RISE

Resilience Innovations

2024 RIVERINE COMMUNITY RESILIENCE CHALLENGE

APPLICATION DEADLINE: MAY 6, 2024, 2PM EST
ALL INQUIRIES SHOULD BE DIRECTED TO INFO@RISERESILIENCE.ORG

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Overview

As climate change brings more frequent and intense storms, riverine communities are increasingly vulnerable to unique flood threats that can change lives in an instant. On August 30, 2021, Hurley, Virginia, experienced severe consequences when 7 inches of rainfall from the remnants of Hurricane Ida led to a riverine flood that tragically took one life, destroyed 19 homes, and severely damaged 24 more. Less than a year later, on July 12, 2022, similar circumstances struck Whitewood and Pilgrims Knob in Virginia. Though no lives were lost in this latter event, the storm led to the destruction of 21 homes and damage to 25 others.

In both instances, FEMA did not provide individual homeowner assistance, and few affected residents received insurance payouts.

The hazards of such events are multifaceted, including heavy rain, strong winds, high and swift waters, and mudslides. These natural forces can cause significant damage to buildings, potentially leading to destruction, injuries, or fatalities. Furthermore, they often result in large quantities of debris, the collection and removal of which are not only costly but also time-consuming, adding to the challenges faced by impacted communities.

Before a disaster, communities need several key preparations to mitigate the impact of flooding:

- ***Affordable Building Protection:*** Implementing cost-effective measures to make buildings more flood resistant.
- ***Early Warning Systems:*** Establishing awareness and alert mechanisms for imminent flooding threats, including varying threat levels.
- ***Pre-Event Coordination Plan:*** Developing a swift and efficient coordination plan that can be activated immediately after a flooding event. This plan will support relief efforts and help meet residents' needs at various stages after an event.
- ***Insurance Programs:*** Having insurance options in place to aid residents in managing the disruptions caused by flooding, and to support home repair or rebuilding efforts post-event.

After a disaster, the focus shifts to recovery and reinforcement:

- ***Rebuilding and Repair Funds:*** Securing access to funds for repairing or rebuilding damaged properties within a set timeframe, ideally supported by a sustainable risk transfer insurance model.
- ***Support for Residents' Recovery:*** Often residents require support to find shelter, food, and other needs after an event. Understanding those needs will be an important part of this Challenge.
- ***Guidance for Resilient Reconstruction:*** Offering expertise and guidance in repairing or rebuilding damaged buildings to better withstand future flooding events.

The RISE Riverine Community Resilience Challenge aims to source innovative solutions that support comprehensive pre- and post-disaster protection for the entire Southwest region of Virginia, including areas within LENOWISCO PDC, Cumberland Plateau PDC, Mount Rogers PDC, and the New River Valley Regional Commission by addressing the range of needs described above.

With its rich biodiversity and socio-economic fabric, Southwest Virginia offers a unique pilot site for developing, testing, and refining innovative solutions that enhance environmental adaptability. Innovators have a rare opportunity to validate their technologies in real-world conditions, ensuring their solutions are both effective and scalable across different ecosystems and cultures.

Below are Challenge Topic Area descriptions, including links to related regional flooding analyses and datasets for download.

Following this initial Challenge, a subsequent effort will aim to broaden the impact and application of solutions, further strengthening disaster preparedness and resilience throughout Southwest Virginia

Topic Areas

Flood Event Early Warning

Riverine Flooding Early Warning Problem(s)

Forecasting riverine flooding is a topic of interest nationally and internationally. According to recent research, from 2000 to 2018, 5338 water-related disasters have been reported and have led to over 326,000 fatalities and economic losses of more than USD 1.7 trillion globally. The UN Sendai Framework for Disaster Risk Reduction is an international effort with 4 priorities:

- Understanding disaster risk
- Strengthening disaster risk governance to manage disaster risk
- Investing in disaster risk reduction for resilience
- Enhancing disaster preparedness for effective response, and to "Build Back Better" in recovery, rehabilitation and reconstruction

In the US recently, several events focused attention on riverine flooding:

- In Hurley, Buchanan County, Virginia, on August 30th, 2021, within hours, 7" of rain caused life-threatening flash flooding that damaged or destroyed homes, roads, and bridges. $17M relief funding was secured.
- In Whitewood, Buchanan County, Virginia, on July 12th, 2022, within hours, 6"+ of rain caused life-threatening flash flooding that destroyed 21 homes and damaged 25 more. $18M relief funding was secured.
- Record heavy rain from 9th to 11th July 2023 triggered the worst flooding seen in the state of Vermont, USA, since Tropical Storm Irene in 2011.

Riverine flooding events are getting more severe and frequent. There is a need for accurate, timely, advance warning to protect the communities. Solutions being sought in this topic will meet some of the priorities of the Sendai Framework thereby having potentially international application.

The goals in this Topic Area are:

1. To produce localized (community-by-community) forecasts of flooding events that will give communities adequate forewarning of severe (pluvial induced) riverine flooding allowing residents and emergency services time to either evacuate or prepare for the event and the recovery thereafter. In the event evacuation is possible or recommended, evacuation direction guidance is needed.
2. Provide regional planners, municipalities, and state agencies with information and suitable information distribution tools and protocols and with which to manage land use, and plan.
3. Provide guidance for identifying those parcels threatened by significant flooding that should not be built on or, if they are, alerting owners.

Successful solutions will address at least one of the above.

The Pain Points in Current Solutions

The need for flood early warning systems has become greater in the past years. The elements and limitations of current programs as well the needs for new generations have been described in the literature. In order to produce a flood early warning system for the riverine communities advances are required in all four areas:

1. ***Risk knowledge:*** Understanding the nature of riverine flooding in terms of duration, water levels, water speeds, and other hazards.
2. ***Monitoring and forecasting:*** Since most of these events are caused or exacerbated by heavy rainfall events, the inclusion of meteorological observations and forecasts, as well as other sensor information, will be critical to feed the necessary analysis models which will lead to hazard assessment and prediction.
3. ***Warning, dissemination, and communication:*** Applying analysis results to identify hazardous events (location, severity, and duration) and producing and delivering meaningful and timely information and guidance.
4. ***Response:*** Recipients of the warnings need them in a timely and manageable manner and know and understand the necessary responses. Past warning systems (and their distributed warnings) have been seen to cause system overload, confusion, and lack of clarity within the emergency management organizations as well as residents.

There are needs for further development, integration and testing in all these four areas for a flood early warning system for the riverine communities.

The National Weather Service's Flood Hazard Outlook (FHO), while a valuable tool, exhibits several limitations in its application as a riverine flooding early warning system:

1. ***Lack of Localized Flood Risk Details:*** The FHO does not provide specific information on localized flood risks. This is a significant limitation for communities and emergency responders who need detailed, area-specific data to adequately prepare and respond to flood threats.
2. ***Non-representative Graphics:*** The graphics included in the FHO do not accurately represent the actual extent or expected footprint of flooding. This lack of precise visual representation can lead to misinterpretation of the flood threat in specific areas, potentially causing inadequate preparation or response.
3. ***Limited Communication Infrastructure in Target Areas:*** Many riverine environments, particularly those most vulnerable to flooding, lack basic communication infrastructure like telephones, cell networks, or cable systems. This impedes the dissemination of FHO information to the communities that need it most, reducing the overall effectiveness of the warning system in real-time situations.

These points highlight critical areas where the FHO falls short in providing an optimal solution for early warning in riverine flooding scenarios.

Solutions Being Sought

RISE is seeking solutions to produce localized, accurate, and rapidly updated forecasts to warn communities of impending threats, provide evacuation guidance, and can communicate the information and guidance in real-time to the communities.

Successful end-to-end solutions will provide:

- Identification of flooding affected regions from 12 hours before pluvial-induced flooding events, continuously updated through the passage of the rainfall activity.
- Generation of flood event warnings and the development of a warning-generation protocol to keep potentially affected regions aware of threats.
- Inclusion of communication infrastructure to ensure that messages/data get transferred to required personnel in a timely manner.
- Protocols for actions to messages for all constituents (e.g., emergency managers, rescue squads, first responders, etc.).

It is understood that various districts' emergency management systems operate in different ways. Flexibility will have to be built into solutions for adaptability to different departments and regions. To accommodate this, selected winners will have access to emergency personnel within chosen pilot site regions who will assist in providing guidance in the design of the information requirements and concept of operation.

Data Available Upon Request

Some data that may be useful or helpful:

- Weather: The High-Resolution Rapid Refresh (HRRR). Other NOAA/NWS products may be used as applicants see fit.
- Topography: The Virginia LiDAR Inventory Web Mapping Application for the State of Virginia.
- Hurley flood event modeling: Hurley (Data sets available upon request.)
- LENOWISCO report by UVA.
- LENOWISCO CEDS report.

Landscape and Building Adaptation

The Landscape and Building Adaptation Problem(s)

Building adaptation strategies are increasingly recognized as crucial for mitigating the impacts of flooding. Modeling has shown that in the absence of building adaptation, nationwide damages from riverine flooding will increase by 20%–30% under high levels of global warming. In the past, four types of flood adaptations for buildings have been the focus of attention:

1. ***Dry Floodproofing:*** This method involves making the flood-exposed areas of a building watertight to prevent water inundation. It is typically suitable for flood events up to 3 feet, corresponding to a 1% Annual Exceedance Probability (AEP). Dry floodproofing is an effective way to protect the interior of a building from flood damage.
2. ***Wet Floodproofing:*** This approach includes measures that allow floodwaters to enter the structure but minimize potential damage. It's not always applicable in mountainous riverine environments due to technical constraints. However, advancements in building design and adaptation may broaden the applicability of wet floodproofing in these areas.
3. ***Building Elevation:*** Elevating a structure above the designated flood elevation level is another effective adaptation strategy. It is more straightforward for buildings with basements other than those on slab foundations. Building elevation is typically considered for flood events up to 8 feet (1% AEP).
4. ***Buyout/Demolition:*** For properties facing more than eight feet of flooding (1% AEP), structural solutions like floodproofing and elevation may become impractical. In such cases, buyout or demolition is often the only viable option to mitigate risk.

Post-flood, events frequently result in significant landscape changes, impacting the suitability of certain areas for rebuilding. Recognizing this, there's a growing consensus that some land parcels are no longer fit for traditional construction. Identifying the most beneficial post-flood use for these areas presents a challenge. Potential solutions include repurposing them into green spaces or community amenities, which are less infrastructure-intensive and more flood-resilient. Alternatively, these areas could serve as testing grounds for innovative building methods designed to withstand flooding.

Adopting such adaptive building strategies not only addresses the immediate effects of flooding but also bolsters long-term resilience and sustainability in areas vulnerable to water-related disasters. Tailoring these strategies to fit the unique environmental and topographical features of each location ensures that they provide the most effective defense against future flooding events. This approach aids in safeguarding communities while maintaining the ecological balance and aesthetic value of the landscape.

While it is understood that building adaptation can only withstand up to a certain level of flooding threat, using building adaptation as an approach to risk mitigation will, if successful, have an effect of lowering the total cost of risk transfer (insurance) for a community. This is an important aspect of this topic area and will be a key finding of winners' solutions.

Landscape adaptations are also of interest in this topic, particularly those that are needed to either enhance or support the building adaptations or provide other protection to surrounding buildings or property.

The Pain Points in Current Solutions

While there are several physical constraints in deciding the best building adaptation approach (on a parcel-by-parcel basis), cost is an important driver. One approach is to perform a benefit-cost analysis of implementing flood adaptations on each property. A good description of the Benefit-Cost Analysis of Flood Protection Measures states:

> *"....benefits are defined as damages avoided; therefore, the benefits of a project are equal to the damages without the project minus the damages with the project. If the project is technically sound, the damages with the project should be less than the damages without it and the net benefits will be positive.*
>
> *Most flood damage is physical and includes structural damage to buildings, loss of contents in those buildings, damage to infrastructure, and damage to special or unique facilities. Nonphysical damage includes income loss for wages and profits to businesses, emergency response, temporary relocation, and post-flood cleanup.*
>
> *Flood protection projects can be one or a combination of flood barriers (levees and floodwalls), building elevation, building relocation, and floodproofing. The costs of the project are mainly the capital cost of construction and O&M costs consisting of periodic inspection, preventive maintenance, and repairs throughout the useful life of the project."*

In addition, a summary of unit costs for dry floodproofing and elevation are available here.

Floodproofing, elevation and property acquisition can each be cost-effective adaptations in certain situations, depending on the desired return on investment (e.g., benefit cost ratio) and each may be subsidized in the United States if they can be shown to be cost-effective.

In mountainous riverine communities, proposing building adaptations for flooding typically requires a parcel-by-parcel assessment, which can be a complex and time-consuming process. Furthermore, flooding events can alter the topography, necessitating a reassessment of adaptation strategies for each parcel as the suitability of previous solutions may change. In towns or more concentrated living communities, the adaptations may be considered for groups of houses with similar attributes (e.g., first floor height, construction, etc.). Both scenarios are of interest in this Challenge.

Assessing landscape adaptations involves weighing the pros and cons of various solutions, which can be more intricate and vary widely depending on each specific parcel. This complexity arises from the need to consider a variety of factors, including environmental impact, cost, and effectiveness of each solution in the unique context of the parcel.

It is also expected that the benefits and protections of the building/landscape adaptations will also yield benefits in the cost of insurance, as these buildings will withstand some greater level of threats. Credit will be given to those solutions that address and quantify those benefits.

Solutions Being Sought

RISE is seeking solutions that:

1. Consider building/landscape mitigations in the four areas described above. Either new or existing adaptation techniques may be applied. Additional mitigations may be considered if the applicant provides comprehensive details of the technology and its benefits. Both rural and more urban environments may be considered.
2. Identify the most appropriate and cost-effective building/landscape adaptations on a parcel-by-parcel basis including a method or access to a method, for performing a benefit-cost analysis for every building and parcel.
3. Provide mitigation that can be implemented on properties pre- and post-disaster.
4. Offer a benefit-cost analysis (BCA) on a parcel-by-parcel basis using the most current topography and flood event datasets.
5. May be implemented using local labor and contractors, to support the local business community and workforce.
6. Provide analysis and estimate of the reduced cost of insurance enabled by the mitigations.

Data Available Upon Request

- First Street Foundation database.
- Topography:
- Hurley (Data sets available upon request.)
- Topography:
- The Virginia LiDAR Inventory Web Mapping Application for the State of Virginia.
- Hurley flood event modeling: Hurley (Data sets available upon request.)

Community Insurance Program

The intent of this effort is to establish a riverine flood insurance policy design covering the region of Southwestern Virginia (as defined by the coverage areas of the four PDC's: LENOWISCO PDC, Cumberland Plateau PDC, Mount Rogers PDC, and the New River Regional Commission). In describing the problems and desired solutions for a Community Insurance Program, it is necessary to consider the needs of both the payment recipients (e.g., residents, businesses) and the payment providers (e.g., insurers).

The Residents' Community Insurance Problem(s)

Costs and impacts of the effects of a flooding event are borne by several parties:

- Homeowners
- Renters
- Rental property owners
- Municipalities
- Local businesses

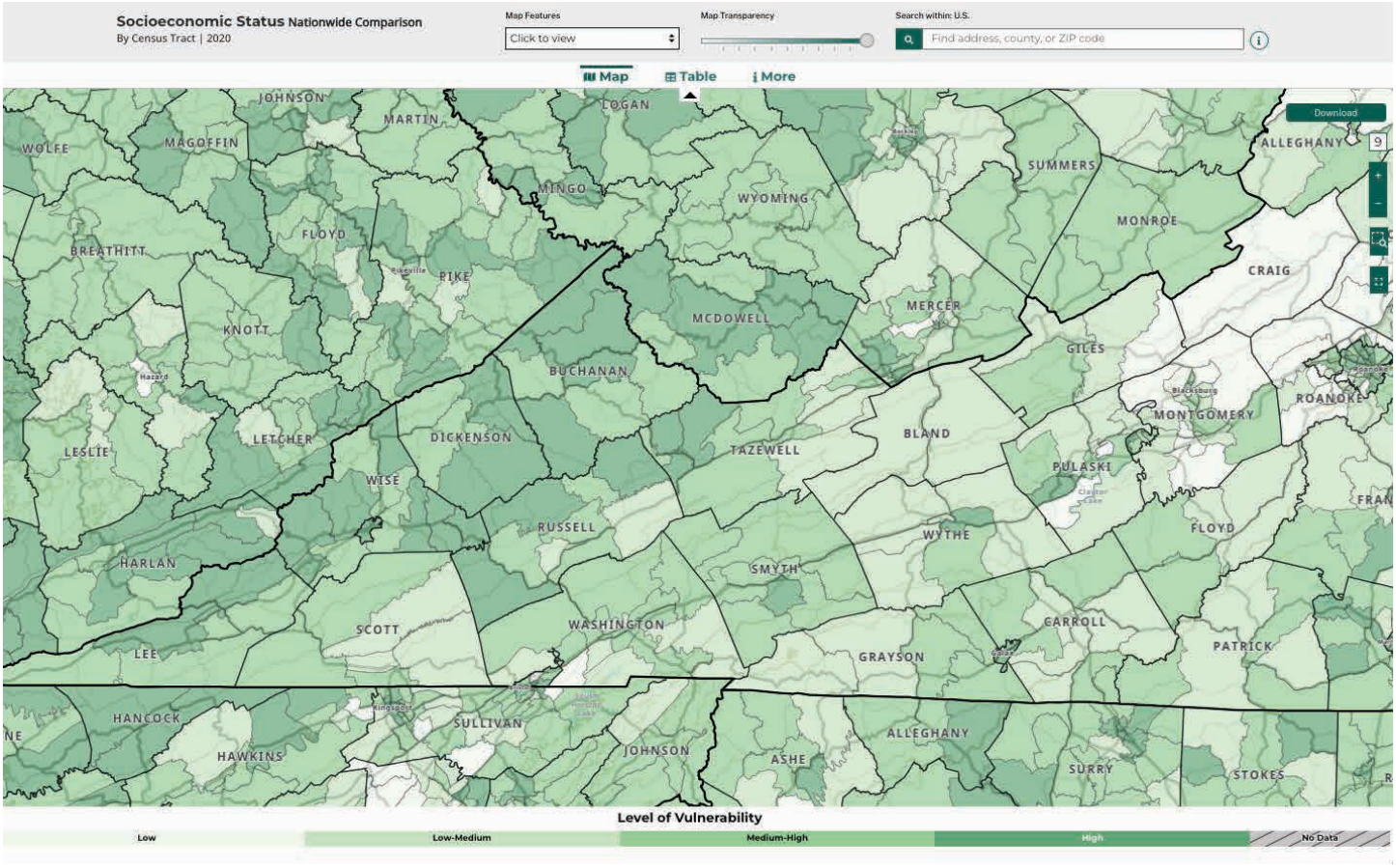
Many homeowners and renters in rural areas lack flood insurance. As a result, financial aid (and other support) for these communities after flood events typically comes from state flood relief funds, which are often allocated through specific budget requests, or from charitable donations. However, these funds are primarily directed towards homeowners, often leaving renters without similar support.

In the past, rebuilding and other support has been provided through donations to the local United Way:

> *'Recovery from major natural disasters is always going to be a long process", said Travis Staton, President and CEO of United Way of Southwest Virginia.*
> *"Typically, 24 to 36 months is a good turn-around," he said. "Overall, we are making tremendous progress."*
> *The nonprofit raised about $1 million for Hurley relief, with $850,000 of that "already out the door" to residents, he said. It raised $928,000 for Whitewood and Pilgrim's Knob, with close to $500,000 of that already distributed.'*

The Insurance Providers' Problem(s)

The median income of the region is low (one of the reasons that many in the community do not participate in flood insurance programs) and therefore has a high Social Vulnerability Index (see map below). Such highly vulnerable communities typically have increased vulnerability to the effects of natural disasters. The intent of this topic is to build a sustainable insurance program that helps these residents and others.



Several considerations should be taken into account in such an insurance program:

- The needs of residents and businesses identified in the previous section) should be met as much as possible
- The costs of riverine flooding events to each of the constituents above have not been fully characterized at a regional level. Understanding these costs is key to building a useful flood insurance program.
- When developing an insurance program, there is not just an interest in transferring risk from one party to another, but also in reducing the costs of repairs, protections, etc. The solutions from the other topic areas in this Challenge address, in different ways, approaches to reduce these costs.
- To make the riverine insurance program sustainable, the total cost of risk needs to be spread over several parties. Insurance products may need to be layered to make them useful.

The Pain Points in Current Solutions for Residents

The State government allocated $17M for recovery in Hurley and $18M for Whitewood. These funds became available around 15 months after the respective events, and were intended for homeowners to repair/rebuild their properties or reimburse already-incurred expenses with receipt proof. This system, however, led to several issues:

- Residents' needs ranged from those needs immediately after the event (1-7 days), where the needs were for water, food shelter, and cash, to longer term (1 month - 1 year) repairing or rebuilding dwellings, or relocating permanently elsewhere.
- Residents who completed repairs without keeping receipts couldn't get full reimbursement.
- The delay in fund disbursement forced residents to either cover costs for an extended period or move away.
- Non-homeowners (e.g., renters) were not eligible for these funds.
- Support was not provided to businesses to compensate for the loss of and/or disruption of business.

In Hurley's flood, immediate relief and support depended exclusively on charitable donations.
Also, in the Whitewood flood:

> *"According to an online dashboard maintained by United Way of Southwest Virginia, a lead agency in the recovery effort, 21 homes were destroyed; as of Aug. 31, six had been built to replace them. Another 25 had major damage of $10,000 or more, and 18 had been repaired. Twenty-five more homes saw damage of $10,000 or less."*

The Pain Points in Current Solutions for Providers

Current insurance programs' (e.g., NFIP) premiums are not generally affordable, nor are the programs sustainable in their current form in this region. Often, FEMA payouts are triggered by flooding produced by named storm events. Severe convective events are not typically named storms, and so FEMA support cannot be guaranteed.

Funding allocated by State for Hurley and Whitewood ($17M and $18M respectively) were special legislative appropriations using Regional Greenhouse Gas Initiative (RGGI) funds from the Commonwealth, which arrived around 14-15 months after the events. While this relief was very helpful it is neither sustainable nor quick.

Solutions Being Sought

Solutions are being sought for the design of an insurance program that:

- Provides support to households and businesses after events by shifting risk through insurance and other financial strategies, ensuring protection against major losses. In its final form, support should align with Residents' needs (see above).
- Address residents' and businesses' needs at (approximately) defined times:
    - Pre-flood event.
    - Within hours after the flood event.
    - Up to one week after the flood event.
    - Up to one month after the flood event.
    - Up to one year after the flood event.
- Needs may range from food, shelter, and short-term funds to building replacement costs. Part of the Challenge will be to document these needs.
- Pays out after clearly describable and measurable flooding event level if a parametric program is proposed. Approaches other than parametric programs will also be considered.
- Provides payout funds quickly and in a way that is accessible by all constituents – in conjunction with findings from the Residents' Community Insurance topic area.
- Considers riverine flooding as the only peril.
- Is sustainable throughout the region of Southwest Virginia covered by the LENOWISCO PDC, Cumberland Plateau PDC, Mount Rogers PDC, and the New River Regional Commission. Some sustainability objectives are:
    - The insurance program design incentivizes adaptation which will bend the total cost curve down over time.
    - The program will allocate costs in an equitable way.
    - The cost of the program is affordable and defendable to stakeholders based on scope and allocation of costs.
    - The total cost is affordable over long time horizons to the stakeholders paying the costs contemplated.
    - The premium payment(s) allocation is clear.
    - Clear rules and processes are set for fund distribution.
- Is supported by a resident recovery program to provide guidance pre- and post-event assistance and guidance. Offers pre- and post-event assistance and guidance through a resident recovery program. The goal of this Challenge is not to develop such a program, but to design an insurance program that can work with and aid in such support programs.

These considerations are crucial for the program's effective and sustainable operation.

Clearly for a solution design process to be successful access to various stakeholders in the region will be necessary. Applicant Winners will be given access to these stakeholders to design their solutions.

There are several steps to be taken in developing a flood insurance program such as this. It is up to the winning applicants to apply their own processes and analyses to their final design.

Datasets Available Upon Request

- First Street Foundation database.
- Topography:
- Hurley (Data sets available upon request.)
- Topography:
- The Virginia LiDAR Inventory Web Mapping Application for the State of Virginia.
- Hurley flood event modeling: Hurley (Data sets available upon request.) LENOWISCO report by UVA.
- LENOWISCO CEDS report.
- Cumberland Plateau report.