Relationship Building and Pre-Disaster Planning: Effective Strategies for Rural Resilience Following the 2016 West Virginia Floods

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ABSTRACT

Extreme weather events are becoming more commonplace in the United States and across the globe. Infrastructure cannot be built to completely withstand damage from these extreme events, thus communities must prepare themselves to recover quickly and efficiently to limit disruption to community members' livelihoods. Non-coastal, rural communities in the Appalachian region are affected by many of the same barriers to recovery as more populated suburban and urban communities, however, they can also face unique circumstances due to heightened vulnerability caused by depressed socioeconomics, reduced access to public services, and nominal capabilities of small, rural town governments. Rural communities face challenges to disaster recovery, but they can also benefit from increased social capital and population homogeneity that reduces cultural and language barriers and has the potential to improve coordination and collaboration. Financial and coordination barriers, such as the late or slow allocation of funding and limited management capacity of local governments during disaster recovery, are prevalent in rural Appalachian communities. Legal and socio-cultural barriers to rural disaster recovery include historical development patterns in and around floodplains, higher percentages of vulnerable populations, and difficulty navigating the federal disaster aid application process. Collaborative planning efforts and capacity building through the cultivation of relationships among disaster recovery stakeholders are necessary to provide an efficient and effective recovery. Additional funding, and more timely funding, are often proposed to solve a variety of challenges, but money alone will not be enough to overcome many prominent barriers. By adopting planning and cross-sector collaborative practices, local governments can better leverage available resources and facilitate the recovery process for the benefit of the affected communities. The 2016 West Virginia floods served as a case study and recovery strategies used following this event provide lessons learned to mitigate disaster recovery barriers in the future. Semi-structured interviews were conducted with 25 people from 15 organizations ranging from state cabinet secretaries and mayors to engineers and nonprofit workers. Interviews were transcribed and coded using qualitative data analysis software. Site visits accompanied interviews and thematic content analysis was used to analyze interview transcripts and supporting documentation. Codes were validated by an independent, third-party coder.

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GENERAL AUDIENCE ABSTRACT

A recent increase in natural disasters in the United States, and the recognition that infrastructure cannot be built to completely withstand damage from these extreme events, has created a greater interest in disaster recovery. Communities must prepare themselves to recover quickly and efficiently following events like flooding to limit disruption to community members' livelihoods. Rural communities in Appalachia are affected by many of the same barriers to recovery as suburban and urban communities, but they often also face unique circumstances due to heightened vulnerability caused by fewer financial resources, reduced access to public services, and limited capabilities of small town governments. Rural communities face challenges to disaster recovery, but they can also benefit from increased trust among community members and population homogeneity that reduces cultural and language barriers and has the potential to improve coordination and collaboration. Financial and coordination barriers, such as the late or slow allocation of funding from government agencies and limited management capacity of local governments during disaster recovery are common in rural Appalachian communities. Legal and socio-cultural barriers to rural disaster recovery include historical development patterns in and around areas prone to flooding, higher percentages of vulnerable populations like those over 65 years of age, and people's difficulty applying for federal disaster aid. Collaborative planning efforts and capacity building through the cultivation of relationships among disaster recovery stakeholders help provide an efficient and effective recovery. Additional funding, and more timely funding, are often proposed to solve a variety of problems, but money alone will not be enough to overcome many prominent barriers. By adopting planning and cross-sector collaborative practices, local governments can use available resources more wisely and facilitate the recovery process for the benefit of the affected communities. The 2016 West Virginia floods served as a case study and recovery strategies used following this event provide lessons learned to mitigate disaster recovery barriers in the future. Interviews were conducted with 25 people from 15 organizations ranging from state cabinet secretaries and mayors to engineers and nonprofit workers. Interviews were transcribed and coded using qualitative data analysis software. Site visits accompanied interviews and thematic content analysis was used to analyze interview transcripts and supporting documentation. Codes were validated by an independent, third-party coder.

Dedication

I dedicate this research to the glory of my Lord and Savior, Jesus Christ. Near the start of my graduate school, He was more of a storybook character to me than a historical person, but now, through countless hours of research not unlike that completed for this dissertation, has become, as a dear friend of mine would say, “a real person in the space-time continuum”. I would never have been able to complete this endeavor without His countless provisions. I did not plan to study the topics contained in this dissertation prior to starting graduate school, nor can I say I had any special interest in them, however, I do not believe I have traveled this path by mere chance.

I adopted the phrase “Engineering a Better West Virginia” in my recent pursuit of public office. That phrase has, somewhat to my surprise, seeped into nearly every other area of my life. “Engineering a Better West Virginia” isn’t about working on the biggest or the most profitable projects, or receiving recognition, but rather about changing the lives of the people in my community, state, country, and world for the better. I believe a life in service to others is the most honorable life a person can live, and that is the kind of life I dedicate myself to living.

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First and foremost, I would like to thank my advisor and mentor, Dr. Tripp Shealy, for his unwavering support over the course of the last several years. Thank you for always advocating for me, the countless hours spent on research calls and reviewing papers, all of the career advice, and allowing me to get to know you and your amazing family. You have impacted my life more than you know and I will forever be grateful. I look forward to continued collaboration and a lifelong friendship.

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To my research lab mates, I will always cherish the time we spent together, both inside and outside the classroom. The time spent pursuing a Ph.D. can be both stressful and wonderful at the same time and your friendship, encouragement, and support has helped my experience be more of the latter.

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after estimating class to ask if I should apply for the master's program. I couldn't ask for a better sounding board, neighbor, or friend.

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To my loving parents, this degree is almost as much yours as it is mine. There is no universe in which I could have accomplished this without you. You have always put me first and encouraged me to follow my dreams wherever they may lead. Your support, in the too many ways to recount, allowed me to reach this point in my academic career. I cannot thank you enough.

I want to acknowledge the National Science Foundation and the Disaster Resilience and Risk Management Program at Virginia Tech for their financial support through NSF grant # 1735193. The funding provided through this grant enhanced my studies and gave me more time to focus on research.

I also want to thank the Via family and Davenport family for their generosity. Your fellowships blessed me with a degree of financial freedom and peace of mind not possible without giving hearts like yours. Education is a powerful agent for change and I am grateful for families like yours who invest in future generations.

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Introduction

Natural disaster events are becoming more frequent and severe (Smith, 2020; Zobel & Baghersad, 2020). The United States has experienced 371 billion-dollar disaster events since 1980 with the cost of these events exceeding $2.6 trillion (NOAA NCEI, 2023). An increased emphasis has been placed recently on making the U.S.'s infrastructure more resilient given these facts and is evidenced by the inclusion of the Promoting Resilient Operations for Transformative, Efficient, and Cost-saving Transportation (PROTECT) Grant Program in the Bipartisan Infrastructure Law passed in 2021.

There are multiple facets of the word "resilience", which is defined as "the ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions" (United Nations Office for Disaster Risk Reduction, 2015). Building infrastructure to resist extreme storm events, like the 2016 West Virginia floods studied in the following chapters, is impractical and prohibited by limited government resources. Given this and the rise in storm intensity and frequency, disaster recovery must necessarily become a more central focus of disaster research.

Natural disasters do not discriminate, but various factors make some people more vulnerable to disasters like flooding than others. For example, people with fewer economic resources live in flood-prone areas at higher rates than those with higher incomes because of housing affordability (Sarmiento & Miller, 2006). Rural areas tend to have higher poverty rates (Economic Research Service, 2021), a greater proportion of elderly (Smith & Trevelyan, 2018), and offer fewer social services (Skoufalos et al., 2017) than urban areas. For these reasons, rural areas can struggle to recover more than their urban counterparts. The government has recognized the importance of investing in disadvantaged communities by setting aside a portion of federal grants, such as the PROTECT Grant, for disadvantaged communities (The White House, 2022), yet many rural communities remain vulnerable to disasters like flooding.

Research on barriers to disaster recovery exist (Rouhanizadeh et al., 2020; Rouhanizadeh & Kermanshachi, 2020a), but much of it focuses on urban and coastal areas (Jerolleman, 2020). With respect to disaster policy, existing literature primarily explores disaster policy at the international and national level, leaving local and regional disaster policy understudied (Crow et al., 2018). The presented research seeks to explore these gaps in knowledge by studying the disaster recovery efforts in rural Appalachia following the devastating 2016 West Virginia floods. The research is separated into three chapters each focusing on a unique research question as outlined in Table 1.

Table 1: Outline of Existing Gaps in Knowledge

Chapter	Gap in Knowledge	Research Question
1	Rural communities are among the most vulnerable to disasters, yet disaster recovery literature focuses more on urban and coastal areas. This chapter confirms the barriers present to understudied, rural Appalachian communities following severe flash flooding.	What were the barriers associated with long-term recovery in rural Appalachian communities following the 2016 West Virginia floods?
2	Existing literature neglects the impact organizational relationships have on long-term recovery. This research is needed to identify best practices for the structure and operations of organizational partnerships to overcome the unique financial and coordination barriers to rural recovery.	How can rural communities overcome financial and coordination barriers to long-term recovery following disasters?
3	Current knowledge of disaster policy focuses on international or national contexts, leaving more regional and state-level contexts less researched. This chapter examines policies and practices to mitigate legal and socio-cultural barriers.	What strategies from the 2016 West Virginia flood recovery efforts helped mitigate legal and socio-cultural barriers to disaster recovery?

The motivation of this research is centered around one central question – what can rural communities do to recover more quickly and more resiliently from disasters. Rural communities may lack the resources of urban areas, but what they lack in finances they make up for in grit and a culture of cooperation and collective action from heightened levels of social capital (Shinn & Caretta, 2020).

Each of the three chapters can serve as a standalone document that tell a small piece to the larger long-term recovery story of West Virginia communities following the 2016 floods. Chapter one identifies barriers that rural communities faced and breaks them down into four categories – financial, coordination, legal, and socio-cultural . Chapter two explores methods used to overcome the financial barriers, which include inadequate financial resources and delayed or late allocation of funding, and coordination barriers, which include unclear roles and responsibilities and a lack of management capacity. Chapter three examines practices used to mitigate legal barriers, including regulatory delays and an onerous reimbursement process, and socio-cultural barriers, including historical development patterns and an aging population.

Semi-structured interviews were conducted with a total of 25 people representing 15 organizations. Interviewees came from a range of backgrounds and fields including nonprofits and local government to engineers and state officials. Thematic content analysis was performed in Nvivo software and validated using a negotiated agreement approach. More detailed descriptions of the methodology can be found in each of the three chapters.

Following the three chapters is a conclusion summarizing the major lessons learned, a reflection on the multiyear study and its impact on my professional growth, and recommendations for future research.

This research was reviewed by Virginia Tech's Division of Scholarly Integrity and Research Compliance and received approval under IRB #21-621.

Chapter 1: Barriers to Rural Appalachian Communities' Long-Term Infrastructure Recovery: An Analysis of the 2016 West Virginia Flood Recovery Efforts

Abstract

The research presented in this paper explores the barriers to disaster recovery for an understudied and often vulnerable group. Non-coastal, rural communities in Appalachia are impacted by many of the same barriers as urban communities during disaster recovery but frequently face unique circumstances due to heightened vulnerability caused by depressed socioeconomics, reduced access to public services, and nominal capabilities of small, rural town governments. However, while rural communities face unique challenges, they can benefit from increased social capital and population homogeneity that reduces cultural and language barriers and has the potential to improve coordination. The recovery efforts following the 2016 West Virginia floods were used as a case study to understand the unique barriers and challenges these types of communities face. Interviews were conducted with local, state, and federal government officials, nonprofit disaster recovery groups, and private industry professionals to gain insight into the barrier each faced during recovery efforts. The findings from this research show that opportunities exist to bolster rural resilience, but cannot be done without collaborative efforts from academic, nonprofit, private, and government sectors. The results presented here are from one focusing event. More research is recommended to compare these findings with other rural areas in Appalachia and beyond, including places with different legislative environments.

Introduction

Historical trends and predictive weather modeling imply that the frequency and intensity of precipitation events are rising (Field et al., 2012; Mills, 2009). Changes in climate patterns will continue to cause an increase in global heavy precipitation events and increase the number of thunderstorms experienced in North America (Moore et al., 2015). With this rise in precipitation, the frequency and intensity of natural disasters in the United States are also rising (Zobel & Baghersad, 2020). Not only are the number of disasters increasing, the costs associated with recovery efforts are also escalating. The National Oceanic and Atmospheric Administration (NOAA) released a report showing the average number and costs of disasters between 1980 and 2019 have increased in recent years (Smith, 2020a).

Americans tend to settle in hazard prone areas at significantly higher rates than in areas less susceptible to hazards (Iglesias et al., 2021). An example of this can be seen in U.S. coastline counties, which experienced 20% higher population growth than non-coastline counties between 1960 and 2008 (Freeman & Ashley, 2017). One reason for this type of riskier development is people's affinity to the coastal environment, but another reason is due to historical development patterns. Historical development patterns have also shaped many southern and central West Virginia communities. Like development in many regions of the country, early settlement in West Virginia often occurred near waterways, which are often low-

lying areas. The topography of the state is shaped by the Appalachian Mountains, thus creating the potential for flash flooding caused by runoff during heavy precipitation events. The topography puts housing, utilities, and transportation infrastructure at increased risk for flash flooding.

In June 2016, West Virginia experienced one of the most devastating storm events in its history. A weather event known as a derecho impacted West Virginia by dropping nearly ten inches of rain in communities like Clendenin and Elkview in Kanawha County, and Rainelle and White Sulphur Springs in Greenbrier County. Flash flooding in these towns caused 23 people to lose their lives (Caplan, 2016). Damage across West Virginia and neighboring states led to this event being classified as a billion-dollar storm event by NOAA (Smith, 2020b).

Despite the magnitude of the event, loss of life, and significant federal involvement and investment through funds distributed by the Federal Emergency Management Agency (FEMA) and a community development block grant from the Department of Housing and Urban Development (HUD) in excess of $100 million, no after-action study and report were ever completed and made public. As such, this research examines the recovery efforts and seeks to identify the specific barriers to recovery efforts of flood-battered Appalachian communities in Kanawha and Greenbrier Counties in the aftermath of the 2016 floods.

The goal of this study is to identify barriers that rural communities faced so they can be better mitigated in the future. This will help to facilitate a higher-quality recovery process for rural communities following future events. The Background section provides more detail about the types of barriers communities often face after a disaster event and highlights the lack of clarity specifically around rural communities and long-term disaster recovery. The Research Question and Methods follow outlining the lack of research investigating rural, long-term recovery and the complementary case studies selected to investigate multi-year recovery efforts following the 2016 floods that devastated small communities in Appalachia. The Results and Discussion include a comprehensive list of barriers identified by interviewees and discuss how these findings compare with previous disaster recovery studies. The Conclusion discusses which barriers were found to be the most impactful, so they can be addressed in future research and practice.

Background

Community capacity and preparedness are difficult to cultivate in fair weather times, let alone during periods when stakeholders face significant barriers due to the post-disaster recovery environment. Opdyke et al. summarizes this atmosphere by saying, “The inherently complex post-disaster environment places stress on social and organizational networks, economic systems and infrastructure systems…” (Opdyke, 2017). Breaking down the stresses placed on these systems into more specific challenges is necessary so solutions can be developed. These solutions can then be used to aid rural communities in navigating the high-stakes environment that is disaster recovery.

Much of the current literature on disasters focuses on urban and coastal areas, while the ones that do focus on rural communities often look at environmental or technological incidents such as mining disasters, rather than events like flooding (Jerolleman, 2020). Flooding events in rural communities, such as the 2016 West Virginia floods that impacted parts of Appalachia, are often neglected. A recent study of the differences between urban and rural disaster resilience goes so far as to say, "research into urban resilience has dwarfed our understanding of disaster resilience in rural places" (Cutter et al., 2016). Research on the disaster recovery of small rural communities is needed not to simply balance the scales between urban and rural recovery, but because rural communities are arguably the most vulnerable and in need of assistance. The social vulnerability framework of disaster management contends that rural communities are more vulnerable due to socioeconomic and demographic factors than their urban counterparts, which have more resources, including financial and personnel, to carry out needed recovery functions (Flanagan et al., 2011).

The U.S. is a highly developed country with the world's largest GDP and immense capacity to recover from disasters. This capacity has been attributed to factors such as higher levels of wealth, stronger governance than less developed nations, and the availability of insurance (Pyles et al., 2018). However, with its large geographic size and diverse regional populations come variability in regional cultures and economies. What has been neglected in recent disaster recovery literature is the fact many rural communities do not benefit nearly as much as their urban counterparts from these capacity-building factors. Using these three examples, rural areas experience higher rates of poverty (Economic Research Service, 2021), which combined with small and shrinking populations can weaken local governance, and also prevent the most vulnerable from being able to afford flood insurance. People making below the poverty line also live in flood prone areas at a disproportionately higher rate than those in higher income brackets, due to the affordability of at-risk housing (Sarmiento & Miller, 2006).

Recent literature reviews of disaster recovery barriers have been conducted, but given the affinity of disaster research towards urban and coastal contexts (Jerolleman, 2020) rural barriers are underrepresented. This research seeks to expand upon the barriers found in existing disaster recovery literature by focusing on the challenges experienced by small Appalachian communities following the 2016 West Virginia floods. While there is no agreed upon approach to grouping barriers into categories, common themes involve financial, legal, coordination, and socio-cultural issues (Rouhanizadeh et al., 2020; Safapour et al., 2021). Late or insufficient allocation of funding, both political and regulatory uncertainty, ineffective coordination and weak cooperation, and various matters regarding public engagement are commonly cited barriers (Safapour et al., 2021).

Financial and Resource Barriers

Insufficient financial resources are the second most frequently cited barrier to effective recovery, preceded only by ineffective coordination and management (Safapour et al., 2021). This lack of financial resources and management capacity are closely related as lack of funds to hire necessary staff, to improve management capacity, diminishes a local government's ability to

respond in other ways to constituent needs, communicate and coordinate with state and federal government agencies, and maintain expected services.

Rouhanizadeh & Kermanshachi (2021) list financial barriers, such as late allocation of funding, lack of insurance, and delay in disbursement of funds as high importance barriers. These types of delays in getting access to federal funds demonstrate the need for local governments to keep a rainy day fund, so high priority recovery projects can be started quickly (Crow et al., 2018). Keeping a reserve fund can be difficult, especially for rural communities who have experienced declining economies and typically have higher rates of poverty than urban areas (Skoufalos et al., 2017). To make the situation worse, despite property losses being worse in more densely populated urban areas, relative impacts are worse in rural communities, although direct comparisons are difficult due to little consideration being given to percentage impacts (Jerolleman, 2020).

Legal Barriers

Institutions often offer stability in chaotic times following a disaster and can encourage inter-organizational collaboration, but they can also impede interactions if the structure is too rigid and inflexible (Wang, 2019). Regulations and legislation are commonly cited challenges in the disaster recovery literature (Hidayat & Egbu, 2011). Legal barriers, such as lacking post-disaster reconstruction policies, political uncertainty, and residents' inability to provide legal documents can make recovery challenging (Safapour et al., 2021). Government regulations and legislation strongly influence the restoration of communities through funding awards and award stipulations to permitting and building codes.

Most regulations and legislation dealing with the architecture, engineering, and construction (AEC) industry are not crafted with time constraints related to recovery from natural disasters in mind (Masurier et al., 2006). An example of this is the permitting process. Local government agencies that handle construction permits are usually not staffed to handle the kind of large influx of construction requests that occur following a disaster. Their limited capacity has been identified as a barrier to reconstruction (Kennedy et al., 2008; Mannakkara & Wilkinson, 2013). Allowing retroactive permitting is an example of a measure to avoid potential bottlenecks, however, suspending normal building code design procedures and permitting has led to quality problems in the past (Hidayat & Egbu, 2011). These quality problems do not live up to the aspirations of "building back better" so commonly found among the disaster recovery community.

Coordination Barriers

Rebuilding communities after disasters is often too great a challenge for any one entity to overcome alone. Rebuilding resilient communities "requires effective intergovernmental and cross-sector collaboration and cooperation" as highlighted in the National Disaster Recovery Framework (Kapucu, 2014). Stakeholders from the affected communities work alongside local, state, and federal government agencies, as well as businesses and nonprofits, but this can be difficult, especially for small, rural governments. Local governments are responsible for every phase of the emergency management process, from preparedness and response to recovery

and mitigation (Shaw, 2014). Given most communities do not regularly experience large-scale disasters, the collaborative partnerships required are not always in place. Coordination barriers refer to those involving lack of capacity among community members, the private sector, nonprofits, and government entities to work together toward achieving shared goals. "Coordination and resources" has been ranked as the most important category of barriers by experts (Rouhanizadeh & Kermanshachi, 2021a). Ineffective coordination and management is a frequently cited barrier to effective recovery and is difficult for local governments to overcome due to the number and variety of organizations that participate in the recovery efforts (Safapour et al., 2021).

Cultivating relationships among community members can help to make a community more resilient and overcome coordination and management barriers (Shinn & Caretta, 2020). Recovery committees have steep learning curves, thus communities that are able to plan and develop relationships among stakeholders prior to a disaster have an advantage over communities that do not (Jerolleman, 2020). This is an especially important lesson for rural communities which typically have higher social capital, but less economic capital than their urban counterparts (Jerolleman, 2020). Previous studies have found that trusting relationships between organizations was facilitated by having existing relationships prior to the disaster event and highlighted that organizations in these relationships had a better understanding of each other's capabilities (Curnin & O'Hara, 2019). This recognition can lead to more effective cooperation and is yet more evidence supporting the growing research findings that investment in cultivating social capital to decrease social vulnerability is an effective means to improve disaster recovery outcomes (Fraser & Naquin, 2022).

Socio-cultural barriers

Disaster recovery is not a one size fits all process, because every community is comprised of a diverse set of economic, environmental, and socio-cultural factors. Socio-cultural factors affecting a community's resilience include poverty levels, education, and linguistic seclusion (Tierney & Bruneau, 2007), as well as the number of elderly and disabled (Safapour et al., 2021). Experts have ranked "lack of support of family and/or friends" as the most important socio-cultural barrier (Rouhanizadeh & Kermanshachi, 2021a) to disaster recovery. Lack of support can place additional stress on victims' mental health. This can be exacerbated considering social services like counseling may not be widely accessible or overextended in the aftermath of a disaster.

Rural areas experience higher levels of poverty (Economic Research Service, 2021), have a greater proportion of elderly (Smith & Trevelyan, 2018), and offer fewer social services than urban areas (Skoufalos et al., 2017). These factors increase their vulnerability to disasters. Despite this vulnerability, rural communities generally possess greater social capital than their urban counterparts (Jerolleman, 2020). An elevated sense of social cohesion may lend itself to greater cooperation, thus helping reduce the impact of barriers such as lack of community engagement and unclear roles and responsibilities.

A confluence of factors affect a community's ability to build back better. Given the number, variety, and location differences of natural disasters, as well as the reality of changing climate patterns, there is a need for ongoing research to establish best practices that address the many barriers to effective recovery. It is not possible to predict exactly what barriers will emerge in the aftermath of a given disaster despite existing research that has cataloged and categorized barriers from hundreds of studies. Disaster recovery is context specific and thus the barriers, and strategies to overcome them, are also highly variable by context (Moser et al., 2010). Because much of the current literature on disaster losses focus on coastal and urban areas (Jerolleman, 2020), this confirmatory research seeks to compare the barriers identified in an understudied rural area of Appalachia to those described in previous literature so mitigation strategies can be developed and implemented.

Research Question

What were the barriers associated with long-term recovery in rural Appalachian communities following the 2016 West Virginia floods?

Methods

To assess the various barriers associated with rural communities' long-term recovery, a geographic region was first selected. There were 12 counties declared federal disaster areas in the aftermath of the 2016 flooding in West Virginia. From these 12 counties, four were identified as the "Most Impacted and Distressed" (MID) by the U.S. Department of Housing and Urban Development (HUD) (WV-Action-Plan, n.d.). These counties were Kanawha, Greenbrier, Clay, and Nicholas. News articles and FEMA Individual Assistance application numbers were used to identify communities within the most affected counties. The towns of Clendenin and Elkview in Kanawha County, and Rainelle and White Sulphur Springs in Greenbrier County were the four most severely affected (WV-Action-Plan, n.d.). Therefore, these two counties were selected for the scope of this study.

Within this region, three projects were chosen as cases. The projects include (1) private residential bridges, (2) public roadways, and (3) a new residential community. The recovery of private residential bridges after a natural disaster presents a unique challenge faced by homeowners in restoring their essential transportation links. These types of bridges are also primarily found in rural areas. The West Virginia Bridge Home Program (WVBHP) was led by a nonprofit and involved collaboration with numerous other nonprofits and state organizations. Public roadways were included because this response effort was led by the West Virginia Department of Transportation (WVDOT) who not only maintain a high percentage of the total roadways in the state, but also helped establish the WVBHP and provided both technical and logistical assistance throughout the program's life. Lastly, Hope Village, a new residential neighborhood born out of the 2016 floods, was created with minimal government involvement or funding and involved a unique buyout program relocating citizens, rather than rebuilding their homes in the same place. These types of programs are often resisted by rural communities that have a strong attachment to place. These projects span a range of nonprofit and

government sectors and involve varying levels of government involvement and unique funding structures. More detail about each of the cases is provided in the following section.

Case Studies

Case Study 1: Private Residential Bridges

The 2016 floods caused many private bridges to be severely damaged and unsafe, as seen in Figure 1. The West Virginia Voluntary Organizations Active in Disaster (WV VOAD) created the West Virginia Bridge Home Program (WVBHP) to help residents reestablish a safe passageway from the main road to their homes. Estimates for the number of bridges in need of repair or replacement following the 2016 floods were in the hundreds (Curtis, 2016). The Bridge Home Program was made possible through the collaborative efforts of the WV VOAD Bridge Committee member organizations like Lutheran Disaster Response, Operation Hope, Mennonite Disaster Service, and many others. These members partnered with and received advisement from county permitting officials, FEMA officials, the West Virginia Department of Homeland Security and Emergency Management officers, state floodplain managers, WVDOT engineers, and U.S. Army Corps of Engineers representatives to devise a program that would not only be expedient, but would improve the resiliency of the transportation network through betterment of homeowners private access bridges.

Figure 1: Private Bridge Example (*Bridge Program*, n.d.)

Case Study 2: Public Roadways and Bridges

Many sections of public roadways and bridges throughout the southern and central parts of the state were severely damaged or destroyed. Some 1,300 state road washouts occurred, 123 bridges were damaged, and 15 bridges were destroyed (*WV-Action-Plan*, n.d.). One example of such a roadway, Route 4, is depicted below.

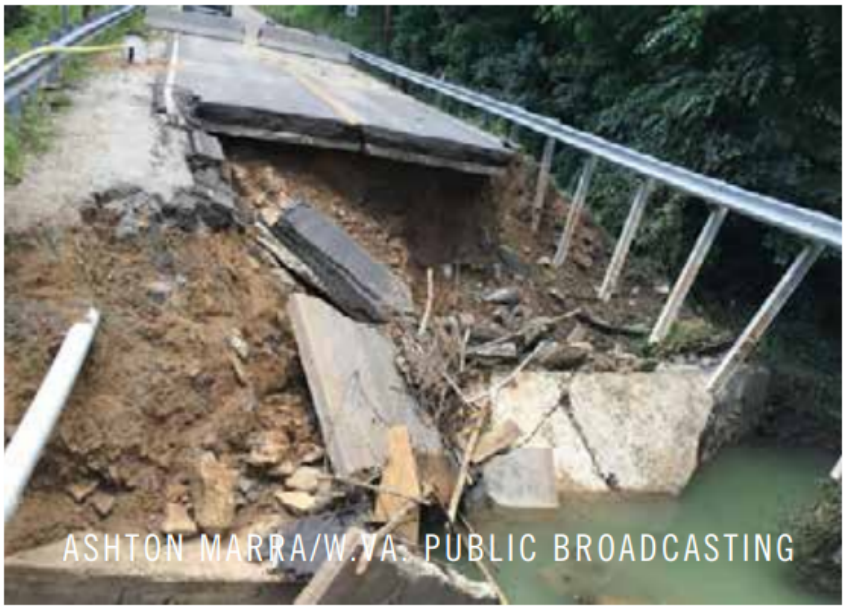

Figure 2: Route 4 Near the Kanawha County Line (*WV-Action-Plan*, n.d.)

Roadway projects in and around the areas of interest were included in this study. Given the prominent role that the West Virginia Department of Transportation played in rebuilding these roads and bridges, the stakeholders interviewed for this case study consisted of engineers at the WVDOT overseeing Kanawha and Greenbrier Counties but also included FEMA Region III officials, representatives from the WV Economic Development Office, Mayors, and several others.

Case Study 3: Hope Village

Hope Village is a neighborhood born out of the 2016 floods. Mill Hill Drive in White Sulphur Springs was one of the most critically damaged neighborhoods in the entire state, with five lives lost along this one street (Raby, 2017). After such considerable loss of life and destruction, several local non-profit organizations led by Homes and Hope for White Sulphur Springs devised a plan to construct Hope Village—a new neighborhood consisting of 42 home sites (*Hope Village*, n.d.). A local engineering firm, E. L. Robinson Engineering, provided land development plans at no cost, and construction labor was provided at no cost by Mennonite Disaster Service, Appalachia Service Project, and other volunteer organizations (*Hope Village*, n.d.). Interviewees included committee members on the Hope Village board of directors, volunteers, White Sulphur Springs government officials, and other stakeholders.

Figure 3: Aerial View of Hope Village Pre-Construction

Data Collection

Semi-structured interviews were the primary method of data collection. A combination of convenience and snowball sampling was utilized. Stakeholders were identified, and additional interviewees were recruited based on recommendations provided by stakeholders during the interviews. When possible, site visits were made to observe the construction process. The site of the private residential bridge serving as the model project for the WV Bridge Home Program, called Big Blue, was visited by members of the research team multiple times. Sites of public road washouts were visited with the district engineer for the White Sulphur Springs district of the WVDOT. Hope Village was also visited by the primary investigator. Notes, photos, and videos were recorded during these visits. Additionally, documents, such as government grants, engineering drawings, permits, and state laws, were identified and used as supporting documents for the interviews.

Interviews were conducted from June to September 2022, except for two pilot interviews, which were conducted in October 2021. A total of 25 people representing 15 organizations participated in the semi-structured interview process. Interviewees included mayors and FEMA officials, professional engineers, and nonprofit disaster workers. Interviews lasted approximately one hour. Stakeholders for the private bridges were identified using documents from the WV VOAD Bridge Home Design Guidelines, which identified people serving on the Bridge Committee and advisors who created the program, as well as recommendations from WV VOAD's Executive Director. Engineers working at the state and regional levels of the WVDOT with working experience and knowledge of the 2016 floods were identified to interview regarding public roads and bridges. For Hope Village, the project manager and director of the nonprofit in charge of the project were interviewed and recommendations for other participants were gathered.

Interviewees from these different cases came from the public, private, and nonprofit sectors and hold varying roles and degrees of involvement with the different projects.

Interview questions were drafted by the primary researcher and then reviewed by four researchers familiar with the research project. The primary investigator modified the interview questions based on feedback aimed at limiting bias and considering the local culture. One such example is the rewording of a question phrased "were you thinking of how to build back better" to "were you thinking about how to build it better than it was before". The intentional rewording was to reduce political opinions surrounding the then recently passed "Build Back Better Act." Another example was framing questions about resilience rather than climate change. One such question was, "how big of a role does the idea of resilience play during the design and permitting process". A recent study, as well as media coverage in 2020, suggested that Republican-dominated communities are not as receptive to the concept of climate change and are more supportive of taking steps to increase their community's resilience and future risk capacity (Giordono et al., 2020).

Data Analysis

Data analysis involved using software to transcribe interviews, then the research team reviewed and corrected the transcriptions. Thematic content analysis was then used to derive meaning from the interview data by assigning codes to group comments reflecting similar themes. Nvivo software was used to perform the thematic content analysis. An initial set of codes were established before any analysis, and additional codes were added during analysis. Creating an initial set of codes before performing analysis is a form of deductive coding (Yin, 2011a). Generating new codes during the analysis aligns with an inductive approach as it allowed the relevant themes and concepts to emerge from the data (Yin, 2011a). This hybrid approach balanced the benefits of both an inductive and deductive methodology.

Identification and Ranking Process of Barriers

Interviewee responses discussing barriers to disaster recovery were identified and coded during the thematic content analysis process. A third-party coder reviewed the transcripts searching for terms like barrier, challenge, weakness, and difficult to ensure barriers were not overlooked during earlier rounds of coding by the primary researcher. An inventory of the barriers was taken and was comprised of interviewee names, the statements they made related to the barriers they experienced, and a descriptive name for each statement, such as "cultural ties to land" or "regulatory delays". Once the barrier inventory was created, the number of quotes related to each barrier was recorded, as well as the number of interviewees who mentioned each barrier. Barriers were grouped into one of four categories: financial, coordination, legal, or socio-cultural. No widely accepted method of grouping barriers exists, but these categorizations are closely aligned with ones in recent studies (Rouhanizadeh & Kermanshachi, 2021b; Safapour et al., 2021).

Barriers were ranked higher by considering both the number of quotes pertaining to a given issue, as well as the number of interviewees who mentioned said issue. Existing literature was consulted and provided insight related to the frequency with which barriers were mentioned in

prior studies (Rouhanizadeh et al., 2020; Safapour et al., 2021), the importance of those barriers as ranked by disaster recovery experts and the public (Rouhanizadeh & Kermanshachi, 2021a), and the applicability of barriers to rural and urban contexts (Safapour et al., 2021). Barriers that were discussed numerous times by multiple interviewees were prioritized, as well as barriers that were ranked as important in existing literature. Lastly, barriers that were present in this study and were frequently mentioned in literature were prioritized in the results section. Additionally, prominent barriers in this research, but less frequently mentioned in existing literature, are called out in the results. This was done to emphasize unique barriers faced by the rural communities within the context of the 2016 floods.

Validation of Coding

The coding for this research was validated by using a negotiated agreement approach to establish an intercoder reliability score. Two researchers coded a subset of the transcripts, compared their codes, and then reviewed differences to resolve discrepancies (Campbell et al., 2013). This approach is advantageous in situations when the degree of knowledge on the subject varies between the primary researcher and the validator, and where a study is exploratory in nature (Campbell et al., 2013). One researcher created the coding scheme and an independent, third-party coder with no prior exposure to the research was brought in as a validator.

There is no universally accepted sample size for establishing intercoder reliability, but recent literature supports using 10 – 25% of data units (O'Connor & Joffe, 2020). As such, a sample size of three interviews was used for this study. The sample transcripts were from two professional engineers and a public permitting agency. The research team member discussed the research study with the validator, explained the coding scheme, and reviewed how to operate the NVivo software. The validator independently coded the three interview transcripts, then NVivo was used to calculate a Cohen's Kappa (K) intercoder reliability score (ICR) for each.

The average initial ICR across the three transcripts was K = 0.54. The research team member and validator reviewed the two sets of coded transcripts line by line, discussing the differences and explaining each coders' logic for coding it their particular way. They found that many of the discrepancies between codes involved a lack of expertise by the validator on topics such as engineering design and disaster recovery regulations. Additionally, the beginning and end points of some coded sections differed. In some of these instances, both coders agreed on the code to be applied to a certain section of text, but may have begun or ended the code at slightly different points. This is known as the unitization problem in which different people assign the "units of meaning" to different portions of a text, and is another example of why the negotiated agreement approach is an appropriate method of validation for this study (Campbell et al, 2013). After several iterations of reviewing the transcripts and making adjustments to harmonize the coding logic between the research team member and validator, a final Cohen's Kappa of K = 0.90 was established across the transcripts.

Results and Discussion

Twenty-two (22) unique barriers were identified. The barriers were grouped into four categories: (1) financial, (2) coordination, (3) legal, and (4) socio-cultural, which are consistent with existing disaster recovery literature (Rouhanizadeh et al., 2020; Safapour et al., 2021). Financial and coordination barriers were the two most numerous with six and seven barriers respectively, followed by legal and socio-cultural barriers with five and four respectively. The following sections provide lists of the barriers within each category and supporting quotes.

Financial Barriers

Financial barriers to recovery deal with economic challenges like shortages of funding, securing needed labor and resources, as well as aging infrastructure. Effective disaster recovery requires adequate funding and resources, however, numerous financial and resource barriers (hereafter referred to as just financial barriers) hinder rural recovery efforts. This section explores the financial barriers identified from the interviews:

1. Limited economic resources
2. Lack of flood insurance
3. Late/slow allocation of funding
4. Insufficient skilled labor
5. Aging infrastructure
6. Supply chain shortages

The most mentioned barrier in this category was the limited economic resources of both residents and local governments. Examples can be found in the West Virginia Bridge Home Program Design guidelines, as well as interviewees', like the Mayor of the Town of Clendenin's, statements.

> "Economic resources in this area are severely limited. The poor state of construction of most of the [private residential] bridges attests to the fact that the owners had limited economic means for design and construction. State and federal assistance is either unavailable or very limited for private bridges." – WV Bridge Home Project and Design Guidelines

> "You only have so much money, so and that money you have to have a contractor, you have to have a lawyer, you have to have a certified inspector. We don't have those things. The Town of Clendenin doesn't have that. So you're going to have to go out and hire that so you can do this. So it's just it's just tough, it really is. There again, I said to them, small towns like Clendenin, we don't have those people. We don't have those positions." – Mayor of the Town of Clendenin, WV

Local governments are expected to lead recovery efforts in their communities (Shaw, 2014). Federal agencies like FEMA and the U.S. Department of Housing and Urban Development (HUD) are meant to help guide local and state governments through the recovery process and provide additional resources. This lack of capacity at the local and state level can be seen materializing

following the 2016 floods as described by a FEMA official saying, “But a lot of it [recovery efforts] was federally led, and that's not ideal.” This leadership role is difficult for rural Appalachian communities who, as the Mayor of Clendenin said, do not have significant staff to perform the variety of functions necessary for effective recovery.

Beyond the lacking financial resources making it difficult for rural Appalachian governments to hire staff, it is also connected to an inability of residents to afford flood insurance. Although the size of the flood meant many people outside the floodplain, and thus not required to have flood insurance, were affected, an estimated 90% of FEMA applicants seeking assistance following the 2016 floods did not have flood insurance (*WV-Action-Plan*, n.d.). This put an immense burden on residents because without flood insurance, whether it was required or not, residents had to rehabilitate their damaged homes using a FEMA housing assistance grant, which in 2016 was capped at $33,000 (Lindsay, 2017). If this amount was not sufficient for fully restoring their home, they had to rely on their own funds, aid provided by nonprofits, or wait for additional government funds to be allocated through a community development block grant (CDBG) award.

Waiting for a CDBG award created significant problems because there was a delay of several months from the time FEMA concluded its response function to CDBG funds being awarded. This makes both the amount and speed of state and federal aid more critical. Late allocation of funding is a frequently cited barrier and also one of the most important as ranked by both experts and the public (Rouhanizadeh et al., 2020; Safapour et al., 2021). The pressure of this barrier was faced in the community of White Sulphur Springs as indicated by the Project Manager for Hope Village.

> “So the drawback of the system or the weakness of the system as it exists today, is that federal money doesn't flow quickly. It takes two years to arrive. By that time people have scattered...” – Architect and Project Manager for Hope Village

Long-term planning and recovery planning are not always in place prior to disasters because small towns may not have the funding to undertake planning activities. To keep people from leaving the local community, as was the case for some following the 2016 floods, recovery must begin quickly. To do so, the three things required are: (1) a recovery plan or long-term community plan, (2) skilled volunteer labor, and (3) funding. The first is described by the Executive Director of Mennonite Disaster Service.

> “Some communities cannot get together. And we have to move on to another community that says we're organized. You need a White Sulphur Springs. That was the beauty and a community Moses to lead to lead the way. Need somebody with a vision, always say money will follow a vision, not the other way around.” – Executive Director, Mennonite Disaster Service

Plans devised with community engagement prior to a disaster are preferrable, but impromptu plans like that found in Hope Village can be successful with sufficient local leadership and

community support. In the case of Hope Village, numerous community leaders collaborated on the development of the new neighborhood, which allowed them to utilize their limited time in the national spotlight. Delays in recovery due to lack of planning can negatively affect a communities' ability to fundraise and attract volunteers. Funding and volunteers are needed to bring the recovery plan to life. These are two things usually in short supply as described by a member of the Greater Greenbrier Long-Term Recovery Committee.

> "But probably the biggest two biggest impediments is you're always chasing funding to make that work. And if you're trying to keep your costs down, you're always chasing skilled volunteer labor." – Member of the Greater Greenbrier Long-Term Recovery Committee

Without proper planning, labor and funding will be underutilized. Without labor or funding, projects will not be able to proceed. All three are crucial to implementing successful recovery that keeps residents in their communities.

Coordination Barriers

Coordination barriers make the cooperation and collaboration of various organizations difficult, thereby complicating the execution of plans and utilization of available resources. Lack of planning and difficulties communicating often plague communities following disasters that wreak havoc on communications infrastructure and make even the best laid plans difficult to implement. Coordination barriers often rank by experts as the most important type of barrier to the recovery process (Rouhanizadeh & Kermanshachi, 2021a). In this study, interviewees stressed the importance of coordination, especially nonprofit interviewees like members of WV VOAD who helped execute the Bridge Home Program and members of the Greater Greenbrier Long-Term Recovery Committee. The coordination barriers described by interviewees include:

1. Need for improved communication
2. Unclear roles and responsibilities
3. Need for long-term community planning
4. Lack of asset mapping
5. Lack of management capacity
6. Need for more accurate flood models
7. Knowledge retention between disasters

Communicating accurate information quickly, was found to be the most cited barrier in this category. It was described as, "a remarkable challenge," and was made difficult not only by the typical limitations placed on communication servers immediately following the disaster event, but also by some community members' lack of internet use, mobility challenges, and road closures separating remote homes from towns. This made getting information to residents about public meetings, and then getting them there, difficult. These public meetings were spaces for the community to engage with private and government stakeholders about the recovery process, so having members from all areas of the community attend was important.

In addition to communicating with the broader community, those who are leading local recovery efforts need to do a better job communicating with one another, so that stakeholders understand their various roles and responsibilities. This was discussed by a FEMA official when they said:

> "I think in West Virginia, what we've seen is those roles and responsibilities aren't always clearly defined." – FEMA Emergency Management Specialist, FEMA Region III (Italics added for emphasis)

This lack of clearly defined roles and responsibilities is the number one ranked barrier by disaster recovery experts (Rouhanizadeh & Kermanshachi, 2021b). This barrier goes hand-in-hand with a lack of long-term planning, which many small towns and local governments do not have the economic resources to perform. The need for long-term planning was brought up by a FEMA official who said:

> "You have to identify the risks ahead of time and probably have some projects already identified so that when you get the funding. You can fund those projects. They have to pass a BCA, stuff like that. It was a lot of money for the state. Since the state has in a lot of ways an abundance of funding coming its way. And it becomes almost a challenge for how and where they're going to spend it. I mean, that's. It sounds like a good problem to have, right? But like, it's hard, it's hard." – FEMA Emergency Management Specialist, FEMA Region III

Having an influx of funding sounds like a "good problem to have", but not when it takes months to be disbursed in part due to lack of prior planning and justification on how to spend it. One factor that would help communities better respond and plan recovery activities would be to develop an asset management system as described by a member of the Greater Greenbrier Long-Term Recovery Committee.

> "A shortcoming, if you will…asset mapping. Where are your shelters? Well, they got a pretty good idea where shelters are because your county EMS managers will work with local communities to establish the shelters. OK, how about where is a space that I can get to? How about feeding? How about fill in the blanks? How many people in your church kitchen can you feed? Can you house people? Where can we? And it just goes on and on and on. Who are the, who are the contractors that you know you're going to need on short notice, it's guys to do excavation, can you go ahead and clear a creek bed out real quick or or whatever it might be. We're not there with asset mapping. There's no central system for asset mapping." – Greater Greenbrier Long Term Recovery Committee Member

West Virginia communities lacked a comprehensive asset management plan, which made knowing where feeding facilities, shelters, and other assets were located and available difficult for local recovery groups and volunteer organizations. This made effectively coordinating an

influx of people and resources challenging and exacerbated the stress state, and especially local, governments were under.

> "I think probably where the biggest issue is is capacity to manage all this. And it takes, you know, typically it takes some at the local level to support that, either local government or the planning councils. And then having that state capacity to manage these grants can be overwhelming." – FEMA Disaster Coordinator, FEMA Region III

Lack of planning and lack of a strong disaster network in West Virginia, especially at the local level, prior to the floods led to a diminished level of preparedness. Long-term recovery committees were established following the flooding at the urging of FEMA, but the learning curve for the organizations is steep as shared by the former Chair of the Greater Greenbrier Long Term Recovery Committee.

> "But we, it took us, it took us probably, I'm going to say, about two and a half months before we really started to become effective in long term recovery." – Former Chair of the Greater Greenbrier Long Term Recovery Committee

The need for long-term recovery groups will inevitably decrease as recovery progresses, but there is opportunity for transformation from a focus on recovery to mitigation and preparedness to keep stakeholders engaged with one another and share institutional knowledge. This would reduce the time needed for recovery groups to become effective following the next disaster, and could also help resolve the issue of stakeholders being unclear on their roles and responsibilities. This was only specifically mentioned once by a FEMA official who served as the disaster recovery coordinator following the floods, and also Town of White Sulphur Springs officials when they described the need to bring in private consultants to guide them through various recovery processes.

Legal Barriers

Legal barriers describe challenges navigating government processes either by individuals or organizations. The "Professional liability in the face of uncertain design standards" barrier reveals both a technical and policy gap regarding private access bridges. Legal barriers posed a considerable challenge to the long-term recovery efforts following the 2016 floods. The legal barriers described by interviewees included:

1. Regulatory delays
2. Onerous reimbursement process
3. Professional liability in the face of uncertain design standards
4. Difficulty filling out government assistance forms
5. Difficulty assisting renters

Regulatory delays, difficulty of residents understanding and providing legal documentation for government forms, a quick turnaround time for FEMA aid applications, professional liability, and other factors were all identified as challenging in the recovery process.

Regulatory delay, means the time required to follow regulatory procedures that prevented reconstruction activities from commencing. There are multiple steps to obtaining long-term recovery funds from the Department of Housing and Urban Development's (HUD) Community Development Block Grant – Disaster Resilience Grant Program (CDBG – DR) including an act of Congress. The length of the process has recently been publicly recognized as "producing unnecessary barriers" by HUD officials (HUD Public Affairs, 2022). This study highlights its impact on rural communities in Appalachia with limited funds to perform recovery activities. The architect and project manager for Hope Village described the challenge of waiting for federal recovery funds as too lengthy for meaningful recovery that will retain and give hope to affected residents. He said:

> "A key element was that the restrictions on public money are that it takes a long, long time. And if you're going to try to get somebody, if you're going to try to have a recovery, that's meaningful. And you're going to try to encourage the residents of the community that were impacted to stay in the community. We felt like you needed to move quickly. We needed to give people a reason to stay. So we moved very quickly. And the only way you can do that is with private money." – Architect and Project Manager for Hope Village

Delays in funding are among the most commonly cited barriers in disaster recovery (Rouhanizadeh et al., 2020). One step that could be taken is guiding and incentivizing communities to develop long-term planning that can be used to guide post-disaster decision-making and streamline planning and approval processes.

FEMA, which is usually on site within days of events that are declared as natural disasters, has taken steps to help streamline its procedures and has a relatively short timeline for getting residents funding. Residents applying for FEMA aid have up to 60 days after a disaster declaration to apply for aid and applicants should receive a check within 10 days of a FEMA inspector conducting an inspection (Insurance Information Institute, n.d.). FEMA's ability to quickly distribute aid to meet immediate needs demonstrates the government's ability to devise programs that can be executed in an expeditious manner.

However, consideration is also needed not to create a timeline that is too aggressive so that additional stressors are imposed on disaster victims. One affected resident described her fellow community members' struggle to "comprehend all of the paperwork, and the wording, and then contracts and the agreements…". She explained that both navigating the process and providing some of the legal documentation, such as deeds to a house, proved difficult when many people own their home due to generational homeownership and because people's home flooded and many of their possessions – sometimes including legal documents – were destroyed. Some documentation required by FEMA and insurance agencies need to be secured from local governments, which can become overwhelmed following a disaster. One FEMA official echoed this by saying, "Our process is not simple" when discussing the need for case managers to assist residents with aid applications.

Similar problems arise with FEMA's public assistance program. When discussing the reimbursement process for public infrastructure projects, one town's officials shared their struggles following FEMA's processes for reimbursement.

> "As I mentioned, FEMA as well, that FEMA is tough to work. I mean, you have to know the ins and outs. And if you don't cross the right T and dot the right I, you might get something here and they bring it back the next time. So we have to be very careful with dealing with FEMA." – White Sulphur Springs Town Official

> "We were okay in doing what they [FEMA] told us to do and then they denied our request for reimbursement. We'd already spent the money. We spent the money… I think we finally, after a long period of time, that they finally gave us a go ahead on it [the reimbursement]. But it didn't, it wasn't like months. It was a matter of a couple of years. – White Sulphur Springs Town Official

This onerous reimbursement process puts strain on local governments' finances and inhibits recovery efforts. Reimbursements can vary in award amount and the time in which an applicant submits a request to the time of repayment (Crow et al., 2018). These regulatory concerns do not end at a difficulties following processes. Gaps in the regulations regarding the eligibility of private access bridges, as well as appropriate design standards for private access bridges proved challenging to recovery stakeholders.

A gap in the legal system discovered in the aftermath of the 2016 floods was a lack of widely accepted design standards for private access bridges. These bridges are rarely found in urban areas and are more prominent in rural areas as they typically serve to connect a small number of homes (sometimes only a single home) to a main road by spanning a small creek or stream. This gap in design standards led to the hesitancy of professionals to take part in innovative programs, such as the West Virginia Bridge Home Program (WVBHP) due to liability concerns. Not only was there a lack of widely accepted standards for these structures, but there was no clear way to fund their reconstruction through traditional channels of federal disaster aid. Private bridges, prior to the 2016 West Virginia floods, fell into a gap between public transportation infrastructure and private residence as described in the quote below.

> "So it [private access bridges] kind of fell in this little gap. Like it didn't fall under individual assistance because people will pay for private bridges, right. Then, I think the state came in and the state was like, well, if not, those aren't our roads…They [the West Virginia Department of Transportation] would be responsible for the maintaining and certification and inspection of that bridge." – FEMA Emergency Management Specialist, FEMA Region III

To reiterate what this quote is saying, individual assistance does not cover infrastructure because infrastructure is covered under FEMA's public assistance program, but because the bridges are privately owned and maintained they are not public infrastructure. After discussion between FEMA and the state, it was determined private access bridges are eligible for individual

assistance dollars, but FEMA does not yet recognize them for their mitigation grant programs. Another FEMA Region III representative intimately involved with the 2016 flood recovery discussed this issue and the need for FEMA to adapt its procedures to include private access bridges when they said:

> "It'll be interesting to see how mitigation evolves and looks at private bridges and things like that as a way, because we've been working on the state [level] to see it, that right now we can't fund, through our mitigation program, private bridges. But if your private bridge is impacted and your home is impacted and there's an individual assistance declaration, you can get some funding from there. So how do we, you know, how does FEMA look at mitigation of private bridges? And is that something that may come along since HUD's been doing it?" – FEMA Disaster Coordinator, FEMA Region III

This policy gap demonstrates the impact government regulations have on the ability of states and localities to perform disaster recovery and mitigation when relying on federal funding.

Socio-cultural barriers

Socio-cultural barriers address social and cultural factors specific to the people and place of the case study. Socio-cultural barriers included the smallest subgroup of codes, with only four barriers, including:

1. Mental Health and Cognitive Ability
2. Historical development patterns
3. Cultural ties to land
4. Lacking knowledge of local building codes

Flood survivors had varying levels of difficulty recovering based on factors such as age and the impact of the flood on their mental health. Navigating the FEMA application process for replacing or repairing their home or bridge was challenging for citizens, but especially the elderly who tend to struggle more than other age brackets. One White Sulphur Springs resident reported seeing this barrier while working with the public at a community call center.

> "…mental capacity to be able to comprehend all of the paperwork and the wording and then contract and the agreements and, you know, options being able to understand those things. I think those were definitely barriers as well. And majority of the time, it was elderly people that I saw that were struggling more than anyone else when it came to navigating those situations." -White Sulphur Springs Resident and Community Call Center Worker

This finding is consistent with Rouhanizadeh & Kermanshachi (2021) as they found a large elderly population was ranked as the most impactful socio-cultural barrier to recovery. Not only should the age of many disaster survivors be considered when reviewing the FEMA application process, but so too should the significant stress and mental strain disaster survivors are placed under. One survivor shared, "…I just had to like, I had to do what I had to do, and it was not easy mentally at all." "I lived in two other, I lived in two other places and I also couch surfed on

friends couches for a while. And that was with my kid, you know?". The loss flood survivors face and the difficulties must be considered when designing processes and paperwork targeted at disaster survivors to make the process as simple and efficient as possible.

The most frequently cited socio-cultural barrier from their review was a "diversity of culture and languages in affected area" and another obstacle was "distrust among stakeholders". While diversity can be a tremendous life-enhancing asset to a community, in the context of disaster recovery citizens sharing a cultural background and similar language can prove to be an asset. Following the 2016 floods, many nonprofit, faith-based organizations contributed to rural recovery efforts. These faith-based organizations can help overcome distrust because many are already involved in the affected communities (Shinn & Caretta, 2020). It is unclear if there is a difference between the faith-based response in rural and urban areas, but it is possible that the significant involvement of nonprofits, and specifically faith-based nonprofits, following the 2016 floods helped overcome the barriers of distrust found in other contexts. Limited cooperation among nonprofits and government agencies existed prior to the establishment of the WVBHP, but trusting relationships have been fostered in the years following the flooding during long-term recovery and have persisted and expanded to today. These relationships and coordination efforts help plug gaps in and speed up the response of state agencies to flooding which is West Virginia's most experienced disaster.

Many West Virginia communities are the product of historical development patterns along streams and rivers. Unlike less mountainous regions, these areas of low-lying development in Appalachia are vulnerable to flash flooding. When heavy precipitation events occur in West Virginia, runoff from nearby mountains, which can include woody debris, can quickly cause culverts to backup and streambanks to overflow – leaving the surrounding community at risk. Many people who live in these low-lying and repeatedly flooded communities do not move to less flood-prone areas because many do not have the resources to do so, as discussed in the financial barriers section, but also Appalachians hold strong attachment to place (Barcus & Brunn, 2009). This attachment to the land and desire to preserve both family and local history was evident throughout the interviews and is exemplified in the following quotes from an affected citizen, public official, and private sector professional.

> "The fact that like my, the property was like my grandmother's, you know, um, there is some family connection to it." – Flood Survivor and Hope Village Resident

> "…people will not even move like a county over for a job or a better job like people. They're very connected to the land and the place. A sense of place is very strong." – FEMA Emergency Management Specialist, FEMA Region III

> "That was my initial thing. Why are you building in this river valley – move. And then the more you talk to people, the people don't move. You know, even if the wars in Syria and the bombs bursting over your head, this is your home. You don't move. And same if you're living in a hollow that your grandfather, planted an apple tree, you're not going to move. And so, yeah, the idea of why people building back in New Orleans, you know,

> below the levees. It's because I've always lived here. Yes, it's I think it's built in us and people to stay right where they are." – Professional Engineer, JZ Engineering

This strong attachment to place makes balancing socio-cultural factors, such as place attachment, and recovery and mitigation options such as buyout programs difficult. One of the most effective forms of flood mitigation is to move homes, businesses, and other infrastructure out of the floodplain through buyout programs. Some people will accept moving out of harm's way after a devastating event like the 2016 floods, as evidenced by population loss in some Greenbrier County communities immediately after (Caretta et al., 2021), but many more people desire to stay. One condition for federal disaster assistance funding is that residents are required to maintain flood insurance on those properties in perpetuity. This places an immense financial burden on many of these homeowners.

While some people understand the risks of living in a floodplain and desire to stay and harden their homes using methods such as floodgates or elevating structures, there are those in harm's way that do not even realize they are at increased risk for flooding. Part of this is due to the very rural nature of Appalachia and residents sometimes lack knowledge of building codes that would prevent them from building in floodplains.

> "And people aren't educated on, you know, most people don't know out in the rural areas that you need a building permit. And technically, you're supposed to have a building permit for anything you do, whether you're in the floodplain or not. You know, but if you're back in the woods on a farm and you build a place back here and AEP hooks electric to it and you got a septic system and a well, you know nobody's to the wiser." – Former WV National Floodplain Insurance Program (NFIP) Director

Building codes and federal regulations are intended to minimize flood risk, but legislators and federal regulators must be careful to write laws and subsequent regulations in a way that allows for common sense judgement to be used by engineers and local building professionals. One such example comes from the FEMA regulations that require homeowners who wish to rebuild or substantially repair damaged structures in the floodplain to do so in the existing footprint.

> "The regulations, the FEMA regulations, say it has to go back in the existing footprint." – Former WV NFIP Director

This means that even if the building could be moved to a less at-risk location on the same property, owners must rebuild in the exact same footprint. This finding is consistent with Crow et al. (2018) finding that some stipulations tied to federal funding limit the ability of local communities to adapt outdated infrastructure to meet current standards. These types of regulations, while having the intent of working with residents' desires to preserve local history and culture, need to be carefully scrutinized and updated to account for these kinds of issues.

Barriers to Rural Recovery

Financial barriers, such as limited funding for recovery projects, are faced by both rural and urban communities following disaster, but nuanced differences can exacerbate the struggles of rural areas. For example, providing more funding to a rural town government like Clendenin may allow for the funding of more projects, but it will not necessarily address the staffing shortfalls and lack of expertise preventing the development and selection of projects aspiring to "build back better" principles. Urban localities may have year-round staff with experience working with federal agencies like FEMA and HUD and have case management experience that can be drawn on to quickly scale up following a disaster. Many rural towns lack even basic full-time positions and are unlikely to have individuals with disaster recovery expertise on staff, thus making it more difficult and time-consuming to increase their capacity. Given federal agencies involved in disaster recovery, such as FEMA and HUD, try to empower local communities to lead their own recovery efforts, it is important they recognize staffing limitations and the necessity of speed for vulnerable citizens who may not be able to remain in their communities for long without aid. Rural recovery must be viewed and addressed systematically in light of these limitations.

Navigating the federal aid application process, including the need to fill out multiple forms to different organizations, and especially producing documentation required to prove home ownership, proved to be difficult legal barriers. Case managers that directly assisted residents were described as invaluable in the years following the 2016 floods as they helped guide residents through the processes and assist them in documenting homeownership. FEMA has made changes recently to the documentation requirements for their Individuals and Households Program, which make it easier to prove home ownership, but residents still benefit from one-on-one help for case managers due to flood victims' various health, financial, and other limitations.

The most mentioned socio-cultural barrier was the pattern of historical development that caused many communities in West Virginia, and more broadly Appalachia, to be located in low-lying regions subject to flash flooding. This combined with people in Appalachia who have strong attachment to place presented a challenge to the Hope Village project because of the necessity for property buyouts and relocation efforts. Relocating citizens subject to repeat flooding to property outside the floodplain but nearby in the same community, and also maintaining a connection and usability of their land are ways to make property buyouts more feasible in Appalachia. This has the added benefit of retaining the population and revenue of localities, and creating new amenities like parks and recreation opportunities that came out of the Hope Village project.

Conclusion

Several of the rural barriers presented in this paper are underrepresented in existing literature. Lack of capabilities and staffing for rural Appalachian governments to navigate the federal disaster aid application process, difficulty providing certain legal documents by citizens who own their homes from generational homeownership, and lack of standards for private access

bridges are examples of these barriers. Inability to prove home ownership with legal documents like deeds can prevent homeowners from applying for federal funding – effectively stopping recovery in its tracks and extending existing hardship for these individuals and their families. A recent literature review of housing reconstruction barriers following disasters that included 209 articles found only 7 mentions of this important issue to rural recovery (Safapour et al., 2021).

Communities devastated by a disaster like the 2016 West Virginia floods need money to rebuild, but rural areas often lack positions that many urban areas may have on full time staff, thus creating a need for staffing assistance to help manage federal recovery funds and coordinate recovery efforts. Potential solutions in rural communities to this challenge may include the creation of regional positions that can be funded by either pooling resources from a wider area or from a state government, employing case management professionals part-time, or partnering more closely with volunteer organizations for these types of services. WV VOAD and their member organizations, primarily made up of faith-based disaster recovery groups, can help to bolster state disaster response. Establishing state funding for a state's VOAD to fund baseline positions like a director and case managers could help support a state's capacity to respond to disasters like flooding and allow the scaling up of operations more quickly when needed.

The findings of this research could apply to rural areas outside of West Virginia and Appalachia, or more broadly communities with a lower socioeconomic status. Future research is recommended to verify the barriers faced by small, rural communities in southern and central West Virginia also impact other communities with similar characteristics. Additionally, this work focuses on barriers to rural recovery and does little to suggest solutions. Solutions to these barriers, such as long-term planning, recovery planning, disaster network building, policy changes, and other efforts to mitigate these barriers, exist and should be further explored in a rural context in future work.

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Chapter 2: The Importance of Planning and Relationships in Overcoming Financial and Coordination Barriers for Rural Communities: Lessons Learned from the 2016 West Virginia Floods

Abstract

The research presented in this paper explores the often-slow allocation of funding to and limited management capacity of local governments during disaster recovery in rural Appalachian communities. Recovery efforts across multiple communities and a case study of the West Virginia Bridge Home Program from the 2016 West Virginia floods were used in the study. Semi-structured interviews were conducted with stakeholders from local, state, and federal governments to nonprofit organizations and private engineering firms. Site visits accompanied interviews and thematic content analysis was used to analyze interview transcripts and supporting documentation. The findings suggest that while funding is often the broad solution posed to overcome many barriers to recovery, collaborative planning efforts and capacity building through the cultivation of relationships among disaster recovery stakeholders are necessary to provide an efficient and effective recovery for rural Appalachian communities. Routine meetings and regular collaborative efforts among nonprofits, private industry, and various levels of government helped make the most of available resources. By adopting planning and cross-sector collaborative practices local governments can overcome barriers, leverage available resources, and facilitate an efficient and effective recovery process for the benefit of the affected communities.

Introduction

Given the recent rise in both the frequency and severity of natural disaster events, rural communities have never been in greater need of disaster recovery preparedness and long-term resilience (Zobel & Baghersad, 2020). Previous research has identified various categories of barriers to disaster recovery, including financial resources, coordination between stakeholders, legal constraints, and socio-cultural factors (Poling and Shealy, 2023a). While many barriers affect both rural and urban areas, some are more pronounced in rural contexts. Barriers including ineffective operational management, inadequate planning and planning capacity, higher poverty rates, and limited access to legal documents are more prevalent in rural disaster recovery (Safapour et al., 2021).

The research presented in this paper uses previously identified barriers to discuss context-specific mitigation strategies for rural communities. More specifically, strategies to overcome challenges related to finances and coordination are explored because these challenges consistently rank among the most important and most frequently cited to disaster recovery in rural communities (Rouhanizadeh & Kermanshachi, 2021b; Safapour et al., 2021). Financial challenges relate to either monetary shortages or broader resource deficiencies, while coordination challenges reference issues for stakeholders to work together effectively.

This paper builds on the study by Poling & Shealy (2023a). This prior work found that limited funding for full-time positions in cash-strapped rural municipalities led to overlooking disaster recovery planning. The lack of disaster planning created delays in federal funding and a reduction in recovery funds in the aftermath of a disaster. The lack of full-time staff also created coordination barriers including unclear roles and responsibilities and a lack of management capacity (Poling & Shealy, 2023a). The work presented in this paper also builds on Shinn & Caretta (2020) by expanding on their study measuring the impact of social capital on community resilience.

The background section further outlines the financial and coordination barriers rural communities face, how this relates to long-term disaster recovery, and the potential of social capital particularly found in a rural context to help rebound after a disaster event. The research question and methods follow, describing the qualitative approach used to understand these challenges and strategies used by one rural Appalachian region to overcome them. The results and discussion present both the strategies used to overcome financial and coordination barriers and how these strategies differ from the prior understanding. The conclusion provides recommendations and future next steps.

Background

Inadequate financial resources are the most frequently cited financial barrier to disaster recovery (Safapour et al., 2021). The amount of destruction and accompanying cost to repair and replace infrastructure can quickly overwhelm individuals' and local governments' resources. This creates the need for funding from larger entities like state and federal governments. This funding usually comes from programs like the Federal Emergency Management Agency's Individual Assistance or Public Assistance Program, and The U.S. Department of Housing and Urban Development's Community Development Block Grant – Disaster Recovery (CDBG-DR) Program.

FEMA funds are distributed quickly after a disaster occurs but are not designed to fully restore a community to its pre-disaster state, but rather to help meet immediate needs. Community Development Block Grant – Disaster Recovery (CDBG-DR) funds are intended to be much more comprehensive in meeting a community's long-term recovery goals, but the application process takes months with the average award not being granted until 15-18 months after disaster occurrence (Gimont, 2022). This is problematic given federal laws require money allocated through the CDBG-DR program to be approved before local and state governments can begin to use them.

Many rural communities lack the ability to begin meaningful long-term recovery before receiving CDBG-DR funds. This delay can prolong the recovery process, thus extending the harmful effects of the disaster. Late allocation of funding was recognized as an issue in previous research on disaster recovery barriers broadly (Rouhanizadeh & Kermanshachi, 2021b), as well as barriers specific to the 2016 West Virginia flood recovery (Poling & Shealy, 2023a). Strategies for improving long-term recovery must include ways of getting money to communities more quickly. Recovery funding is vital for reconstruction efforts (Rouhanizadeh & Kermanshachi,

2020; Shaw, 2014), but it alone cannot guarantee a successful recovery without proper coordination.

In addition to inadequate financial resources and late or slow allocation of funding, two coordination barriers are prominently mentioned in the long-term recovery literature: unclear roles and responsibilities of stakeholders and a lack of management capacity (Rouhanizadeh et al., 2020; Rouhanizadeh & Kermanshachi, 2021; Safapour et al., 2021; Poling & Shealy, 2023a). The post-disaster recovery environment can be chaotic and this places stress on both infrastructure and institutional systems, making decision-making and coordination difficult (Opdyke, 2017). Under these circumstances, stakeholders often find themselves unsure of their specific roles in the recovery process. This can lead to duplication of effort or inactivity – both of which can cost valuable time to resolve. For example, in the absence of an asset management plan that identifies storage locations for donated materials, rather than coordinating to identify these locations, multiple organizations may attempt to secure these facilities in silos leading to repeat duplication of tasks and lost time.

Coordination barriers can also be seen in the establishment of long-term recovery committees shortly after response efforts in affected communities. Long-term recovery committees (LTRC's) usually consist of cross-sector organizations and local community members, and their creation is recommended by FEMA following a disaster (U.S. Department of Homeland Security, 2016). Their goal, as outlined in the National Disaster Recovery Framework (NDRF), is "to unite recovery resources with community needs to ensure that even the most vulnerable in the community recover from disaster" (U.S. Department of Homeland Security, 2016).

According to a member of one local recovery committee, it took approximately two and a half months before the committee began to be effective in long-term recovery (Poling & Shealy, 2023a). This committee faced challenges with fundraising, coordinating volunteers, working with FEMA and state agencies, and managing communications. Lack of asset management contributed to difficulties coordinating volunteers and managing resources because knowledge of location, quantity, and availability of resources is critical to their timely utilization.

After the 2016 floods in West Virginia, local emergency managers had mechanisms in place to establish shelters and feeding locations, but a comprehensive database to assist with tasks like housing and feeding volunteers and storing donated materials for an extended period was needed to quickly build their community's capacity to receive and retain volunteer labor and donated resources more quickly and for longer (Poling & Shealy, 2023a). Published guidelines to assist communities in establishing long-term recovery groups exist (U.S. Department of Homeland Security, 2016), but collaborating among numerous government and non-government organizations to execute meaningful recovery can take years (Government Accountability Office, 2010). Additionally, the makeup of these groups varies by community and disaster, and how long they remain active and the evolution of their roles and effectiveness over time is unclear.

The lack of full-time staff can also contribute to inadequate management capacity by making balancing tasks like navigating federal aid applications, assisting constituents, and managing recovery grants more difficult (Poling & Shealy, 2023a). For example, the Town of Clendenin in Kanawha County, West Virginia did not have full-time positions for professionals like building inspectors and legal counsel (Poling & Shealy, 2023a). This made preparing applications for grants that require input from these kinds of technical positions nearly impossible without outside assistance.

While rural communities face distinct challenges, they also possess unique strengths. Rural communities tend to rely more on their community network to help after a disaster (Cutter et al., 2016). Rural communities tend to hold a proportionately higher number of native-born residents, religious adherents, and civic organizations, and more easily leverage these community resources during the recovery process when compared to their urban counterparts (Jerolleman, 2020). These community connections are part of their social capital, which is the collective asset of shared norms, values, beliefs, trust, networks, social relations, and institutions that facilitate cooperation and collective action for mutual benefit (Bhandari & Yasunobu, 2009).

Increased social capital helps build positive relationships between local officials and state and federal officials, which in turn, can lead to increased efficiency during the reconstruction process following a disaster event (Rouhanizadeh & Kermanshachi, 2020b). It can also help to leverage resources from across the community for a more holistic approach to recovery (Shinn & Caretta, 2020; U.S. Department of Homeland Security, 2016). While social capital can improve disaster recovery outcomes (Fraser & Naquin, 2022), and is often tied to the culture (Toya & Skidmore, 2014), current literature says very little about specific, replicable mechanisms for both fostering and utilizing social capital in overcoming rural barriers during disaster recovery. Only about 6% of studies in recent decades even explore institutional and organizational relationships during disaster recovery (Opdyke et al., 2017). The research presented in this paper examines the impact of prior planning by collaborative partnerships on recovery efforts and to what extent those relationships helped achieve community plans or overcome a lack thereof. It advances the work of Shinn & Caretta (2020) by expanding their study of social capital's impact on community resilience to identify specific factors important to overcoming long-term recovery barriers in rural communities.

Research Questions

The research question the study outlined in this paper tries to answer is how can rural communities overcome financial and coordination barriers to long-term recovery following disasters. The expectation is pre-existing relationships among disaster recovery organizations lead to increased teamwork to plan for, and thereby improve, recovery efforts from disasters. Rural communities benefit from social capital that helps enable more collaborative planning efforts.

Methods

The 2016 West Virginia floods were used as a focusing event to investigate how rural communities overcome financial and coordination barriers. The focus area was narrowed down to two counties within the most impacted and distressed (MID) communities as classified by the U.S. Department of Housing and Urban Development (HUD) (*WV-Action-Plan*, n.d.). News articles and FEMA Individual Assistance application data from HUD's community development block grant were examined. From this analysis, the towns of Clendenin and Elkview in Kanawha County, and Rainelle and White Sulphur Springs in Greenbrier County were identified as the most severely affected (*WV-Action-Plan*, n.d.). Consequently, these two counties were chosen for the study's scope.

Within this region, one recovery program, the West Virginia Bridge Home Program, was selected for case development. This case was chosen because the private residential bridges this program replaces are a type of infrastructure primarily found in rural areas. These bridges are often located in high-risk flooding areas and suffer from limited maintenance. The West Virginia Bridge Home Program (WVBHP) utilized both donated dollars and federal recovery funds to rebuild residents' bridges. This involved the collaboration of numerous cross sector stakeholders, including private, nonprofit, and government organizations, and had varying government involvement and funding mechanisms. Information on the case is presented below.

Case Study: The West Virginia Bridge Home Program (WVBHP)

The West Virginia Bridge Home Program is an effort by numerous nonprofit and government entities to replace private access bridges for homeowners in need. Many residents in mostly rural areas of West Virginia rely on these residential bridges to access their homes from state-maintained roads. Before the 2016 floods, the WV Bridge Home Program was in its early stages. After the floods, it proved to be an essential mechanism in providing safe access to homes for hundreds of affected residents. The program came about because residents would contact the Department of Transportation (DOT) after smaller flooding incidents, seeking assistance in rebuilding their bridges, which had often been constructed decades earlier and were either damaged or destroyed. However, the DOT could not help as the bridges were located on private property. WV Voluntary Organizations Active in Disaster (WV VOAD) recognizing the growing need for such assistance throughout the state, brought together a diverse team of government agencies, non-profits, and an engineering firm to address this issue. Since the 2016 floods, the program has successfully constructed over one hundred safe, low-cost, and resilient private access bridges (see Figures 1 and 2 as an example). Interviewees for case study one included members of WV VOAD, permitting officials, elected officials, and representatives of state and federal agencies, such as the West Virginia Resiliency Office and FEMA.

Figure 1: Poorly Designed Private Residential Bridge Before Bridge Home Program Replacement (Courtesy of WV VOAD)

Figure 2: Private Residential Bridge After Bridge Home Program Replacement (Courtesy of WV VOAD)

Data Collection

The primary method of data collection was through semi-structured interviews, using a combination of convenience and snowball sampling. Stakeholders were identified, and additional interviewees were recruited based on recommendations provided by stakeholders. The construction process was observed through site visits, including multiple visits to the

private residential bridge serving as the model project for the WV Bridge Home Program. Supporting documents for the interviews included government grants, engineering drawings, permits, and local laws.

Interviews were conducted from June to September 2022, with two pilot interviews conducted in October 2021. A total of 25 people representing 15 organizations participated, including mayors and FEMA officials, professional engineers, and nonprofit disaster workers. Stakeholders were identified using various sources, including documents from the WV VOAD Bridge Home Design Guidelines and recommendations from WV VOAD's Executive Director. Interview questions focused on stakeholder relationships, government regulations, and perceptions of risk in long-term infrastructure design and construction post-disaster, and were reviewed by four researchers to limit bias and consider local culture.

To avoid potential bias, some questions were rephrased, such as changing "were you thinking of how to build back better" to "were you thinking about how to build it better than it was before". The researchers also used phrasing around resilience rather than climate change in some questions, such as "how big of a role does the idea of resilience play during the design and permitting process?" Interviewees came from the public, private, and nonprofit sectors and held varying roles and degrees of involvement with the different projects.

Data Analysis

The data analysis process began by transcribing the interviews using software, which were then reviewed and corrected by the research team. Thematic content analysis was then conducted using Nvivo software, where comments with similar themes were grouped and assigned codes to derive meaning from the interview data. An initial set of codes was established before analysis, while additional codes were generated during analysis. The creation of an initial set of codes before analysis was a form of deductive coding, while generating new codes during analysis aligned with an inductive approach. This hybrid approach balanced the advantages of both inductive and deductive methodologies (Yin, 2011b).

Validation of Coding

To establish intercoder reliability, the research team used a negotiated agreement approach, where two researchers coded a subset of transcripts and resolved discrepancies through discussion. The primary investigator created the coding scheme, and an independent, third-party coder with no prior knowledge of the research was brought in to validate the coding. For this study, a sample size of three interviews was used from two professional engineers and a public permitting agency. Although no widely accepted standard for coding validation exists, recent literature supports the use of 10-25% of data units for this process (O'Connor & Joffe, 2020). After independently coding the transcripts, NVivo was used to calculate a Cohen's Kappa intercoder reliability score.

The initial average score across the three transcripts was K=0.54, with discrepancies mainly due to the validator's lack of expertise in engineering design and disaster recovery. Additionally, the bounds of some coded sections differed, meaning both coders agreed on the code to be applied to a certain section of text, but may have started or stopped the code at slightly different points. This is known as the unitization problem in which different people assign the "units of meaning" to different portions of a text (Campbell et al, 2013). After several iterations of reviewing the transcripts and making adjustments to harmonize the coding logic between the research team member and validator, a final Cohen's Kappa of K = 0.90 was established across the transcripts.

Results and Discussion

The interviews revealed the importance of planning to overcome both financial and coordination barriers. The development of relationships through these efforts prior to disaster events can help communities overcome unclear roles and responsibilities. The results and discussion are broken into two sections: (1) Pre-disaster planning efforts helped overcome inadequate financial resources and late or slow allocation of funding post-disaster and (2) pre-disaster planning helped overcome post-disaster coordination barriers, with a subsection devoted to the pre-disaster development of stakeholder relationships and social capital to overcome unclear roles and responsibilities when coordinating post-disaster.

Pre-disaster planning efforts helped overcome inadequate financial resources and late or slow allocation of funding post-disaster

The West Virginia Bridge Home Program (WVBHP) was successful in helping communities recover through the rebuilding of private access bridges following the floods because of the pre-disaster planning efforts that took place before the flooding event. The West Virginia Bridge Home Program was created with input from numerous nonprofit groups, county, state, and federal permitting agencies, and a private engineering firm working together weekly, and sometimes daily, over a period of about 10 months prior to the flooding event. Stakeholders involved with the bridge home program identified private access bridges as vulnerable infrastructure before the 2016 flooding events and preemptively began meeting regularly to develop a solution. While this group did not have the measure of financial resources needed to replace the plethora of bridges in need prior to the flooding event, these pre-disaster planning efforts were leveraged once the community development block grant (CDBG-DR) funds were available post-disaster. Pre-planning involved the gathering of nonprofit, private, and government organizations working together prior to the 2016 floods to shorten permitting times, develop a resilient, replicable, and low-cost private access bridge design, and plan for the availability of future funding – funding which became available because of the 2016 floods. The program stands out among other 2016 recovery efforts because of its pre-disaster planning that saved time post-disaster and allowed the community to act more quickly when funding became available.

Identifying vulnerable infrastructure and future improvement projects can help overcome limited financial resources by increasing the amount of funding a community receives. This

ensures they are included in recovery grant proposals as described by the FEMA Region III Disaster Field Coordinator.

> "But if that [planning at the local level] doesn't happen and there's no state plan in place, that's where it just leaves a lot to the question. And *sometimes assistance isn't identified or they don't get it* because you can't read the minds and know. So it's, it's one of those things. We prefer that states and communities have a plan in place of how they're going to manage long-term recovery…" – Disaster Field Coordinator, FEMA Region III (italics added for emphasis)

The WVBHP was designed when minimal funding was available through donations, but in the hopes that government funding would be granted at some point in the future. The 2016 floods occurred only a few months after the development of this program, thus creating the opportunity to apply for funding through HUD's CDBG-DR program.

Application windows for federal funding, whether made available through HUD's CDBG-DR Program or other federal grant opportunities more targeted toward mitigation, like FEMA's Hazard Mitigation Grant Program (HMGP), Hazard Mitigation Assistance (HMA) Grants, and Flood Mitigation Assistance (FMA) Grants, are limited and local governments do not have time to identify and prepare for those funding opportunities after they have been published.

> "*My experience at [the] local level is if you weren't ready for the federal funding, it would pass you up and it would go to the next community*… I*f you're not ready for it and you don't have shovel ready projects, you don't have a year to get your application ready*." – Disaster Field Coordinator, FEMA Region III (italics added for emphasis)

Communities across West Virginia have greatly benefitted from the 'shovel ready' Bridge Home Program. The WVBHP would not have had the level of success and widespread impact if it had not been planned prior to the 2016 floods. The forward-thinking of members of WV VOAD and their partners, who led to the inclusion of millions of dollars in the CDBG-DR funding award for the reconstruction of private bridges following the 2016 floods. This need may have been underfunded or entirely overlooked without the existence of the WVBHP. The planning involved limited financial resources, instead drawing from the commitment of a small group of state and local stakeholders, with a desire to help their communities. This highlights that more funding is not sufficient to address financial barriers to rural recovery without the inclusion of collaborative pre-disaster planning. Planning was necessary to identify the needs of the community and efficiently ask for, and use, future available funding post-disaster.

Federal partners in disaster recovery provide expertise and supplement local and state resources, but federal disaster recovery funds can often take months post-disaster to arrive – leaving residents with the difficult decision of remaining in their community and trying to rebuild with minimal government assistance or moving elsewhere. This dilemma was described by an architect and project manager for one of the post-disaster housing recovery projects, Hope Village, in White Sulphur Springs.

> "A key element was that the restrictions on public money are that it takes a long, long time. And if you're going to try to get somebody, if you're going to try to have a recovery, that's meaningful, and you're going to try to encourage the residents of the community that were impacted to stay in the community, we felt like you needed to move quickly. We needed to give people a reason to stay." – Architect and project manager for a post-disaster housing recovery project

Not only does a community vision "give people a reason to stay", but it can help expedite the allocation of recovery funds. Shaw (2014) found that pre-disaster recovery planning, like the planning that established the WVBHP, can allow funds to be distributed more quickly and encompass more community involvement. This does not mean planning eliminates the slow allocation of funds barrier. If the community does not have a long-term vision or recovery plan with priorities guiding how to build back, recovery can be slowed while local decision-makers chart the best way forward. This could mean an overall delay in the allocation of recovery funds. Decisions may include which mitigation strategies to employ, relocating buildings and infrastructure, rebuilding and hardening infrastructure in place, implementing buyout programs, and abandonment of buildings. These decisions are easier when guided by a community vision, which is usually developed in traditional community planning. A Greenbrier County housing recovery project, known as Hope Village, demonstrated a clear vision with the intended outcome of moving flooded residents out of the floodplain, as seen in the quote below.

> "The next step was, we wanted and this would be something to me that in flood recovery should be an essential element, and that is, try not to rebuild where the problem was." – Architect and project manager for a post-disaster housing recovery project

Long-term planning provides the opportunity for communities to combine disaster relief efforts with disaster risk reduction (Kennedy et al., 2008). In other words, long-term community plans and disaster recovery plans are complementary to one another since the projects and long-term vision of the community can be used in the disaster recovery plan to justify projects that go beyond simply building back and aspire to build back better with the integration of climate adaption and resilient design principles. The process to develop these plans can take months to years because various public meetings are held and public feedback on design iterations is solicited. After disasters, decision-makers may involve the public to a lesser extent to accelerate the recovery schedule. Previous studies have shown community involvement in planning efforts is needed to impart a sense of ownership and ensure plans align with community needs and desires (Opdyke, 2017).

The WVBHP is an example of a planning effort that incorporates community needs with resilient design principles. The planning for this program would not have been possible following a disaster event like the 2016 floods, because the stakeholders would not have had time to juggle the WVBHP planning meetings with daily responsibilities and other recovery tasks.

Pre-disaster planning helped to overcome unclear roles and responsibilities of stakeholders and a lack of management capacity

The involvement of permitting agencies, the WVDOT, nonprofit volunteer groups, and private industry in the planning of the WVBHP helped mitigate the "unclear roles and responsibilities" barrier since each organization was familiar with the overarching program and knew their role in it. This meant that once funding was allocated for the program there was little to no delay in its execution because everyone knew what was expected from their organization. The State Floodplain Management Assistant Coordinator described the planning effects by saying, "Once we had our team established and everybody knew the processes they had to go through, they worked well together."

An example of their effectiveness comes from the collaborative efforts of the bridge designer working directly with permitting agencies on the design of the bridges. This meant the permitting agencies knew that bridges designed from this program followed their guidelines, and aspired to greater resilience than the preexisting conditions. This allowed them to review and approve permits more quickly than typical projects. According to the structural engineer for the Bridge Home Program, a typical WVBHP bridge can go through the permitting process in approximately two to four weeks compared to four to six months in other states. That is up to five and a half months faster than a similar bridge elsewhere – all without compromising quality, and in fact improving it far beyond traditional solutions found elsewhere.

Despite the success of the WVBHP, lack of local and state management capacity was identified as a barrier to the long-term recovery following the 2016 floods. This lack of capacity stemmed from a lack of personnel and asset management. These deficiencies made managing an influx of people and resources difficult, as described below.

> "I think probably where the biggest issue is, is capacity to manage all this. And it takes, you know, typically it takes some at the local level to support that, either local government or the planning councils. And then having that state capacity to manage these grants can be overwhelming." – Disaster Field Coordinator, FEMA Region III

Lack of management capacity is not unique to rural communities, but it can be exacerbated due to rural governments' lack of funding for personnel.

> "You only have so much money, so and that money you to have a contractor, you have to have a lawyer, you have to have a certified inspector. We don't have those things. The Town of Clendenin doesn't have that. So you're going to have to go out and hire that so you can do this. So it's just, it's just tough, it really is. There again, I said to them, small towns like Clendenin, we don't have those people. We don't have those positions." – Mayor of the Town of Clendenin, WV

The lack of professionals in full-time positions like lawyers and inspectors inhibits rural localities' ability to maintain daily operations, assist their constituents with recovery, and apply for public disaster assistance funds. Case managers from volunteer organizations help disaster survivors

apply for aid, but may not be able to provide the amount of long-term assistance required for full recovery. FEMA's Disaster Case Management Program will provide money for additional personnel, such as case managers to assist homeowners with reporting damage and applying for aid, but the time needed to hire and train staff is valuable (FEMA, 2023b). Individual rural communities like Clendenin or White Sulphur Springs cannot sustain full-time positions for roles like case managers that dramatically increase following disasters. This is why including provisions in disaster recovery plans for quickly increasing staffing or contracting outside assistance is an important measure to increase management capacity following disasters. Additionally, these communities could benefit from being served by regional case manager positions who can move between localities as disasters occur and thus not place all the burden on one locality.

Homeowners struggle to navigate FEMA and HUD application processes, especially when generational homeownership makes providing legal documents difficult (Poling & Shealy, 2023a), and case managers assist homeowners with this process. Having case managers serve in regional capacities for organizations like WV VOAD has eliminated the burden put on localities to hire these professionals individually while still increasing recovery capacity within these communities. Additionally, having people already in these positions when disasters strike reduces the time needed to respond and scale up operations because of the existence of up-to-date institutional knowledge and practices.

Beyond case management, institutional knowledge of available assets was required for Greenbrier and Kanawha County communities after the 2016 floods to effectively receive and utilize volunteer labor and goods. Local management of assets, such as locations to house volunteers, feed volunteers, and assign tasks to volunteers was a challenge in Greenbrier County and is discussed by the former Chair of the Greater Greenbrier Long-Term Recovery Committee.

> "A shortcoming, if you will…asset mapping. Where are your shelters? Well, they got a pretty good idea where shelters are because your county EMS managers will work with local communities to establish the shelters. OK, how about where is a space that I can get to? How about feeding? How about fill in the blanks? How many people in your church kitchen can you feed? Can you house people? Where can we? And it just goes on and on and on. Who are the, who are the contractors that you know you're going to need on short notice, it's guys to do excavation, can you go ahead and clear a creek bed out real quick or or whatever it might be. We're not there with asset mapping. There's no central system for asset mapping." – Greater Greenbrier Long Term Recovery Committee Member

Planning how assets will be managed is necessary to make the most of valuable skilled volunteer labor – which is arguably one of the two most important resources to recovery (Poling & Shealy, 2023a). Asset management extends beyond locations of church kitchens and lodging to include human assets. The planning that took place as part of the WVBHP was successful in part due to stakeholders' knowledge of the human capital available. WV VOAD knew what

human resources were available to them through partners like the WVDOT and JZ Engineering with their engineering expertise, and nonprofits that provided construction labor.

The WVBHP could not plan for the exact bridges that would need to be replaced after future flooding, but they were able to combine traditional long-term planning that uses a "predict and plan" approach laying out their future vision for widespread adoption of resilient bridges with disaster recovery planning that laid out the steps to execute the process for evaluating and prioritizing bridge replacements. This planning aligns with the recommendation from Platt & So (2017) to make 'meta decisions' in advance for areas that experience specific types of hazards routinely, thus eliminating some potential high-level areas of indecision. In the example of managing incoming volunteers, these 'meta decisions' may include the locations and staffing for volunteer centers responsible for receiving volunteers and supplies and the adoption of a case management and damage reporting tool to promote consistency in damage reporting and identifying unmet needs.

A message that arose throughout the interviews was the need for planning to occur prior to the disaster so that adequate time and resources could be utilized. This allows for the public and other recovery stakeholders, like disaster recovery nonprofits, to be engaged in the development of long-term community plans.

> "…you have to identify the risks ahead of time and probably have some projects already identified so that when you get the funding, you can fund those projects. They have to pass a BCA [(benefit cost analysis)], stuff like that. It was a lot of money for the state since the state has in a lot of ways an abundance of funding coming its way. And it becomes almost a challenge for how and where they're going to spend it. I mean, that's it, it sounds like a good problem to have. Right? But like it's hard, it's hard." – FEMA Region III Disaster Recovery Specialist

The WVBHP was successful because of prior planning. Nonprofits and state agencies involved with the program knew their roles and were able to ramp up the program immediately upon funding award.

Development of stakeholder relationships to overcome unclear roles and responsibilities

The existence of social capital in the affected Appalachian communities was evident from the volunteerism and neighborhood acts of kindness in the aftermath of the flooding, and gave hope to residents that their communities would be restored (Shinn & Caretta, 2020). A FEMA Region III Disaster Recovery Specialist described some of these acts during her time in West Virginia soon after the flooding occurred.

> "When I was out there a few days after the event, I've seen people on ATVs, and they were buying groceries for their neighbor. They were delivering stuff, they were recording information."

> "I think the sense of community and the sense of volunteerism that's, that's stepped up. I don't know whether it's just because you know, West Virginia has that kind of people there or whether it's because you have folks who don't like to rely on the government…there is a unique, yeah, there is a unique culture there."

The "sense of community" and "unique culture" displayed through community members' volunteerism are indicators of social capital (Yamamura, 2010). These communities could utilize this to overcome the unclear roles and responsibilities barrier by fostering cross-sector collaboration through the development of trusting relationships. Relationships among disaster recovery stakeholders can be cultivated prior to a disaster through regular, "fair weather" meetings.

Development of relationships prior to a disaster can lead to improved coordination among stakeholders. Relationships can be formed during the recovery process, but the time required to do so eliminates the benefit to efforts at the onset of recovery, which is when unclear roles and responsibilities are at their peak. This shortcoming was expressed by members of the Greater Greenbrier Long-Term Recovery Committee, which began in the aftermath of the flooding rather than before.

> "It took us, it took us probably, I'm going to say, about two and a half months before we really started to become effective in long-term recovery." – Greater Greenbrier Long-Term Recovery Committee Member

Building relationships, much like planning, is most effective when done prior to a disaster event when time and resources are less scarce.

> "…One of the things that I've seen is that you've got to build those relationships there in blue skies…" – Disaster Field Coordinator, FEMA Region III

Many local and state governments do not have sufficient resources to spend on disaster planning and prevention, and because disaster recovery lacks a strong constituency (Berke et al., 2014) it may be seen as undesirable to legislators to advocate for additional funds for those purposes. Government employees' time, as well as that of nonprofits and private sector stakeholders, is valuable, but the level of funding and political capital needed to spend time building relationships that can improve recovery efforts is minimal considering its potentially profound impact once a disaster occurs. Such an impact is evident in the success of the West Virginia Bridge Home Program.

> "So what's been very innovative, especially for our VOAD, and this comes into partnerships and relationships…is the permitting side of the bridge. And dealing with the environmental side has been a huge obstacle that took tons of agencies to work together to resolve. Right. If you go to other states, they'll say, 'Oh, never work with the Army Corps of Engineers, it's horrible.' But that's not the case in our state. Right. And that's because we have this relationship building." – WV Development Office Official

The relationships developed through the time and effort spent planning the WVBHP led to a design for the bridges that was cost-effective, resilient, and environmentally friendly. Getting the buy-in from permitting and Department of Transportation officials through the incorporation of their concerns and ideas led to immense time savings of weeks to months for each bridge.

Developing these relationships takes time – a luxury not afforded in the throes of disasters. The availability of time to get input and buy-in from stakeholders was key to the success of effective relationship-building and planning operations in the aftermath of the 2016 floods. The act of developing a disaster recovery plan can improve the connections between the public and involved stakeholder groups (Horney et al., 2016). Organizations like faith-based disaster recovery groups, which play a major role in rural disaster recovery and may not ordinarily have interactions with many other private and public entities, have the opportunity to share their capabilities and find places to "plug in" to official channels during these meetings. Faith-based nonprofit organizations like Mennonite Disaster Service, Catholic Charities, Presbyterian Disaster Relief, and countless others provide millions of dollars and countless volunteer hours around the nation following disasters and their capabilities could be better paired with government recovery efforts if better collaboration existed. The WVBHP benefitted greatly from the volunteer labor these nonprofit organizations provided on countless bridge projects.

Multiple stakeholders emphasized the importance of organizations that operate at critical junctures in infrastructure design, construction, approval, and management, as well as influential community members and volunteer organizations being involved in this collaborative process. These can include local and state government officials, religious organizations, engineering and construction companies, and permitting agencies. It takes time to develop these relationships, but it will pay dividends as indicated by the former West Virginia National Floodplain Insurance Program Director and FEMA Disaster Field Coordinator for Region III.

> "Once we had our team established and everybody knew the processes they had to go through, they worked well together." – Former WV NFIP Director

> "Yeah, but if you're not, if you're not doing that coordination early and often, recovery will have its hiccups and people will not understand their roles and responsibilities and step over one another. It just it really leads to a lot of challenges." – Disaster Field Coordinator, FEMA Region III

The type of collaborative effort being discussed already partially occurs after disasters in the form of long-term recovery groups, but their startup period can be weeks to months after a disaster and their useful life varies as evidenced by the inactivity of most 2016 West Virginia long-term recovery groups only a few short years after the floods. On the other hand, the collaborative partnership forged between WV VOAD and agencies like the U.S. Army Corps of Engineers and WVDOT through the creation of the WVBHP remains active to this day. Additionally, their scope extends beyond recovery to mitigation efforts.

West Virginia did not have the disaster recovery network in 2016 that it has today. Much growth was accomplished in the aftermath of the 2016 floods and the relationships that were fostered have persisted. That is in part thanks to steps taken to continue the good working relationship between state agencies and organizations that do disaster work as described by the state's Resiliency Director.

> "So there's a large group of people that meet regularly now that I don't think that occurred prior to this, where before was more of a necessity to come together when they had to. Now it's become commonplace to collaborate and come together and communicate on a regular basis…" – Director of the West Virginia Resiliency Office

This constant communication and regularly scheduled meetings between organizations like the WV Department of Homeland Security and Emergency Management, State Resiliency Office, and WV VOAD not only make response and recovery faster and better coordinated, but they also serve to foster collaboration on planning and mitigation. Strong, trusting relationships and regular interaction are key to facilitating effective response and recovery as described by the Secretary of the West Virginia Department of Transportation.

> "We communicate and probably, probably one of the one of the reasons we communicate is because we know each other. We've done it before *we work together all the time*." – WV Secretary of Transportation (Italics added for emphasis)

> "I think that *that sense of community, that sense of state*, that communication, knowing each other, working together in these, in these trying times, particularly in these flood events or any any natural disaster… No problem because we knew we could rely on each other." – WV Secretary of Transportation (Italics added for emphasis)

These quotes from the Secretary of Transportation – a person intimately involved in the early stages of the WVBHP – emphasize the value of relationships in disaster recovery. These findings align with past research from Curnin & O'Hara (2019) that found pre-existing relationships made trust between organizations across and within sectors easier and meant organizations already understood one another's capabilities. This knowledge could help reduce unrealistic expectations and improve coordination.

When asked what key lessons should be taken away from the 2016 floods and the development of the WVBHP, the Executive Director for Mennonite Disaster Service shared the following thought:

> "Create a tent. Create a welcoming table for various organizations to come together, like we did in Charleston that August 2015 day. To say here are the challenges. What can we do together and it takes a whole community approach…. We need a whole community approach. Takes private, takes public, takes corporate, government, local government,

> citizens. We need the whole community to come together." – Executive Director, Mennonite Disaster Service

In other words, invite everyone to the table and collaborate. Prepare for disasters through planning and keep stakeholders engaged through regular meetings, especially during times outside recovery. If it is difficult to garner the level of support needed for this type of engagement, the community could suffer initially following the next disaster, but the gathering of those groups in the aftermath could serve as a platform for longer-term collaboration. This collaboration can lead to better outcomes in every part of the emergency management process.

> "I worked in the community in Lewisburg, you know, in that area for four years in community development, and there was never another time in that four years that all of the organizations worked so cohesively together." – Hope Village Resident and Flood Survivor

Oftentimes the buy-in is only strong enough to create change following a disaster (Birkland, 1998; Platt & So, 2017), which means the window of opportunity should be utilized to build as much institutional support for longer-term commitments as possible.

Many of the findings from this research are not new concepts in disaster recovery (Berke et al., 2012; Fraser & Naquin, 2022). Indeed, discussion began with "the age-old adage 'prior planning prevents poor performance'". Similarly, the idea that people and organizations who are familiar with one another and have worked together previously work better together is not an earthshattering discovery. Prior research has already stated social capital, a sense of trust and cultural similarity, among a community can improve disaster recovery outcomes (Fraser & Naquin, 2022).

What this paper seeks to do is place an emphasis on the importance of planning and establishment of collaborative partnerships prior to a disaster, rather than the long-term recovery group model which only occurs following a disaster, and stress that what rural communities lack in finances they can make up for with effective planning and coordination. These groups could be called something along the lines of community resilience groups rather than long-term recovery groups and, beyond disaster recovery, their functions could include identifying projects that would improve a community's resilience to hazards like flooding and developing projects and priorities to include in a hazard mitigation plan, as well as a disaster recovery plan. Utilizing stakeholders like faith-based disaster recovery organizations to increase capacity in rural communities can help overcome obstacles to recovery and community resilience even with lacking local and state government capacity (Shinn & Caretta, 2020). This type of thought out and robust collaboration requires time to cultivate, time which is not available post-disaster.

The specific makeup and functionality of these collaborative partnerships can vary based on the needs of the communities they serve, but lessons learned from the 2016 West Virginia floods and existing literature can provide insight into best practices. Nonprofit, private, and

government organizations each bring unique capabilities and resources to the disaster recovery and mitigation field. In the case of the Bridge Home Program, nonprofits led the coordination efforts and provided much needed labor, while the private sector assisted with technical expertise, and government agencies provided permitting support. The coordination efforts by the Executive Director of WV VOAD played a critical role in the Bridge Home Program's success and highlights the need for a community champion to spearhead these collaborations, as seen in the following quotes.

> "She got the ball rolling and she pushed it and she got it. She did a really good job of pushing it out." – Former West Virginia NFIP Coordinator

> "But you need a community leader too. Some communities cannot get together…and we have to move on to another community that says we're organized." – Executive Director, Mennonite Disaster Service

This finding of needing a community champion takes the recommendation in the National Disaster Recovery Framework which states, "Successful recovery requires informed and coordinated leadership throughout all levels of government, sectors of society, and phases of the recovery process through meaningful coalition building" (U.S. Department of Homeland Security, 2016) a step further by saying the "coordinated leadership" is best achieved when one of the leaders takes responsibility for moving a particular effort forward. This idea is supported by research on collective responsibility, which states, "the basic bearer of responsibility is individuals"(Narveson, 2002).

The Executive Director of West Virginia VOAD was able to bring together members of organizations who do not ordinarily have regular interactions and capitalize on the sociological concept promoted in Granovetter (1973) coined "the strength of weak ties". The strength of weak ties can be described as the idea that individuals who are a part of different organizations with minimal interaction can be crucial to information sharing efforts and lead to innovative ideas when working collaboratively. The best example of this comes from the Bridge Home Program workshops where the engineer worked alongside the permitting agencies to develop the engineering guidelines that helped reduce permitting times and improve resilience. The engineer was able to ensure each bridge met or exceeded the permitting agencies' expectations, as well as gain their trust and buy-in for the program.

These workshops proved invaluable to the success of the program and should be continued in future efforts. The exact nature of what these workshop type meetings should look like exceeds what can be discussed here, but the field of community planning provides a rich ground for the development of this concept and allows for workshops to be adapted to meet each community's needs. Design charette type workshops similar to the one held by WV VOAD to develop the bridge design guidelines and described by Roggema (2014) and role-play simulation exercises that help stakeholders work through complicated scenarios as described by Schenk (2017) are but two examples of the "create a tent" idea emphasized by interviewees.

Conclusion and future considerations

Long-term planning and disaster recovery planning are vital for overcoming both financial and coordination barriers to rural disaster recovery. Long-term planning prior to disasters can guide community decision-making, lead to increased disaster recovery funding, and shorten the recovery timeline. Disaster recovery planning speeds up decision-making by encompassing meta-decisions that clarify priorities and reduce confusion around stakeholders' roles and responsibilities. Regular collaboration between government at all levels, private partners, and sometimes less thought of entities like faith-based nonprofits can lead to innovative disaster recovery and mitigation solutions as exemplified in the West Virginia Bridge Home Program. All these cross-sector organizations play important roles in the design and reconstruction of communities, but collaboration is required to use their skills and resources most efficiently.

Building relationships and proactive planning efforts can facilitate the development of innovative programs like the West Virginia Bridge Home Program that can be used to request funding and improve the resilience of a community. Support for these planning and relationship building efforts has been expressed by interviewees in this study, but legislative support to fund projects varies by government entity. In the case of the political and funding support, it is recommended that stakeholders be prepared to present plans and projects during the window of opportunity opened by future focusing events as described in Birkland (1998).

This research focused on flood recovery efforts across two counties, Greenbrier and Kanawha, in West Virginia. Given the limited study area, future research focused on areas outside these two counties is recommended to explore the replicability and value of pre-disaster planning efforts of the West Virginia Bridge Home Program in other states. Comparison of findings in this research to recovery efforts following similar events in comparable communities can provide the extent improvements and lessons learned have been incorporated into federal and state disaster recovery processes since the 2016 floods.

While this case study emphasizes the important role that pre-disaster planning can have in helping overcome both financial and coordination barriers during disaster recovery in rural Appalachia, additional questions about when and how this pre-disaster planning should occur and its effectiveness in different types of communities remain underexplored. Future research could begin to explore how far in advance pre-disaster planning should occur to be effective post-disaster. In addition, Greenbrier and Kanawha counties are small and rural with limited staff and resource capacity, necessitating a strong reliance on others after disaster events. Future research could explore the replicability of these findings in communities of medium to large size with more staff and capacity and the effect of this on inter-organization coordination.

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Chapter 3: Strategies for Reducing Legal and Socio-cultural barriers to Rural Disaster Recovery: A Case Study of the 2016 West Virginia Floods

Abstract

Rural communities face unique challenges in overcoming legal and socio-cultural barriers to disaster recovery. Specific barriers to rural disaster recovery include historical development patterns in and around floodplains, higher percentages of vulnerable populations, and difficulty navigating the federal disaster aid application process. Strategies used following the 2016 West Virginia floods provide lessons learned to mitigate these barriers in the future. Semi-structured interviews were conducted with 25 people from 15 organizations ranging from state cabinet secretaries and mayors to engineers and nonprofit workers. Interviews were transcribed and coding using qualitative data analysis software and the thematic content analysis was validated by an independent, third-party coder. The results highlight the importance of cross-sector collaborative disaster groups that meet regularly pre-disaster. The local adoption of long-term community plans and disaster recovery plans was also critical to overcoming these barriers. Future research should explore mechanisms to help encourage these strategies in other rural communities.

Introduction

Never before have communities been so exposed to natural hazards. Last year was the 10th consecutive year in which the U.S. experienced at least 10 billion-dollar disaster events (Smith, 2023). With the severity and frequency of disaster events on the rise, research exploring how to recover more quickly and resiliently from these devastating events is imperative to the preservation and betterment of communities. Developing practices that shorten recovery to the greatest extent possible, while allowing for mitigation and "build back better" principles to be incorporated, is in the best interest of affected communities. All four phases of emergency management (preparedness, response, recovery, and mitigation) are intricately connected (U.S. Department of Homeland Security, 2016), thus efficient recovery starts in the planning activities of the preparedness phase and begins to take shape in the response phase through repairs undertaken immediately following a disaster.

Funding infrastructure improvements can be difficult and time-consuming as insurance rarely covers anything beyond in-kind replacement or repair (Tonn et al., 2021), and getting approved for government funding can be time-consuming. Current federal regulations governing the disbursement of emergency funds can mean that local governments do not have time to go through the approval process to improve a piece of infrastructure beyond its pre-disaster state, thus high-priority repairs will likely not exemplify "building back better", which is problematic given short-term response often become permanent solutions (Tonn et al., 2021). Recovery is arguably the most important and least understood phase of emergency management (Rouhanizadeh & Kermanshachi, 2020a). The complexity and uncertainty of post-disaster situations create a chaotic environment that makes decision-making around recovery priorities and how to spend limited funds arduous (Kapucu & Garayev, 2011).

Regulations and legal codes may dictate which organizations coordinate, how funding and resources must be procured, and how socio-cultural factors are considered in decision-making. Shaw (2014) asked if a fast recovery is always necessary and points out that while centralized decision-making can speed up recovery, community consultation and consideration of the local history and culture take time. So, how do we shorten recovery time and improve outcomes when so many socio-cultural and legal barriers are in the way?

In this paper, the authors pose that both going through a predefined regulatory process and community engagement process, while necessary parts of recovery, place a burden on the recovery schedule. Regulatory delays, as used in this article, describe the "time required to follow regulatory procedures that prevent recovery activities from moving forward" (Poling & Shealy, 2023a). These delays can be minimized through the incorporation of effective community and disaster recovery planning when combined with policy revisions. Specifically, agencies should consider the potential time savings of reducing the public comment period on community development block grant (CDBG-DR) proposals if applicants can provide evidence that the proposed plans align with long-term community planning and disaster recovery planning crafted with community engagement prior to disaster occurrence.

The 2016 West Virginia floods, an event caused by a 1,000-year storm that killed 23 people and caused over one billion dollars in damage across several states, was used as the focusing event. Specific cases drawn from the overarching focusing event include – (1) the reconstruction of private residential bridges through the West Virginia Bridge Home Program (WVBHP), (2) the repair and replacement of public roads and bridges, and (3) the creation of a new housing development known as Hope Village. These projects varied in their dependence on federal funding tied to regulatory processes and government involvement. Their varying timelines, procedures, and levels of success offer a cross-case comparison shedding light on the complexities of disaster recovery and resilience planning in the aftermath of such a catastrophic event. Additionally, the CDBG-DR award that funded a significant amount of the long-term recovery efforts post-2016 flooding in West Virginia ended at the time of this paper. This allowed for the entirety of the federally funded recovery timeline to be considered while limiting the potential loss of stakeholders' memory and records of these efforts.

The Background section provides an additional overview of the 2016 West Virginia floods, outlining the extensive damage and ensuing challenges. Legal and socio-cultural barriers in disaster recovery are discussed, with a focus on federal funding complexities, professional liability, population demographics, and historical development patterns unique to Appalachia. The Research Question explores strategies to mitigate these barriers and the Methods section explains the research approach to understand these strategies. The Results and Discussion section provides detailed evidence and first-hand quotes. The conclusion offers recommendations and future directions.

Background

The 2016 West Virginia floods caused damage to state roads in over 1,300 locations, including damage to 123 bridges, thousands of homes were damaged causing residents to file for FEMA

assistance, and required local governments to apply for millions of dollars in public assistance funds (*WV-Action-Plan*, n.d.). Poling & Shealy (2023a) identified numerous barriers citizens and local governments faced during this recovery process. This paper focuses on the solutions, particularly to the legal and socio-cultural barriers experienced in the aftermath of this flooding event. The legal barriers to a swift recovery included (1) regulatory delays, (2) onerous reimbursement processes, and (3) professional liability in the face of uncertain design standards. The socio-cultural barriers to recovery included (1) an aging population, (2) historical development patterns, and (3) mental health and cognitive ability of flood survivors. These barriers are further discussed in the following subsections.

Legal Barriers

Funding is arguably the most important factor affecting the speed of rebuilding infrastructure like roads and bridges (Rouhanizadeh & Kermanshachi, 2020b), but policy dictates how much, how fast, and for what purposes funding gets distributed. Federal laws like the Stafford Act and regulations regarding procurement and reimbursement processes determined by the Department of Housing and Urban Development (HUD) and FEMA are examples of this (Crow et al., 2018). Towns and other local governments with small budgets may be less able to complete recovery activities in a timely manner due to limited capital and the need to be reimbursed on one project before moving to another; this is problematic considering the reimbursement process can be unpredictable with respect to both time and amount (Crow et al., 2018). Olshansky & Johnson (2014) reviewed the evolution of federal disaster aid and found federal disaster policies, such as the National Disaster Recovery Framework and the Sandy Recovery Improvement Act are insufficient for providing communities with resources needed for disaster recovery planning, in streamlining FEMA's Public Assistance Program while also incentivizing improvement, and reducing barriers between FEMA and HUD. Individuals and organizations alike have expressed difficulty in navigating the federal disaster aid application processes of FEMA and HUD. Applying to multiple agencies, regular updates to forms and procedures, and difficulty producing legal documents like deeds have all been brought up in interviews.

Beyond fiscal policy, other types of policy, such as engineering design standards are instrumental to the success of community recovery. Professionals are left navigating design and construction with uncertainty due to a lack of minimum design standards – as was the case for private residential bridges following the 2016 West Virginia floods. This uncertainty can lead to increased costs due to the overdesigning of infrastructure or outright refusal of professionals to get involved with a project deemed to carry too much professional liability (Poling & Shealy, 2023c). Land-use policies can create natural barriers and keep people from building in hazardous areas, but changing these policies comes with challenges, including the need for local buy-in (Platt & So, 2017). Many citizens in Appalachia have strong cultural ties to their land (Barcus & Brunn, 2009) and, despite being subjected to increased vulnerability, they may not want to relocate. Voluntary property buyouts after flooding events have gained popularity in some places in recent years and are cost-effective in reducing the future impact of flooding in case studies like Cedar Rapids, Iowa after devasting flooding in 2015 (Tate et al., 2016), but may not be suitable in Appalachian regions given their strong connection to place.

Most laws dealing with the architecture, engineering, and construction (AEC) industry are not crafted with time constraints related to recovery from natural disasters in mind (Masurier et al., 2006). For example, most government agencies must procure companies to work on AEC projects through public bidding processes. These processes usually mandate a certain length of time from the posting of the project to the project being awarded to the lowest qualified bidder. Steps can include public advertising, responding to requests for information, and stakeholder meetings. Going through this process is a long-established practice in the AEC industry, but it is not always conducive to the urgency associated with disaster recovery.

Different types of infrastructure can be left vulnerable to natural disasters because of the rigidity with which institutional systems and regional legislative environments limit the degree engineers can incorporate long-term considerations into their design (Schenk et al., 2016). Many of the current methods of infrastructure design do not incorporate long-term adaptation into the design process, which is partially due to differences in risk perceptions, thus making infrastructure design both a technically and politically influenced task (Schenk et al., 2016). For infrastructure to be more resilient, engineers must have the ability to design with future conditions in mind, and not be restricted to outdated resilience measures.

Socio-cultural barriers

Local social and cultural factors influence a community's ability to recover from disasters, and prior research has highlighted the context-specific nature of disaster risk reduction efforts like climate adaptation (Moser et al., 2010). Perhaps one of the most influential aspects affecting a community's social fabric is its population density, which affects local government revenue and the ability to provide social services and develop economically. Rural areas, like those found throughout much of Appalachia, have experienced declining economies and higher poverty rates than urban areas (Economic Research Service, 2021; Skoufalos et al., 2017). Rural areas also have a higher percentage of elderly citizens than urban areas (Smith & Trevelyan, 2018). Urban areas have different strengths than rural areas and vice versa with respect to disaster recovery. For example, urban areas have higher economic resilience, while rural communities have been found to have greater social capital, (Jerolleman, 2020). In other words, rural communities may benefit from social capital, and accompanied trust among community members, contributing to better cooperation among stakeholders, but they often lack the larger budgets and access to capital and resources of metropolitan areas.

Not only do urban and rural communities have different strengths, they also face uniquely different challenges to disaster recovery. Safapour et al. (2021) found social and cultural barriers (called socio-cultural barriers in this study) unique to rural communities include inadequate education, a lower income level, an increase in vulnerable people, inadequate public awareness about recovery, increased poverty, higher economic inequality, greater unemployment, a lack of social services, and lower levels of healthcare access.

The location of a disaster is important because a community's culture is affected by its historical background and sense of place. Two examples are important for this research. First, many Appalachians have strong connections to their land (Barcus & Brunn, 2009). This can affect the

viability of certain recovery methods. For instance, property acquisition for properties with repeated flood damage, a best practice, can be difficult in Appalachia due to the reluctance of some citizens to move. If recovery is to incorporate any kind of property acquisition and relocation, the preservation of local history and culture needs consideration. Second, historical development patterns are a cause of local vulnerability. Many communities in West Virginia were founded near waterways, and when combined with the regional topography caused by the Appalachian Mountain, this places infrastructure at heightened risk for flash flooding (Poling & Shealy, 2023a). Given the significant amount of development that has already occurred, the financial and socio-cultural costs of moving portions of a community can prove monumental.

Financial and coordination barriers are often ranked among the most important and most frequently cited barriers to disaster recovery efforts (Poling & Shealy, 2023a; Rouhanizadeh et al., 2020; Safapour et al., 2021) and while many studies include mentions of legal and socio-cultural barriers, less emphasis is placed on their impact. This is demonstrated through both the public and experts' ranking of "financial and economic" and "coordination and resources" barriers as more important than socio-cultural barriers (Rouhanizadeh & Kermanshachi, 2021b). Some legal barriers were included in their study but did not receive their own category, further underscoring their lower priority.

Existing literature primarily explores disaster policy from an international or national context, thus leaving local and regional disaster policy processes and improvement understudied (Crow et al., 2018). Recognizing the context-specific nature of disaster recovery and the unique socioeconomic, cultural, and geographical factors of the Appalachian region, this paper seeks to expand on the work of Crow et al. (2018) beyond, but not excluding fiscal policy learning by local and state governments to include lessons that can be used to address legal and socio-cultural barriers to rural, Appalachian disaster recovery as identified by Poling & Shealy (2023a).

Research Question

To bridge the gap between existing literature's focus on international or national disaster policy and the need to address local and regional processes, this paper aims to investigate how the strategies employed during the 2016 West Virginia flood recovery efforts contributed to alleviating legal and socio-cultural barriers to disaster recovery in the Appalachian region. The specific research question was what strategies from the 2016 West Virginia flood recovery efforts helped mitigate the legal and socio-cultural barriers to disaster recovery?

Methods

Twelve West Virginia counties were declared federal disaster areas following the 2016 West Virginia floods, and of those twelve, four were declared the most impacted and distressed (MID) (*WV-Action-Plan*, n.d.). The four MID counties included Clay, Greenbrier, Kanawha, and Nicholas. The researchers selected Greenbrier and Kanawha counties for this study because these counties included the highest number of FEMA individual assistance (IA) applications. Four towns, Clendenin and Elkview in Kanawha County, and White Sulphur Springs and Rainelle in

Greenbrier County had the four highest totals of IA applications, in addition to numerous news articles written about the destruction across these four towns.

Within these two counties, three case studies were selected: (1) the West Virginia Bridge Home Program (WVBHP), (2) public roads and bridges, and (3) Hope Village. Each of these cases have varying degrees of public and private/nonprofit involvement. The West Virginia Bridge Home Program was selected for study because private residential bridges are primarily found in rural areas. This program utilized both donated dollars and federal recovery funds to rebuild residents' bridges. Numerous public, private, and nonprofit entities were involved. The West Virginia Department of Transportation (WVDOT) oversees recovery efforts of the state's transportation assets, and as such plays a significant role in recovery and overall asset management in West Virginia. West Virginia has a high percentage of state-maintained roadways, which meant understanding the procedures for government projects would be essential to understanding the bigger picture of disaster recovery in the state. Finally, since the first case has both government and nonprofit involvement, and case two is heavily government led, case three has very little government involvement or financial support. The creation of Hope Village, an entirely new neighborhood in White Sulphur Springs, involved property buyouts, which often face resistance from Appalachians who culturally have a strong attachment to place. These three case studies involve a range of stakeholders, including private, nonprofit, and public organizations, and vary in government involvement and funding mechanisms. Each case is explained in detail subsections below.

Case Studies

Case One: The West Virginia Bridge Home Program (WVBHP)

The West Virginia Bridge Home Program was developed by a group of stakeholders spanning the public and nonprofit sectors. The effort is led by the West Virginia Voluntary Organizations Active in Disaster (WV VOAD) and was created after WV VOAD saw a growing need across the state for the replacement of private access bridges. Residents would call the Department of Transportation (DOT) for assistance repairing or replacing their bridge after flooding, only to be turned away by the DOT due to the structures being private rather than part of the public transportation system. Often these private access bridges were built decades earlier and were in a state of disrepair. With limited economic means to repair or replace these bridges, homeowners were left with poor access to their homes. The program's goal is to assist low-to-moderate-income residents with private access bridge replacements. A damaged bridge prior to replacement by the Bridge Home Program is shown in Figure 1, and its replacement follows in Figure 3.

Figure 1: Private Access Bridge Before WVBHP Replacement (Courtesy of WV VOAD)

Figure 2: Private Residential Bridge After Bridge Home Program Replacement (Courtesy of WV VOAD)

Case Two: Public Roads and Bridges

The 2016, West Virginia floods, devastated the public transportation system by washing out over 1,300 sections of roadways and damaging 123 bridges across the state, while destroying 15 completely (*WV-Action-Plan*, n.d.). West Virginia Department of Transportation engineers were

interviewed to gain insight into the processes and regulations surrounding the reconstruction of the public transportation system. A destroyed section of a state-maintained road is provided in Figure 3 to illustrate the type of damage experienced by roadways throughout the affected areas.

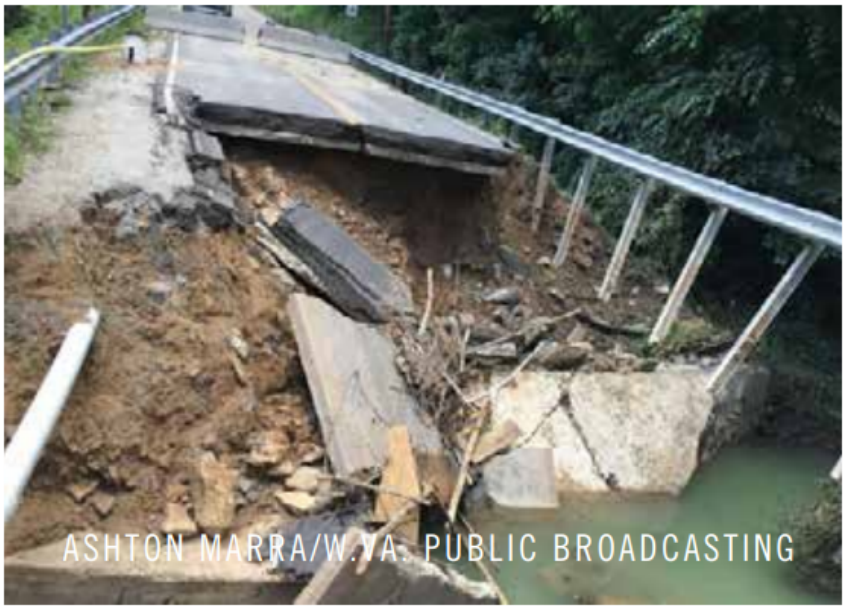

Figure 3: Route 4 Near the Kanawha County Line (*WV-Action-Plan*, n.d.)

Case Three: Hope Village

Case study three involves the development of a new housing complex called Hope Village. Mill Hill Drive in White Sulphur Springs was one of the most impacted areas with five residents losing their lives (Raby, 2017). Numerous local nonprofits, led by an organization named Homes and Hope for White Sulphur Springs, as well as private companies, and the town of White Sulphur Springs collaborated on the development of this new neighborhood. Hope Village includes 42 homesites (*Hope Village*, n.d.). Many residents were hesitant to leave their properties in the floodplain, but through various efforts, many were eventually convinced to relocate to Hope Village. This project has become a model for disaster recovery. The entrance to the community is shown in Figure 4.

Figure 4: Entrance to Hope Village

Data Collection

The researchers conducted interviews with 25 people across 15 different organizations from June to September 2022, excluding two pilot interviews which were conducted in October 2021. Stakeholders for interviews were identified by reviewing documents from the West Virginia bridge, home program, and design guidelines, which listed members of the bridge home program committee responsible for the creation and some oversight of the program. Stakeholders from the initial set of interviews were asked to recommend other projects and interested parties to flood recovery projects following the 2016 floods. Connections with the leaders of Hope Village, as well as engineers with the DOT, were made to conduct interviews for cases two and three. Interviewees included professional engineers, executive directors of nonprofits, FEMA officials, elected officials, and influential community members. Interviews were semi-structured, and questions focused on how three primary themes: (1) stakeholder relationships, (2) government regulations, and (3) perceptions of design risks post-disaster. Questions were reviewed for face and content validity by four researchers to help minimize bias and account for local culture.

Around the time these interviews were being conducted, the United States Congress passed legislation called the “Build Back Better” Act. Some interview questions were rephrased to limit the impact of political bias, which could be caused by using phrasing such as “build back better”. One such example of this is the rewording of "were you thinking of how to build back better" to "were you thinking about how to build it better than it was before". Similar steps were taken when considering the use of the term climate change. Questions tended to utilize the term resilience rather than climate change, such as in the example: "how big of a role does the idea of resilience play during the design and permitting process".

In addition to interviews, the construction process for the West Virginia Bridge Home Program was observed through site visits to a model bridge named Big Blue. A ride-along was performed

with the district engineer from the White Sulphur Springs district of the West Virginia Department of Transportation. Hope Village was also visited by the primary investigator. Notes, photographs, and videos were recorded during many of these visits, and supporting documents, including state codes, engineering drawings, and accounting documents were gathered.

Data Analysis

Nvivo software was used to transcribe interview recordings, and then researchers manually reviewed and corrected the transcriptions. NVivo software was also used to conduct thematic contact analysis in which statements from interviewees with similar themes were grouped using various codes. Codes were created by the primary researcher prior to coding, but additional codes were also generated during the analysis. Code creation prior to coding is a form of deductive coding and is influenced by prior research, while code creation during the coding process aligns with an inductive approach. An inductive approach is more heavily influenced by themes emerging from the data rather than a researcher's propositions and existing literature. Utilizing both coding methodologies helps to balance the advantages of both (Yin, 2011b).

Validation of Coding

The research team utilized a negotiated agreement approach to establish intercoder reliability. This involved two researchers coding a subset of the transcripts and resolving discrepancies through discussion. The primary investigator, having the greatest background understanding of this research and existing literature, created the code set used to code the interviews. An independent, third-party coder, with no prior exposure to the research was brought in to validate the primary researcher's coding. This difference in knowledge between the two coders is a reason documented in existing literature to use the negotiated agreement approach (Campbell et al, 2013).

Three interviews were used for coding validation and encompassed transcripts from two professional engineers, and a public permitting agency. This sample size aligns with recent literature, which supports the use of 10-25% of data units for coding validation (O'Connor & Joffe, 2020). After both researchers had independently coded the samples, an intercoder reliability score in the form of a Cohens Kappa (K) score was established as $K = 0.54$ across the three interviews.

The researcher and third-party coder discussed discrepancies and found many to be caused by the third-party coder's lack of expertise in certain topic areas. Additionally, the beginning and end points of some coded sections differed. In some of these instances, both coders agreed on the code(s) to be applied to a certain section of text, but may have begun or ended the code at slightly different places. This issue is known as the unitization problem and can be described as different people assigning the "units of meaning" to different sections of a text, and is another example of why the negotiated agreement approach is an appropriate method of validation for this study (Campbell et al, 2013). After several iterations of reviewing the transcripts and making adjustments to harmonize the coding logic between the research team member and validator, a final Cohen's Kappa of $K = 0.90$ was established across the transcripts.

Results and Discussion

The results and discussion are broken into six sections: (1) overcoming regulatory delays through collaborative pre-disaster planning, (2) reducing regulatory delays by beginning the environmental permitting processes earlier, (3) improving outcomes and reducing recovery times by adopting the West Virginia Bridge Home Program private bridge design guidelines for private water crossings, (4) exploring federal policy changes for reimbursement procedures to better assist disadvantaged communities, (5) overcoming historical development patterns through relocation efforts that preserve residents' connection to their land, and (6) improving recovery of mentally distressed survivors and the elderly through an emphasis on in-person interactions. Sections one through four are focused on overcoming the legal barriers which include: regulatory delays, legal uncertainty related to design standards, and an onerous reimbursement process. Sections five and six describe methods for overcoming socio-cultural barriers including historical development patterns, an aging population, and mental health challenges of flood survivors.

Overcoming regulatory delays through collaborative pre-disaster planning

A common theme that emerged in overcoming regulatory delays was the necessity of planning prior to a disaster event occurring. Many localities lacked the capacity to develop projects and plans for recovery and therefore had difficulties recovering from the 2016 floods. Localities must have these plans and projects in place prior to an event to take advantage of funding opportunities. Not being prepared can prove costly as described by a FEMA disaster field coordinator.

> "*My experience at the local level is if you weren't ready for the federal funding, it would pass you up and it would go to the next community* and perfect example is EDA every year has a supplemental fund for communities and states impacted by disasters. I*f you're not ready for it and you don't have shovel ready projects, you don't have a year to get your application ready*." – FEMA Disaster Field Coordinator, Region III (italics added for emphasis)

The disaster recovery process is complex and has many steps meaning even small missteps along the way have the potential to prolong funding awards. A recent article by the Bipartisan Policy Center highlighted the fact that most Community Development Block Grant – Disaster Resilience awards did not become available to communities until 15-18 months after disaster occurrence (Gimont, 2022). Time is required to develop plans and identify projects that align with community goals. Unfortunately, time is one thing that communities do not have in the wake of severe flooding like that in 2016. This is why planning and preparedness efforts during blue skies are so critical to minimizing regulatory delays – so that the time spent developing these plans does not extend the application process.

> "You've got to build those relationships there in blue skies… if you're not doing that coordination early and often, recovery will have its hiccups…." – FEMA Disaster Field Coordinator

Simply saying localities should prepare for disasters by planning is not a solution. The underlying problem is the lack of capacity – both personnel and funding capacity – of rural towns and counties to undertake these activities, as seen in the quote below.

> "You only have so much money, so and that money you to have a contractor, you have to have a lawyer, you have to have a certified inspector. We don't have those things. The Town of Clendenin doesn't have that. So you're going to have to go out and hire that so you can do this. So it's just, it's just tough, it really is. There again, I said to them, small towns like Clendenin, we don't have those people. We don't have those positions." – Mayor of the Town of Clendenin, WV

Expansion of current funding sources like FEMA's Hazard Mitigation Grant Program and Flood Mitigation Assistance Program, and HUD's Community Development Block Grant – Mitigation Program, could potentially help by increasing the funding available to these communities, but this funding does not always reach these disadvantaged communities. Setting aside a percentage of these grant program funds for these communities has been done in recent years (The White House, 2022), but many smaller, rural governments do not have the resources to prepare grant application packages.

State governments, likely through their emergency management departments, have an opportunity to collaborate with local governments, nonprofits, academic institutions, and the private sector to pool expertise and resources to identify projects of benefit to local communities and apply for grants. This type of collaborative effort is exemplified by the group responsible for the development of the West Virginia Bridge Home Program (WVBHP) and the importance of collaboration is summarized by the following quote.

> "Create a tent. Create a welcoming table for various organizations to come together, like we did in Charleston that August 2015 day. To say here are the challenges. What can we do together and it takes a whole community approach…. We need a whole community approach. Takes private, takes public, takes corporate, government, local government, citizens. We need the whole community to come together." – Executive Director, Mennonite Disaster Service

The collaboration that occurred on "that August 2015 day" was a gathering of state and local officials, nonprofits led by WV VOAD, and national partners like FEMA. An history of smaller floods destroying private residential bridges prompted the executive director of WV VOAD to call for this gathering to discuss technical challenges, resource sharing, liability, and permitting. Both private engineers and West Virginia Department of Transportation engineers worked together on designing a low-cost, resilient private access bridge. County floodplain managers, officials from the state historic preservation office, and representatives from the U.S. Army Corps of Engineers talked about the necessary permits required for these structures and how to expedite the approval process. Lastly, the nonprofits coordinated efforts to raise funds and utilize volunteers for construction of the bridges.

This cross-sector collaboration allowed for the creation and eventual funding of the WVBHP that has benefitted hundreds of low-to-moderate income residents and made infrastructure across the state more resilient to flooding. Some of the benefits stemming from the cross-sector collaboration include: (1) permitting agencies' involvement helped to shorten permit approval times from approximately 4-6 months to 2-4 weeks, (2) technical expertise through collaboration between state DOT officials and JZ Engineering led to a resilient and low-cost design that has proven resilient in recent flood events, and (3) nonprofit oversight has ensured maximum benefit to residents and minimal oversight costs.

These groups developed relationships through weekly, and sometimes daily, meetings for a period of months during the creation of the Bridge Home Program that have lasted long after its conception in 2015 and have led to regular collaboration to this day.

> "So there's a large group of people that meet regularly now that I don't think that occurred prior to this. Where before was more of a necessity to come together when they had to. Now it's become commonplace to collaborate and come together and communicate on a regular basis" – Director of the West Virginia Resiliency Office

The regular collaboration of stakeholders like WV VOAD, the State Resiliency Office, the U.S. Army Corps of Engineers, and FEMA is a clear sign that West Virginia's emergency management network is stronger today than it was prior to 2016.

In light of these findings, we recommend the following three steps to assist rural governments with overcoming capacity shortfalls in their pursuit of disaster preparedness, which done properly can double as an economic development (FEMA, 2023a).

Step 1: Create a cross-sector group(s) to supplement localities' personnel capacity.
Step 2: Work with localities to develop or refine community goals and identify projects that align with those goals.
Step 3: Assist localities with grant writing.

Cross-sector groups like the one responsible for the WVBHP can work with localities to develop or refine community goals and identify projects that align with those goals. Once that is done grant writing assistance will likely be needed. If working directly with every small town is not feasible, these collaborative committees could develop high-level plans and considerations small towns could use to develop their priorities. Development of these templates and guidelines could provide localities with a foundation to make "meta-decisions" that mitigate against indecision and provide some direction in disasters (Platt & So, 2017). Lastly, these high-level templates and guidelines can be used to write grants to fund the conceptual planning, design, and eventually construction of projects depending on which funding sources are sought. These planning efforts serve the dual benefit of helping prepare communities for disasters by providing a vision that can be used in recovery grant applications, and can also be used to apply

for mitigation grant funding used to reduce the vulnerability of communities and minimize the impact of future disasters.

Reducing regulatory delays by beginning environmental permitting processes earlier

A major contributing factor to regulatory delays is the environmental permitting process. This was shared by several interviewees who had differing levels of satisfaction with environmental permitting procedures that must be followed post-disaster. When asked how government regulations affected disaster recovery, the District Nine Engineer for the West Virginia Department of Highways shared, "The, the big thing is probably the environmental permitting," because, "It can take some time to get permits." Despite acknowledging the potential delays, he emphasized the important role they play in protecting the public.

On the other hand, a local elected official expressed a strong sense of disapproval with the environmental permitting procedures citing a work stoppage for rebuilding a destroyed school. They said, "Well, the school, it was stopped one time because of bats. Saving bats, and mussels in the stream. Now give me a break. Give me a break."

Regardless of one's opinions on environmental protection, streamlining this process could reduce recovery times by weeks or months. Care is needed to responsibly rebuild following disasters like extreme flooding, but it is possible to accelerate environmental processes without compromising quality. This could be done by initiating environmental reviews earlier by states or localities who can pay for the costs prior to a CDBG-DR award.

This has already been implemented in states that experience large-scale disasters, like hurricanes, regularly. Officials in West Virginia looked to these larger states like Texas, Florida, and Louisiana for best practices when building up the West Virginia Development Office's capabilities to manage CDBG-DR funding. These states allocate funding in their state budgets to perform environmental reviews and then reimburse themselves with grant funding upon approval.

> "So some of the things that they [larger states like Texas, Florida, and Louisiana] do is in their state budget they already have long term disaster recovery funds budgeted so they can immediately start doing environmentals and they pay for everything upfront. And then when they sign the grant agreement with HUD, they reimburse themselves…you can't do a whole lot of things upfront. But the environmental piece is huge. You can do an environmental because it's categorically excluded. We're not disturbing any new ground, we're just planning a possible project. So a lot of states upfront that entire cost." – WV Development Office Official

Environmental reviews for projects funded by CDBG-DR funds can take months to complete, but their cost is only a small percentage of recovery projects' total cost, so why do states like West Virginia not pay to begin environmental reviews on expected projects earlier? Once again, the problem is rooted in a lack of funding. States that do not anticipate major disasters each year, and therefore likely lack the political capital to allocate money for these over other constituent

priorities, do not have the luxury of allocating millions of dollars to recovery funds. This limitation leaves them reliant on grant funding that, by HUD's own acknowledgment takes far too long to be awarded. A possible solution to this is the use of rainy day funds as a replacement funding source for states who struggle to set aside funds for long-term recovery.

Tapping into these funds to perform environmental reviews could reduce the time to get to the construction phase on projects by weeks to months by overlapping the time of environmental permitting with grant preparation and approval. The Department of Housing and Urban Development has recognized the need to reduce the CDBG-DR award timeline, which was recognized as a barrier by Principal Deputy Assistant Secretary for Community Planning and Development Marion Mollegen McFadden when she stated:

> "Unfortunately, the one-off appropriation process delays local access to these funds by months, confusing grantees, producing unnecessary barriers to participation in recovery programs, and thus dulling the effects of our efforts. It's time we right these wrongs by streamlining how these funds are disseminated – while doubling down on our responsibility to ensure equitable outcomes." (HUD Public Affairs, 2022)

Beginning the environmental permitting process earlier could serve as a low-cost, minimal risk method to achieving a reduction in the recovery timeline.

Improve outcomes and reduce recovery times by adopting West Virginia Bridge Home Program private bridge design guidelines for private water crossings

The private residential bridges completed following the West Virginia Bridge Home Program guidelines had to meet the requirements for the following (Bridge Program, n.d.):

1. U.S. Army Corps of Engineers (USACOE) Nationwide Permits (NWP):
    a. NWP 3 Maintenance
    b. NWP 13 Bank Stabilization
    c. NWP 14 Linear Transportation Projects (Bridges)
2. WV Division of Natural Resources (WVDNR)- Endangered Species
3. WV Division of Natural Resources (WVDNR)- Land and Streams
4. WV Department of Highways (WVDOH)- Encroachment Permit (Driveway Permit)
5. WV State Historic Preservation Office (WVSHPO) Review
6. County Building Permit

Permitting requirements mostly involved environmental considerations and logistics like getting WVDOT permission to access public roads. Few to zero structural design standards for private residential bridges existed at the time of the 2016 floods or at the time of this writing. This lack of design standards created professional liability for engineers and builders and was overcome through collaboration between numerous stakeholders, including WV VOAD, JZ Engineering, Mennonite Disaster Service, and state agencies like the WVDOT (Poling & Shealy, 2023C).

Many of the existing bridges replaced by the WVBHP had piers located within the stream which altered the natural streambed and restricted flow (see Figure 5). Additionally, many were decades old and built by homeowners, therefore, few were designed in accordance with accepted engineering principles.

Figure 5: Private Access Bridge Before WVBHP Replacement (Courtesy of WV VOAD)

The WVBHP guidelines require all bridges to be built with abutments outside the streambed to promote low to zero disturbance to aquatic life and prevents the disruption of the natural flow of water. This provision benefits aquatic life, but also helped to streamline the permitting process through the West Virginia Department of Natural Resources because the agency knew bridges built under this program would minimize habitat disturbance. Investigation of previously washed-out bridges led to the discovery that many bridges were merely laid across the bank or did not have the superstructure properly attached to the substructure. Therefore, abutments on all WVBHP bridges are tied down to prevent bridges from being overturned during high-flow events and stream banks are secured using riprap or gabion baskets. Lastly, all WVBHP bridges are designed by a licensed engineering firm and sealed by a professional engineer to ensure localized factors are considered in the design.

The combination of these design criteria have resulted in a resilient design that has withstood the test of time. Many of these bridges have experienced flooding since their construction and every bridge has remained functional after floodwaters receded. The only repairs that have been required are replacement of bank stabilization material and minor decking repairs.

Figure 6: Private Residential Bridge After Bridge Home Program Replacement (Courtesy of WV VOAD)

State and county permitting officials were involved in developing the guidelines for the WVBHP from the program's inception. This not only ensured the guidelines met or exceeded state and county requirements, but also reassured permitting officials that any projects associated with the WVBHP automatically met or exceeded their office's minimum requirements. Additionally, all WVBHP bridges improved the bridge and site from its existing condition. This meant that WVBHP projects were typically reviewed and approved at a significantly faster rate (approximately two to four weeks compared to four to six months) than other similar projects in neighboring states.

> "And usually around here [in another state outside West Virginia], you can take four to six weeks, I mean months, usually to get something approved that's anywhere around water. But in West Virginia, all those agencies have come together and two to four weeks and we have a permit." – Professional Engineer, JZ Engineering

As seen from the bridge designer, this result would not have been possible without the collaborative efforts of various organizations and serves as a testament to the importance of relationships in disaster recovery (Poling & Shealy, 2023B). Without the permitting officials contributing their expertise to the planning and design process these bridges would have taken significantly longer to permit. Additionally, some governing bodies waved permit fees for the Bridge Home Program since they were often deemed emergency situations and they did not want to deplete minimal funding resources by charging permitting fees. Adopting practices to speed up both the grant application and approval process are necessary to decrease the overall recovery timeline.

Explore federal policy changes to reimbursement procedures to better assist disadvantaged communities

Small communities with minimal cash reserves struggle to recover under FEMA's current reimbursement driven funding model. Small towns like White Sulphur Springs have limited operating capital and the uncertainty behind the reimbursement process restricts the projects they can responsibly undertake. This was described by town officials in White Sulphur Springs, WV.

> "We were okay in doing what they [FEMA] told us to do and then they denied our request for reimbursement. We'd already spent the money. We spent the money… I think we finally, after a long period of time, that they finally gave us a go ahead on it [the reimbursement]. But it didn't, it wasn't like months. It was a matter of a couple of years. – White Sulphur Springs Town Official

Damage to critical infrastructure can overwhelm the available finances of small towns like White Sulphur Springs after disasters and navigating the documentation and procedures required for reimbursement are recognized challenges (Crow et al., 2018). The reimbursement process can vary in both award amount and time from applicant request to repayment (Crow et al., 2018). Crow et al. (2018) found in their study of flood recovery in one Colorado town that the local government had "challenges managing its fund balances and cash flow because agency reimbursements for flood repair are unpredictable in both amount and timeliness" and "The complex reimbursement and grant-making process administered by federal agencies is significantly more difficult for local governments if they do not have internal resources to pay for recovery to begin prior to reimbursement funds being disbursed."

Navigating FEMA's reimbursement processes and keeping up with changing regulations proved challenging for both local and state officials.

> "In dealing with FEMA, um, their regulations change at least somewhat for every disaster. So it's hard to get a good, consistent flow for what FEMA wants us to do. In general, it's the same procedure, but there are always new regulations thrown in or they want to see information in a different way…" – District Engineer, WVDOH District 9

Given the challenge with the reimbursement procedures and the limitations sometimes placed on local governments needing to fund projects one-by-one due to dependence on being reimbursed before funding the next project (Crow et al., 2018), one recommendation is federal agencies consider the creation of a new fund, or modification of existing policies, to allow for some funding to be disbursed in a non-reimbursement, grant type method. This would allow local governments to draw funds from the grant to pay for projects as they are completed, similar to if they were using their own revenue generated funds. The details of such a policy change or fund creation exceeds the scope of this paper, but should be investigated further as it could help cash-strapped local governments pay for recovery projects in a more timely manner.

Hope Village is a prime example of a successful project that would not have been possible for a cash-strapped locality who would have relied on federal funds that only become available months after the disaster. The two primary reasons Hope Village was a success is the expediency with which funds were secured and the substantial amount of volunteer labor utilized as seen in the following quotes.

> "I mean, you knew that these people, the people were displaced and they were going to leave if they didn't have a better option and came up with the Hope Village concept found the piece of property that the city had and started building homes within 60 days." – Executive Director, Homes and Hope for White Sulphur Springs

> "We had people moving into their homes at Thanksgiving, and the flood was in June…we had people moving in in 5 months." – Architect and Project Manager, Hope Village

> "They [nonprofit groups] helped us a great deal. They helped us tremendously in helping us get housing, getting things built. We came up with donations and so on for materials so that they'd have something to work with. They provided the labor. They came up, set up shop and provided the labor, especially at Hope Village." – Town Manager, White Sulphur Springs, WV

Residents were moving into Hope Village just five months after the flood – approximately 15 months before CDBG-DR funding was even awarded. The nonprofit and private sectors were able to collaborate with local government to design, permit, and build an entirely new neighborhood in approximately one-fourth the time it takes for federal recovery funding through HUD to be allocated. Steps to decrease the time it takes to allocate federal disaster recovery funds and streamline and simplify reimbursement procedures can help overcome legal barriers to long-term disaster recovery.

Overcoming historical development patterns through relocation efforts that preserve residents' connection to their land

Historical development patterns along low-lying areas near streams put many West Virginia communities at risk for flooding, and the relocation of infrastructure out of the floodplain is difficult due to cultural place attachment of local residents. For example, the replacement of one substantially damaged school in Kanawha County led to project delays caused by community members' disagreement over the location of the new school. Some wanted to rebuild the damaged school in the existing location, while others (including FEMA) insisted the school be moved to higher ground. Many Appalachian communities are vulnerable to flash flooding due to historical development patterns in low-lying regions along streams.

> "…a hundred years ago when a lot of our communities in West Virginia were built, we had to be by the stream. It's like that everywhere. Communities and developments

> happen on rivers or streams or near oceans or. So automatically you're, you're putting yourself in harm's way." – WVDOT Chief District Engineer

In addition to many older communities being settled along waterways, as pointed out by the WVDOT Chief District Engineer, these low-lying areas were also chosen because of the regional topography. The Appalachian Mountains dominate the landscape of the region making development anywhere but the flat areas along streams more difficult. Solutions to this issue must not compromise the safety of residents and infrastructure rebuilt after flooding, but must also honor and preserve local history and culture.

Oftentimes repair or in-kind replacement is the most expeditious recovery method and may be local citizens' preferred method of recovery, but a balance must be struck to respect locals' wishes, while also ensuring federal dollars are used to recover in sustainable, resilient ways. A former federal disaster responder and West Virginia Development Office Official shared that sometimes expediency is preferred over resilience by local governments by saying, "…they're [local governments are] about the immediate response and recovery, not thinking of long term." This can be true of disaster survivors as well as shown by the testimony of a flood survivor and Hope Village resident when she shared her belief that "…people should not be allowed to live in flood plains or build in flood zones or whatever, like even if they have their houses on six-foot stilts. Absolutely not." Later in the interview when asked if she would have moved back to her flood-damaged home if the opportunity presented itself the same person said "…I would have rebuilt and put my house on six-foot stilts." The reason for this is because in-kind repair or replacement was seen as the quickest way back to normalcy. This resident was a single mother and was moving from friend's home to friend's home with her young daughter and was seeking the quickest way back to normal for her family. She also shared that the floods took a significant and lasting toll on her mental health (discussed in the next section).

Preservation of local history and culture, resilient recovery, and expediency do not have to conflict, and indeed in the case of Hope Village all these factors coalesced. Preservation of local history does not need to mean rebuilding in the exact building footprint within the floodplain. Rather, preservation can focus on maintaining locals' connection to their land, which is often passed down through generations, by preserving access and utility. This was done in White Sulphur Springs by relocating families out of the floodplain to a newly developed community located nearby, but outside the floodplain, named Hope Village and the creation of a new system of parks. Residents were offered a trade – their destroyed homes and property in the floodplain for a new home in Hope Village. While many residents readily accepted the offer, some took convincing to give up their homes and land that held deep sentimental value and family history.

One way this was accomplished was through the creation of a series of parks out of the land in the floodplain. Midland Trail Park, Old Mill Park, and Nicely Park in White Sulphur Springs were all born out of the 2016 floods and allow residents to enjoy their land, have a sense of pride that it is positively contributing to the community, and gives the assurance that both they and their posterity can maintain a connection to it for generations to come.

> "People really liked that idea because then they knew that we were going to create this park. They, they come back, you know, they have birthday parties there on their property that they lived on. They're very connected to that little area." – Architect and Project Manager for Hope Village

Hope Village and the creation of the community parks mitigated loss of tax revenue by keeping residents in White Sulphur Springs and had the added benefit of providing the community with a new amenity. The relocation of residents out of the floodplain is a common practice in flood recovery and mitigation and has been used in flooding disasters in the past (Tate et al., 2016).

Improving recovery through an emphasis on in-person interactions

Disaster survivors, especially elderly disaster survivors, face mental health challenges.

> "…mental capacity to be able to comprehend all of the paperwork and the wording and then contract and the agreements and, you know, options being able to understand those things. I think those were definitely barriers as well. And majority of the time, it was elderly people that I saw that were struggling more than anyone else when it came to navigating those situations." -White Sulphur Springs Resident and Community Call Center Worker

This finding is consistent with other studies that highlight disasters' impact on mental health (Safapour et al., 2021; Stanke et al., 2012) and that "unstable mental condition of affected people" acts as a barrier to disaster survivors' recovery (Rouhanizadeh & Kermanshachi, 2021b). One interviewee from Clendenin expressed a sense of disconnectedness between locals and the federal government by saying, "They have no idea what you're going through," and "…when you talk to John Doe on the phone, John Doe's just reading off a script. He's just telling you exactly what's on that black and white [paper]". Survivors want to feel like someone cares about their situation – they want to feel like they matter.

In-person interaction has been linked to a person's sense that they view themselves as significant, or in other words, they matter (Vaillancourt et al., 2022). Citizens, want to feel like they are talking to a person, not a huge government agency. They don't want someone "just reading off a script", they want a human being with whom they can relate. They place a high value on having someone available to meet with them in-person, as exemplified by a single visit from a leading FEMA administrator addressing concerns of the Mayor of Clendenin.

> "I was so impressed with that man because he knew he could talk on a level that wasn't intimidating. He came to my office and stayed three hours." – Mayor of the Town of Clendenin, WV

To this small-town mayor, it made a world of difference meeting this FEMA official in person. In person interaction is not just important for community members, it is valued by professionals as well. The structural engineer for the West Virginia Bridge Home Program expressed an

appreciation for being able to meet permitting officials in-person and on-site when working on bridge designs.

> "Maybe it's also because the rural people are out in the field more. I can, just like I can in West Virginia, I can call up the local building official for this county, [name] – I've got this issue can you meet me on the site? Which you don't get with larger agencies who are sitting in Atlanta, for instance… so *accessibility, they're there. They can meet you on the site*." – Professional Engineer, JZ Engineering (Italics added for emphasis)

As the WVBHP engineer brought up, it is possible that government agencies in smaller, more rural states may be more active in field work and site visits than their urban counterparts due to regional differences. Regardless of rural versus urban geography, remote work has become much more widespread and accepted in the post-covid era. Remote meetings have made some aspects of communication easier and quicker, but the in-person aspect is still important and highly valued – especially in more rural contexts like Appalachia. Recent statistics show less than half of adults 65 and older own a tablet computer, less than half use social media, and only 61% own a smartphone (Faverio, 2022). In-person interaction is needed to effectively reach rural populations given both the higher percentage of elderly in rural communities (Smith & Trevelyan, 2018), and the lower percentages of this population's use of communication methods like social media.

Conclusion

Legal and socio-cultural barriers can delay rural communities' ability to recover by reducing and delaying federal funding awards. Collaborative cross-sector group(s) consisting of public, private, and nonprofit organizations that meet regularly during "blue skies" are needed to develop pre-disaster plans that identify, prioritize, and propose projects that promote the community's goals and resilience. Beginning environmental permitting as early as possible post-disaster is a way to reduce recovery times, while taking on a minimal amount of additional risk. Adopting the private bridge guidelines of the West Virginia Bridge Home Program is a meaningful step for a local or state government to promote resilient designs of private water crossings and potentially reduce permitting times. The process for awarding CDBG-DR funds has been recognized as taking too long and must be revised to shorten the time between disaster occurrence and the community receiving funding. Additionally, policy revisions are needed to FEMA's public assistance reimbursement process to better assist cash-strapped local governments who struggle to pay for recovery efforts upfront and get reimbursed later.

Socio-cultural barriers linked to regional culture like Appalachians' attachment to place can pose challenges to recovery best practices, such as relocation. This can be overcome through preserving residents' connection to their land through the creation of community amenities like parks and relocating residents in the same community nearby. Reframing their loss to their land as an asset they are providing to the community and preserving access to it can help overcome this barrier. An emphasis on the value of in-person interaction was also shared by interviewees. Expanding the in-person response to disasters has potential to help overcome some of the mental health challenges faced by survivors young and old.

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Conclusion

This study explores the struggles and triumphs of the long-term recovery of rural communities following the 2016 West Virginia floods. Disaster recovery in rural contexts has received less attention than that of urban and coastal areas (Jerolleman, 2020), despite rural communities' unique challenges with disaster recovery. Interviews were conducted with engineers and nonprofit workers to mayors and cabinet secretaries to gather insight into the recovery process and develop mitigation strategies. The use of three case studies, inclusion of professionals from nonprofit, public, and private sectors, and comparisons with existing literature provide for internal and external validation of findings. Interviews were transcribed and coded using qualitative analysis software and the coding results were validated by a third-party coder.

The research presented in this study contributes to existing knowledge of long-term disaster recovery by identifying barriers that communities in Greenbrier and Kanawha Counties faced following the 2016 floods and discussing mitigation strategies for overcoming them in future disasters. Barriers to disaster recovery were categorized into four groups: financial, coordination, legal, and socio-cultural. Prominent barriers identified included lack of economic resources at the individual and local levels as well as late allocation of recovery funding, lacking management capacity at the state and local levels, unclear roles and responsibilities of stakeholders, difficulty navigating the federal aid and reimbursement processes, difficulties providing legal documentation, and a lack of well-established design standards for private access bridges. There is no one-size-fits-all solution to overcoming these challenges, but several overarching themes emerged.

Interviewees mentioned the importance of building relationships with other disaster recovery stakeholders during "blue skies" so they can gain an understanding of each other's capabilities. This promotes better coordination because a measure of trust and mutual understanding has been built. Developing these meaningful relationships takes time, which is something communities do not have following a disaster. This leads to the next point which is the need for pre-disaster planning. Pre-disaster planning can increase the amount of funding a community receives, expedite the recovery process, and provide direction to stakeholders who are unclear of their roles and responsibilities following a disaster.

The effectiveness of relationship building and pre-disaster planning is exemplified in the West Virginia Bridge Home Program. This innovative program was developed through the collaboration of government, private, and nonprofit entities prior to the 2016 floods and has resulted in the construction of over one hundred safe, low-cost, and resilient private access bridges for families in need. Through weekly and sometimes daily meetings engineers, permitting officials, and nonprofits were able to drastically reduce permitting times, develop a resilient, low-cost, and replicable design, and maximize use of funds through nonprofit labor and volunteers.

Despite the success of efforts like the Bridge Home Program, policy changes are needed to reduce delays to recovery. Funding from the United States' Department of Housing and Urban

Development's (HUD) Community Development Block Grant – Disaster Recovery Program (CDBG-DR) took approximately 20 months to arrive following the 2016 floods. Meanwhile, a property buyout and relocation effort in White Sulphur Springs, WV known as Hope Village was able to have survivors moving into new homes outside of the 100-year floodplain within five months. This was accomplished using donated resources and volunteer labor and would not have been possible in such a short timeframe using government funding. Not only must the CDBG-DR timeline be shortened, but the FEMA reimbursement process for public assistance awards should be revaluated to better assist local governments who are unable to pay for infrastructure repairs out of pocket. Beginning environmental permitting of projects earlier using rainy day funds and adding provisions for shortening public review periods for CDBG-DR grants if pre-disaster planning is in place are two possible solutions provided for consideration.

The intent of this study has always been to act as an after-action report of recovery efforts stemming from the 2016 West Virginia floods. As such, the next steps are to provide these findings to policymakers and practitioners to inform both legislation and best practices. Officials from the West Virginia Resiliency Office, West Virginia FEMA Integrated Team, nonprofits involved in the Bridge Home Program, and engineers at the West Virginia Department of Transportation have all requested access to the findings of this research. As such, this study will be widely distributed.

Future projects taking these findings from theory to practice are already in development. Rural Appalachian communities do not have the personnel or economic resources to hire professionals to conduct vulnerability assessments and develop disaster recovery plans. Therefore, proposals to develop an "Appalachian Disaster Resilience Center" exemplifying the kind of cross-sector collaborative partnerships recommended in this study is currently in development. A team of researchers and industry professionals are exploring various funding sources to pilot a program aimed at helping Appalachian communities become more resilient and mitigate barriers to recovery by assessing vulnerabilities and planning for future disasters.

Reflection

As I reflect on my professional growth as both a researcher and engineer, I am amazed at how much can change over the course of a few short years. In addition to the knowledge gained on the subject of disaster recovery, I offer here some supplementary considerations.

Qualitative research is NOT easier than quantitative research.

As someone who conducted quantitative research for their master's degree, and an engineer who has heard critique of the rigor with which qualitative research is performed when compared to quantitative, I offer this conclusion – qualitative research is not easier than quantitative research. The time required to develop and refine interview questions, conduct the interviews and any required follow-ups, and then perform the data analysis is considerable. Answers to qualitative questions are not a number produced by performing a sequence of mathematical processes, but rather a synthesis of various sources whether they be documents, news articles, or conversations. Synthesizing interview data from people with different life experiences, dialects, and opinions is anything but straightforward.

Relationship building is not only important for effective disaster recovery, but also in other areas of life.

One of the most difficult aspects of qualitative research is finding people willing to be interviewed, especially when there is no incentive being offered and the interviews can last an hour or more. One key connection made by a shared love of Virginia Tech and West Virginia led to almost every other interview for this study. The entirety of the 25 interviewees stemmed from initial interactions with less than a handful of people. An even shorter way of making this point could be summarized in two words – relationships matter.

Don't judge a book by it's cover.

Yes, I know this is a cliché, but it is also true. West Virginia is a state with immense natural beauty, resources that support energy and manufacturing across the U.S. and globe, and is home to some truly amazing people. With that said, it is also a state that routinely places in the bottom of national rankings in healthcare, infrastructure, and education. West Virginians are thought of by some as uneducated, redneck, hillbillies. My hope is that through this study others can see West Virginians are a caring group of people who are resilient, can develop innovative solutions to problems, and compete with others on a national and international scale. West Virginians, and people in general, may not always look or talk like the societal standard for engineers, politicians, or other professionals, but don't let that cause you to underestimate them and discount their knowledge.

What I would do differently.

I'm not sure I would do anything differently if I were to rewind time and start again. That isn't to say I couldn't have done certain tasks better, but I learned and grew through every step of this process. Perhaps I could have been a bit more thorough and organized in my literature review, or maybe I could have pursued a few extra interviewees, but I doubt any good researcher can look back on a research endeavor of this scale with the time and resource constraints of this study and not find items that could have been improved in one way or another.

Communication through scholarly writing is difficult and time consuming.

I found myself frustrated at multiple points throughout the writing phase of this research, not caused by any external factor, but due to my inability at various times to effectively communicate what was in my head onto a page. I am indebted to my advisor for the many meetings where he would allow me to ramble on about an issue, repeat what I was saying back to me, and rinse and repeat this over and over again to help me process what I was thinking and saying into a coherent and concise thought and format that could be easily understood by a reader. Additionally, this process was not "one and done", rather it was an iterative one. Sometimes a section may need only two or three reviews, other times it may need a dozen. It is hard not to get discouraged when it is the latter, but sometimes that is what it takes to communicate an idea effectively.

To future graduate researchers – pick a topic you are passionate about.
I cannot imagine devoting the time and energy it takes to perform a study of this magnitude on a subject I was not sincerely passionate about. Pursuing a doctoral degree is not an easy feat, but more than anything it is an endurance race, not a sprint. You do not want to spend years of your life working on a project you aren't passionate about, because there will be times when you feel like you cannot read one more journal paper, and times when you cannot write one more word. It is in these moments when you must take a step back and remember why it is you are conducting the research in the first place. Another strategy to help reduce burnout is almost silly to even say – take a break. Going for a walk, taking a lunch break, or giving yourself the occasional long weekend off can do wonders to reinvigorate you. Additionally, find a schedule that works for you. A rested hour of writing first thing in the morning was worth far more to me than four hours of writing after a long day's work. Find out what schedule and strategies work best for you and commit yourself to adhering to them.

Do not be discouraged for efforts that do not yield instant, visible results.
There were periods where I would spend hours, sometimes days working and have almost nothing to show for it. I would sit at my desk and read journal articles and interview transcripts, go for walks around my apartment complex or simply pace back and forth in my living room, and write lengthy paragraphs only to delete them moments later. All these activities left me anxious at times, because there was nothing concrete I could point to for all the hours of time spent processing information. These efforts are necessary, and they are often time consuming. Do not be discouraged by them, because they are a necessary part of the research process.

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Appendix A: Uncertainties in Design Standards Create a Barrier for Long-Term Disaster Recovery: A Case Study of the West Virginia Bridge Home Program

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Abstract
West Virginia was ravaged by devastating flooding across its central and southern regions in June of 2016 by a 1,000-year storm event. Many residents in the rural areas of the affected regions rely on private bridges to access their homes from state-maintained roadways. The flooding destroyed hundreds of these bridges and created a need to replace them. This research explores the challenges stemming from a lack of up-to-date and widely accepted design standards for private bridges. Interviews were conducted with 15 stakeholders, including mayors, disaster workers, government agencies, engineers, and others, to identify these challenges and best practices. A reoccurring theme in interviews was the role liability played in inhibiting the nonprofit and private sectors from contributing to the project. The solution to this issue came through in-person meetings where the public agencies listened to the concerns of the technical experts and nonprofit sectors, and all parties agreed to continued collaboration throughout the project. These meetings helped build trust among the stakeholders, which decreased the perceived liability among the engineering firm and nonprofit sector organizations and enabled the project to proceed. The resulting design of the bridges – although relatively simple to design, build, and maintain – has proved resilient in recent years. The design principles, which incorporated resilience as a best practice, could be replicated in future flood recovery efforts, and adopted into an updated set of private water crossing guidelines to ensure future recovery efforts are not relying on outdated engineering practices.

Introduction
Communities have never been in greater need of resilient infrastructure, given both the historical and projected increases in the intensity and frequency of storm events. The recent flooding in Eastern Kentucky, the devastation caused by Hurricane Ian across Florida and the Carolinas, and the devastating 2021 European floods are the latest in many examples demonstrating the need for more resilient infrastructure. These severe storm events cause devastation but also create the opportunity to construct new, more resilient communities. Resilience is “the ability to prepare and plan for, absorb, recover from, or more successfully adapt to actual or potential adverse events” (National Academies Press, 2012). The 2016 West Virginia floods were used as a focusing event, and the post-disaster long-term recovery process was examined – specifically, the design, permitting, and construction of private residential bridges – to better understand how to build more resilient communities and the current barriers to this process.

Many homes in the affected areas of West Virginia require these bridges for access. These bridges may not reach the level of societal importance facilities like hospitals and power plants do, but to the residents who rely on them to access their homes, they can mean the difference between life and death. This is evidenced by cases such as a resident, who, only one day after their bridge was replaced by the Bridge Home Program, had a medical emergency, and was taken away in an ambulance. Emergency services used the bridge to reach the resident's home.

Background and Research Question

Deciding how to rebuild after a disaster is difficult, given that the previous standards used to construct the infrastructure led to failure. New standards that better account for the type of disaster the community recently experienced and future forecasted events take time to develop. New standards are often not available by the time recovery begins. Engineers and project stakeholders are left to make design and construction decisions using the same guidelines and standards in place before the disaster event. Building back to the same standards leaves the community vulnerable to similar future events.

The research presented in this paper explores what happens in the absence of up-to-date design standards and guidelines during the long-term recovery process. People who experience flooding view themselves as more vulnerable to future flooding and tend to have greater intentions of taking precautionary measures against future flooding than non-flood victims (Zaalberg et al., 2009). Similarly, the expectation in West Virginia was that stakeholders responsible for designing and building back communities would be motivated to ensure their projects could resist future similar disaster events. However, the financial burden of these design decisions may still drive recovery decisions. In a survey of over 9,900 eligible voters in the United States and Germany, Fesenfeld & Rinscheid (2021) found that people's sense of urgency was a critical factor for supporting "low-cost" climate mitigation efforts but that it did not lead to support for more burdensome measures. In other words, upfront costs were still a greater priority than long-term resilience. The research question the study presented in this paper attempted to answer was how do uncertainties in design criteria affect long-term recovery efforts.

Research Methodology and Approach

Multiple types of infrastructure projects were considered. However, private residential bridges were chosen due to a lack design standards before and after the flooding event in West Virginia in 2016. Before the flooding, a nonprofit disaster recovery organization, the West Virginia Voluntary Organizations Active in Disaster (WV VOAD), created the WV Bridge Home Program. This program brought together nonprofits, such as Mennonite Disaster Service (MDS) – an organization that helps homeowners rebuild after disasters, engineering firms, and local, state, and federal government agencies to address the issue of private bridges washing out due to flooding events already occurring throughout the state.

Communities in West Virginia like White Sulphur Springs, Clendenin, Rainelle, and Elkview were unprepared for the nearly 10 inches of rain that fell in under 48 hours in June 2016. The region's

mountainous topography and historical development on flat land near streams led to infrastructure being built in low-lying areas, which left them vulnerable to flooding. In many areas, state roads were built on one side of the stream while homes were built on the other and connected using a private residential bridge like the one seen in Figure 1.

Figure 1: Poorly Designed Private Residential Bridge Before Bridge Home Program Replacement (Courtesy of WV VOAD)

These bridges are the homeowners' responsibility and are not maintained by any government entity. The design and construction of private residential bridges pose unique challenges. They are not common in all parts of the country, homeowners usually have limited funds to design, construct, and maintain them, and their location in the floodway makes them especially vulnerable to damage from flooding. This vulnerability led to homeowners' bridges being inundated by raging floodwaters in the 2016 floods, causing hundreds of bridges to be severely damaged or destroyed.

The WV Bridge Home Program, in its infancy prior to 2016, became an instrumental mechanism for getting hundreds of residents safe access to their homes following the 2016 floods. The program began because residents would call the Department of Transportation (DOT) after smaller flooding events asking for help reconstructing their bridges after the original bridge (often built decades early) was damaged or destroyed. The DOT had to deny residents' requests for assistance because the state agency could not take responsibility for the bridges on private property. WV VOAD saw this growing need throughout the state and assembled a diverse team of government agencies, nonprofits, and an engineering firm to address this issue. The program has produced over one hundred safe, low-cost, and resilient private access bridges since the flooding event in 2016 (see Figure 2).

Figure 2: Private Residential Bridge After Bridge Home Program Replacement (Courtesy of WV VOAD)

The bridges are described as resilient because they are secured in place by driving micro piles down to bedrock or refusal, the curbs allow water to flow through them during flood conditions, the bridges span from bank to bank, and the banks are stabilized using riprap or gabion baskets. These design elements were decided on after the structural engineer conducted numerous site visits of bridges destroyed during flooding in the area in 2015. He found that many of the bridges failed by water overturning them, pushing them off their foundations, or eroding the banks – causing them to fall into the side of the streambed. These design elements significantly reduce the risk of these failure modes occurring. There is a much lower chance of the bridge being overturned or pushed off its foundation due to the abutments being secured to bedrock using the micro piles. Similarly, to reduce the transverse loading from the water and the additional force from debris buildup, the bridge curbs were designed to allow water and small debris to flow through them. Spanning from bank to bank preserves the natural width and height of the stream to the greatest extent possible, thus preventing abutments from being undermined when water flow increases. Additionally, it places the bridge at the highest practical height to allow the maximum amount of water to flow beneath it.

Lastly, the banks are less likely to experience severe erosion because of the protection offered by the riprap or gabion baskets. Bank stabilization is a common practice and was mentioned in a FEMA report titled “Private Water Crossings: Considerations before you build or rebuild” (FEMA, 2009). The FEMA report, while it mentions bank stabilization as a best practice, also endorses the use of wingwalls. Wingwalls are commonly used as a source of protection for bridge abutments, however, they are often designed in a way that infringes on the sides of the stream, thus restricting the natural flow of water at the bridge location. This makes them susceptible to undermining during high water events. For this reason, wingwalls were not used for any of the Bridge Home Program bridges. Several of the Bridge Home bridges have experienced flooding

that submerged the bridge despite the fact the oldest of these bridges are still relatively young at an age of approximately seven years old. After the floodwaters receded, the bridges were completely functional and only required minor work to reestablish the bank stabilization.

Additional benefits of these bridge designs are that they are environmentally conscious (elevated above the streambed), easy to build, and require minimal maintenance. By keeping the bridge out of the stream there is little disruption or damage to the natural habitat. This is a major benefit of the design since one of the towns most severely impacted by the 2016 floods, The Town of Clendenin, is home to the Guyandotte Crayfish – an endangered species that lives in streams and stream banks. The bridges require minimal construction knowledge and skill to build, thus they can be built using volunteer labor, and they are low maintenance. Owners sign a maintenance agreement upon completion of the construction of the bridge stating they will replace wooden boards that make up the bridge decking and reestablish bank stabilization after flood events as needed.

Data Collection

Semi-structured interviews were the primary method of data collection. A combination of convenience and snowball sampling was utilized. Stakeholders were identified, and additional interviewees were recruited based on recommendations provided by stakeholders during the interviews. When possible, site visits were made to observe the construction process. The site of the private residential bridge serving as the model project for the WV Bridge Home Program, called Big Blue, was visited by members of the research team several times. Notes, photos, and videos were recorded during these visits. Additionally, documents, such as government grants, engineering drawings, permits, and laws, were identified and used as supporting documents for the interviews.

Interviews were conducted from June to September 2022, except for two pilot interviews, which were conducted in October 2021. A total of 15 people from ten organizations participated in the semi-structured interviews. Interviewees included mayors and FEMA officials, professional engineers, and nonprofit disaster workers. Interviews lasted approximately one hour. Stakeholders were identified using documents from the WV VOAD Bridge Home Design Guidelines, which identified various Bridge Committee members and advisors who created the program, as well as recommendations from WV VOAD's Executive Director. Stakeholders included the public, private, and nonprofit sectors and hold varying roles and degrees of involvement with the Bridge Home Program.

Interview questions were drafted by the primary investigator to explore how three topics – stakeholder relationships, government regulations, and stakeholders' perceptions of risk – affect long-term infrastructure design and construction post-disaster. These questions were then reviewed by four researchers familiar with the research project. The primary investigator modified the interview questions based on feedback aimed at limiting bias and considering the local culture. One such example is the rewording of a question phrased "were you thinking of how to build back better" to "were you thinking about how to build it better than it was before". This may seem like a small change, but the researchers did not want political opinions

surrounding the then recently passed "Build Back Better Act" to influence the interviewees' responses. In another example, a recent study, as well as media coverage in 2020, suggested that Republican-dominated communities that are not as receptive to the concept of climate change are supportive of taking steps to increase their community's resilience and future risk capacity (Giordono et al., 2020). Given this, questions tended to use phrasing around resilience rather than climate change. One such question was, "how big of a role does the idea of resilience play during the design and permitting process?".

Data Analysis

Data analysis involved using software to transcribe interviews, then the research team reviewed and corrected the transcriptions. Thematic content analysis was then used to derive meaning from the interview data by assigning codes to group comments reflecting similar themes. Nvivo software was used to perform the thematic content analysis. An initial set of codes were established before any analysis, and additional codes were added during analysis. Creating an initial set of codes before performing analysis is a form of deductive coding (Yin, 2011a). Generating new codes during the analysis aligns with an inductive approach as it allowed the relevant themes and concepts to emerge from the data (Yin, 2011a). This hybrid approach balanced the benefits of both an inductive and deductive methodology.

The researcher established two levels of codes. The first level of codes represented three topics of interest – (1) stakeholder relationships and the organizations involved in recovery, (2) legal and regulatory concerns, and (3) stakeholders' perceptions of future risk. These codes were used to highlight phrases that addressed questions like who was involved in each recovery activity, what laws, permits, or other regulations were they considering, and what risks were affecting decision-making. The second level of codes showed more specific subtopics. For example, when an organization involved in the recovery process was mentioned by an interviewee that comment was coded under the organizations code within the topic one (relationships) code set. Many of the themes fit under the umbrella of one of the three topics; however, some themes were broader and were established as high-level, standalone codes. An example of this is the design considerations code which can apply to all three topics. Figure 3 below shows an example of some of the codes used and their hierarchy.

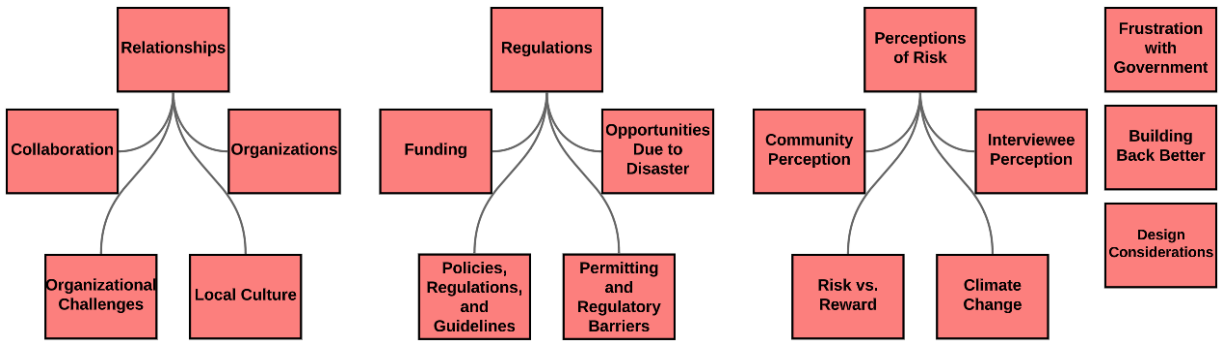

Figure 3: Example of Coding Hierarchy

Many of the interviewees' comments fit into one topic and subtopic, such as the mention of a specific type of permitting into the permitting and regulatory barriers subtopic of topic two (regulations); however, some comments were relevant to multiple topics and subtopics, in which case more than one code was applied. An example of a subject coded more than once was from a FEMA Emergency Management Specialist. She discussed challenges associated with rebuilding a substantially damaged school in Clendenin, WV. Federal regulations deemed any work done to repair or reconstruct the school to be the same as a new build. Discussions with locals ensued about relocating the school, but was met with resistance due to the history associated with the school building. Her comments were coded as both "building back better" and "permitting and regulatory barriers" because they involve restrictions tied to government recovery funds to rebuild the school outside of the floodplain, rather than rebuild to the pre-disaster state.

Validation of Coding

The coding for this research was validated by using a negotiated agreement approach to establish an intercoder reliability score. This type of approach describes a process in which two researchers code a subset of the transcripts, compare their codes, and then discuss differences to resolve discrepancies (Campbell et al., 2013). The PI created the coding scheme and an independent, third-party coder with no prior exposure to the research was brought in as a validator.

There is no universally accepted sample size for establishing intercoder reliability, but recent literature supports using 10 – 25% of data units (O'Connor & Joffe, 2020). As such, a sample size of three interviews was used for this study. The sample transcripts were from two professional engineers and a public permitting agency.

The PI discussed the research study with the validator, explained the coding scheme, and reviewed how to operate the NVivo software. The validator independently coded the three interview transcripts, then NVivo was used to calculate a Cohen's Kappa (K) intercoder reliability score (ICR) for each. The average initial ICR across the three transcripts was K = 0.54. The PI and validator met to discuss differences and found that many of the discrepancies between codes involved a lack of expertise by the validator on topics such as engineering design and disaster recovery regulations. After several iterations of discussion between the PI and validator, a final Cohen's Kappa of K = 0.90 was established across the transcripts.

Key Findings

One prominent theme emerging from the interviews was the importance of risk, specifically professional liability, related to uncertainty associated with the lack of design standards for private access bridges. Design uncertainties increased the perceived liability for the bridge designers and contractors involved in the recovery making them less inclined to participate. The biggest concern was the lack of standards for the design of private access bridges. The bridge engineer explained that engineers typically rely on industry-accepted standards to guide their design process. Without those standards, engineers and contractors are hesitant to become

involved. The bridge engineer, who eventually designed many of the bridges alongside WV VOAD, expressed:

> "So I think probably the biggest reason we got involved was, um, maybe a liability issue. First of all, there is no code for residential bridges, so for a firm to go and stick their neck out with the liability issues. And so, yeah, liability is a concern for me. – Professional Engineer, JZ Engineering

The Executive Director for Mennonite Disaster Service (MDS), one of the organizations that helped build the bridges emphasized the liability issue by recalling an experience over a decade earlier in 2004, saying:

> "We drove up and down all over West Virginia, seeing the need for private access bridges. I got excited and I thought this is something MDS could do. But we ran into a roadblock and that was liability. If we build these bridges, these are on private land, but if a five-ton coal truck delivers coal in the winter and they break through this bridge. Who's liable? Who are they going to sue?" – Executive Director, Mennonite Disaster Service

MDS was not willing to take on the liability of building these bridges on its own over a decade before because of the liability concerns. It took WV VOAD's leadership, government cooperation, and the engineering provided by JZ Engineering to overcome the challenges an effort like the Bridge Home Program faced.

Standards provided by the State or Federal Government are often used by design professionals to justify their decision-making and ensure their design is in line with accepted norms and practices. Without any accepted standards for designing private bridges, the engineering team had little guidance to help justify their design decisions. Such void in guidance may lead to overdesigning in an effort to limit their liability by ensuring the infrastructure is far more resilient. In this case, overdesigning was not feasible, given the financial constraints of the WV Bridge Home Program. This is where the theme of collaboration and value of organizational relationships became evident. The good working relationship and sense of trust among the stakeholders that decreased the perceived liability became instrumental in ensuring the project team was willing to design and construct the new bridges. The Executive Director for the Mennonite Disaster Service said:

> "We had EPA, we had floodplain managers. We had personnel from FEMA and Washington, D.C. come, and we had JZ Engineering and a number of other people. Twenty or thirty of us in that room, and we started talking about the various issues and challenges that we had, and in that room, we discovered a way that MDS could effectively build a bridge and local authorities and the state authorities said, yeah, we can provide liability coverage. We can work with you on endangered species. We can work with you on the roads and highways as far as setbacks and so on."

Everyone involved desired to help victims of flooding, but the uncertainty behind the design guidelines and permitting created liability that no one volunteer organization or engineering firm was able to accept. The shared goal of rebuilding would not have been possible without the various stakeholders collaborating to pool resources and take shared ownership of the program to limit the liability on any one party.

The ongoing discussions between stakeholders throughout the project were critical to overcoming the uncertainty in the design criteria.

> "It took us probably ten months to come up with the guidelines and the process and the engineering and everything that we were going to do. It probably took us at least 10 months of meeting daily, sometimes through the week and sometimes weekly." – Executive Director, West Virginia VOAD

These discussions served to develop technical designs and figure out logistics, but they also created a sense of community and a shared vision. At the end of the first meeting, one of the participants described the sentiment this way:

> "We're here to help each other, not stand in each other's way…I said, you know, I can't believe this is happening here. And someone just said, 'Well, we live here. These are our hollows, these are our bridges, these are neighbors not getting to the hospital. We have to make it work.'"

The trust and good working relationship among nonprofit and private entities ultimately made the project more tenable across parties where everyone shared responsibility and liability for its outcomes. Communities coming together and working collaboratively on disaster recovery is not a new phenomenon. Studies have found that knowledge developed through experiencing past disasters makes people more likely to cooperate (Cassar et al., 2017; Toya & Skidmore, 2014). This strengthened sense of community can be a valuable asset. In a similar manner, lack of coordination and effective management is a commonly cited barrier to effective recovery (Safapour et al., 2021). As such, having a single person coordinating efforts to ensure organization and limit duplication of effort is important (Rouhanizadeh & Kermanshachi, 2020b, 2021a). The Bridge Home Program was a success because there was effective leadership, which created an environment that capitalized on stakeholders' desire to collaborate with one another for the good of their community.

Implications

The uncertainties in design criteria led to an unwillingness among the design team to participate in the project and ultimately was resolved through collaboration among all the major non-public entities agreeing to share liability. The bridge designer believed the lack of design guidelines from the State or Federal Government increased their liability due to the lack of a benchmark on which to base their design decisions. Overcoming this barrier required government agencies to work alongside nonprofits and private sector organizations to decrease perceived liability.

Uncertainties in design criteria for private residential bridges pose a barrier to future recovery efforts. West Virginia, and other mountainous regions requiring similar infrastructure, will continue to experience flash flooding in the future. The long-term recovery process could be streamlined through Government agencies adopting private bridge design and construction guidelines to promote the resiliency of the methods used in the WV Bridge Home Program and provide a measure of liability protection to stakeholders who abide by those guidelines in future design and construction projects. Guidelines should not be overly prescriptive to the point that engineering judgment is constrained because the design for each bridge varies based on individual homeowners' needs and the surrounding environment's conditions. The WV Bridge Home Program is a nationally renowned model whose fundamental design principles and collaborative efforts among stakeholders could be replicated.

Limitations and Future Work

The oldest of the Bridge Home Program bridges are approximately seven years old, so a long-term study of their performance has not yet been possible. Although the effects of repeated exposure to long-term flooding have not been possible yet, the bridges have performed as expected under flood conditions during that time span. Revisiting these bridges in the future and evaluating their condition immediately following future floods are two methods that could provide additional, valuable insight into their strengths and vulnerabilities.

Future work should also begin to explore if there is a threshold for a disaster to be a catalyst for change. The flooding event of 2004, mentioned by the Executive Director of Mennonite Disaster Service (MDS), did not result in the same type of response as the flooding in 2016. A better understanding of why each event led to different responses is essential to identify the factors that motivate change and how to predict it. For example, future work could explore the difference in the number of bridges destroyed, public outcry, economic and social impact, availability of resources, or political will between the two cases. The WV Bridge Home Program being established prior to the 2016 floods but not before the 2004 floods likely also contributed to the difference in response. Creating public-private working groups at the state or local level around vulnerable infrastructure is a model that needs further study. Preemptively creating these working groups, before a disaster occurs, helps open lines of communication, build trust among local partners, and helps identify the gaps in design guidelines that could hinder future recovery when a disaster occurs. These types of working groups are relatively inexpensive compared to the cost of infrastructure. Understanding their impact and monetary savings after an event is a necessary next step.

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Appendix B: Interview Questions

1. Ask the participant to introduce themselves and their job title and responsibilities for the recording.
2. What were the goals of the project?
3. What organizations were involved with the project?
4. Were all of these organizations in agreement about the goals of the project? Were they in agreement about the sequence or schedule of action items to move the project forward?
5. For each of the organizations you just mentioned, could you briefly describe their roles in the infrastructure design and recovery process?
6. Which organizations did you and your organization have direct interactions with?
    a. Please rank the organizations *you* most frequently contacted for this project.
        i. Could you tell me how meaningful this communication was to complete the project?
    b. My prior question was about who you reached out to for the project. I am also interested in communication going in the other direction. Can you please rank the organizations that most frequently contacted *you* while working on this project?
    c. Could you tell me how meaningful this communication was to complete the project?
7. How did the organizations you mentioned work together? Was there any formal or informal organizational structure established over time?
8. Which organizations were the most influential in the infrastructure design process after the event?
9. How did local, state, or federal government entities work together?
    a. What worked well?
    b. What didn't work well?
    c. How could it have been better?
10. How involved was the community in recovery decision-making?
    a. Were there any design charrettes held or other public meetings?
11. How have government regulations influenced this project?
    a. Were these helpful or hindersome?
12. Could you please name some of the regulations, permits, or other similar items that were involved with this project and how they impacted the design and/or construction?
13. Were any special conditions agreed upon to ease regulations for this infrastructure project?
    a. Are these exceptions because of the relationship between your organizations, or is it because of the special disaster-related classification of this project?
14. If yes, what was the effect of these changes in regulations on the project? (e.g., on cost/time?)
15. Are you aware of any permanent changes to either regulations or policy that have resulted from the flooding of 2016? (e.g., West Virginia RISE and Office of Resiliency both came from it)

16. What are the most important steps the government can take to promote more resilient infrastructure in the state? What needs to be done at the local, state, and federal level?
17. When you were in the process of rebuilding, were you thinking about how to build it better than it was before?
18. Do you think weather events, like the flooding in 2016, will become more frequent in the future?
19. Do you think the people in the affected areas will see an event like the 2016 floods again in their lifetime? In other words, do you think this was a once-in-a-lifetime kind of event, or do you think it will happen again in your lifetime? How many more times in your lifetime?
20. Do you think weather events, like the flooding in 2016, will become more or less harmful for communities in West Virginia in the future?
21. How worried are people in this region about another major flood harming their community?
22. How big of a role does the idea of resilience play during the design and permitting process?
23. Was resilience a design requirement? How was it measured when evaluating design options?
24. How do you think the design may been different if the disaster had not occurred? (i.e., how did the flood influence the priority given to resilience by decision-makers)
25. Were there any considerations that the destroyed or damaged infrastructure should not be rebuilt?