13 DRAFT Pathways for Adaptation and Building Resilience in Natural and Working Lands, Pathway B: Adaptation - 10-26-21

**Pathways for Adaptation and Building Resilience in Natural and Working Lands**

**Pathway B: Adaptation: Sustain, restore, and enhance the health and function of Vermont's natural and working lands to help both natural and human communities adapt to climate change**

This pathway includes strategies and actions that bring science-based, technical and traditional knowledge to bear on management of natural and working lands to absorb and recover from the impacts of climate change. The increased incidence of drought, extreme precipitation events, and changes in temperature patterns associated with climate change in Vermont have already begun to be negatively impacted farms and wildlands. At the same time, features of Vermont’s natural and working landscapes have absorbed and reduced climate-risks, such as the impacts of extreme precipitation and associated floods. Broadly, the strategies that the State of Vermont must take to secure the health, resilience, and benefits of climate adaptation in natural and working lands include critical investments in the upfront costs of proactive implementation of adaptation practices, research and training to support land managers in making climate informed plans and decisions, active integration of traditional ecological knowledge with science-based knowledge, innovative funding mechanisms to enable adaptation and resilience, greater support for floodplain and riparian restoration efforts, and protection of biodiversity.

**Key Strategies & actions:**

1. **Increase technical assistance, capacity, education, and resources to support private and municipal forestland owners, planners and managers for climate change adaptation.** Farms and forests have already been impacted by the increasingly extreme weather associated with a changing climate, and though the majority of Vermont farmers understand their vulnerability to the extreme weather associated with climate change, they report a lack of financial capacity and technical skills to adequately address climate-related risks and invest in adaptation[[1]](#footnote-1). Outreach, education, and technical assistance will enable Vermont’s land managers to better anticipate, prepare for, respond to, and recover from the impacts of climate change. Farmers and foresters already seek out this kind of advice from UVM Extension and technical assistants, but climate programming is soft-funded and dependent on competition with national grant opportunities. To meet the needs of Vermont’s land managers in adapting to the impacts of climate change, dedicated funding to provide consistent expertise, education and assistance is essential.
2. Enhance and support funding for technical assistance to farmers (e.g. fully fund UVM Extension), landowners (e.g. fund climate adaptation training through FPR’s Forests & Climate program), and municipalities (e.g. fully implement Act 171)
3. Increase funding to Regional Planning Commissions (RPCs) to hire and support natural resource staff.
4. Develop & fund climate adaptation planning and training for all farmers and foresters.

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| *Preliminary Assessment of Strategy against Criteria* |
| *Impact:* Education and training for farmers and foresters will have a significant positive impact on adoption of climate adaptation practices and planning among land manager. |
| *Equity:* To enhance equity of this strategy, traditionally underserved communities can be consulted during the design of trainings, and then targeted programming can be developed to meet contextually specific needs. |
| *Cost-effectiveness*: Proactively investing in climate adaptation on natural and working lands costs far less than the cost of recovering and rebuilding from climate damage, and is extremely cost effective. |
| *Co-Benefits:* This strategy is primary focused on resilience and adaptation but will have mitigation benefits of carbon sequestration, as well as biodiversity, water quality, soil conservation, buffering damage to downstream built communities, create jobs in rural communities, enhance sustainability of rural and working livelihoods, and reach impacted communities, |
| *Technical Feasibility*: Yes |

1. **Promote and incentivize Climate-Adaptation forest management practices.** Integrating climate change adaptation considerations into planning and forest management can help reduce climate-related risks, such as declines in forest productivity, losses in forest cover and biodiversity, and changes in ecological processes. However, Vermont’s forest managers need to know what those options are and how to implement them, as well as have the financial capacity to adopt new measures. Resources on climate adaptation for northern forests have already been developed in part by regional efforts such at the USDA Climate Hubs which can be used to create locally specific guidance[[2]](#footnote-2). Practice-based cost-share incentive programs are needed to enable manager to make changes and adopt new practices.
2. Develop education/outreach materials and training regarding climate-adaptation forestry, with a focus on planting future climate adapted tree (and crop) species for private landowners and caretakers
3. Create state guide to maintaining and creating resilient forests
4. Develop a ‘pay-for-practice’ incentive program and explore state tax policy incentives for forest landowners and farmers to adopt climate adaptive management practices

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| *Preliminary Assessment of Strategy against Criteria* |
| *Impact:* Education and support foresters will have a significant positive impact on adoption of climate adaptation practices and planning in forests. |
| *Equity:* To enhance equity of this strategy, traditionally underserved communities can be consulted during the design of trainings, and then targeted programming can be developed to meet contextually specific needs. Incentive programs can offer differentiated rates and enrollment preference to address equity. |
| *Cost-effectiveness*: Proactively investing in climate adaptation on natural and working lands costs far less than the cost of recovering and rebuilding from climate damage, and is extremely cost effective. |
| *Co-Benefits:* This strategy is primary focused on resilience and adaptation in forests but will have mitigation benefits of carbon sequestration, as well as biodiversity, water quality, soil conservation, buffering damage to downstream built communities, create jobs in rural communities, enhance sustainability of rural and working livelihoods, and reach impacted communities, |
| *Technical Feasibility*: Yes |

1. **Promote funding for nature-based solutions and traditional ecological knowledge efforts and incorporate into state funding and planning efforts.** Nature-based solutions and traditional ecological knowledge systems are knowledge domains that are leveraged to address climate change adaptation around the world. Integrating this expertise will have a positive impact on climate adaptation and resilience in Vermont. Nature-based solutions [[3]](#footnote-3) **protect, sustainably manage, and restore natural and modified ecosystems in ways that simultaneously address climate change, protect biodiversity and support human well-being.** Traditional ecological knowledge (TEK) is increasingly recognized as playing an important, and sometimes central, role in climate adaptation initiatives[[4]](#footnote-4). Defined as ‘a cumulative body of knowledge, practice, and belief, evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment’, TEK can support detection of environmental changes, the development of adaptation strategies, and offer guidance or inspiration for cultural and psychological shifts in how society relates to nature.
2. Complete a statewide audit of technical assistance, funding and regulatory programs to review support for nature-based solutions and traditional ecological knowledge and assess the degree to which they support or hinder climate adaptation, and use the findings to create planning and/or funding prioritization criteria that better align state programs
3. Develop financial mechanisms (e.g. a revolving loan fund, green bank, loan guarantees, pension fund investments, etc.) to de-risk capital investment in and support for nature-based solutions and traditional ecological knowledge (TEK) projects
4. Elevate the role traditional ecological knowledge (TEK) plays in climate adaptation and resilience and incorporate TEK into state-led climate assessments, planning efforts, and prioritization frameworks
5. Elevate and incentivize nature-based solutions and traditional ecological knowledge (TEK) in funding programs at ANR, AOT and AAFM
6. Include Tribal members, traditional ecological knowledge traditional ecological knowledge (TEK), youth in state, regional and municipal resource management planning

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| *Preliminary Assessment of Strategy against Criteria* |
| *Impact:* Investments in nature based solutions and TEK can have a significant positive impact on both the climate resilience of our communities and infrastructure and the adaption of both aquatic and terrestrial species and natural communities. |
| *Equity:* Local indigenous experts should be compensated for consulting the state on integration of TEK. The way TEK is integrated should be approached with culturally sensitive approaches to knowledge exchange and communication. |
| *Cost-effectiveness*: Mitigating major flood damage and losses of biodiversity through investment in natural solutions and TEK is extremely cost effective. |
| *Co-Benefits:* This strategy is primary focused on resilience and adaptation in forests but will have mitigation benefits of carbon sequestration, as well as biodiversity, water quality, soil conservation, buffering damage to downstream built communities, create jobs in rural communities, enhance sustainability of rural and working livelihoods, and reach impacted communities |
| *Technical Feasibility*: Yes |

1. **Manage natural and working lands for biodiversity, forest health and climate resilience.** The reality of a changing climate and a changing world means that working lands biodiversity, forest health and climate resilience must be protected, cultivated and actively managed for. Enhancements in soil health and increases in vegetative cover will slow overland water velocity and increase infiltration, and therefore mitigate downstream flood surges. While some management practices are well understood in their impacts on resilience, research is needed on new and emerging climate adaptation practices in working and wild lands. The cost of implementation of adaptation practices limits the degree to which land managers can make changes with biodiversity and climate resilience in mind. The impacts of severe weather events have already proved devastating to farms, and Vermont farmers report a lack of financial capacity to adequately address climate-related risks and invest in adaptation[[5]](#footnote-5). The same is likely true for Vermont forest managers, many of whom are farmers. Resilience funds have been identified as helpful for recovery but they are currently underdeveloped and under resourced.
2. Fund increased investment in healthy soils education and implementation of practices
3. Enhance resilience funds to support the financial capacity of land managers to respond and adapt to natural hazard and climate impacts
4. Fund and support for local academic institutions, researchers and applied research to evaluate best climate management practices for natural and working lands
5. Fund and support research efforts to better understand forest ecosystems, local climate change and impacts to forests and ecosystem services
6. Incentivize and provide appropriate support for invasive species control efforts, specifically where populations threaten the perpetuation of forest cover
7. Protect forest health and biodiversity through direction to VT Fish & Wildlife programs and promotion as a primary objective of state and municipal lands in UVA

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| *Preliminary Assessment of Strategy against Criteria* |
| *Impact:* Investing in the management of natural and working lands for climate resilience will have significant climate adaptation and resilience benefits to both landscapes and downstream built communities. |
| *Equity:* Can be an equitable strategy provided investments are made and there is a willing landowner who is compensated fairly. To enhance equity of this strategy, impacts communities can be consulted during the development of programs or RFPs, and then targeted programming can be developed to meet contextually specific needs of impacted communities. Incentive programs can offer differentiated rates and enrollment preference to address equity. |
| *Cost-effectiveness*: Mitigating flood damage, irreparable biodiversity loss, and farm colures through proactive investment in natural solutions is extremely cost effective when compared to the cost of doing nothing. |
| *Co-Benefits:* This strategy is primary focused on resilience and adaptation but will have mitigation benefits of carbon sequestration, as well as biodiversity, water quality, soil conservation, buffering damage to downstream built communities, create jobs in rural communities, enhance sustainability of rural and working livelihoods, and reach impacted communities. |
| *Technical Feasibility*: Yes |

1. **Plan and regulate for climate resilience and adaptation.** The integration of a ‘climate lens’ across existing state planning and regulations can help meet the GWSA’s resilience and adaptation goals. Likewise increasing an awareness of other climate change efforts and climate action across state agencies and employees, and creating power-balanced spaces for communication among staff from multiple levels could increase synergy among goals and work across the State of Vermont agencies who will implement the recommendations of the climate action plan.
2. Establish "climate resilience zones" informed by existing data, bolstered with new research/science, to identify locations that have high resilience potential for both the natural and built environments and use to inform land use development and regulations
3. Per the formula in statute, fully fund Regional Planning Commissions (RPC)
4. Consider reviving the State’s Central Planning Office to better, more comprehensively address land use and land use changes that support healthy natural and human communities and align state programs. This could offer an entity to create and help implement a state-wide plan, provide state wide perspective, and harmonize across RPAs and municipal offices. Examples to look at include the state hazard mitigation plan, comprehensive energy plan, state outdoor recreation plan.  However, because the role of a state planning office is unclear and without a clear scope or legislative action to establish a state land use plan, planning could be better and more effective when managed by a lead state agency with support from other agencies.  As well, a centralized approach diminishes community influence and local control, leaving a new entity that could be less accessible to local Vermonters. \*
5. Create an Interagency Office of Climate to coordinate implementation of climate change action across agencies. The office will include representatives from each agency implicated in the CAP, and have one secretary that answers directly to the governor, with an oversight board or committee with representatives from the NWL economy, NGOs and academia to inform and steer the process. This concept shares similarities with the role of the existing Climate Coucil, but expands it. One role of the office would be to coordinate work across agencies, buffer potential power dynamics among agencies, and create a group outside state agencies that is intergovernmental at the Cabinet level to make permanent what the VCC started. However, the creation of another state office should be addressed cautiously, lest it unnecessarily create delays and burdensome oversight. And the role of this new entity would need to be well defined vis a vis the many climate responsibilities of many agencies. Simply extending the charge of the existing VCC, which features greater citizen/legislative involvement, could be a better mechanism than a new office. \*

\* *Indicates that the subcommittee was not in full consensus on this strategy, though it was ranked high enough to be elevated to the plan document. Key considerations from our deliberations are included.*

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| *Preliminary Assessment of Strategy against Criteria* |
| *Impact:* Identifying and protecting resilience zones will have significant climate adaptation and resilience benefits to both landscapes and downstream built communities. Greater climate awareness and coordination among agency staff may have impacts on climate adaptation and mitigation efforts |
| *Equity:* Inclusion of more voices and paying to power dynamics in the implementation of climate policy and programs embodies procedural equity . |
| *Cost-effectiveness*: This strategy has the potential to be very cost effective, in that it draws on exiting efforts and structures, and may create synergy and efficiency through better government coordination on climate change, and climate informed planning. |
| *Co-Benefits:* Equity, resilience, education, potentially others |
| *Technical Feasibility*: Yes |

1. **Increase flood resilience of the natural and built environments.** Vermont has a long history of major flood events; however, in recent years these events have become more common, more widespread and more severe due to climate change. (*Insert data from Lauren Oates re flooding #/severity/$cost over last decade*). These trends will continue so Vermont must plan for flood resilient human and natural communities and invest in and maintain our intact landscape to leverage nature based solutions that mitigate the impacts of severe flooding.
   1. Invest transportation funding in improving flood resilience and aquatic and terrestrial connectivity.
   2. Incentivize water storage in natural areas to promote flood resilience and biodiversity through expansion of wetland easements to better compensate landowners/managers.
   3. Ensure opportunities for floodplain reconnection and nature-based solutions are considered a high priority in the Statewide Conservation & Buyout Program through incorporation of multi-stakeholder developed prioritization criteria.

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| *Preliminary Assessment of Strategy against Criteria* |
| *Impact:* Increasing flood resilience through investments in nature based solutions can have a significant positive impact on both the climate resilience of our communities and infrastructure and the adaption of both aquatic and terrestrial species and natural communities. |
| *Equity:* Can be an equitable strategy provided investments are made where there is a willing landowner who is compensated fairly. |
| *Cost-effectiveness*: Mitigating major flood damage on Vermont’s built environment and natural communities through investment in natural solutions is extremely cost effective. |
| *Co-Benefits:* This strategy is primary focused on resilience and adaptation but will often have mitigation benefits, especially when areas are maintained or restored to a natural condition where trees, shrubs and other vegetation can sequester and store carbon at a higher rate than the baseline. |
| *Technical Feasibility*: Yes |

1. **Increase vegetative growth in riparian areas.**  Riparian areas can be defined as a zone of interaction and influence between aquatic and terrestrial ecosystems along streams, rivers, lakes, wetlands and other waterbodies (RSTC 2007). These areas perform important ecological functions which link aquatic and terrestrial ecosystems and thereby support unique habitats, natural communities and high biological diversity (RSTC 2007, ANR 2005).[[6]](#footnote-6). Riparian areas function as terrestrial wildlife habitat and travel corridors connecting larger areas of intact habitat. These corridors are critical for the species migration that climate adaptation necessitates. Riparian areas also maintain high quality aquatic habitat by protecting water quality and by providing shade, organic matter and structure necessary for healthy aquatic systems.
   1. Expand support for riparian buffer enhancements to easements.
   2. Support and fund research and design to strategically invest in floodplain and river corridor reforestation efforts.

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| *Preliminary Assessment of Strategy against Criteria* |
| *Impact:* Can maintain or increase the functions and values of riparian areas across the state leading to a more resilient and adaptive landscape for a wide range of species. |
| *Equity:* Can provide additional funding for landowners interested in protecting riparian areas but may result in some loss of use by other landowners in riparian areas. |
| *Cost-effectiveness*:The additive cost of riparian provisions in easements and the cost of riparian restoration is relatively low and the benefits can be great. |
| *Co-Benefits:* Vegetated riparian areas enable ecological adaptation to climate change, improve the resilience of our communities, and provide some mitigation benefits through the growth and maintenance of trees, shrubs and plants; there are also water quality benefits. |
| *Technical Feasibility*: Yes |

1. **Promote healthy, connected river corridors and floodplains.**  A river corridor is the land area adjacent to a river that is required to accommodate the dimensions, slope, planform, and buffer of the naturally stable channel and that is necessary for the natural maintenance or natural restoration of a dynamic equilibrium condition… and for minimization of fluvial erosion hazards.[[7]](#footnote-7) Floodplains are the areas adjacent to rivers where inundation flooding occurs during high flow events, which are increasing in frequency and intensity due to climate change. Both the inundation flooding of floodplains and the dynamic fluvial erosion hazards associated with river corridors pose a risk to health and safety when homes, transportation corridors or other permanent infrastructure is sited too close to a river. Minimizing new encroachments in these areas helps to maintain adequate connections between a river and its floodplain and sufficient room for river corridors to meander overtime, without resulting in costly and potentially life-threatening impacts.
   1. Develop an inventory of priority/critical headwater and floodplain storage areas, prioritize investments for restoration and protection in these areas, and use to inform Compact Settlement planning efforts.

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| *Preliminary Assessment of Strategy against Criteria* |
| *Impact:* Identifying areas with critical floodplain and river corridor function to inform land use planning, conservation and regulatory efforts can result in river systems that have the room to safely flood and meander, reducing impacts on homes, infrastructure and other costly investments, resulting in a more resilient landscape. |
| *Equity:* If the identification of these critical areas ultimately results in a loss of certain land use or development rights, landowners will need to be compensated in a fair and equitable manner. |
| *Cost-effectiveness*: Identification of these critical areas through remote sensing and analysis is relatively cost-effective, but will require some investment in state agencies, universities or consultants to conduct the work. Site specific analysis will be more costly. However, if inundation flooding or significant fluvial erosion can is avoided through this strategy, the magnitude of savings to the state and individual landowners far exceeds the cost. |
| *Co-Benefits:* This strategy primarily has resilience and adaptation benefits, but if critical areas are identified and retained in a natural condition, they may reforest or otherwise see an increase in carbon sequestration and storage resulting in mitigation benefits. |
| *Technical Feasibility*: Yes |

1. No actions where prioritized here, so unsure if we include this strategy or not?

**Increase support for wetland restoration and protection.** The carbon budget developed for the Vermont Climate Council confirms wetlands are a net carbon sink. In addition to these mitigation benefits, wetlands absorb stormwater during heavy rain and flooding events and provide important habitat for a range of species adapting to climate change. (Insert Lauren Oates states from Otter Creek wetlands and TS Irene) In Vermont, wetlands enjoy significant regulatory protection and benefit from a host of conservation programs; however, opportunities exist to do more.

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| *Preliminary Assessment of Strategy against Criteria* |
| *Impact:* Wetlands are highly protected but expanded conservation and restoration efforts will yield increased impacts over the baseline. |
| *Equity:* Generally these areas have low commercial potential and are valued for their ecological, recreation and aesthetic qualities, so expanded protections are likely equitable. |
| *Cost-effectiveness*: Wetland protection and restoration is generally a cost-effective endeavor. |
| *Co-Benefits:* Wetlands support climate mitigation, adaptation and resilience. |
| *Technical Feasibility*: Yes |

**Glossary of Terms**

**Adaptation:** Adaptation refers to action to prepare for and adjust to new conditions, thereby reducing harm or taking advantage of new opportunities. [[8]](#footnote-8)

**Resilience:** A capability to anticipate, prepare for, respond to, and recover from significant multi-hazard threats with minimum damage to social well-being, the economy, and the environment.[[9]](#footnote-9)

**Traditional ecological knowledge:** A cumulative body of knowledge, practice, and belief, evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment [[10]](#footnote-10)

**Nature-based solutions: actions to protect, sustainably manage, and restore natural and modified ecosystems that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits**[[11]](#footnote-11)**.**

1. White, A., J. Faulkner, S. Sims, P. Tucker, and K. Weatherhogg. "Report of the 2017–2018 New England Adaptation Survey for Vegetable and Fruit Growers." *Department of Plant and Soil Science, University of Vermont, Burlington* (2018). [↑](#footnote-ref-1)
2. https://www.climatehubs.usda.gov/sites/default/files/USDA%20FS\_2016%20Forest%20Adaptation%20Resources\_GTR\_NRS87-2.pdf [↑](#footnote-ref-2)
3. https://www.iucn.org/theme/nature-based-solutions [↑](#footnote-ref-3)
4. https://www.fs.fed.us/pnw/pubs/pnw\_gtr879.pdf [↑](#footnote-ref-4)
5. White, A., J. Faulkner, S. Sims, P. Tucker, and K. Weatherhogg. "Report of the 2017–2018 New England Adaptation Survey for Vegetable and Fruit Growers." *Department of Plant and Soil Science, University of Vermont, Burlington* (2018). [↑](#footnote-ref-5)
6. https://vtfishandwildlife.com/sites/fishandwildlife/files/documents/Conserve/RegulatoryReview/Guidelines/Riparian\_Management\_Guidelines\_ANR\_Lands\_2015.pdf [↑](#footnote-ref-6)
7. https://floodready.vermont.gov/flood\_protection/river\_corridors\_floodplains/river\_corridors [↑](#footnote-ref-7)
8. Bierbaum et al. 2014 . Third National Climate Assessment https://nca2014.globalchange.gov/report/response-strategies/adaptation [↑](#footnote-ref-8)
9. USGCRP. Glossary. https://www.globalchange.gov/climate-change/glossary [↑](#footnote-ref-9)
10. Fikret Berkes, resilience scholar. See https://www.fs.fed.us/pnw/pubs/pnw\_gtr879.pdf [↑](#footnote-ref-10)
11. https://www.iucn.org/theme/nature-based-solutions [↑](#footnote-ref-11)