident Composting** is estimated to divert 23 tons of waste annually, based on self-reporting.
- **Swap Barn** The ASWRC holds a biweekly event for residents to donate or trade unwanted items.



Figure 21: The Swap Barn serves as the venue for twice monthly swapping events.

# 11. WASTE EFFICIENCY

## 11.3 Community Actions

### 11.3.1 Invest in the Town's Composting Program.

#### Why

Encouraging increased participation in the Town's composting program is a way to divert waste, helping the Town save on costs for solid waste removal while reducing carbon emissions. Some ways to increase participation could include purchasing town composting bins with educational signage, hosting composting workshops, coordinating with a local composting business (such as Garbage-to-Garden), and/or conducting an outreach campaign.

#### How

Participation could be increased through educational opportunities, such as holding workshops/demonstrations on composting techniques (mixing compost, building at-home composting containers, etc.). There are Solid Waste Diversion grants available through Maine's Department of Environmental Protection that can be used to improve organics management. With grant funding, an intern could be hired to organize a workshop series or develop brochures and educational signage.

#### Resources & Examples

- Solid Waste Diversion Grant Program: <https://www.maine.gov/dep/sustainability/compost/grant.html>
- Social Marketing Toolkit provided by the Environmental Protection Agency, with resources, examples, and templates for increasing compost participation: <https://www.epa.gov/sustainable-management-food/forms/composting-food-scraps-your-community-social-marketing-toolkit>

## 11.4 Individual Actions

- Participate in the composting. Research what can be composted and best practices for participation.
- Limit your waste. Buy less, participate in the Swap Barn, purchase items with less single-use packaging, and buy in bulk when possible.

# 12. HOUSING & BUILT ENVIRONMENTS

## 12.1 Discussion

While no buildings are predicted to be inundated by either the 1.6-foot or 3.9-foot sea level rise scenarios recommended as planning benchmarks by the State of Maine, some buildings could be impacted by storm surge or erosion under these scenarios. Loss of marshland and vegetative barriers around shorefront property can exacerbate this vulnerability. An equal threat is the inundation of private roads and long driveways, which could hinder evacuation or access by emergency services. In many cases, long driveways are not mapped, which makes the risk more difficult to understand and plan for.

## 12.2 Existing Policies & Projects

- **Floodplain Management Ordinance (FMO)** Arrowsic has an updated FMO that follows State recommendations. The Codes Enforcement Officer acts as the Town Floodplain Management Administrator.
- **Community Rating System Participation (CRS)** Arrowsic voluntarily participates in the CRS, which qualifies homeowners for insurance discounts based on Town actions to protect against flood losses, beyond those that are required.
- **Floodplain Development Prohibited** The Town's Zoning Ordinance prohibits new development in current FEMA flood hazard areas.
- **Development Erosion Controls** The Town's Zoning Ordinance requires new building sites to meet erosion control requirements throughout the building process. New buildings are required to conform to natural contours as closely as possible. New driveways must be constructed to withstand a 100-year storm.
- **Shoreland Setbacks** The Town's Shoreland zoning requires setbacks from the high water line, in most cases ranging from 100 to 150 feet. In areas with unstable bluffs, this setback is measured from the edge of the bluff rather than the water line.

## 12.3 Community Actions

12.3.1 Adopt Low Impact Development standards for storm-water management, for both public and private infrastructure.

See the Low-Impact Development information in the Groundwater Resources Section 3.3.5 on page 40.

12.3.2 Continue to participate in the National Flood Insurance Program (NFIP) & Community Rating System (CRS).

### Why

Even though none of the buildings in Arrowsic are predicted to be submerged in high tide under the 1.9 foot and 3.9 foot sea level rise scenarios, it could still be possible for houses to flood during storm or high-precipitation events. While no houses are within current 2015 FEMA flood hazard areas, these designations were produced using historical flood data to predict 100 year storms without consideration of sea level rise. More areas may be included in flood hazard areas if future updates incorporate sea level rise projections.

### How

Continue to regularly update the Floodplain Management Ordinance based on State recommendations. Continue to identify and incorporate relevant actions recommended by the CRS to earn points towards flood insurance savings for residents.

### Resources & Examples

- NFIP resources: <https://www.floodsmart.gov/why-buy-flood-insurance>

## 12. HOUSING & BUILT ENVIRONMENTS

12.3.3 Map all private drives and incorporate this information into emergency services & planning.

### Why

Arrowsic has many long private driveways that are unmapped, which could cause delays in emergency services accessing a residence, especially if the driveway is blocked or washed out. Having an updated map of all the private driveways in Town could mean a quicker response during an emergency.

### How

The Town could start by looking at site plans for residences and identifying drives longer than ¼ mile. The Town may be able to collaborate with Midcoast Council of Governments (MCOG), a local university, or hire a consultant.

### Resources & Examples

- MCOG Technical Assistance for mapping: <https://www.midcoastcog.com/town-resources>

## 12.4 Recommended Individual Actions

- Use Low Impact Development (LID) standards when building a new structure.
- Implement natural stormwater control measures, like bioswales and native plantings.
- Maintain a healthy shoreline buffer of native vegetation.

# 13. GOVERNANCE

## REGIONAL COOPERATION

### 13.1 Discussion

The Town should continue and expand its work with neighboring communities to implement policies, share experiences, and apply for grants. Collaborating regionally can increase capacity to apply for grant funding, implement new projects to achieve shared goals, and address needs during emergencies. Some issues, such as transportation and emergency response, are regional in nature and require a larger, coordinated effort. Regional knowledge sharing and coordination should be built into the Town’s approach to climate action.

### 13.2 Existing Policies & Projects

- **Mutual Aid Agreement** The AFD is a contributing Mutual Aid partner that provides services to surrounding communities commensurate with Arrowsic’s capabilities. In return Arrowsic is provided with increased emergency services capacity.

### 13.3 Recommendations

13.3.1 Coordinate with regional planning agencies and stay updated on ongoing projects, services, and collaborative programs.

#### Why

Small towns like Arrowsic benefit from pooling resources and information with similar communities in the region. The Midcoast Council of Governments (MCOG) can help connect Arrowsic to other communities, as well as offer resources and technical assistance.

#### How

Encourage each standing committee in town to attend or plan one “regional meeting” with their counterparts in neighboring towns each year. This should include the select board. Use the resources and plans provided by SCEMA and MCOG, and make sure town plans are in line with these plans. Stay in touch with the staff at these organizations for relevant updates and information.

#### Resources & Examples

- Midcoast Council of Governments: <https://www.midcoastcog.com/>

# 13. GOVERNANCE

## REGIONAL COOPERATION

13.3.2 Attend regional training opportunities and report back to the appropriate committees.

### Why

Regional opportunities for training and workshops can expand the capacity of Arrowsic and provide connections to other municipalities and service providers.

### How

Assign a member of the ACRC to regularly check the event pages of these organizations, sign up for email lists and newsletters, and include these opportunities in Town announcements.

### Resources & Examples

- MCOG Events Calendar: <https://www.midcoastcog.com/upcoming>
- SCEMA Trainings Webpage: [https://www.sagadahoccountyme.gov/departments\\_and\\_services/emergency\\_management\\_agency\\_and\\_board\\_of\\_health/training.php](https://www.sagadahoccountyme.gov/departments_and_services/emergency_management_agency_and_board_of_health/training.php)

13.3.3 Consider regional renewable energy opportunities including solar, wind, and tidal.

### Why

While Arrowsic may not have appropriate spaces or funding to support certain types and scales of renewable energy projects, pooling resources with other surrounding communities may make these more feasible.

### How

Create a multi-town clean energy collaborative, perhaps facilitated through a regional council of governments (MCOG), to pool the resources, funds, and knowledge of several communities and develop a shared clean energy project (solar, wind, etc.). This results in better bids from energy developers, less municipal staff time, and competitive contract terms.

### Resources & Examples

- Community Solar information from the Maine Office of the Public Advocate: [https://www.maine.gov/meopa/electricity/community\\_solar](https://www.maine.gov/meopa/electricity/community_solar)
- [An example of how Southern Maine Planning and Development Commission created a collaborative partnership between 6 towns to request a joint proposal for community solar: https://smpdc.org/solar](https://smpdc.org/solar)
- A study on regional energy projects: <https://energysustainsoc.biomedcentral.com/articles/10.1186/s13705-021-00295-4>

# 13. GOVERNANCE

## REGIONAL COOPERATION

### 13.3.4 Consider inter-municipal cooperation.

#### Why

Certain issues and opportunities cross town boundaries, such as the infrastructure (road, electrical, broadband) that passes through Arrowsic to Georgetown. The capacity of each town to address these issues is increased when municipal actions are complementary.

#### How

Collaboration could be as simple as establishing quarterly meetings or creating a system for regular email updates between corresponding committees within each town (such as Climate Resilience Committees). It could also be formalized as a joint committee between towns, designated to address or discuss shared issues. A grant-funded inter-municipal climate coordinator position could also be established to guide cooperative projects.

#### Resources & Examples

- An example in Long Island, NY, of how communities can create inter-municipal committees to address shared concerns: <https://www.huntingtonny.gov/content/13749/16439/16577/99657/42854/default.aspx>

### 13.3.5 Additional Options

- Consider regional transportation models including EV buses, ride sharing, commuting options.



# 14. GOVERNANCE

## TOWN POLICIES/ORDINANCES

### 14.1 Discussion

Increasing resilience and reducing emissions are connected to many of the activities the Town is engaged in and should be embedded into the decision-making process from start to finish. This can be done by adding language related to climate change impacts into Town ordinances and policies, and incorporating climate change considerations into capital planning and comprehensive plans. Fostering communication and coordination between committees is important for lasting change.

### 14.2 Recommendations

14.2.1 Enact the existing purchasing standard for Town equipment, requiring new purchases to meet efficiency standards.

#### Why

Incorporating the cost of an upgrade to increase efficiency into an existing need can help save money and resources in addition to reducing emissions.

#### How

Incorporate the cost of these replacements into the existing maintenance and improvement plan and budget created by the Properties Committee.

#### Resources & Examples

- Efficiency Maine provides resources on the options for more efficient appliances: <https://www.energymaine.com/>
- Energy Star: <https://www.energystar.gov/products>

# 14. GOVERNANCE

## TOWN POLICIES/ORDINANCES

14.2.2 Evaluate budget and incorporate consideration of climate change impacts into the Town's financial values.

### Why

Incorporating climate resilience priorities into the Town's budget, especially by building on existing projects or programs, will make sure that action is taken to make the Town more resilient. Adding funds to make existing capital improvement projects more resilient can amplify the benefit of investing in the community and save money in the future.

### How

Each committee that is responsible for contributing to creating budget proposals could reflect on where their priorities overlap with climate change considerations, using the data in this plan. This could include allocating more funding for emergency services, updating Town buildings, or conducting coastal restoration projects. Funding for specific projects may be able to be accessed through grants, but these may require some amount of match, which the Town could budget for in advance.

### Resources & Examples

- The Casco Bay Estuary Partnership and New England Environmental Finance Center held a workshop in 2021 on how communities could budget for climate change, and the resources are available online: [https://neefc.org/wp-content/uploads/2021/05/Resilience-Funding-Guidance-Series\\_Municipalities\\_052621.pdf](https://neefc.org/wp-content/uploads/2021/05/Resilience-Funding-Guidance-Series_Municipalities_052621.pdf)

### 14.2.3 Additional Options

- Conduct an energy audit of Town buildings.
- Evaluate Town operations and develop operation policies for water & energy conservation.
- Incorporate predicted climate change impacts for Arrowsic into all applicable plans the community creates in the future.

# IMPLEMENTATION PLAN

The Action Plan identifies and explains a series of actions the town can take to mitigate and adapt to climate change. The Implementation Plan is a crucial document which outlines the steps, costs, and timelines for various actions.

The table below identifies the priorities developed with the Arrowsic Climate Resilience Committee and the public who attended the public meeting. This information was collated to create the “Priority” column in the database. Actions were listed as a high priority when they received more than 66% of the votes in a particular section. If they received 33% - 66% they were listed as a medium priority action and if they received less than 33% of votes they were listed as low priority.

The “Cost” column is an estimate of the range of funding a project might require, from minimal-cost project to ones which would require a large amount of money or grant funding.

The “Length of Time to Accomplish” column identifies projects which would take anywhere from a few weeks to more than two years for the town to complete. It also identifies projects which are ongoing, meaning that they either already exist and should be maintained or they will need to be continuously monitored in order to be of value to the community.

The “Scale” column refers to the scale of work, whether it is organized and identified at the municipal level (Arrowsic), regional level (Midcoast Council of Governments), or state level (Climate Resilience Planning).

The “Competence” column is intended to identify each committee’s skills, knowledge and expertise to implement an action.

The implementation plan serves as a bridge connecting the desire to implement climate change mitigation and adaptation and the action needed to do so. The table is intended to provide a structured framework to guide the allocation of time, energy, resources, and expertise to have the greatest impact on Arrowsic’s resilience. The implementation should serve as a compass to guide the community to a more resilient future.

# IMPLEMENTATION PLAN

	Priority	Estimated Cost	Length of Time to Accomplish	Scale	Competence
<b>Topics</b>					
<b>Actions/Strategies</b>	High	\$	Short (< 1 yr)	Municipal	Committee with expertise and other committees to involve
	Medium	\$\$	Medium (1- 2 yrs)	Regional	
	Low	\$\$\$	Long (> 2 yrs)	State	
			Ongoing		

## Infrastructure: Roads & Bridges

Incorporate resilience to sea level rise into the Capital Improvement Plan. This includes upgrading culvert sizes and bridge spans and adjusting road surface heights to effectively accommodate tidal elevations caused by sea level rise and storm surge under present and projected conditions. SLR scenarios will be selected based on the risk consequence (such as public safety and accessibility to critical services) for each site.	High	\$\$\$	Long	Municipal	ACRC, Roads Commission, Maine DOT
Coordinate with Georgetown and Maine Department of Transportation on state road improvement projects.	High	\$\$\$	Long	Regional	ACRC, Roads Commission
Adopt the CoastWise Approach and Stream Smart Crossing Guidelines as standard practice for culvert and bridge design. Identify vulnerable crossings and apply for DEP improvement funds.	Medium	\$	Short	Municipal	ACRC / Conservation Commission / Shellfish Commission
Encourage marsh restoration and resilience practices, both on Town lands (area near bridge) and on private properties.	Medium	\$\$-\$\$\$	Ongoing	Municipal	Conservation Commission
Create an emergency response plan for flood scenarios and incorporate sea level rise and the Federal Emergency Management Act's Flood Insurance Rate Maps (FIRM) into emergency planning.	Medium	\$\$ - \$\$\$	Medium	Municipal/Regional	AFD, Sagadahoc Emergency Management
Educate private road owners about sea level rise impacts and Stream Smart culverts and other best practices for resilient road design.	Low	0	Short	Municipal	ACRC
Review standards for new roads that incorporate sea level rise in the design process (including culvert design) and update as needed.	Low	\$	Ongoing	Municipal	ACRC, Planning Board

## Infrastructure: Broadband & Electric

Consider diversifying energy sources through community solar initiatives, especially projects that enable "islanding" during an outage.	High	\$\$\$	Long (>5 yrs)	Municipal / Regional	ACRC, Conservation, Selectboard
Petition Central Maine Power to reinforce power lines in Arrowsic.	Medium	\$	Short	Municipal	ACRC, Selectboard, in collaboration with Georgetown

# IMPLEMENTATION PLAN

	Priority	Estimated Cost	Length of Time to Accomplish	Scale	Competence
<b>Groundwater Resources &amp; Water Supply</b>					
Collaborate with regional efforts to understand impacts of saltwater intrusion.	High	\$	Ongoing	Municipal/ Regional	ACRC/MCOG
Update the existing 1989 Wellhead study. Capture location, depth, recharge rate, mineral levels (at least potassium), well history (has it been redrilled, hydro-fractured, deepened, etc.).	High	\$-\$	Medium	Municipal	ACRC
Support research on current and future capacity of wells in Arrowsic.	High	\$\$\$	Long	Municipal	ACRC
Educate and encourage residents to adopt water conservation measures.	Medium	0	Completed/ Ongoing	Municipal	ACRC/Conservation
Encourage homeowners to implement water recycling systems.	Low	0	Ongoing	Municipal	ACRC/Conservation
<b>Surface &amp; Water Resources</b>					
Prioritize conservation and management of significant freshwater habitat.	High	\$ - \$\$\$	Ongoing	Municipal	ACRC/Conservation
Educate community members on best practices for limiting runoff, including maintaining healthy native plant buffers.	High	\$	Ongoing	Municipal	ACRC/Conservation
Review state standards for Low Impact Development to determine if we should limit the amount of impervious surfaces allowed in new development in Arrowsic.	Medium	\$-\$	Ongoing	Municipal	Planning Board
Consider increasing restrictions on pesticide use in the Town.	Low	\$	Short	Municipal	Town Owned Lands/ Roads Committee/ ACRC
<b>Environmental Resources: Coastal Erosion &amp; Salt Marsh Migration</b>					
Identify and conserve open land adjacent to priority wetlands.	High	\$\$\$	Long	Municipal/ Regional	Conservation
Consider adding a Climate Change Observatory Network site or a similar community science site to document change over time at priority wetlands.	Medium	\$	Short	Municipal	ACRC
<b>Environmental Resources: Habitat Protection &amp; Species Change</b>					
Adopt Stream Smart culvert requirements in new road projects and subdivisions.	High	\$ - \$\$	Short	Municipal	ACRC/Planning Board/ Roads Committee
Prioritize conservation of the most vulnerable habitat types in Arrowsic, such as riparian areas and land adjacent to salt marshes.	High	\$\$\$	Long	Municipal	Conservation
Understand implications of populations of particularly damaging species for example green crabs, woolly adelgid, etc.	Medium	\$	Ongoing	Municipal	ACRC/Conservation/ Shellfish
Compile available species inventories. Maintain data so it can be monitored, updated, and visualized over time.	Low	\$\$	Med	Municipal	Conservation
Advocate for the Maine TREE Foundation to continue research on key datasets in Holt Research Forest.	N/A	0-\$	Ongoing	Municipal	Conservation
Encourage participation in existing citizen science projects to monitor species changes.	Low	\$	Short	Municipal	ACRC

# IMPLEMENTATION PLAN

	Priority	Estimated Cost	Length of Time to Accomplish	Scale	Competence
<b>Emergency Response</b>					
Conduct a confidential survey of vulnerable households (e.g., older adults, people with life-sustaining equipment that uses electricity, those with mobility difficulties, etc.) to inform emergency response.	High	\$	Short	Municipal	AFD
Identify priorities for investment and identify funding opportunities to support AFD.	High	\$ - \$\$\$	Ongoing	Municipal	AFD
Develop a non-emergency communications plan to incorporate updates from the AFD into Town communications and generate community awareness of AFD's volunteer needs.	Medium	0	Short	Municipal	AFD
Update the town road map for use by the AFD.	Low	\$	Short	Municipal	Roads Committee/ AFD
Create a Community Emergency Response Team (CERT).	Low	\$	Medium	Municipal	AFD
Implement a standardized house addressing program.	Low	0	Short	Municipal	AFD/ Sagadahoc Emergency Management
Designate an emergency alert official to join the Integrated Public Alert and Warning System (IPAWS).	Low	0	Short	Municipal	Roads Committee/ AFD
<b>Community Resilience</b>					
Maintain and strengthen channels of communication between committees. Consider implementing regular meetings or email updates between committee chairs.	High	0	Short	Municipal	ACRC/All
Develop a system to encourage neighbors to check in on neighbors during emergencies, and to provide aid to people who need it. This could include a phone tree or a "buddy program" to pair individuals in need with a check-in partner/neighbor.	High	\$	Ongoing	Municipal	?
Incorporate chances for public input and workshops into community planning and projects at every possible step.	Medium	\$ - \$\$	Ongoing	Municipal	Selectboard
Make public meetings more accessible by adjusting meeting times, spaces, and/or formats to accommodate working people, families, and people with limited mobility or immunity issues.	High	0	Ongoing	Municipal	All Committees
Re-invigorate the Food Co-op.	Low	\$	Short	Municipal	?
Have an annual upcycle/recycle party	Low	\$	Short	Municipal	Recycling Committee
<b>Public Health</b>					
Coordinate with the AFD to ensure that vulnerable people are contacted during heat waves, power outages, or other emergencies.	High	\$	Ongoing	Municipal	?
Understand various options for reducing populations of disease-carrying pests. Create programs to control the populations of these pests while balancing water quality standards.	High	\$ - \$\$\$	Ongoing	Municipal	ACRC/Conservation
Create a system for residents to report information about the spread of pests and disease in the community.	Medium	\$ - \$\$	Short	Municipal	Conservation

# IMPLEMENTATION PLAN

	Priority	Estimated Cost	Length of Time to Accomplish	Scale	Competence
<b>Energy Efficiency</b>					
Provide information to residents about the savings available through Efficiency Maine credits for energy audits, insulation, and efficient appliance upgrades.	High	0	Ongoing	Municipal	ACRC
Developing bike lanes/paths to encourage non-auto travel.	High	\$\$	Long	Municipal	ACRC
Create guidance for weatherization of existing houses and structures and aid for weatherization for vulnerable households	Medium	\$\$	Medium	Municipal	ACRC
Keep track of energy use in Town buildings to understand use and document impacts of future improvements.	Low	0	Ongoing	Municipal	Town Property Committee
Consider adopting the IECC 2021 "Stretch" building and energy efficiency code.	Low	0	Medium	Municipal	Codes
Conduct energy audits of Town buildings with an Efficiency Maine approved contractor. Prioritize efficiency improvements to lower energy consumption and operating costs.	Low	\$\$	Medium	Municipal	ACRC/Town Property Committee
Install EV charging locations at town hall/fire barn.	Low	\$\$	Short	Municipal	ACRC
<b>Waste Efficiency</b>					
Invest in the Town's Composting Program.	High	\$\$	Medium	Municipal	Recycling
<b>Housing &amp; Built Environment</b>					
Map all private drives and incorporate this information into emergency services and planning.	High	\$	Short	Municipal	AFD/ Roads Committee
Adopt Low Impact Design standards for stormwater management, for both public and private infrastructure.	Medium	\$	Medium	Municipal	ACRC/Codes/ Planning Board
Continue to participate in the National Flood Insurance Program (NFIP) & Community Ration System (CRS).	Medium	0	Ongoing	Municipal	Codes

# IMPLEMENTATION PLAN

	Priority	Estimated Cost	Length of Time to Accomplish	Scale	Competence
<b>Governance: Regional Cooperation</b>					
Coordinate with regional planning agencies and stay updated on ongoing projects, services, and collaborative programs.	High	0	Ongoing	Municipal/ Regional	ACRC/Others
Consider regional renewable energy opportunities including solar, wind, and tidal.	High	0	Ongoing	Municipal/ Regional	ACRC/Others
Consider regional transportation models including EV buses, ride sharing, commuting options.	Medium	\$ - \$\$\$	Long	Regional	ACRC/Others
Attend regional training opportunities and report back to the appropriate committees.	Low	\$	Ongoing	Municipal	ACRC/Others
Consider inter-municipal cooperation.	Low	0	Ongoing	Municipal/ Regional	ACRC/Others
<b>Governance: Town Policies &amp; Ordinances</b>					
Evaluate budget and incorporate consideration of climate change impacts into the Town's financial values.	High	0	Ongoing	Municipal	ACRC
Incorporate predicted climate change impacts for Arrowsic into all applicable plans the community creates in the future, including comprehensive plans, open space plans, etc.	High	0	Ongoing	Municipal	ACRC/Others
Enact the existing purchasing standard for Town equipment, requiring new purchases to meet efficiency standards.	Low	0	Short	Municipal	ACRC
Conduct an energy audit of Town buildings. Add foam insulation if needed.	Low	\$\$	Medium	Municipal	ACRC
Evaluate Town operations and develop operation policies that encourage water and energy conservation.	Low	0	Ongoing	Municipal	ACRC



## Arrowsic Climate Action Plan Public Meeting Report

**Date:** September 26<sup>th</sup> 6 - 8 pm

**Location:** Arrowsic Fire Station

**Participants:** 46, including ACRC members

Everyone was welcomed by the chair of the Arrowsic Climate Resilience Committee co—chair, Jody Jones. She introduced the consultants from Viewshed, Judy Colby-George and Madeline Tripp. Judy then gave a brief introduction to the Climate Action Plan, the planning process so far, and how the feedback of this meeting will be used to prioritize the implementation of actions in the plan. Participants then broke out into five groups of 6-10 people for the interactive portion of the meeting.

### Discussion Takeaways

After these discussions, each group shared the top three words they used during their discussions, as well as the main topic they discussed. The word cloud below represents the words that were reported, with larger words being mentioned more.



Participants shared that their conversations centered around topics like groundwater resources, infrastructure (communications and roads), and marshes. There were also discussions on how to support the most vulnerable in the community. Another topic of discussion was about how to

frame success, when so many actions/tasks seem overwhelming. It will be important to prioritize where capacity and resources are used and provide a clear implementation plan.

The following sections provide more detailed responses from the notes and individual packets collected from each participant.

### **Exercise 1 - Thinking about the Climate Action Plan**

Groups were asked to discuss the following questions at their table and record their thoughts and ideas.

1. *How do you define Climate Action?*
2. *What is the significance of Climate Action for the community of Arrowsic?*

Defining Climate Action:

- Response to impending change—both prepare for climate change and stop emissions.
- Intentional, proactive actions in response to scientific based changes in climate
- Issues are often interconnected—restoring marshes results in better flood protection for infrastructure. Need to prioritize actions that will have the greatest impacts.
- Mitigation of the impacts to our lives and the environment.
- Building a more sustainable future.
- Prevention of further temperature increase through stopping emissions now.

Needs/Concerns:

- Timeline for actions
- Strengthen local communication.
- Collaboration with neighboring communities
- Keep scope of actions manageable
- Do not redo work that has already been done.
- Collective, community-wide thinking/discussion/action
- Burnout in volunteer base, small population, and changing demographics make capacity building even more important. How can the Town enlist help—contracting work out, securing funding, collaborating with regional projects.
- Lack of control over state/regional jurisdictions
- Data on groundwater is important.
- Make sure that appropriate committees are pulled into planning and implementation planning.
- Ensure that plant life can survive and thrive in changing climate.

Values and Ideas:

- Align with goals for state of Maine
- Individual action matters, but also collaborating with neighboring communities.
- Prioritizing safety, and then protecting people's net worth (property, wells, septic)

- Access for first responders
- Protecting marshes, wildlife, and ecosystem function
- Include consideration of vulnerable groups, such as those who will need help during a power outage.
- Consider microgrids and creating an electrical grid capable of islanding.
- Strengthen communication between neighbors, first responders, etc.
- Roads, especially to Midcoast Hospital
- What’s needed for human-created environment (rising tide and causeway)
- Need timeline for actions.
- Strengthen local communication.

### Exercise 2 – Topic Prioritization

Groups were asked to spend some time discussing the broader topics/categories discussed in the Climate Action Plan and then vote on the ones they felt were most urgent or important, as well as any topics they felt were missing. Each participant was given three dots to distribute among the topics however they liked.

Roads & Bridges was the topic that received the most votes, followed by Groundwater Resources and Coastal Erosion and Marsh Migration. Many groups connected actions adapting to marsh migration to the resilience of transportation infrastructure. Several groups also highlighted the importance of maintaining roads to the ability of emergency services to respond/provide care. This underscores the urgency felt about the effect of sea level rise on roads, and how barriers to access undermine the community’s resilience during emergencies. Every topic received at least some votes, and many groups discussed the interconnectedness of each of these topics. See the following chart for the full results.



These rankings can be used to inform the organization and prioritization of each of the topics/issues that the plan addresses. Based on these results, the topics were reordered in the list below. Common themes were kept together (infrastructure, environmental resources, etc.) to preserve the progression of the sections. These results will also be used to prioritize the implementation table.

<b>Infrastructure</b>	<b>Roads &amp; Bridges</b>
	<b>Broadband &amp; Electric</b>
<b>Water Resources</b>	<b>Groundwater Resources</b>
	<b>Surface Water Resources</b>
<b>Environmental Resources</b>	<b>Coastal Erosion &amp; Marsh Migration</b>
	<b>Habitat Protection &amp; Species Change</b>
<b>Response &amp; Resilience</b>	<b>Emergency Response</b>
	<b>Community Resilience</b>
	<b>Public Health</b>
<b>Efficiency</b>	<b>Energy Efficiency</b>
	<b>Waste Efficiency</b>
<b>Housing &amp; Built Environments</b>	<b>Housing &amp; Built Environments</b>
<b>Governance</b>	<b>Regional Cooperation</b>
	<b>Town Policies/Ordinances</b>

### Exercise 3 – Prioritizing Actions

Finally, individuals were asked to select their top two actions from the recommendations in each section of the plan. Then, the groups came together to discuss their thoughts about the actions, as well as any additional actions or changes they wanted to suggest.

Below are the results tallied from the meeting packets that were collected at the end of the meeting, organized by section. These rankings will be used to create the implementation plan and to decide what actions are prioritized.

1 Surface Water Resources		Total	% of section votes
1.1	Prioritize conservation and management of significant freshwater habitat.	20	32.8%
1.2	Educate community members on best practices for limiting runoff, including maintaining healthy native plant buffers.	20	32.8%
1.3	Require new development to incorporate Low-Impact Development standards, limit the amount of impervious surfaces allowed.	13	21.3%
1.4	Restrict pesticide use on town owned property and roadways.	8	13.1%

2 Groundwater Resources		Total	% of section votes
2.1	Collaborate with regional efforts to understand impacts of saltwater intrusion.	23	39.7%
2.2	Update the existing 1989 Wellhead study. Capture location, depth, recharge rate, mineral levels (i.e. potassium), well history.	21	36.2%
2.3	Educate and encourage residents to adopt water conservation measures.	9	15.5%
2.4	Encourage homeowners to implement water recycling systems.	5	8.6%

3 Environmental Resources: Habitat Protection & Species Change		Total	% of section votes
3.1	Prioritize conservation of the most vulnerable habitat types in Arrowsic, such as riparian areas and land adjacent to salt marshes	22	37.9%
3.2	Adopt Stream Smart culvert requirements in new road projects and subdivisions.	15	25.9%
3.3	Understand Implications and work to reduce populations of potentially damaging species (e.g., woolly adelgid, green crabs)	8	13.8%
3.4	Conduct a natural resource inventory. Maintain data in a GIS format so it can be monitored, updated, and visualized over time.	7	12.1%
3.5	Encourage participation in existing citizen science projects to monitor species changes.	4	6.9%
3.6	Conduct more detailed soil studies to understand the impacts of climate change on the soil characteristics and plants they can support.	2	3.4%

4 Environmental Resources: Coastal Erosion & Marsh Migration		Total	% of section votes
4.1	Identify and conserve open land adjacent to priority wetlands.	28	52.8%
4.2	Consider adding a community science site to document change over time at priority wetlands.	19	35.8%
4.3	Study boat speeds around the island and impacts to the shoreline. Consider speed limit modifications.	6	11.3%

5 Waste Efficiency		Total	% of section votes
5.1	Create a resident education & outreach program.	22	48.9%
5.2	Invest in the Town's Composting Program.	14	31.1%
5.3	Create a Town Waste Efficiency Ordinance.	9	20.0%

6 Transportation & Infrastructure: Broadband & Electric		Total	% of section votes
6.1	Consider diversifying energy sources through community solar initiatives, especially projects that enable “islanding” during an outage.	28	54.9%
6.2	Petition Central Maine Power to reinforce lines in Arrowsic.	16	31.4%
6.3	Implement Broadband Plan for Town.	7	13.7%

7 Transportation & Infrastructure: Roads & Bridges		Total	% of section votes
7.1	Incorporate resilience to sea level rise into the Capital Improvement Plan, including installing culverts able to handle 3.9 ft of sea level rise by 2100, implementing stormwater management and/or raising road surfaces as a part of normal road improvements.	15	22.7%
7.2	Coordinate with Georgetown and Maine Department of Transportation on road improvement projects.	15	22.7%
7.3	Create an emergency response plan for flood scenarios and incorporate sea level rise and the Federal Emergency Management Act’s Flood Insurance Rate Maps (FIRM) into emergency planning.	13	19.7%
7.4	Adopt the Maine Coastal Program’s Coastwise Approach and Maine Audubon’s Stream Smart Crossing Guidelines as standard practice for culvert and bridge improvements. Identify vulnerable crossings and apply for DEP improvement funds.	11	16.7%
7.5	Encourage marsh restoration and resilience practices, both on Town lands (area near bridge) and on private properties.	11	16.7%
7.6	Educate private road owners about sea level rise impacts and Stream Smart culverts and other best practices for resilient road design.	1	1.5%
7.7	Create standards for new subdivisions roads that are candidates for Town adoption, which require incorporating sea level rise in the design process (including culvert design).	0	0.0%

8 Housing & Built Environments		Total	% of section votes
8.1	Develop shoreline erosion control standards for the Town. This could include native plantings or other natural stabilization measures.	16	30.2%
8.2	Map all private drives and incorporate this information into emergency services and planning.	14	26.4%
8.3	Adopt Low Impact Design standards for stormwater management, for both public and private infrastructure.	13	24.5%
8.4	Continue to participate in the National Flood Insurance Program	10	18.9%

9 Public Health		Total	% of section votes
9.1	Create a system for residents to report information about the spread of pests and disease in the community	11	22.0%
9.2	Coordinate with the AFD to ensure that vulnerable people are contacted during heat waves, power outages, or other emergencies.	23	46.0%
9.3	Understand various options for reducing populations of disease-carrying pests. Create programs to control the populations of these pests while balancing water quality standards.	16	32.0%



10 Community Resilience		Total	% of section votes
10.1	Develop a system to encourage neighbors to check in on neighbors during emergencies, and to provide aid to people who need it. This could include a phone tree or a “buddy program” to pair individuals in need with a check-in partner/neighbor.	25	43.9%
10.2	Maintain and strengthen channels of communication between committees. Consider implementing regular meetings or email updates between committee chairs.	15	26.3%
10.3	Incorporate chances for public input and workshops into community planning and projects at every possible step.	9	15.8%
10.4	Re-invigorate the Food Co-op.	6	10.5%
10.5	Have an annual upcycle/recycle party	2	3.5%

11 Governance: Regional Cooperation		Total	% of section votes
11.1	Consider regional renewable energy opportunities including solar, wind, and tidal.	23	40.4%
11.2	Coordinate with regional planning agencies and stay updated on ongoing projects, services, and collaborative programs.	14	24.6%
11.3	Consider regional transportation models including EV buses, ride sharing, commuting options.	11	19.3%
11.4	Consider inter-municipal cooperation.	7	12.3%
11.5	Attend regional training opportunities and report back to the appropriate committees.	2	3.5%

12 Governance: Town Policies/Ordinances		Total	% of section votes
12.1	Incorporate predicted climate change impacts for Arrowsic into all applicable plans the community creates in the future, including comprehensive plans, open space plans, etc.	24	49.0%
12.2	Evaluate budget and incorporate consideration of climate change impacts into the Town's financial values.	9	18.4%
12.3	Conduct an energy audit of Town buildings. Add foam insulation if needed	5	10.2%
12.4	Evaluate Town operations and develop operation policies that encourage water and energy conservation.	5	10.2%
12.5	Conduct a Town-wide greenhouse gas inventory.	4	8.2%
12.6	Adopt a purchasing standard for Town equipment, requiring new purchases to meet efficiency standards, such as Energy Star rated appliances.	2	4.1%

13 Energy Efficiency		Total	% of section votes
13.1	Provide information to residents about the savings available through Efficiency Maine credits for energy audits, insulation, and efficient appliance upgrades.	15	25.9%
13.2	Developing bike lanes/paths to encourage non-auto travel.	15	25.9%
13.3	Create guidance for weatherization of existing houses and structures and aid for weatherization for vulnerable households.	10	17.2%
13.4	Consider adopting the IECC 2021 "Stretch" building and energy efficiency code.	6	10.3%
13.5	Install EV charging locations at town hall/fire station.	6	10.3%
13.6	Keep track of energy use in Town buildings to understand use and be able to compare impacts of future improvements.	4	6.9%
13.7	Conduct energy audits of Town buildings with an Efficiency Maine approved contractor. Prioritize efficiency improvements to lower energy consumption and operating costs.	2	3.4%

14 Emergency Response		Total	% of section votes
14.1	Conduct a confidential survey of vulnerable households (e.g., older adults, people with life-sustaining equipment that uses electricity, those with mobility difficulties, etc.) to inform emergency response.	16	26.7%
14.2	Identify priorities for investment and identify funding opportunities to support these projects.	13	21.7%
14.3	Develop a non-emergency communications plan to incorporate updates from the AFD into Town communications and generate community awareness of AFD's volunteer needs.	8	13.3%
14.4	Create a Community Emergency Response Team (CERT).	6	10.0%
14.5	Designate an emergency alert official to join the Integrated Public Alert and Warning System (IPAWS).	6	10.0%
14.6	Create an Addressing Ordinance to set standard requirements for address signage for houses.	5	8.3%
14.7	Map private drives to make emergency response more efficient.	3	5.0%
14.8	Designate funding in the Town Budget for providing standardized/approved address stickers/ signs or create a program for residents to purchase signs from the town.	2	3.3%
14.9	Create an Addressing Committee.	1	1.7%

## Arrowsic 2021 Green House Gas Emissions

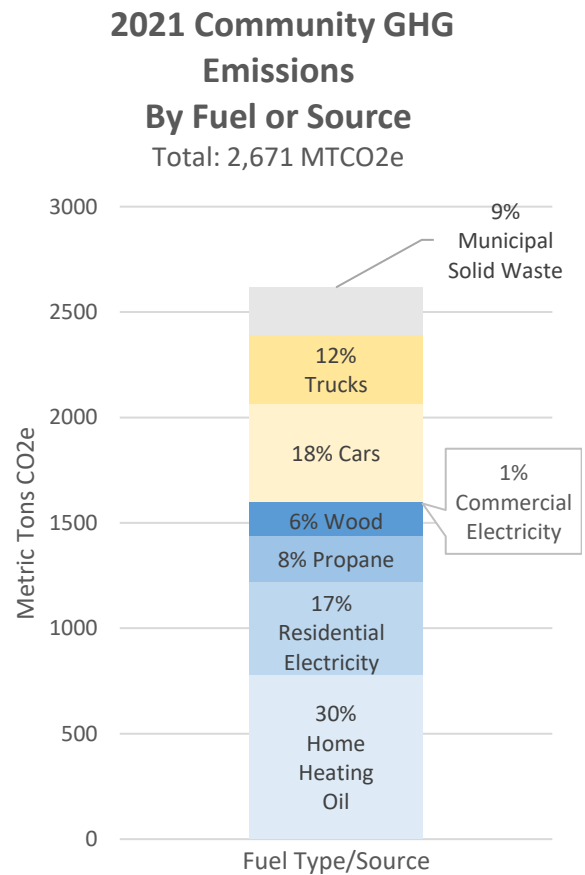
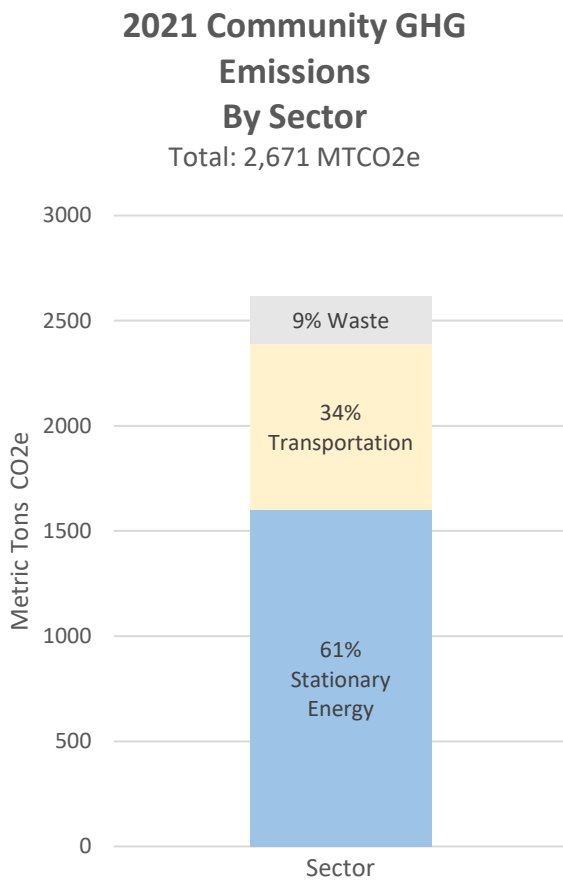
Creating a green houses gas (GHG) emissions inventory involves collecting data on activities that produce or contribute to greenhouse gas emissions such as fuel consumption, energy use, and waste generation. For Arrowsic, two types of inventories were completed.

Community-wide GHG Emissions Inventory which provides a snapshot of emissions generated by people living, working and visiting Arrowsic.

Municipal GHG Emissions Inventory which focused on energy use by Arrowsic’s municipal buildings.

### Results - Community-Wide Inventory:

- The primary drivers of Arrowsic’s GHG emissions are from the following sectors: stationary energy, transportation, and waste. These sectors can be broken down by the fuel type or source of emissions, and indicate that the two largest contributors are vehicles (30%) and residential heating oil (30%). These results are shown in the graphs below.



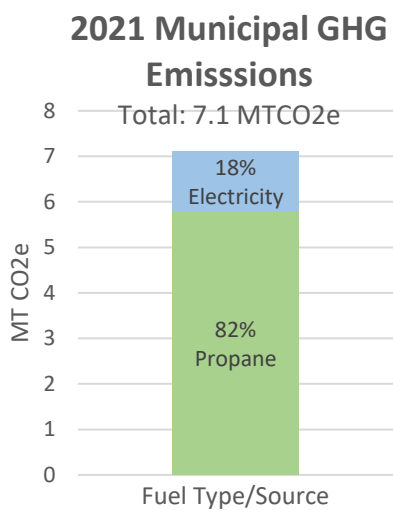
- Total metric tons of carbon dioxide emissions (MTCO2E) breakdown as follows:

Fuel Type/Source	MTCO2e
<u>Stationary Energy</u>	
Residential Heating Oil	782
Residential Electricity	438
Propane	220
Wood	145
Commercial Electricity	14
<u>Transportation</u>	
Cars	467
Trucks	327
<u>Municipal Solid Waste</u>	
	224
<b>TOTAL</b>	<b>2,617</b>

- Transportation data reflects trips by cars and trucks within Arrowsic, and to and from adjacent towns, and adjacent counties. This gives a reasonable picture of the regular trips by drivers to and from Arrowsic and moving within town borders. A total of 1,904,570 vehicle miles<sup>1</sup> were driven in 2021.
- Average daily traffic to and from Bath and Brunswick accounted for 44% of the total mileage, with an estimated 164 average daily trips between Arrowsic and Bath, and an estimated 89 average daily trips between Arrowsic and Brunswick.

**Results – Municipal Inventory:**

- Arrowsic uses propane and electricity to power their municipal operations. Total emissions do not make a significant contribution to Arrowsic’s total community GHG emissions. Breakdowns of the GHG emissions are as follows:



Fuel Type/Source	MTCO2e
<u>Stationary Energy</u>	
Propane	5.8
Electricity	1.3
<b>TOTAL</b>	<b>7.1</b>

<sup>1</sup> Vehicle Miles Traveled (VMT) measures the amount of travel for all vehicles in a geographic region over a given period of time, typically a one-year period.

**Methodology:**

This inventory was based on a protocol developed by the Southern Maine Planning and Development Commission<sup>2</sup> and modified to fit Arrowsic as a small, mainly residential community. The inventory excluded some sectors commonly found in a community-wide inventory such as an in-depth survey of commercial/industrial energy use, commercial vehicles, and commercial/industrial waste because emissions under these categories would be insignificant because of the low level of activity within these sectors.

The year 2021 was used as the baseline year because that was the most recent year the majority of the data was available.

Calculations were done using ClearPath, a leading online software platform for completing greenhouse gas inventories.

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<sup>2</sup> Greenhouse Gas Inventory Protocol for Southern Maine Cities and Towns. Southern Maine Planning and Development Commission, September 2021.