WESTERN NORTH CAROLINA

Regional Communications Resiliency Plan

A path from post-Helene recovery to regional coordination.

2026

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A path from post-Helene recovery to regional coordination.

PREPARED BY

The Ruckus Group, LLC

FOR

Information Technology Disaster Resource Center (ITDRC)
and Land of Sky Regional Council

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2026

In memory of those lost during Hurricane Helene.

For the communities of Western North Carolina, and for the responders, neighbors, and stakeholders whose voices built this plan.

WESTERN NORTH CAROLINA REGIONAL COMMUNICATIONS RESILIENCY PLAN

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DISCLAIMER

This plan reflects stakeholder input gathered through structured listening sessions, participatory mapping, and validation conducted in 2025 - 2026. Facts, statistics, and citations are drawn from named sources; any errors are the responsibility of the authors.

Foreword

In September 2024, Hurricane Helene exposed long-standing vulnerabilities in Western North Carolina's communications systems. Cell towers went silent, fiber routes were severed, radio capacity was overwhelmed, and entire communities were cut off from information, services, and from one another. The lessons of that experience are documented in this plan, alongside the practical solutions the region's emergency managers, industry partners, and community organizations identified to keep it from happening again.

This plan was built from the ground up. Across four Land of Sky counties, 113 stakeholders shared what they saw, what failed, and what they believe should change. Their voices are the foundation of every finding and every recommendation that follows. The role of Land of Sky Regional Council, Information Technology Disaster Resource Center (ITDRC), and The Ruckus Group was to listen carefully, structure what we heard, and shape it into a usable plan.

This plan is a Western North Carolina regional resource meant to be adapted by other regions building preparedness. It provides a shared analytical basis for action, a coordination framework that supports local autonomy, and a phased roadmap for investment. It is also a living document, designed to be revisited, refined, and extended as conditions, capabilities, and partners evolve.

We invite county leaders, federal and state partners, industry providers, community organizations, and residents to engage with this plan, adopt what is useful, contribute what is missing, and use it as a foundation for sustained regional communications resilience.

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HOW THIS PLAN DEFINES

Communications resilience is the ability to anticipate, withstand, adapt to, and recover from adverse events through an array of strategies that may include diversity and redundancy, network hardening, backup or alternative power, use of temporary facilities, place-based resilience hubs, communication and coordination across agencies, sectors, and the public, and planning, prevention, education, training, and cyber-specific activities.

- ADOPTED FOR THE WNC REGIONAL COMMUNICATIONS RESILIENCY PLAN

Executive Summary

This Regional Communications Resiliency Plan represents the first comprehensive, multi-county framework for emergency communications resilience developed through direct stakeholder engagement in the Land of Sky counties: Buncombe, Henderson, Madison, and Transylvania in North Carolina. Born from the catastrophic communications failures during Hurricane Helene in September 2024, this plan translates lessons-learned into actionable strategies for building a communications infrastructure that can withstand and recover from future disasters.

The Crisis That Exposed Our Vulnerabilities

On September 25, 2024, a stalled cold front set up over the southern Appalachians tapping deep tropical moisture from the outer bands of Hurricane Helene which remained just north of Cancun, Mexico. As a result of this front and over the period September 26 and 27, a Predecessor Rain Event (PRE) occurred producing rainfall totals estimated up to 10 inches in parts of the French Broad and Swannanoa River basins.

Hurricane Helene made landfall in Florida on September 26, 2024, and tracked north through Georgia into Western North Carolina bringing with it additional catastrophic rainfall. Between September 25 and 27, rainfall reached as much as 31 inches, causing record-breaking floods and landslides throughout the area. The storm's impact on communications infrastructure was immediate, widespread, and prolonged.

Figure 1. Helene Retrospective ArcGIS dashboard illustrating landslides, extreme rainfall, wind, and tornado reports used by North Carolina Emergency Management.

Infrastructure Damage

Photo 1. Infrastructure damage in Buncombe County, NC. Source: Madeleine Cook, Federal Emergency Management Agency, 2024

The physical destruction was extensive and region wide. Federal Communications Commission (2024) data documented that 75% of cell sites in the affected region were out of service at the peak of the outage leaving more than 200,000 wireline and cable subscribers without telephone, television, or internet service. The storm destroyed over 1,700 miles (Stein, 2025) of fiber optic cable, much of it following extremely flooded and, in some cases, re-routed river corridors and damaged 6,900+ roads and bridges (North Carolina Office of State Budget and Management, 2024) that severely hampered and halted both emergency response and infrastructure repair.

The Failure Cascade

Stakeholders described a progression of communications constraints as the storm disrupted primary services and reduced the effectiveness of available alternatives. Cellular and broadband failures shifted more demand onto radio systems, while infrastructure damage, power loss, and access limitations affected multiple systems. The sequence and duration varied by location and stakeholder experience. The illustration summarizes how participants experienced the narrowing of their communications options.

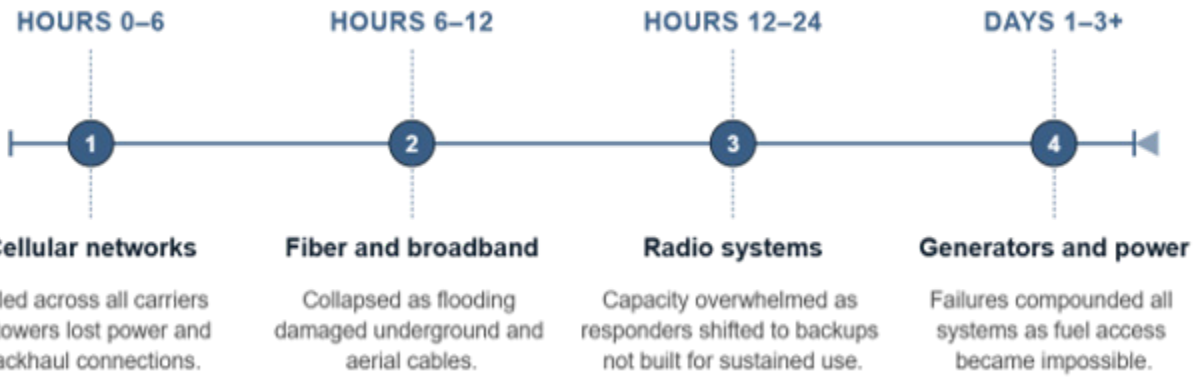

Figure 2. Stakeholder-described progression of communications disruption during Hurricane Helene. Failures overlapped, and their timing and order varied across locations. The sequence illustrates the loss or degradation of usable communications options described in listening sessions.

Seams Between Systems

Beyond the infrastructure damage, the storm revealed a critical insight: the most damaging failures occurred at the interfaces between systems. This “interface fragility” meant that even as individual components were restored, the overall communications lifeline remained degraded because the connections between systems - the seams where cellular meets landline, where local Land Mobile Radio (LMR) meets statewide networks, where emergency services meet commercial providers - were the true points of failure. Emergency managers reported mutual aid resource requests taking up to seven weeks to fulfill. Entire communities became isolated, not just due to blocked roads, but also because all modern communication methods failed at once.

Economic Impact

The North Carolina Office of State Budget and Management (2024) documented $59.6 billion in total damage and recovery needs from Hurricane Helene or 3.5 times the impact of Hurricane Florence in 2018. Communications failure amplified those losses by delaying situational awareness, breaking supply chains, halting electronic transactions, and slowing permitting and repair coordination (Section II). Isolating that share (to communications failures) is not possible from available data, their accounts nevertheless identify practical ways that reliable communications can support continuity and reduce disruption during future events.

**Project team estimate; see Section II for the delay evidence.*

The Human Cost: Vulnerable Populations at Greatest Risk

An estimated 577,000 residents or 20.2% of the population (Marshall et al., 2024) in the 27 disaster-declared North Carolina counties had high social vulnerability factors that amplified the communications crisis into a health and safety emergency. When infrastructure failed:

- Deaf and hard-of-hearing communities lost access to video relay services, caption services, and text-based emergency notifications - their only alternatives to face-to-face communication.
- Non-English-speaking communities faced misinformation and fear, unable to access trusted community leaders or bilingual emergency notifications.
- Medically fragile residents dependent on dialysis, oxygen, and other life-sustaining equipment experienced long-term loss of contact with healthcare providers.
- Elderly residents unfamiliar with alternative technologies became invisible to emergency responders.
- Rural communities with already struggling connectivity challenges were further cut off.

What This Plan Recommends

Stakeholder analysis produced 42 actionable solutions organized under 8 goals with severity scoring across stakeholder groups, temporal phases, and thematic dimensions.

The plan proposes a Regional Emergency Communications Coordination Framework as the foundational enabler, one that:

- Supports collaboration and coordination while maintaining autonomy
- Increases the impact of investments on infrastructure, hubs, training, and policy changes
- Builds regional capacity to pursue state and federal funding as unified partners
- Creates a forum for continuous learning and sustainability

The framework is built around six operating dimensions: interoperability, shared awareness, inclusive reach, private sector partnership, funding alignment, and resource efficiency. Together they produce the outcomes the region needs for stronger mitigation, faster response, economic sustainability, and durable community resilience.

Implementation: Implementation begins with the Framework and foundational solutions, then grows as capacity, opportunity, and partner alignment evolve.

Beyond Land of Sky: The Regional Communications Resiliency Playbook is the generalized form of this framework, available for adoption by other organizations, jurisdictions, or regions building communications resilience.


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SECTION

Methodology

How this plan was built - stakeholder engagement, data collection, and analytical methodology across four Western North Carolina counties.

Opposing page: Banner Elk airport donation transfer

Research Design Overview

This plan uses a participatory research design that centers the experience of those who lived through Hurricane Helene's communications failures. It combines direct stakeholder engagement with targeted use of secondary data to validate and contextualize what participants reported.

The research proceeded in three phases:

Evidentiary Basis and Interpretation

Findings in this plan are grounded primarily in the testimony of stakeholders who directly experienced the event and its consequences. Their accounts define what is treated as "fact" in this document, with quantitative and documentary sources used to support and cross-check stakeholder judgment.

Accordingly, the facts of this report are the facts as reported by stakeholders during the listening sessions. When this document states that radio systems were overwhelmed, that cellular networks failed in a particular sequence, or that vulnerable populations were isolated for specific durations, these statements reflect what those stakeholders directly experienced and reported.

The application of this stakeholder-focused approach has several intended strengths:

- ensures that solutions emerge from those who will implement them.
- captures operational nuances that external research alone might miss.

- builds buy-in for implementation by involving stakeholders from the earliest stages of planning.

There are also natural constraints, including differences in how individuals remember events, viewpoints influenced by their roles within an organization, and varying levels of clarity among stakeholders regarding their experiences. When stakeholder accounts disagreed, these differences were recorded rather than forced into a false consensus.

Lastly, whenever possible, quantitative data from outside sources such as state after action reviews and federal infrastructure impact reporting are used to support and provide context for stakeholder statements.

Stakeholder Engagement Approach

Stakeholder Group Definitions

Engagement reached 113 stakeholders across three groups:

Emergency Management

Operational response & command

- Emergency Management
- Fire, EMS, Law Enforcement
- 911 / Dispatch
- IT Operations

Industry

Communications infrastructure

- Telecom & Broadband Providers
- ISPs and Utilities
- Network Restoration

Community

Residents and service providers

- Government Executives
- Healthcare and Education
- Nonprofits +Faith-Based Orgs
- Vulnerable Population Advocates

Engagement covered all four Land of Sky Regional Council member counties - Buncombe, Henderson, Madison, and Transylvania - reflecting a mix of urban, suburban, and rural mountain contexts. Structured listening sessions were supplemented by mapping exercises and follow-up validation reviews to refine and confirm the picture of what occurred.

Data Collection Methods

Data collection relied on facilitated listening sessions guided by a common question set, supplemented by mapping coverage gaps and review of key external datasets and reports. This produced more than 1,030 discrete data points describing failures, workarounds, impacts, and proposed solutions across the four-county region.

Analysis applied a structured, multi-dimensional framework that examined impacts by stakeholder group, phase of the disaster, and thematic dimensions such as Technology Infrastructure, Coordination and Interoperability, Resource Management, Operational Resilience, Vulnerable Population Impacts, and Training and Preparedness.

A 1–5 severity scale was used to characterize the degree of disruption reflected in stakeholder accounts, including effects on communications systems, response operations, organizational processes, and daily life. Scores represent the project team's interpretation of those experiences, informed by frequency of mention, geographic spread across the four-county region, and corroboration across stakeholder groups. The overall average score was 4.2 out of 5.0, reflecting substantial disruption across the experiences documented. Scoring was reviewed through the research design's validation phase. These assessments informed the eight goals and forty-two actionable solutions presented in Sections III and IV.

Relationship with Other Planning Efforts

This communications resiliency planning effort is designed as a stand-alone framework that aligns with and supports other regional and statewide initiatives. Where opportunities for synergy exist, ITDRC and Land of Sky intend for this plan to complement, reinforce, and, when appropriate, integrate with related planning efforts to ensure coherence, reduce duplication, and strengthen collective regional resilience:

- NC VIPER Phase 2 Implementation: State-level radio infrastructure improvements currently underway
- Land of Sky Regional Hazard Mitigation Plan: Broader hazard planning context
- Emergency Operations Plans: County-specific operational planning
- Broadband Expansion Initiatives: WestNGN and other connectivity improvement efforts
- Long-Term Recovery Planning: Coordination with Helene recovery and reconstruction efforts
- Extend plan into other Western North Carolina communities to expand impact

The methodology aims to generate findings and recommendations that can contribute to related planning practices and function independently as a dedicated communications resilience framework.

II

SECTION

Key Findings

What Hurricane Helene revealed about communications systems in Western North Carolina - and what 113 stakeholders across four counties said about the collapse, the workarounds, and the people it hurt the most.

Opposing page: Broad River corridor after Helene

From Analysis to Action

This plan uses three complementary frameworks that build on each other. The six analytical dimensions described in Section I (Technology Infrastructure, Coordination and Interoperability, Resource Management, Operational Resilience, Vulnerable Population Impacts, and Training and Preparedness) are the analytical lens used to score severity of impacts during data collection.

The five cross-cutting themes that follow in this section are the system-level patterns that emerged from analyzing those impacts. The eight goals detailed in Section III organize the 42 actionable solutions developed in response. Each framework serves a different purpose: dimensions assess what was measured, themes describe what was found, and goals direct what should happen next.

These findings synthesize testimony from 113 stakeholders across Western North Carolina who described a cascading communications collapse during Hurricane Helene that removed every layer of redundancy, isolated communities, and degraded emergency response. Their accounts highlight what failed and how pre-existing gaps, social vulnerability, and weak coordination magnified the crisis across all four counties.

Cross-Cutting Themes

Five cross-cutting themes emerged consistently across all stakeholder groups and all four counties. Together, they describe system-level challenges that require regional solutions. Stakeholders also emphasized that routine “blue-sky” communications gaps - coverage, capacity, interoperability, and access limitations present before the disaster - were significantly worsened during Hurricane Helene. Addressing these everyday connectivity gaps should therefore be treated as a core priority for communications resilience planning. These themes bridge the detailed stakeholder experiences described below with the eight goals and 42 solutions presented in Section III.

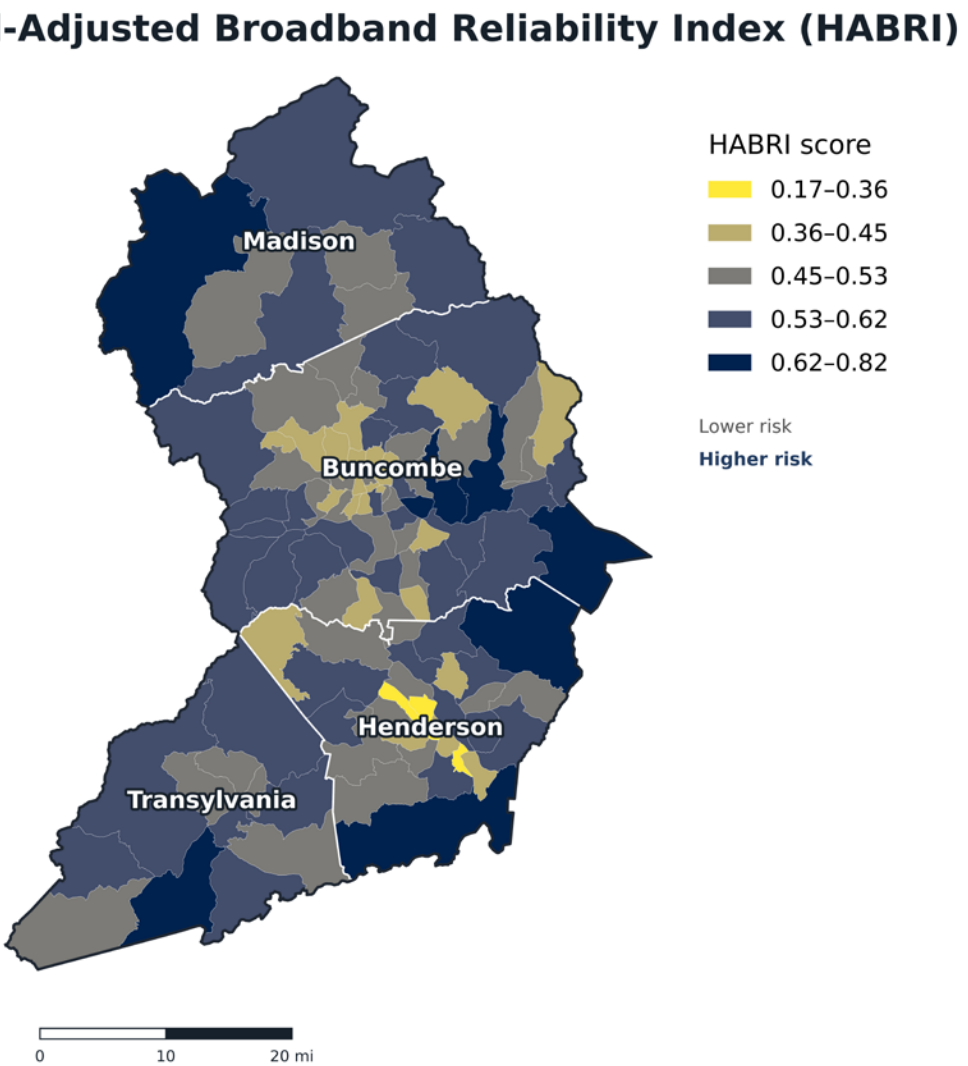

Figure 3. The Hazard-Adjusted Broadband Reliability Index (HABRI). Source: Andrews, Texas Tech University, 2026.

Theme 1: Universal Cellular Over-Dependence

All stakeholder groups relied heavily on cellular communications for day-to-day operations, with inadequate and untested backups. When approximately 75% (FCC, 2024) of regional cell sites failed, every group simultaneously lost its primary communication method triggering a region-wide coordination crisis.

- Emergency Management reported roughly 90% reliance (Land of Sky Regional Council (LOS) & Information Technology Disaster Resource Center (ITDRC), 2024) on cellular for routine and incident communications including voice, text, and data (CAD, MDTs, WebEOC).
- Community stakeholders had virtually no alternative systems and became completely isolated when communications networks failed.
- Even industry, with sophisticated redundancy protocols, reported internal cellular dependencies that complicated restoration efforts.

Note: Helene's impact extended across six states occurring alongside Hurricane Milton, placing extreme pressure on carrier resources and limiting surge capacity.

Theme 2: Interface Fragility

Failures occurred not only within individual systems but at the interfaces between them - cellular to landline, local to state radio systems, and public-sector to commercial networks. As a result, the regional communications lifeline remained degraded even as individual components came back online.

Photo 2. Severed telecomunication line at Chimney Rock debris field. Rodney Cooper, ITDRC.

- Local LMR systems and the statewide VIPER network did not consistently interoperate across jurisdictions, surge in traffic contributed to congestion, and unnecessary monitoring resulted in system "bonks" and delayed access.
- Hand-offs between emergency services, power utilities, and carriers lacked clear protocols, leaving responders unsure which networks were functioning.
- National interoperability channels (e.g., VCALL, VTAC, UCALL) were not consistently programmed into local or mutual-aid radios, limiting cross-agency communications.

Theme 3: Geographic Inequality

Rural and mountainous areas consistently experienced higher vulnerability and longer restoration times across all communications modalities. Geography amplified risk by limiting infrastructure options and slowing repair.

The Hazard-Adjusted Broadband Reliability Index (Andrews, 2026), or HABRI, quantifies this pattern at the census-tract level. HABRI combines Hazard Exposure (40%), Infrastructure Fragility (35%), and Coping Capacity Deficit (25%) into a 0–1 risk score for each tract in North Carolina. Western North Carolina's mountainous and rural tracts score consistently in the upper range, confirming the qualitative pattern stakeholders described.

- These areas often had fewer redundant routes for fiber and power, and difficult terrain constrained both radio propagation and physical access.
- Longer travel times, damaged roads and bridges, and lower commercial investment extended outages, especially in already underserved communities.
- Greater distances between neighbors reduced informal, person-to-person mutual aid when electronic communication failed.

Theme 4: Coordination as Critical Multiplier

Coordination performance, whether good or bad, multiplied the impact of technical conditions. Strong coordination mitigated some failures, while weak coordination turned infrastructure damage into prolonged operational crises.

Examples of coordination breakdown:

- Mutual-aid teams arrived without compatible communications, creating dangerous gaps in active operations.
- Resource requests submitted through formal channels were delayed for weeks or never fulfilled, even when resources existed.
- Limited to no unified situational awareness or common operating picture existed across counties, agencies, and sectors.

Examples of coordination success:

- Teams that arrived with self-contained communications packages (e.g., Ohio USAR) integrated more effectively into local response.
- Pre-existing personal relationships enabled cross-border problem-solving even when formal mechanisms struggled.
- State-level ESF-2 coordination calls provided a venue to align priorities, share information, and expedite solutions such as rapid fiber restoration permitting.

This theme underpins the plan's recommendation to prioritize a Regional Emergency Communications Coordination Framework as a foundational enabler.

Theme 5: Innovation Capacity

Despite systemic failures, all stakeholder groups demonstrated strong innovation and problem-solving during Helene. This human capacity to adapt is a critical asset for implementing the plan's solutions.

Table 1. Innovation Capacity

Stakeholder Group	Key Innovation
Emergency Management	Runners for message delivery, solar power for VHF sites, multi-sim device deployments, and amateur radio integration.
Industry	Helicopter-deployed solar and batteries, unlicensed microwave links, expanded roaming agreements, cross-sector collaboration on routes and repairs.
Community	Sharing of Starlink or other alternative connectivity, use of faith-based and civic facilities as informal hubs, activation of local amateur radio networks. Groups resorted to radio, pen and paper, and personal networks for resource communication.

These innovations show that the primary constraints are infrastructure and coordination and not willingness or capability, supporting the case for investments that unlock and organize existing local ingenuity.

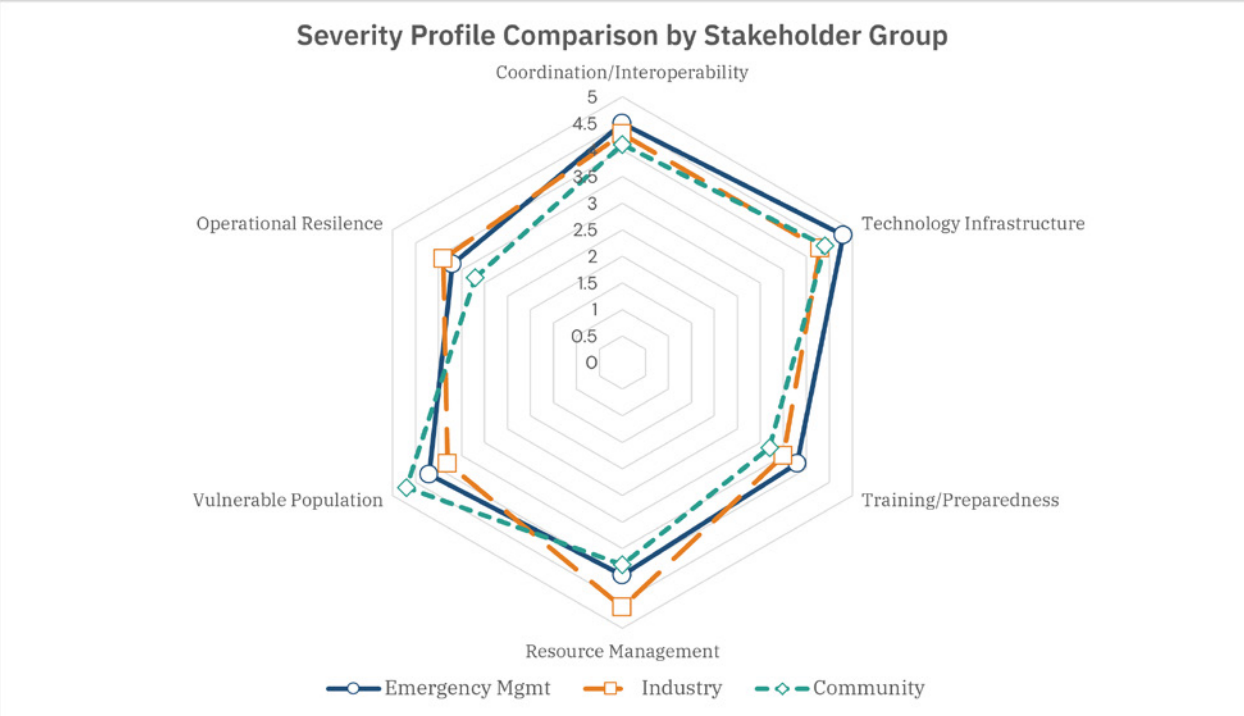

Figure 4. Severity Profile Comparison by Stakeholder Group. Dimensions: Technology Infrastructure, Coordination and Interoperability, Resource Management, Operational Resilience, Vulnerable Population Impacts, and Training and Preparedness.

Note: Higher scores (toward outer edge) indicate more severe impact as voiced by stakeholder participants. Overall average severity score: 4.2/5.0.

Findings by Stakeholder Group

The radar chart illustrates the severity profile for each stakeholder group across six key dimensions. The visual reveals both shared vulnerabilities such as Technology Infrastructure affecting all groups, as well as distinct patterns. Emergency Management experienced the most severe Technology Infrastructure failures (4.8/5), Community stakeholders faced the most severe Vulnerable Population impacts (4.7/5), and Industry encountered the greatest Resource Management challenges (4.6/5).

Severity scores reflect the 1–5 scoring methodology described in Section I, applied by the project team and validated through the research design's validation phase.

Emergency Management

Emergency Management stakeholders reported the most severe Technology Infrastructure and Coordination/Interoperability impacts, with failures across radio, cellular, and power systems that fundamentally challenged operational capacity. Buncombe experienced the most intense congestion due to population and system complexity, while Madison saw some of the longest duration outages, but all four counties shared common vulnerabilities across communications modalities.

SYSTEM LIMITS DRIVE OPERATIONAL FAILURE

Emergency Management operations were constrained less by isolated system failure than by cumulative limits that were exceeded as the incident expanded in duration and scope. When multiple communications modalities degraded simultaneously, the operating model collapsed, forcing manual coordination.

RADIO, POWER & NETWORK CONSTRAINTS

Long-standing radio capacity limits - particularly within 700 MHz systems - became critical as traffic surged following cellular failure. VIPER congestion, site trunking, and repeated "bonks" reduced confidence in statewide radio as a sustained backup. Power loss and generator refueling challenges further degraded otherwise functional sites.

HIDDEN DEPENDENCIES & OVER-RELIANCE

Daily Emergency Management operations had evolved around near-total cellular dependence. Computer-aided dispatch (CAD), mobile data terminals (MDTs), WebEOC, messaging platforms, and FirstNet all relied on the same underlying cellular and backhaul infrastructure, causing "redundant" capabilities to fail together.

FIELD ADAPTATION & WORKAROUNDS

Field personnel rapidly reverted to alternative modes of operation to sustain response. VHF systems were used when trunked radio capacity was exhausted. Starlink terminals were deployed to EOCs and stations to restore limited data connectivity. Solar solutions and ad-hoc power arrangements were used to keep critical radio sites operational.

COORDINATION AS A FORCE MULTIPLIER

Weak pre-event coordination amplified technical failures, while strong informal relationships often outperformed formal systems. Where structured coordination mechanisms such as ESF-2 were activated effectively, integration and restoration accelerated measurably.

Human Toll: The prolonged duration of communications degradation placed extraordinary strain on Emergency Management personnel. Sustained operations under manual, low-information conditions required extended work hours, constant improvisation, and high cognitive load, often while responders themselves lacked reliable contact with family and support networks. Stakeholders consistently reported responder fatigue and mental health stress as compounding risk factors, underscoring that while personnel demonstrated exceptional resilience and adaptability, long-term operations in communications-degraded environments are not sustainable without improved system design, staffing models, and responder support structures.

Industry

Industry stakeholders (telecommunications providers and electric cooperatives) reported some of the most severe Resource Management challenges, driven by physical access constraints and hidden dependencies in redundancy planning. Despite having the most advanced backup systems of any stakeholder group, the scale and duration of infrastructure damage exceeded planning assumptions.

 Hurricane Helene restoration was constrained less by electronics and more by access, shared dependencies, and the speed of cross-sector coordination.	PHYSICAL ACCESS CONSTRAINTS	SYSTEM LIMITS & HIDDEN DEPENDENCIES	FIELD ADAPTATION & INNOVATION
	Over 6,900 damaged roads and bridges severed access to towers and fiber. Landslides and washouts left areas unreachable for days, requiring ATVs and helicopters. Even intact equipment was unusable without safe access for refueling or repair.	Redundant systems failed together due to shared dependencies - fiber, power, and roads. 72-hour backup models were insufficient for prolonged isolation. Fuel and permitting delays rendered generators ineffective, reframing outages as systemic, not just technical.	Responders used helicopters for solar/battery delivery, deployed microwave links, and expanded roaming to maintain connectivity. Improvisation and flexibility preserved critical services despite access challenges.

COORDINATION AS A FORCE MULTIPLIER

Early lack of cross-sector coordination led to repeated infrastructure damage. Once ESF-2 mechanisms activated, information sharing and expedited permitting improved restoration and reduced failures. True resilience requires access-aware design and formalized coordination.

Community

Community stakeholders experienced the highest Vulnerable Population Impact severity (4.7/5), underscoring that communications resilience is fundamentally an equity issue as well as a technical one. Unlike Emergency Management and Industry, most community members had no backup communication systems when commercial networks failed, creating stark gaps between needs and available tools.

LIMITED COMMUNITY-CONTROLLED INFRASTRUCTURE

Community stakeholders consistently reported that residents and service organizations had almost no communications infrastructure they could control locally once commercial networks failed. When cellular and internet services went down, communities lacked independent tools to restore or sustain connectivity, leaving entire neighborhoods isolated without reliable access to information or assistance.

	ACCESS, POWER & CONNECTIVITY GAPS Households and community facilities experienced complete loss of connectivity when cellular networks and power failed. Few locations had backup power, satellite connectivity, or public access points, particularly in rural and mountainous areas. Geographic isolation, damaged roads, and pre-existing coverage gaps extended outages and limited physical access to information and services.
	INFORMATION, LANGUAGE & TRUST BARRIERS Communication failures compounded existing language and trust barriers. Non-English-speaking residents struggled to access bilingual or trusted sources of information, and Deaf and hard-of-hearing residents lost access to video relay, captioning, and text-based alerts. Misinformation spread rapidly in the absence of verified, accessible communication channels.
	HUMAN NETWORKS AS RESILIENCE In the absence of functioning systems, informal human networks became the primary communication lifeline. Neighbors, faith-based organizations, community health workers, and volunteers disseminated information, conducted welfare checks, and shared limited connectivity resources such as satellite links. These networks partially bridged the communications gap but required extraordinary manual effort.

COORDINATION AS A FORCE MULTIPLIER

The lack of formal integration between community organizations and emergency communications planning significantly amplified impacts. Where pre-existing relationships, trusted messengers, and informal coordination existed, communities were able to share information and resources more effectively. However, these successes were uneven and improvised, demonstrating the need to formally integrate community partners into communications planning, training, and activation frameworks.

Human Toll: The communications failure transformed everyday barriers into acute health and safety risks for community members, particularly those with high social vulnerability. Prolonged isolation limited access to medical guidance, emergency services, and recovery resources, placing disproportionate strain on individuals who depended on accessible, language-appropriate, or technology-mediated communication. While community organizations and volunteers demonstrated extraordinary commitment and adaptability, reliance on informal, labor-intensive networks is neither equitable nor sustainable. Sustainable communications resilience requires community-controlled assets, trusted information channels, and formal integration of community organizations into regional emergency communications systems.

Findings by County

This subsection illustrates how the cross-cutting themes and stakeholder-group findings manifested differently in each county, reflecting variations in geography, infrastructure, and governance. While all four counties experienced versions of the regional challenges described earlier (radio congestion, cellular over-dependence, power failures, and coordination gaps), this section highlights what stakeholders identified as most distinctive in each county rather than listing every impact everywhere.

Buncombe County

Highest complexity, highest impact

Buncombe experienced the most severe communications failures due to its role as the regional population and economic center and its complex multi-jurisdictional environment.

- A long-known radio capacity constraint (10 channels supporting only 4 simultaneous users county-wide) became critical when cellular networks failed.
- Incompatibility between city and county radio systems hampered coordination across fire districts, law enforcement, and other responders.
- Emergency Operations Center coordination required physical runners for extended periods because combined radio congestion and cellular outages prevented reliable electronic communication.
- FirstNet adoption was inconsistent across agencies, limiting its effectiveness as a shared backup platform.

Stakeholder Quote: *"I hope you enjoy it, we're about to lose it." - radio system merchant's warning during peak overload*

Henderson County

Best pre-planning, still insufficient

Henderson demonstrated some of the most deliberate redundancy planning in the region, yet still experienced significant failures when regional infrastructure was damaged.

- The county intentionally used multiple ISPs and diverse fiber routing to avoid single-point failures, but across the region, more than 1,700 miles of fiber were damaged or destroyed, beyond the control of any single organization.
- Fire departments operated on separate frequencies, which provided some added resilience when certain systems became congested.
- Water plants maintained radio connectivity through generator backup, supporting continuity of critical services.
- Early deployment of Starlink in some departments proved beneficial in restoring limited connectivity during extended outages.

Stakeholder Quote: *"Multiple ISPs chosen to prevent same backend carrier. Landlines separate infrastructure. Over 1,700 miles of fiber [still] lost."*

Madison County

Longest duration, most geographically challenged. Lowest population, significant impact, lowest capacity.

Madison faced the longest restoration times due to rural, mountainous terrain and limited infrastructure redundancy, turning pre-existing communication challenges into acute vulnerabilities.

- The county experienced the slowest recovery of communications services among the four counties.
- Limited radio coverage in valley areas was a known issue before the storm and became more consequential during the disaster.
- Critical institutions such as the health department and schools had extremely limited radio capability, in some cases only a single radio at a central facility.
- Cross-border coordination with Tennessee often relied on personal relationships rather than formalized protocols or interoperable systems.

Stakeholder Quote: *"1 radio at health department, schools have 1 radio at Madison HS, school bus department had a firefighter [with radio]."*

Transylvania County

Terrain-adapted, focused approach. Less Helene impact than other counties but is more practiced with storm impacts.

Transylvania operated with simpler but more terrain-aware systems and showed how design choices aligned with geography can improve resilience.

- VHF systems outperformed 700 MHz in the county's mountainous terrain, validating long-standing local understanding of propagation constraints.
- The county proactively pursued dark-fiber connections through multiple providers, increasing options for backhaul and future resilience.
- Through partnership with ITDRC, eleven community Wi-Fi locations were established to support long-term recovery and resilience.
- Smaller scale and simpler structures allowed for more direct coordination among agencies and community partners.

Stakeholder Quote: *"VHF works better in our terrain. We've known that."*

Vulnerable Population Impact Analysis

Across the 27 disaster-declared counties in North Carolina, an estimated 577,000 residents, or 20.2% of the population, had high social vulnerability factors (Marshall et al., 2024) that amplified the impact. Stakeholders consistently reported that vulnerable populations faced the most severe and sustained impacts because they entered the disaster with fewer alternatives and greater dependence on modern communication systems. The highest severity scores for the Vulnerable Population Impact dimension (4.7/5 for Community stakeholders) reflect this disproportionate burden.

Who Was Most Affected and How

Communication failures compounded pre-existing barriers for multiple groups:

- Deaf and hard-of-hearing communities lost access to video relay services, caption relay services, and text-based emergency notifications which in many cases serve as their only alternatives to face-to-face communication.
- Non-English-speaking residents struggled to access trusted, bilingual leaders and official updates; 100% of surveyed counties reported difficulty reaching non-English speakers during and after Helene (LOS & ITDRC, 2024).
- Medically fragile populations dependent on dialysis, oxygen, and other life-sustaining equipment lost contact with healthcare providers and care teams for days to weeks in some areas.
- Older adults unfamiliar with alternative technologies became effectively "invisible" (Emergency Management Stakeholder) to emergency responders and support organizations, relying entirely on in-person welfare checks.
- Rural and geographically isolated households in valleys and remote areas experienced pre-existing coverage gaps that became complete information blackouts when primary systems failed.

These impacts transformed communications failures from an infrastructure problem into a direct health and safety emergency for thousands of residents.

How Communities Compensated When Systems Failed

When formal systems collapsed, informal networks and human relationships became the primary communication lifeline for vulnerable residents.

- Neighbors shared access to satellite connectivity (e.g., Starlink) where available, particularly to support isolated or medically fragile residents.
- Amateur radio operators helped relay information and status updates when phones and internet were unavailable.
- Faith-based organizations, schools, and community centers served as informal information hubs and gathering points, especially in rural areas.
- Community health workers and volunteers conducted in-home welfare checks, provided updates, and connected people to limited available services.

Stakeholders emphasized that "technology is the only alternative to face-to-face communication" for some groups, meaning that when technology fails, the burden shifts entirely onto human networks.

Structural Gap: Lack of Community-Controlled Communications

Across all four counties, stakeholders identified a fundamental structural gap: communities have almost no communications infrastructure they can control and access independently of commercial providers.

- Residents and community organizations were completely dependent on carrier networks and public systems that failed catastrophically and could not be locally restored.
- Few locations existed where vulnerable residents could reliably go to connect, charge devices, or receive verified information when household-level connectivity was lost.
- This gap directly informed the plan's recommendations for resilience hubs, community access points, and locally governed infrastructure as core strategies for protecting vulnerable populations in future events.

Timeline Analysis

Stakeholder testimony and federal outage data show that Helene produced a sharp, early spike in communications failures followed by a slow and uneven recovery across the region. The sequence of wireless and wireline outages aligns closely with the cascading failure pattern described by Emergency Management, Industry, and Community stakeholders' groups.

Figure 5 (next page) shows the percent of cell sites out of service by date for Georgia, North Carolina, South Carolina, and Tennessee.

- In North Carolina, cell site outages climbed rapidly in the first 48 hours after landfall, peaking at roughly three-quarters of sites out of service before beginning a gradual decline over the following days.
- This trajectory mirrors stakeholder reports of a sudden loss of cellular capability during the storm, followed by slow, uneven restoration that left many communities without reliable service for nearly a week.

Figure 6 (next page) shows the total number of wireline and cable users affected by date across the same states.

- Hundreds of thousands of wireline and cable customers in North Carolina lost service at the peak of the event, with significant numbers remaining offline for several days.
- These disruptions confirm that the loss of communications was not limited to wireless networks; traditional voice and broadband services also failed at scale, reinforcing the "every modality at once" experience described in listening sessions.

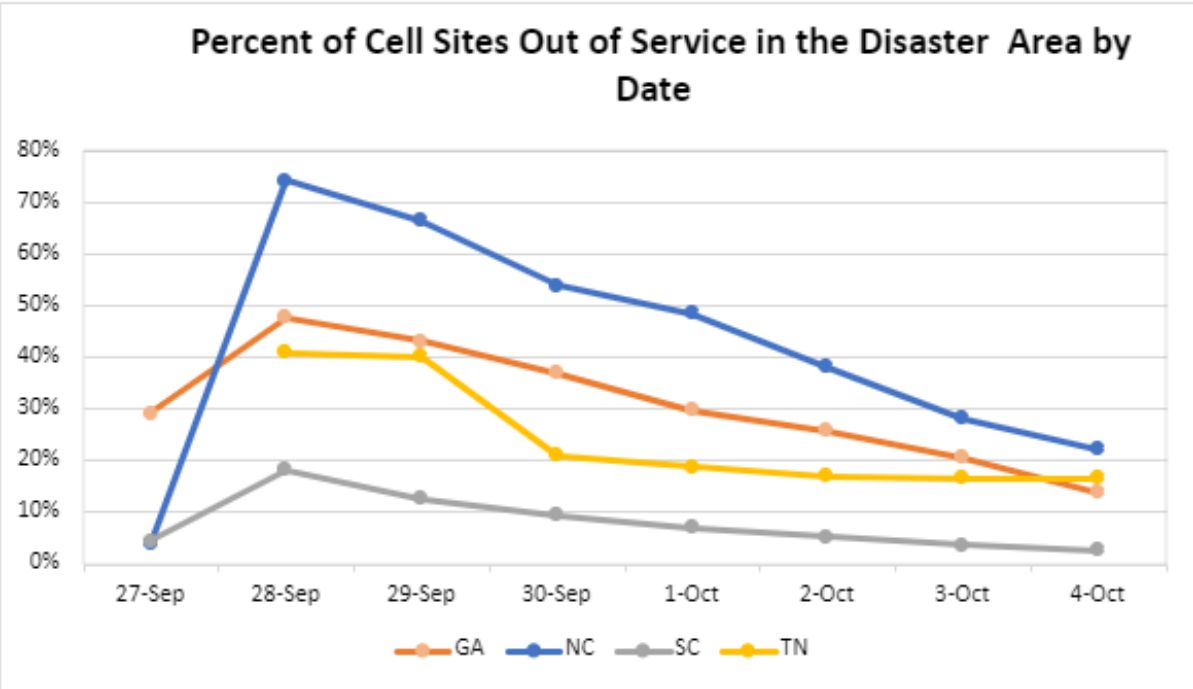

Figure 5. Chart from FCC Disaster Information Reporting System (DIRS) depicting wireless outage and restoration trends during Hurricane Helene. Source: Federal Communications Commission, 2024

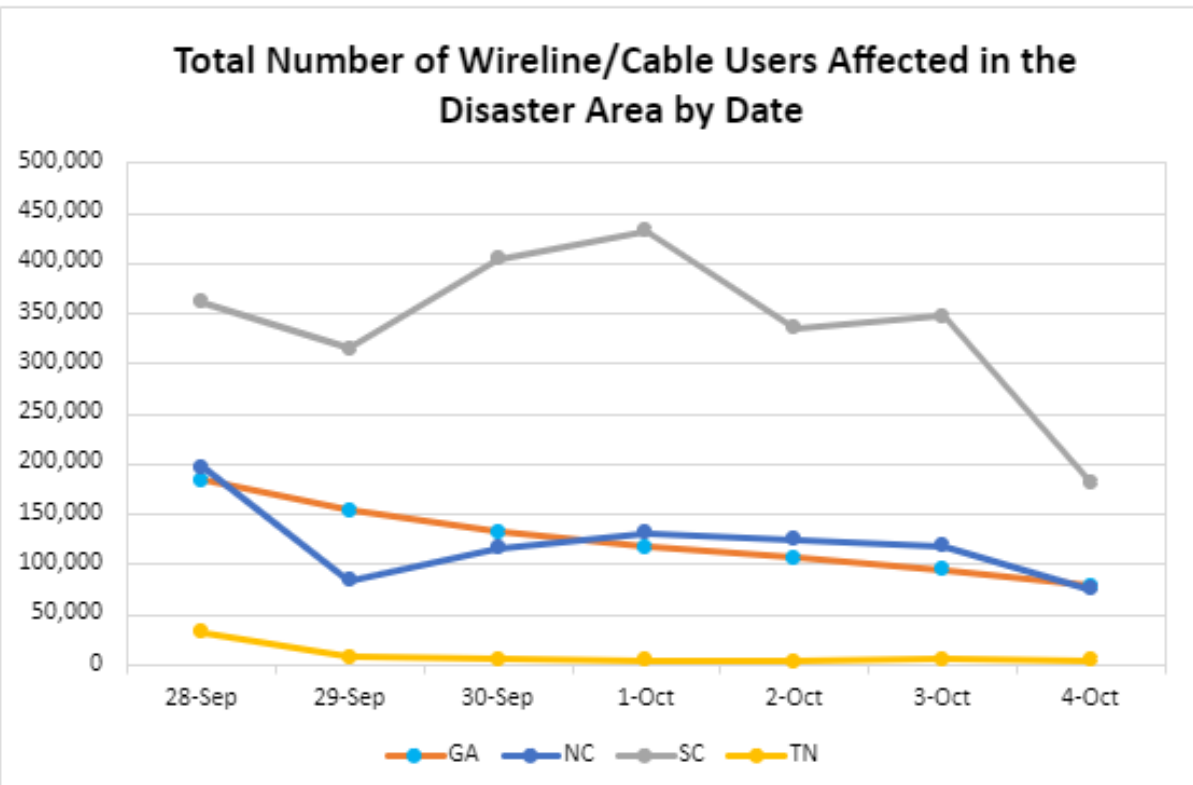

Figure 6. Chart from FCC Disaster Information Reporting System (DIRS) depicting wireline and cable outage and restoration trends during Hurricane Helene. Source: Federal Communications Commission, 2024

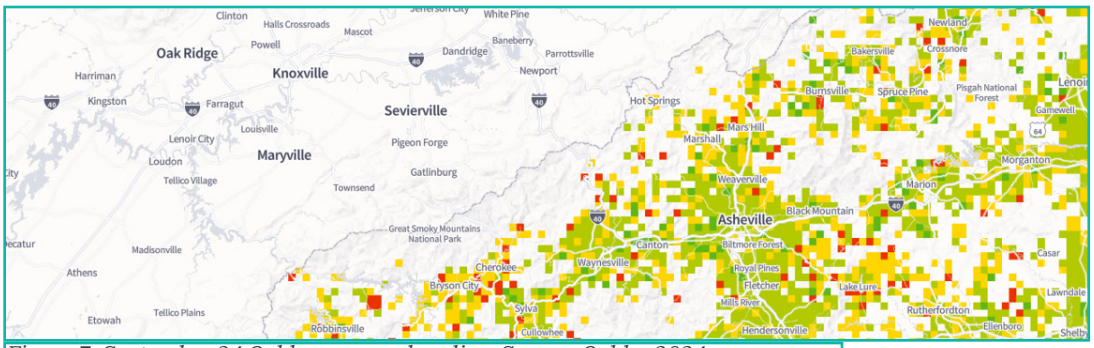

Figure 7. September 24 Ookla coverage baseline. Source: Ookla, 2024

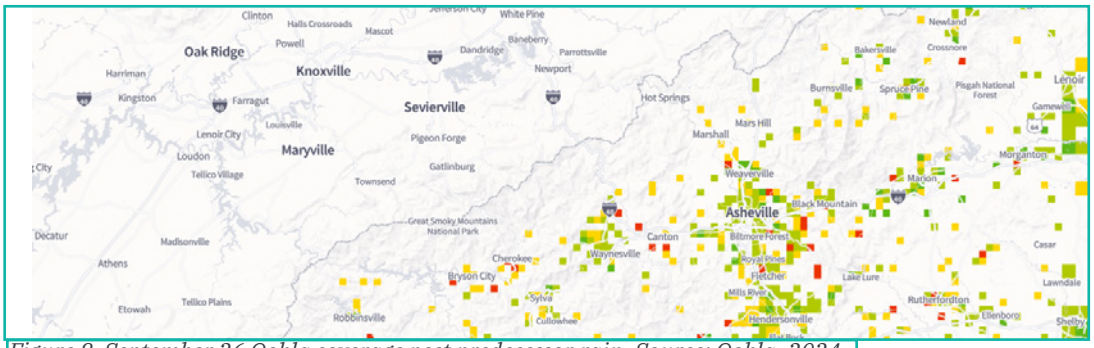

Figure 8. September 26 Ookla coverage post predecessor rain. Source: Ookla, 2024

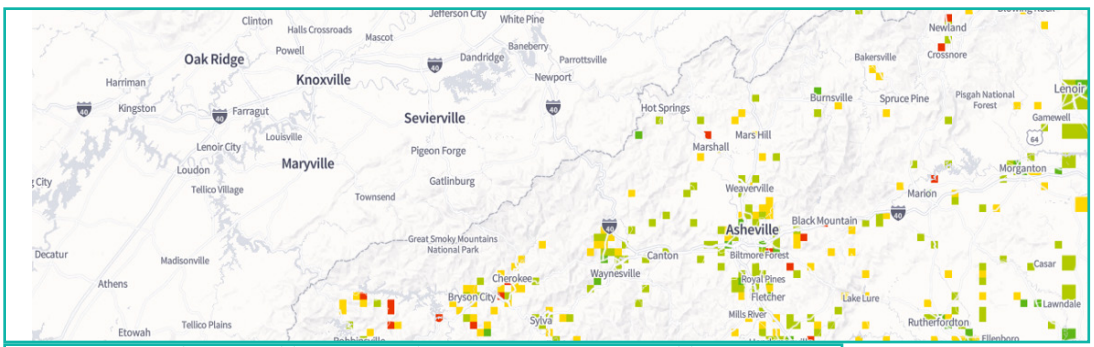

Figure 9. September 27 Ookla coverage during impact. Source: Ookla, 2024

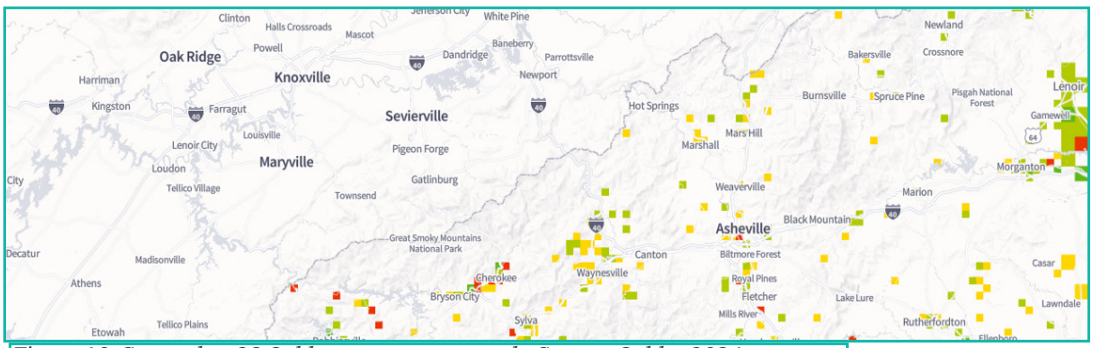

Figure 10. September 28 Ookla coverage post-peak. Source: Ookla, 2024

Excellent | Good | Fair | Poor

Figures 7-10. Images captured via Ookla Speedtest Intelligence®. Maps provided by Ookla® under license, accessed on 16 June 2026. © Ookla, LLC. All rights reserved. Reprinted with proprietary license permission.

Failure Sequence on the Ground

Stakeholders across all four counties described a consistent operational sequence as outages unfolded and persisted. Ookla end-user speed test data (Figures 7–10) traces cellular performance across four inflection points: pre-storm baseline (Sept 24), predecessor rain event (Sept 26), storm arrival (Sept 27), and post-peak (Sept 28).

Table 2. Failure cascades and workarounds

Communications Layer	Sept. 25–26 Pre-impact stress	Sept. 27–28 Peak failure	Sept. 29–Oct. 1 Sustained outage	Oct. 2–19+ Uneven recovery
Cellular / FirstNet	Routine reliance continues as storm conditions build.	**Rapid outage spike:** approximately three-quarters of regional cell sites out at peak.	Limited service returns unevenly; cellular-dependent tools remain unreliable.	Commercial wireless restoration improves through mid-October, but pockets remain degraded.
Fiber / Wireline / Broadband	PRE rainfall begins stressing river corridors and shared routes.	**Fiber routes severed**: wireline and cable outages surge.	Backhaul limits slow restoration across cellular, internet, and landline services.	Restoration continues unevenly; some wireline recovery extends beyond reporting period.
Radio / VIPER / LMR	Normal operations with known capacity and interoperability constraints.	**Traffic shifts to radio**: congestion, site trunking, and bonks increase.	LMR/VIPER remains available but degraded under heavy demand and power constraints.	Generator dependency declines and state radio stabilizes by mid-October.
Power / Fuel / Access	Flooding and landslide risk increase; access routes begin to deteriorate.	**Roads, bridges, and power fail**: repair access becomes a central constraint.	Generator runtime, refueling, permitting, and physical access limit restoration.	Access improves slowly; logistics remain a long-tail recovery constraint.
Community Workarounds	Normal information channels remain primary; few community backups are in place.	**Manual systems emerge**: runners, welfare checks, paper notes, and in-person coordination.	Satellite, amateur radio, faith-based hubs, and volunteer networks bridge gaps.	Ad-hoc hubs and temporary connectivity support recovery and point toward long-term resilience.

Critical failure / degraded operations Workaround or recovery action Context or pre-impact condition

Loss of communications progressed from commercial cellular and broadband systems to public safety radio, then to power and fuel constraints forcing a shift from digital coordination to manual and improvised systems before temporary restoration solutions emerged. Together, stakeholder accounts and outage data show that Hurricane Helene produced not a brief disruption, but a sustained, multi-day communication crisis.

Recovery Sequence

Recovery from Hurricane Helene's communications collapse proceeded along multiple parallel tracks, driven by a combination of carrier infrastructure repair, state-level resource deployments, and local improvisation.

State Radio (VIPER) Recovery. At the peak of impact in the immediate aftermath of the storm, more than 15% of North Carolina's 242 VIPER towers were operating on generator power, with multiple towers in Site Trunking mode. Generator dependency steadily declined over the following two and a half weeks as commercial power was restored to communications sites, reaching normal operating state by mid-October. VIPER did not lose service entirely but operated under degraded capacity throughout the response as radio traffic surged following cellular failure (North Carolina Emergency Management [NCEM], 2025).

PSAP Recovery. Public Safety Answering Points (PSAPs) across the affected region experienced impacts during Helene, with the heaviest concentration in Western North Carolina. All PSAPs maintained operational phone capability with 19 PSAPs rerouting calls to 23 non-impacted PSAPs (Fox-Sowell, 2024). Multi-state TERT (Telecommunicator Emergency Response Taskforce) deployments provided telecommunicator relief and surge capacity across the region. The number of PSAPs operating on rerouted services declined steadily through October.

Commercial Wireless Recovery. Western North Carolina reached approximately 80% restored by October 8, and approximately 90% by October 11 (Federal Communications Commission, 2024). The FCC's last DIRS report on Hurricane Helene was October 19, 2024, at which point wireless outages had dropped below 10% gradually returning to near-zero by mid-late October. Restoration depended heavily on commercial wireline providers bringing central offices back online for inter- and intra-network backhaul.

Wireline and Cable Recovery. More than 200,000 wireline and cable subscribers were affected at peak (Federal Communications Commission, 2024). As of the FCC's October 19 DIRS report, approximately 20,000 subscribers remained disconnected. Full restoration extended beyond the FCC's reporting period and continues in some areas as of the writing of this plan.

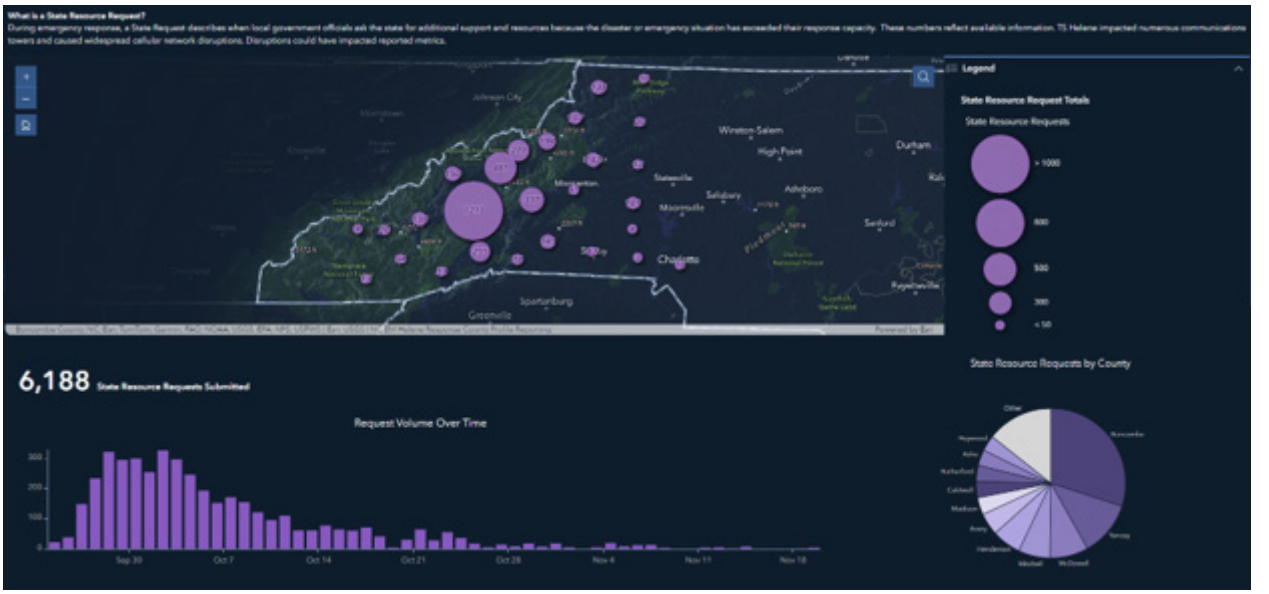

Figure 11. Helene Retrospective ArcGIS dashboard illustrating state resource requests submitted by western North Carolina counties during the Helene response, with data current through December 11, 2024

State Resource Mobilization. Recovery was supported by significant mobilization of state and EMAC resources, including Strategic Technology Reserves (STR), Command Communications Centers, NC Task Force teams, TERT teams for telecommunicator relief, and mutual aid resources including personnel, equipment, and cache radios from other states. NCEM (2024) documented 6,188 State Resource Requests submitted during the Helene response period (September 26 – December 11, 2024), with daily request volume peaking at over 300 per day in early October before tapering through November. Buncombe County received the highest single-county volume at 1,213 requests, reflecting the scale of its complexity and impact relative to neighboring counties. Resource request and management systems were strained throughout - duplicate requests, delayed fulfillments, and coordination bottlenecks complicated the deployment of these resources to the locations and timeframes where they were most needed (North Carolina Emergency Management [NCEM], 2025). Reported metrics from the response period reflect data submitted through systems that were themselves affected by the storm; some requests, fulfillments, and outage figures may be underreported as a result.

What Recovery Revealed. The 22-day trajectory, September 28 - October 19, from peak failure to operational stability at the state level obscured significant variation across the region. VIPER recovered faster than commercial cellular; cellular recovered faster than wireline; and some counties - particularly Madison - experienced restoration timelines extending months beyond the regional averages. Recovery also depended heavily on resources that arrived from outside the region, raising the question of whether the region can sustain its own response if a future event affects multiple states simultaneously or if external resources are slower to arrive.

Summary of Key Findings

The five themes detailed above defined this disaster's distinctive communications profile. The remainder of this summary characterizes how they manifested across all stakeholder groups, counties, and vulnerable populations, and traces the recovery sequence.

Cross-Cutting Themes

Across all stakeholder groups, excessive reliance on cellular communications emerged as a dominant vulnerability. At peak outage, roughly three-quarters of regional cell sites were out of service, and backup systems were limited or untested, triggering a region-wide coordination failure.

Failures also occurred at the interfaces between systems. Breakdowns at the seams between local and state radio networks, commercial and public infrastructure, and cross-sector partners kept communications degraded even as individual components were restored.

Geography further amplified impacts. Rural and mountainous areas experienced fewer redundant paths, longer restoration times, and greater isolation during extended outages.

Coordination performance strongly influenced outcomes. Weak mechanisms led to prolonged delays and underused resources, while strong pre-existing relationships and state-level ESF-2 coordination enabled faster problem-solving and recovery.

Despite these challenges, all stakeholder groups demonstrated significant adaptive capacity, rapidly improvising solutions such as VHF fallback, satellite connectivity, solar-powered sites, ad-hoc hubs, and runner-based messaging.

Stakeholder and County Perspectives

Emergency Management experienced the most severe technology infrastructure and coordination impacts, including radio congestion, loss of cellular-dependent systems, and the absence of a shared operating picture.

Industry faced extreme resource management challenges as physical access constraints, failed 72-hour backup assumptions, and repeated fiber damage overwhelmed even advanced redundancy planning.

Community stakeholders experienced the greatest harm to vulnerable populations, with no independent communications backups and heavy reliance on informal human networks to reach residents.

Vulnerable Populations and Equity

Across the 27 disaster-declared North Carolina counties, an estimated 577,000 residents had high social vulnerability. Communications failures disproportionately harmed Deaf and hard-of-hearing residents, non-English speakers, medically fragile individuals, older adults, and rural households, many of whom were reached only through labor-intensive, in-person efforts.

Recovery Sequence

Outages followed a consistent sequence: rapid cellular failure, loss of fiber and broadband, overload of radio systems, and prolonged degradation driven by power and fuel constraints. Restoration was gradual and uneven, reinforcing the need for layered redundancy, hardened infrastructure, community-controlled assets, and robust coordination frameworks.

Together, these findings define the eight goals and underpin the 42 solutions presented in Section III, with the Regional Emergency Communications Coordination Framework identified as the foundational enabler for all other actions.


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III

SECTION

Identified Gaps and Solutions

Forty-two actionable solutions organized under eight goals, aligned to the gaps Helene exposed.

Opposing page: Field response in Western North Carolina

From Findings to Action

The key findings in Section II reveal system-wide vulnerabilities that demand coordinated, multi-stakeholder solutions. Through iterative analysis of 1,030 stakeholder data points, the project team identified forty-two actionable solutions organized into eight goals that directly reflect those findings and the six analytical dimensions (Technology Infrastructure, Coordination and Interoperability, Resource Management, Operational Resilience, Vulnerable Population Impacts, and Training and Preparedness).

Each goal in this section:

- Explains why the gap matters in practical terms.
- Summarizes the most critical gaps stakeholders identified.
- Presents solutions that stakeholders proposed and refined through validation, with clear leads and partners.

Goal 1: Redundant Communications Systems

Helene showed that Western North Carolina's communications ecosystem is highly dependent on a small number of shared infrastructure paths and non-existent or under-sized backup systems. These hidden dependencies undermined perceived fiber and backhaul redundancy, causing simultaneous failures. Radio systems lacked interoperability across jurisdictions and sufficient capacity to absorb post-cellular traffic surges. Heavy reliance on cellular platforms and the absence of deployable backup assets left agencies without independent, mission-critical alternatives.

Key Gaps

- **Single points of failure in transport diversification:** Perceived redundancy in fiber and backhaul was undermined by hidden dependencies, including shared route ownership and co-located physical corridors, causing multiple "independent" services to fail simultaneously.
- **Interoperability gaps across jurisdictions:** City, county, and neighboring radio systems could not consistently communicate, and incoming mutual-aid teams often lacked compatible programming.
- **Region-wide radio capacity and coverage limits:** Limited channel availability, shared use, and coverage gaps across all four counties became critical as traffic surged following cellular failure.
- **Over-reliance on cellular platforms:** Approximately 90% dependence on cellular communications for routine operations left agencies without independent, mission-critical backup capabilities.
- **Limited deployable backup assets:** Few mobile or rapidly deployable communications solutions were available to restore coverage once fixed infrastructure failed.

Proposed Solutions for Goal 1

Table 3. Goal 1 proposed solutions

Solution ID	Solution	Primary Leads	Key Partners
1a	Regional audit of fiber, radio, tower, and backhaul paths to identify true single points of failure and shared corridors.	Land of Sky, EM/IT/State Broadband Office	ISPs, Telcos, Electric Utilities
1b	Regional standards for emergency radios and interoperability (including mutual programming of neighboring and national interop channels).	Emergency Management/PS/IT	NCDPS/VIPER, Mutual-Aid Agencies
1c	Accelerate Phase 2 P25/VIPER implementation and channel expansion across all counties to increase capacity and interoperability.	State VIPER program, counties	Local Governments, Funders
1d	Deploy multicarrier (multi-SIM) connectivity in emergency vehicles, EOCs, PSAPs, and critical facilities to reduce single-carrier dependence.	Emergency Management/IT	Carriers, Equipment Vendors
1e	Establish a small fleet of mobile, beehive-style microgrid communications units (radio, Wi-Fi, satellite) and add communications equipment such as laptops, hot spots, cell phones for rapid deployment to outages and hubs.	Land of Sky, ITDRC, Emergency Management	Nonprofits, Private Partners, Funders

These solutions address the immediate need to diversify and harden communications pathways while laying the groundwork for longer-term infrastructure planning and investment.

CYBERSECURITY FOR GOAL 1 - DIVERSITY AND HARDENING:
All primary and backup systems, including temporary satellite and mesh deployments, should also follow common regional cybersecurity baselines, including hardened configurations, strong credential management, and defined access controls for emergency and public use.

Goal 2: Cross-Agency and Cross-Sector Coordination

Coordination breakdowns turned infrastructure damage into a longer, more disruptive crisis. Even where some communications capabilities remained available, fragmented structures across counties, agencies, and sectors slowed resource requests, complicated mutual-aid integration, and prevented the region from maintaining a shared operating picture, amplifying the effects of system failures on communities.

Key Gaps

- **Fragmented coordination within and across jurisdictions:** Stakeholders described persistent silos between agencies and counties, with coordination often dependent on informal relationships rather than shared protocols or systems.
- **Lack of unified resource coordination:** Resource requests submitted through existing channels were delayed or unfulfilled, in some cases arriving weeks after they were needed despite regional availability.
- **No shared situational awareness:** Agencies lacked common contact lists, asset visibility, and a shared operating picture across jurisdictions.
- **Mutual-aid integration gaps:** Incoming mutual-aid teams frequently arrived without interoperable communications, and national interoperability channels, as defined in the North Carolina Strategic Communications and Interoperability Plan (North Carolina Statewide Interoperability Executive Committee, 2025), were inconsistently programmed or used.

Proposed Solutions for Goal 2

Table 4. Goal 2 proposed solutions

Solution ID	Solution	Primary Leads	Key Partners
2a	Establish and sustain the Regional Emergency Communications Coordination Framework for communications resilience across counties, sectors, and stakeholder groups, with Land of Sky Regional Council in the convening role.	Land of Sky, Emergency Management Directors	State EM/ESF2, Industry, Community Based Organizations
2b	Develop and adopt regional mutual-aid and protocol sharing arrangements (MOUs) between counties and key partners.	County and Municipal Leadership, Legal Counsel	State Agencies, Mutual-Aid Entities

2c	Create a shared incident communications dashboard or hub (e.g., WebEOC/NC 211 integration) for regional situational awareness and resource tracking.	Emergency Management/IT, State EM/ESF2	ISPs, Carriers, Nonprofit, Community Organizations
2d	Maintain a regional contact directory and preplanned communication playbooks for major incident types (flood, wildfire, cyber, etc.).	Emergency Management, Land of Sky	All Counties, Key Agencies
2e	Standardize use and programming of national interoperability channels and neighboring county talk groups for mutual-aid operations.	County Radio/IT, State VIPER	Mutual-Aid Partners, Federal guidance

These solutions build the coordination, relationships, and shared tools needed so that during future events (of any scale) available assets can be rapidly aligned with needs and mutual-aid resources can be integrated more effectively. They extend the interoperability structures established by the North Carolina Strategic Communications and Interoperability Plan (North Carolina Statewide Interoperability Executive Committee, 2025) to the regional level, and draw on working peer-region coordination models such as the Metropolitan Washington Council of Governments' Regional Incident Communication and Coordination System (Metropolitan Washington Council of Governments, 2026).

> **CYBERSECURITY FOR GOAL 2 - COORDINATION AND SHARED SYSTEMS:** Regional coordination protocols should also address cybersecurity for shared systems by clarifying how configuration changes are governed across agencies and how potential compromises of shared or temporary communications assets are reported, assessed, and remediated.

Goal 3: Technology Access and Training

As agencies shifted routine operations to cellular platforms, many lost independent radio capability and lacked the training or procedures needed to transition when systems failed. Backup tools were unevenly understood, training and exercises varied widely, and community and health organizations lacked access to resilient communications, leaving organizations without clear, practiced paths when primary systems went down.

Key Gaps

- **Loss of independent communications capability:** As agencies shifted routine operations to cellular platforms, some departments moved away from radios entirely, leaving them without independent communications when cellular systems failed.
- **Limited familiarity with backup systems:** Staff in multiple agencies were unaware of existing backup tools or insufficiently trained to transition to alternate platforms under stress.

- **Inconsistent training and preparedness:** Training on backup communications, PACE planning, and interoperability varied widely across counties and sectors, with few joint exercises that included community organizations or industry partners.
- **Insufficient access outside public safety:** Many community organizations, clinics, and facilities serving vulnerable populations lacked radios, satellite devices, or resilient connectivity and relied solely on commercial services.
- **Absence of shared failure playbooks:** Many organizations lacked clear, practiced procedures describing what to do and which tools to use when primary systems went down.

Proposed Solutions for Goal 3

Table 5. Goal 3 proposed solutions

Solution ID	Solution	Primary Leads	Key Partners
3a	Ensure critical non-public safety departments (e.g., public works, utilities, and key community organizations) maintain and train on radio capability alongside cellular.	Emergency Management/IT, Department Heads	Public Works, Utilities, Community Partners
3b	Develop and deliver a regional communications resilience training program (PACE, radio, satellite, alternative platforms) with common curriculum and local customization.	Local / State ESF-2 SMEs, Land of Sky, ITDRC	Counties, Industry, Community Organizations
3c	Integrate backup communications practice into regular exercises, including cross-sector drills with community and industry partners.	Emergency Management, State EM/ESF2	Healthcare, Schools, Nonprofits and Faith-based Orgs
3d	Provide targeted technology access grants or shared equipment pools for community organizations serving vulnerable populations (e.g., laptops, mobile hotspots, radios, portable satellite, and resilient Wi-Fi).	Land of Sky, Philanthropy and Counties	Community Orgs, Healthcare, ITDRC, other NGOs
3e	Create simple, role-specific "communications failure playbooks" that describe step-by-step actions and tools for different outage scenarios.	EM / ESF-2 Exercise Planners	All Agencies, Key Community Partners

These solutions aim to ensure that when primary systems fail, people know which tools to use, how to use them, and where those tools are located across government, industry, and community settings.

CYBERSECURITY FOR GOAL 3 - TRAINING / TEMPORARY EQUIPMENT:
Technology training and exercises should incorporate basic cybersecurity practices for deployed systems, including secure setup of temporary equipment, account, and password management, and recognizing suspicious activity on emergency communications networks.

Goal 4: Pre-Disaster Planning and Alerts

Alerting systems were inconsistent across counties, assumed functioning cellular and internet networks, and were not designed for prolonged outages. Limited coordination on messaging, insufficient attention to language and disability access, and minimal public education left residents uncertain where to find reliable information when alerts failed.

Key Gaps

- **Inconsistent alerting tools and practices:** Counties used different platforms, vendor systems, and policies, creating uneven coverage and public confusion about where to find reliable information.
- **Alerts assumed functioning networks:** Warning and notification plans relied primarily on SMS, apps, email, and web updates, with limited provisions for region-wide cellular or internet failure.
- **Limited integration of vulnerable population needs:** Pre-disaster alerting plans did not consistently account for language access, disability accommodations, or trusted messengers for high-vulnerability communities.
- **Lack of regional coordination on messaging:** Counties and agencies often developed messages independently, increasing the risk of conflicting, duplicative, or incomplete information.
- **Insufficient public education before events:** Residents received little guidance on what to expect when digital alerts fail or where to find verified information during prolonged outages.

Proposed Solutions for Goal 4

Table 6. Goal 4 proposed solutions

Solution ID	Solution	Primary Leads	Key Partners
4a	Develop a regionally aligned alert and warning strategy, including common standards for tools and message types.	Emergency Management, Land of Sky	State EM, Vendors, Municipal Partners
4b	Create offline and low-tech alerting options (e.g., sirens, route alerts, bulletin boards, radio, door to door protocols) as part of PACE planning.	Emergency Management, Public Safety	Community Orgs, Schools, Faith-based Organizations

4c	Embed language access, disability access, and trusted messengers into pre-disaster communications plans and templates.	Emergency Management, Health and Human Services	Community based Organizations, Advocacy Groups
4d	Establish a regional process for coordinated pre-event and incident messaging, including shared templates and approval workflows.	Regional practitioners and subject matter experts	County PIOs, Municipal and State Partners
4e	Conduct ongoing public education on what residents should expect during communications outages and where to go for verified information.	Emergency Management/PIO, Community Partners	Schools, Media, Civic and Faith-based Organizations

These solutions strengthen how the region warns and informs the public before and during disasters, including when digital channels fail, and ensure that vulnerable populations are explicitly considered in planning and messaging.

> **CYBERSECURITY FOR GOAL 4 - ALERT AND WARNING SYSTEMS:**
> Pre-disaster planning for alert and warning systems should explicitly incorporate cybersecurity safeguards - such as controlled administrative access, change management, and, where feasible, multi-factor authentication - so that critical alerts and public information channels cannot be easily altered or misused during an event.

Goal 5: Resilience Hubs and Community Access

Communities lacked communications infrastructure they could control locally once commercial networks failed. Few designated resilience hubs existed, support for vulnerable populations was uneven, community institutions were integrated informally rather than systematically, and hub siting decisions were ad-hoc rather than regionally planned.

Key Gaps

- **Lack of community-controlled communications infrastructure:** Communities were almost entirely dependent on commercial carrier networks and government systems. When those systems failed, few locally managed options existed to restore or sustain connectivity.
- **Limited designated resilience hubs:** Only a small number of facilities functioned as de facto hubs with power and connectivity, leaving most areas without pre-identified, equipped locations during the outage.
- **Insufficient support for vulnerable populations:** Facilities serving high-vulnerability populations - such as clinics, senior centers, and community-based organizations

often lacked backup power, resilient connectivity, language resources, and clearly defined roles in emergency communications plans.

- **Device access and digital literacy gaps in vulnerable populations:** Many vulnerable residents lacked personal communications devices such as laptops, tablets, or cell phones, and others lacked the digital literacy to use available tools effectively during the disruption. This left significant populations unable to access online information, request assistance, or participate in digital coordination even where connectivity remained available.
- **Ad-hoc integration of community institutions:** Faith-based organizations, schools, and nonprofits stepped in informally but were not consistently incorporated into hub planning, training, or communications protocols.
- **No regional approach to hub siting:** Decisions about where to locate hubs and how to connect them were made on an ad-hoc basis rather than guided by regional coverage, equity considerations, or infrastructure data.

Proposed Solutions for Goal 5

Table 7. Goal 5 proposed solutions

Solution ID	Solution	Primary Leads	Key Partners
5a	Design and implement a regional Resilience Hub framework, defining hub types, minimum capabilities, and roles in communications resilience.	Land of Sky, Regional Hub Planners, ITDRC	Counties, Municipalities, Community based Organizations
5b	Identify and equip a network of priority hub sites (e.g., community centers, schools, faith-based facilities) with backup power, resilient connectivity, digital literacy access, and basic communications equipment.	Counties, ITDRC, utilities	Community Partners, Philanthropy, Private sector
5c	Establish community access points (e.g., public Wi-Fi, charging, information desks) that can operate during prolonged outages, with special focus on high vulnerability areas.	Counties, Municipalities, ITDRC	Libraries, Housing Authorities, Nonprofits
5d	Integrate resilience hubs and community organizations into formal emergency plans, training, and exercises, including clear communication and activation protocols.	Emergency Management, Regional / Community hub planners	Community Organizations, Schools, Faith-based Orgs

5e	Use regional infrastructure and social vulnerability data such as the HABRI index to guide hub siting and investment, ensuring coverage for rural and underserved communities.	Land of Sky, County Planning/ EM	State Agencies, Universities, Data partners
5f	Develop pre-disaster device access and digital literacy programs targeted to vulnerable populations, including device loan pools at resilience hubs and pre-event training on emergency communication tools.	Local Government, Community Based Organizations	Land of Sky, Libraries, Digital Inclusion Programs, Healthcare

These solutions build locally governed, physically resilient places where residents can access information, power, and connectivity during future disruptions, with particular benefits for vulnerable populations identified in Section II.

> **CYBERSECURITY FOR GOAL 5 - HUBS AND PUBLIC ACCESS NETWORKS:** Regional hubs should adopt a security-by-design standard, including segmented public and operational networks, appropriate access controls, and lifecycle management of donated or temporary equipment to ensure that hubs strengthen rather than weaken the region's overall security posture.

Goal 6: Infrastructure Hardening

Critical communications facilities lacked sufficient backup power, reliable fuel logistics, physical resilient siting, and assured access for repairs during prolonged outages. Limited alternative backhaul options further constrained connectivity when primary transport paths failed.

Key Gaps

- **Backup power duration below event needs:** Many critical communications facilities were designed for short-duration outages and could not sustain operations during prolonged isolation when refueling and repairs were impossible.
- **Fuel supply and logistics constraints:** Mixed fuel types, permitting limitations, and damaged transportation routes complicated refueling and contributed to avoidable outages.
- **Vulnerable physical siting of infrastructure:** Towers, huts, and generators located in flood-prone or geologically unstable areas were damaged or taken offline by flooding, landslides, and site condemnations.
- **Access barriers for repair and maintenance crews:** Destroyed or blocked roads and bridges delayed inspections, refueling, and repairs even when equipment and personnel were available.

- **Limited alternative backhaul options:** Few sites had pre-planned satellite or other independent backhaul to maintain connectivity when fiber and microwave paths failed.

Proposed Solutions for Goal 6

Table 8. Goal 6 proposed solutions

Solution ID	Solution	Primary Leads	Key Partners
6a	Define and adopt minimum backup power standards for critical communications sites (e.g., multiday runtime with realistic refueling assumptions).	Counties, Utilities, Industry	State EM, Regulators, Funders
6b	Develop regional fuel and access plans for critical sites, including prioritized routes, staging areas, and diverse fuel strategies.	Emergency Management, DOT, Utilities, Providers	Fuel Suppliers, Law Enforcement, Logistics Partners
6c	Assess and mitigate physical siting risks (flood, landslide, erosion) for key towers, huts, and generators, relocating or hardening where necessary.	Providers, Utilities, County Planners	State Geologic and Floodplain Experts
6d	Expand use of independent backhaul options (e.g., satellite, high capacity microwave, site-to-site dedicated and hardened fiber links) at priority sites such as PSAPs, major towers, and hubs.	Industry, ITDRC, Emergency Management/IT	State EM/ESF2, Vendors, Nonprofit Partners
6e	Integrate infrastructure hardening priorities into capital planning and grant strategies at local, regional, and state levels.	Land of Sky, Counties, State Agencies	Industry, Funders, Regional Planning Bodies

These solutions focus on ensuring that critical communications infrastructure can withstand longer-duration outages, physical damage, and access constraints, reducing the likelihood that core systems will fail simultaneously in future events.

CYBERSECURITY FOR GOAL 6 - INFRASTRUCTURE HARDENING AND REMOTE ACCESS:
Infrastructure hardening efforts should pair physical protections and power improvements with core cybersecurity controls such as secure remote access, network segmentation, and logging so that restored or upgraded assets are resilient to both physical and cyber threats.

Goal 7: Regulatory and Policy

Regulatory and policy barriers slowed restoration and resilience investments. Emergency permitting was complex, right-of-way coordination was limited, funding programs were misaligned with regional needs, and local jurisdictions had limited voice in state and federal communications policy decisions.

Key Gaps

- **Slow and complex permitting for emergency repairs:** Providers and governments faced delays securing approvals for time-sensitive restoration activities, including fiber replacement along river corridors, even when damage was clear.
- **Right-of-way and cross-sector coordination challenges:** Limited coordination between transportation, utilities, and communications providers led to repeated damage to infrastructure and difficulty accessing optimal locations for resilient routing.
- **Funding programs misaligned with regional needs:** Existing state and federal funding mechanisms did not always match the scale, timing, or types of investments required, particularly for local and regional service providers.
- **Limited regional voice in policy decisions:** Counties and local partners reported being under-represented in state and federal discussions shaping communications standards, priorities, and investment decisions.

Proposed Solutions for Goal 7

Table 9. Goal 7 proposed solutions

Solution ID	Solution	Primary Leads	Key Partners
7a	Establish a regional policy and permitting practice to identify and address communications related regulatory barriers.	Land of Sky, County/City Planning & EM	State Agencies, Industry, Utilities
7b	Develop expedited “disaster permitting” protocols and templates for communications restoration and hardening projects.	Counties, State Regulators	DOT, Environmental Agencies, Providers
7c	Coordinate with DOT and utilities on shared right-of-way standards and mapping to reduce inadvertent damage and improve access for resilient routes.	DOT, Utilities, Providers	County EM, Planners

7d	Create a regional funding and advocacy strategy to align local needs with state and federal programs (e.g., hazard mitigation, broadband, resilience grants).	Land of Sky, Regional grants practitioners	Counties, Industry, Philanthropy
7e	Encourage adoption of harmonized local ordinances and siting standards that support resilient communications infrastructure across jurisdictions.	County and Municipal Governments	Providers, Utilities, Planning Organizations
7f	Work with utilities and communications providers to address vulnerable infrastructure placement, including burying critical lines in flood-prone corridors and establishing pre-engineered fast-repair corridors that allow rapid restoration after physical disruption.	Utilities, Providers, County and Municipal Planning	DOT, State Regulators, Land of Sky

These solutions seek to remove policy obstacles that slow restoration, reduce unintentional damage, and limit investment, while building a stronger regional voice in shaping future communications resilience policy and funding.

> **CYBERSECURITY FOR GOAL 7 - POLICY AND PERMITTING EXPECTATIONS:** Regional regulatory and policy work should establish minimum cybersecurity expectations for communications assets funded, permitted, or deployed through public-private partnerships and mutual aid arrangements, including baseline configuration standards and data protection requirements.

Goal 8: Monitoring and Continuous Improvement

The region lacked unified systems to track communications outages, capture lessons, update plans, measure resilience performance, or systematically collect feedback from front-line and community stakeholders, limiting continuous improvement across counties and sectors.

Key Gaps

- **No unified system for tracking outages and impacts:** Data describing where, when, and how communications systems failed were scattered across agencies, providers, and after-action reports, limiting the region's ability to build a shared operational picture.
- **Limited structured post-incident analysis:** After-action processes existed but did not consistently capture communications-specific lessons across all stakeholder groups and counties.
- **Static plans with infrequent updates:** Communications plans, contact lists, and

technical inventories were typically updated only after major incidents rather than through a regular improvement cycle.

- **Few region-wide metrics or benchmarks:** The region lacked shared measures to track progress over time, such as restoration timelines, hub readiness, or training coverage.
- **Limited feedback loops with community and front-line stakeholders:** Community organizations, vulnerable residents, and front-line personnel had few formal channels to provide ongoing input into planning, evaluation, and improvement.

Proposed Solutions for Goal 8

Table 10. Goal 8 proposed solutions

Solution ID	Solution	Primary Leads	Key Partners
8a	Establish a regional communications resilience monitoring system, including core indicators and data sources.	Land of Sky, Emergency Management, Technical Practitioners	Counties, Industry, State EM, Community Partners
8b	Conduct an Annual Resiliency Survey across stakeholder groups to track changes in capabilities, gaps, and priorities.	Land of Sky, Emergency Management	Industry, Community Organizations, Healthcare
8c	Integrate communications specific after-action reviews and improvement plans into standard post-incident processes at county and regional levels.	Emergency Management, State EM/ESF2	Providers, Community Partners
8d	Maintain and regularly update regional inventories of critical communications assets, contacts, and hub readiness status.	Emergency Management/IT, Land of Sky	Providers, Utilities, Hub Operators
8e	Create structured feedback channels (e.g., listening sessions, surveys, advisory groups) for community organizations and vulnerable populations to inform ongoing improvements.	Counties, Land of Sky, Community Partners	Advocacy Groups, Healthcare, Faith-based Orgs

These solutions ensure that communications resilience remains a living practice rather than a one-time plan using shared metrics, regular reviews, and stakeholder feedback to guide continuous improvement across the region.

Summary of Solutions

Table 11. Summary of Solutions. Distribution of 42 actionable solutions across the 8 goals aligned with key themes.

Category	Solutions	Key Theme
Redundant Communications Systems	5	Eliminate single points of failure
Cross-Agency and Cross-Sector Coordination	5	Formalize regional collaboration
Technology Access and Training	5	Ensure personnel can use available tools
Pre-Disaster Planning and Alerts	5	Reach all populations before events
Resilience Hubs and Community Access	6	Create community-controlled infrastructure
Infrastructure Hardening	5	Strengthen physical resilience
Regulatory and Policy	6	Remove systemic barriers
Monitoring and Continuous Improvement	5	Sustain progress over time
Total	**42**	

Three Tiers of Solutions

The solutions are organized into three tiers reflecting their enabling relationships and anticipated benefits across the region. These tiers provide an initial structure for coordinated planning. Actual investment priorities will emerge through regional coordination, informed by stakeholder needs, urgency, local conditions, partner readiness, and available resources. Solutions from any tier may advance when circumstances warrant.

Table 12. Three Tiers of Solutions. Prioritization framework grouping the 42 solutions by cross-cutting impact and implementation sequence.

Tier	Solutions	Why First
Tier 1: Foundational	Regional Emergency Communications Coordination Framework; Regional Infrastructure Audit; PACE Planning Methodology	Creates the coordination, shared awareness, and methodology that enable coordinated action
Tier 2: High-Impact	Resilience Hubs; Alert System Standardization; Annual Resiliency Surveys	Delivers compounding benefits across multiple goals
Tier 3: Category-Specific	Remaining 36 solutions	Important but more narrowly focused - implementation enabled by Tier 1 and 2


INFORMATION TECHNOLOGY DISASTER RESOURCE
DISASTER
TECH

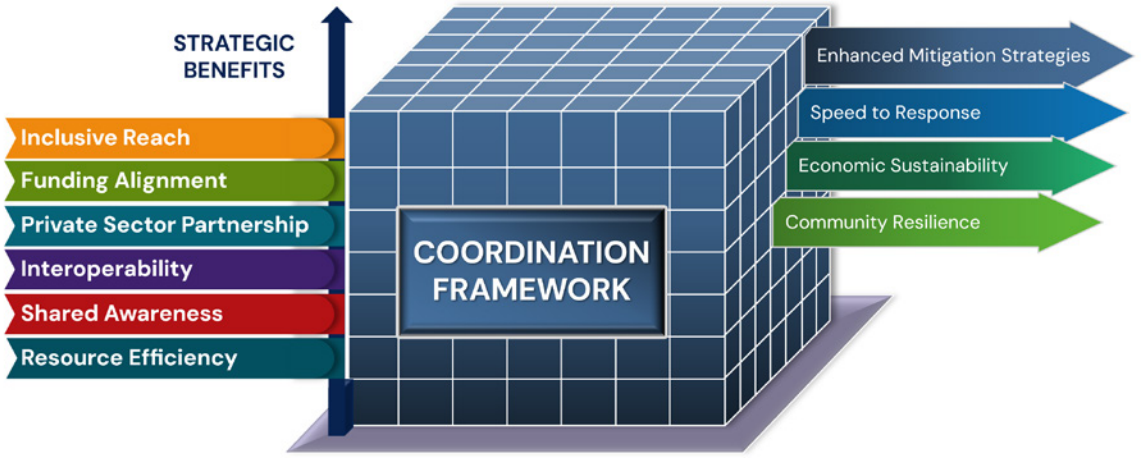
IV

SECTION

Implementation Roadmap

A three-phase roadmap for building the Regional Emergency Communications Coordination Framework and the solutions that flow from it.

Opposing page: Technicians configuring networks



Prioritization Framework

The plan identifies 42 actionable solutions across eight goals. Implementing them all at once is neither realistic nor optimal. This section explains the analytical basis for the Three Tiers of Solutions presented in Section III and how that prioritization informs the phased Implementation Roadmap that follows.

Cross-Cutting Solution Analysis

Several solutions support work across multiple goals. Their cross-goal reach helps identify opportunities for shared investment and provides a basis for the initial tier structure. Regional coordination provides the means for partners to weigh these broader benefits alongside immediate needs and local priorities, including targeted actions that address an urgent vulnerability.

Table 13. Cross-Cutting Solutions Analysis. Solutions with the highest cross-goal reach. Reach informs Tier 1 and Tier 2 placement; tiering itself follows implementation sequence (Table 12).

Solution	Primary Goal	Cross-Goal Reach
Regional Emergency Communications Coordination Framework (2a)	Cross-Agency and Cross-Sector Coordination	7 of 8 goals
Resilience Hubs (5a)	Resilience Hubs and Community Access	6 of 8 goals
Annual Resiliency Surveys (8b)*	Monitoring and Continuous Improvement	8 of 8 goals
Regional Infrastructure Audit (1a)	Redundant Communications Systems	4 of 8 goals
PACE Planning Framework (3b)	Technology Access and Training	4 of 8 goals

**Annual Resiliency Surveys rank highest on reach but first depends on the Framework and therefore falls under Tier 2.*

Framework Value Model

The Regional Emergency Communications Coordination Framework, as the foundational enabler, delivers value at four levels:

1. **The Framework itself.** Shared operating practices, protocols, mutual aid arrangements, training, and continuous improvement practices that enable regional coordination while preserving each entity's operational independence.
2. **Strategic benefits enabled by the Framework.** Shared awareness, interoperability, inclusive reach, private sector partnership, funding alignment, and resource efficiency. These benefits emerge when the Framework is in place and consistently applied.
3. **Community outcomes.** Stronger mitigation before events, faster coordinated response during events, economic sustainability through reduced disaster losses and faster recovery, and durable community resilience over time.
4. **Shared voice.** Together, these dimensions position the region to speak with a unified voice on state and federal policy and funding decisions that affect Western North Carolina's communications resilience.

The phased Implementation Roadmap that follows aligns with this model: early phases build the Framework itself while later phases activate strategic benefits and produce community outcomes.

PACE Planning

PACE (Primary, Alternate, Contingency, Emergency) is a planning methodology used widely in military and emergency communications. It requires each agency to identify four layers of communications capability for any given function:

Basic PACE Example:

- **Primary:** day-to-day system (typically IP, copper, or cellular)
- **Alternate:** first back-up (e.g., secondary fiber route, FirstNet)
- **Contingency:** second backup (e.g., radio, satellite)
- **Emergency:** last resort (e.g., runners, amateur radio)

PACE planning requires minimal financial investment but does require disciplined adoption for maximum efficiency and impact. When applied consistently across agencies it creates shared vocabulary for discussing redundancy, common training expectations, and a systematic way to identify gaps before they become incident-impacting failures. PACE is a Tier-1 priority because it underpins implementation of nearly every other solution in this plan.

Framework and Coordination: A Distinction

The plan refers to two related but distinct concepts:

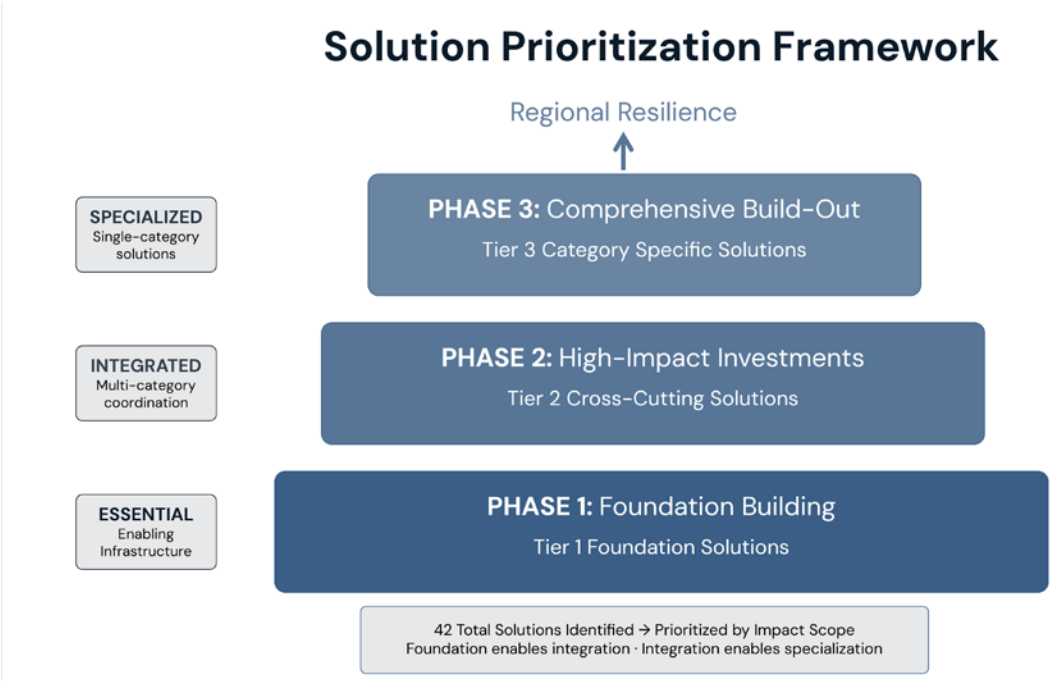
- **The Regional Emergency Communications Coordination Framework** is the shared way of working the region builds together - common protocols, mutual aid arrangements, training, joint learning, and a unified voice for policy and funding. It exists in perpetuity and is what the Plan asks the region to build.
- **Coordination** is the ongoing practice through which the Framework is sustained. It happens through many venues, actors, and moments across counties, sectors, and stakeholder groups rather than through a single body. Land of Sky carries the convening role for regional communications resilience as part of its broader regional planning function.

From Prioritization to Implementation

The Three Tiers of Solutions presented in Section III inform the phases of the Implementation Roadmap that follows. Each phase has a primary tier focus while allowing work from other tiers to advance as needs, partner readiness, and funding align. Each phase also establishes the operating arrangements needed for the capabilities it introduces, including maintenance, accessibility, activation, and sustained support. Later phases expand and strengthen those arrangements as regional capabilities grow.

Table 14. Solution tier alignment to Value Model Layer

Phase	Focus	Value Model Layer
Phase 1	Foundation Building	Center: The Framework
Phase 2	High-Impact Investments	Strategic Benefits
Phase 3	Comprehensive Build-Out	Community Outcomes



Phase 1: Foundation Building

Goal: Establish the Regional Emergency Communications Coordination Framework, complete baseline assessments, and embed core PACE-based planning and training. This ensures subsequent investments are interoperable, strategically sited, and aligned with regional priorities, so work that begins now compounds over time.

Phase 1 Focus

- Establish ongoing coordination practices across the four counties and all three stakeholder groups - Emergency Management, Industry, and Community - with Land of Sky Regional Council in the convening role.
- Conduct a regional infrastructure audit of fiber, radio, towers, power, and backhaul to identify true single points of failure and priority sites.
- Develop and deliver core PACE planning and training, including initial communications failure playbooks and integration into exercises.
- Launch early coordination tools such as a regional contact directory, initial mutual-aid/protocol-sharing arrangements, and basic shared situational awareness practices.

Key Activities and Leads (illustrative)

- Coordination
  - Set a regular cadence for regional communications resilience convening, using existing regional planning venues where practical, and agree on how information flows across counties, sectors, and stakeholder groups.

  - Map existing coordination structures (EOCs, ESF-2, regional planning tables, standing partnerships) and coordinate with them, so plan-related work reinforces rather than duplicates what already happens.
- Baseline Assessment
  - Commission or conduct the regional infrastructure audit (Goals 1 and 6 focus).
  - Compile a regional inventory of critical communications assets, hub candidates, and current backup power arrangements.
- Planning and Training
  - Develop a regional PACE framework and core training package for emergency communications, including public safety, public works, and key community partners.
  - Incorporate communications failure scenarios into at least one multi-county exercise, using the new playbooks.
- Early Wins
  - Begin standardizing mutual-aid and protocol-sharing arrangements where momentum already exists.
  - Pilot one or two resilience hub sites or connectivity upgrades that visibly demonstrate the benefits of coordination.

Phase 1 and Tiers

Phase 1 focuses on Tier 1 solutions: Regional Emergency Communications Coordination Framework, Infrastructure Audit, PACE planning framework while allowing for selected Tier 2 and Tier 3 quick wins where partners are aligned and funding is ready.

Phase 2: High Impact Investments

Goal: Scale high-impact solutions that visibly improve regional resilience, including an initial resilience hub network, standardized alerting, accelerated radio improvements, and a monitoring system that supports continuous improvement.

Phase 2 Focus

- Deploy an initial network of resilience hubs that provide community-level power, connectivity, and communications support across all four counties.
- Standardize locally and regionally managed alert systems, so multi-county events use consistent, accessible tools and protocols, including offline options.
- Accelerate radio system improvements to increase capacity, interoperability, and coverage, aligned with NC VIPER Phase 2.
- Establish a monitoring and continuous improvement system including an annual resiliency survey, dashboard, and reporting cadence.

Key Activities and Leads (illustrative)

- Resilience Hubs
  - Select priority hub locations using infrastructure and social vulnerability data.
  - Equip sites with resilient power, connectivity, and communications capabilities.
  - Integrate hubs into regional plans, exercises, and public outreach so communities know where to go during disruptions.
  - Illustrative leads: Land of Sky and ITDRC, with county and community partners.
- Alert Systems
  - Align county alert platforms and policies into a coherent regional approach.
  - Adopt common alert categories, templates, multi-lingual and offline options.
  - Embed regional alert protocols into county EOPs, exercises, and public education.
  - Illustrative leads: Emergency Management and PSAPs, state and federal warning systems offices, community and language-access partners.
- Radio Systems
  - Use the regional infrastructure audit to prioritize capacity, coverage, and interoperability needs.
  - Coordinate with the NC VIPER program on shared priorities and implementation.
  - Ensure cross-programming of neighboring county and national interoperability channels and validate them in regional exercises.
  - Illustrative leads: County radio/IT teams and Emergency Management, with NC VIPER
- Monitoring and Learning
  - Design and implement an annual resiliency survey for key stakeholder groups.
  - Stand up a regional dashboard and hotwash process to track implementation and performance.
  - Produce regular progress updates and an annual report to county leadership and partners.
  - Illustrative leads: technical practitioners across counties, sectors, and stakeholder groups, supported by Land of Sky Regional Council.

Phase 2 and Tiers

Phase 2 focuses on Tier 2 solutions: resilience hubs, alert standardization, and the annual resiliency survey and monitoring framework while advancing selected Tier 1 and Tier 3 work where it directly supports these investments, such as radio improvements and related infrastructure at priority sites.

Phase 3: Comprehensive Build-Out

Goal: Implement remaining category-specific solutions and achieve optimal regional communications resilience by completing the hub network, hardening critical infrastructure, embedding vulnerable population solutions, and institutionalizing policy and advanced technology improvements.

Phase 3 Focus

- Complete the resilience hub network and strengthen the maintenance, sustainability, and training arrangements established with initial sites.
- Implement priority infrastructure hardening projects identified in the regional audit and gap-solution matrices.
- Scale solutions that specifically serve vulnerable populations across all four counties.
- Streamline policy and regulatory processes that affect communications resilience and embed resilience requirements into core plans.
- Integrate advanced technologies that align with resilience, interoperability, and cybersecurity-by-design.

Key Activities and Leads (illustrative)

- Resilience Hubs
  - Expand the hub network to additional priority locations across the region.
  - Extend and strengthen hub maintenance, lifecycle, and sustainability arrangements as the network expands.
  - Continue integrating hubs into routine training and exercises, refining activation roles through operational experience.
  - Illustrative leads: Land of Sky, ITDRC, counties and community partners.
- Infrastructure Hardening
  - Harden critical facilities and sites, including backup power, fuel, and physical protections.
  - Improve diverse routing and backup options for key communications paths.
  - Align hardening projects with capital plans and mitigation funding opportunities.
  - Illustrative leads: Counties and providers, working with NCEM and other state partners.
- Vulnerable Populations
  - Deploy accessible communications tools and assistive technologies at hubs and key facilities.
  - Establish community liaison networks for non-English speakers and other high-vulnerability groups.
  - Build protocols and training that ensure vulnerable populations are reached when technology fails.

  - Illustrative leads: health and human services agencies, community and faith-based organizations, and Community stakeholder participants across the region.
- Policy and Regulation
  - Simplify emergency permitting and utility coordination processes for communications projects.
  - Embed communications resilience into hazard mitigation plans, EOPs, broadband plans, and recovery plans.
  - Align regional priorities with state and federal programs that influence communications resilience.
  - Illustrative leads: Land of Sky Regional Council convening regional policy alignment, county and municipal leadership, state partners, and industry.
- Advanced Technology
  - Pilot and scale advanced technologies such as mesh networking, formal amateur radio integration, and expanded satellite or hybrid connectivity where they add clear resilience value.
  - Ensure new technologies are interoperable, secure, and integrated into PACE planning and exercises before broader adoption.
  - Use the monitoring system to evaluate advanced technology performance and inform future investments.
  - Illustrative leads: technical practitioners across counties, industry, and community organizations, amateur radio groups, ITDRC and other technical partners.

Phase 3 and Tiers

Phase 3 focuses on Tier 3 solutions: hub network completion, infrastructure hardening, vulnerable population initiatives, policy reforms, and advanced technologies sequenced according to regional coordination priorities, county readiness, and available funding.

Risk Factors and Mitigation

Implementation faces the following risks; each paired with a planned mitigation.

Table 15. Risk Factors and Mitigation. Risks that could affect implementation with planning strategies for each.

Risk	Likelihood	Impact	Mitigation
Funding delays	Medium	High	Use a diversified funding strategy and phase of projects based on available resources, prioritizing Tier 1 and Tier 2 investments that unlock later work.
County participation varies	Medium	Medium	Demonstrate early wins, ensure equitable distribution of benefits, and sustain regional coordination to maintain shared priorities and accountability.
Staff capacity constraints	High	Medium	Share workload through regional structures, pursue a Framework Coordinator role, and align training and planning with existing grant programs.

Risk	Likelihood	Impact	Mitigation
Technological changes	Low	Medium	Design for flexibility, avoid vendor lock-in, and use the monitoring system to evaluate and adjust technology choices over time.
Another major event during implementation	Medium	High	Maintain response capability by prioritizing quick wins, embedding PACE and hub capabilities early, and using lessons from new events to refine the roadmap.

Immediate Next Steps

1. Invite ongoing participation from all three stakeholder groups - Emergency Management, Industry, and Community - across the four counties to sustain regional coordination.
2. Identify a coordinating role (existing staff, or a funded position through Land of Sky Regional Council) to support convening, tracking, and shared learning across counties, sectors, and stakeholder groups.
3. Develop shared operating principles for coordination - how practitioners come together, how information flows, and how mutual aid, shared investments, and joint policy positions are approached.
4. Align an initial funding strategy with Phase 1 priorities, drawing on shared investment interests across counties and partners.
5. Share the plan with county commissions, municipal leadership, industry partners, and community organizations as a shared regional reference for policy alignment, funding advocacy, and coordinated action.

The success of this implementation roadmap depends on sustained commitment from regional leadership. The investments outlined here move the region from post-Helene recovery toward sustained communications resilience.

V

SECTION

Success Metrics and Monitoring

Indicators, tools, and cadence for tracking coordination, system performance, and community outcomes over time

Opposing page: Temporary call center and planning room

Successful implementation of this plan depends on more than completing projects; it requires tracking whether coordination, systems, and community outcomes are improving over time, and adjusting course as conditions change. This section outlines how Western North Carolina will measure progress during initial implementation and sustain continuous improvement over time.

What Success Looks Like

Success for this plan can be understood at three levels:

- **Coordination:** Regional coordination practices sustain shared work across counties, sectors, and stakeholder groups, producing a unified voice on projects, funding, and policy.
- **System performance:** Redundancy, hubs, alerts, radio, and infrastructure hardening reduce the likelihood and severity of cascading communications failures during future events.
- **Community outcomes:** Residents, especially those with high social vulnerability, experience shorter, less severe communication disruptions and have clearer, more reliable ways to access information, support, and services during crises.

The metric framework below identifies a starter set of indicators for the dimensions where measurable, repeatable data is available. Indicators will be refined, expanded, and updated over time through regional coordination as monitoring tools mature and additional dimensions become measurable.

Table 16. Success Metrics Framework. Starter set of indicators for tracking coordination, system performance, and community outcomes across the implementation roadmap.

Metric family	Example indicators	Primary data sources
Coordination	Frequency of regional coordination convenings; participation from Emergency Management, Industry, and Community sectors; number of joint projects or grant applications	Coordination convening notes; annual resiliency survey
Strategic benefits: interoperability and redundancy	Progress on infrastructure audit findings; radio interoperability performance in exercises; diversity of backhaul routes to priority sites	Infrastructure audit updates; exercise AARs; provider data
Strategic benefits: inclusive reach and hubs	Number and distribution of operational resilience hubs; hub participation in exercises and incidents; accessibility features deployed	Hub registry; exercise AARs; hub host reports
Strategic benefits: funding alignment	Total external funding secured; match contributions from philanthropy and industry; number of programs engaged (federal, state, philanthropic)	Coordination-level funding tracker; county finance reports

Community outcomes: outage impacts	Duration and geographic extent of communications outages in future events; time to restore priority functions	Incident AARs; provider outage data; PSAP reports
Community outcomes: equity and vulnerable populations	Ability to reach high vulnerability populations during outages; use of accessible formats and trusted messengers; hub utilization by vulnerable groups	Annual resiliency survey; hub and partner reports; targeted evaluations
Strategic benefits: private sector partnership	Number of signed industry/utility partnerships; carrier and provider participation in joint exercises; rate of coordinated outage reporting during incidents	Coordination-level partnership tracker; exercise AARs; provider reports
Community outcomes: economic sustainability	Business interruption losses in future events; recovery time for critical commerce functions; tourism revenue recovery rate compared to pre-event baseline	County and regional economic data; provider outage data; recovery AARs

Detailed indicator lists and example data collection tools can be developed and maintained through regional coordination and documented in a technical appendix.

Tools and Cadence

Three core tools support monitoring and learning:

- Annual Resiliency Survey: Collects stakeholder perspectives from Emergency Management, Industry, and Community partners on system performance, gaps, and progress.
- Regional dashboard: Provides a shared view of infrastructure status, project milestones, and selected metrics across counties, sectors, and stakeholder groups.
- Post-incident and exercise reviews: Capture lessons from real events and planned exercises, focusing on communications performance, coordination, and equity impacts.

Recommended Cadence

- Quarterly review of key indicators, project status, and funding progress.
- An Annual Regional Resilience Report summarizing survey results, dashboard indicators, and major lessons from incidents and exercises.
- A comprehensive assessment following the foundational phases to inform the next planning cycle.

Coordination for Continuous Improvement

Through ongoing regional coordination, practitioners across counties, sectors, and stakeholder groups track metrics, review results, and share adjustments to priorities, projects, and practices. Those with technical, community, or policy focus can lead work in specific metric areas within their domains.

Findings from monitoring should directly influence:

- Phase 2 and Phase 3 implementation choices (e.g., which hubs to prioritize, where to focus hardening).
- Funding strategies (e.g., which projects are most grant-ready and impactful).
- Updates to county and regional plans (hazard mitigation, broadband, energy, health).

Looking Forward

As the region continues to mature its communications resilience efforts, it should treat assessment, learning, and adaptation as continuous activities. Periodic reassessment of gaps and performance - using the analytical framework described in Sections III and IV - should guide updates to strategies, investments, and priorities. Lessons from incidents, exercises, and evolving technologies should be incorporated into an evolving communications resilience roadmap aligned with long-term regional goals.

By embedding communications resilience metrics into regular reporting and planning practices, the region ensures that resilience is treated as a permanent regional capability, sustained through continuous reporting and planning. This keeps the plan current, evidence-driven, and responsive to future risks and opportunities.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VI

SECTION

Conclusion

Where we go from here - the central recommendation, what this plan provides, and the calls to action.

Opposing page: Post-flood roadway with debris

What Helene Revealed

Hurricane Helene exposed long-standing communications vulnerabilities in Western North Carolina. The region's near-total communications failure in September 2024 - 75% of cell sites offline (Federal Communications Commission, 2024), more than 1,700 miles of fiber destroyed (Stein, 2025), radio systems overwhelmed, and vulnerable populations isolated - was the result of long-standing weaknesses in redundancy, coordination, and equity.

The 113 stakeholders who contributed to this plan defined practical solutions grounded in their direct experience of the crisis.

The Central Recommendation

Among the 42 solutions identified in this plan, one stands above the rest: establish and sustain the Regional Emergency Communications Coordination Framework. This Framework is the key recommendation that makes the other 41 solutions achievable by providing the coordination, shared protocols, mutual aid arrangements, and continuous improvement practices needed to turn separate projects into a coherent regional system. Through this Framework, the region can move from fragmented, county-by-county efforts to a synchronized approach where capacity, capabilities, and investments scale beyond what any jurisdiction could accomplish alone.

The concept of regional emergency communications coordination is not new and has effective, federal precedent under 6 U.S.C. § 575 (US House of Representatives, 2026), which established regional coordination structures at the federal interagency level. This Framework operationalizes the same coordination logic at the SLTT scale where day-to-day emergency communications actually occur.

What This Plan Provides

This Regional Communications Resiliency Plan offers Western North Carolina a path from fragmented vulnerability to coordinated resilience:

- A documented understanding of what failed and why, based on structured listening sessions, participatory mapping, and validation reviews with Emergency Management, Industry, and Community stakeholders (Section I).
- Documented findings from those engagements, organized by cross-cutting themes, stakeholder group, county, and vulnerable population impact (Section II).
- Forty-two actionable solutions across eight goals, reflecting stakeholder-identified needs in redundancy, coordination, training, alerts, hubs, hardening, policy, and monitoring (Section III).
- A prioritization framework and phased implementation roadmap with clear goals,

focus areas, and illustrative leads for each phase, aligned with the Framework Value Model (Section IV).

- A success metrics and monitoring approach that uses surveys, dashboards, and after-action reviews to track coordination, system performance, and community outcomes (Section V).

A Time-Limited Opportunity

The post-Helene moment offers an unusual opportunity to act. State and federal partners understand the region's needs; major programs such as BRIC and BEAD align with this plan's priorities, regional philanthropy is engaged, and local stakeholders have momentum and hard-won expertise. This window will not remain open indefinitely; attention will shift, funding cycles will close, and the lived memory of Helene's failures will fade.

Calls to Action

County and municipal leaders are asked to endorse this plan as a regional reference, sustain participation in ongoing coordination across counties, sectors, and stakeholder groups, and align local policy and capital decisions with the three-phase roadmap. Emergency management, public safety, and technical partners are asked to integrate the Regional Emergency Communications Coordination Framework, PACE methods, and resilience hubs into everyday planning, training, and exercises.

Industry and community organizations are invited to remain active partners with Emergency Management in ongoing regional coordination, helping ensure that investments reflect operational realities and keep vulnerable residents at the center of regional resilience efforts.

Taken together, these actions can turn the lessons of Hurricane Helene into a durable communications lifeline that protects lives, supports recovery, and strengthens Western North Carolina.

Living Document

This plan is a living document, informed by the experiences, expertise, and aspirations of those who lived through Hurricane Helene's communications failures.

Work is already underway. Even as this plan is being finalized, partners are pursuing funding opportunities, hardening public safety infrastructure, deploying resilience hub pilots, building mesh radio networks, and laying the groundwork for regional coordination. The plan captures and aligns this work - it does not wait for perfect conditions to begin.

The plan remains open to continued input.

We recognize that 113 stakeholders, while substantial, do not represent every perspective. Rural communities, tribal nations, small businesses, faith-based organizations, and others may hold insights not yet captured. Continued input is welcome as implementation proceeds.

What did we miss?

Regional resilience requires inclusive dialogue. If you read this plan and see a gap, a vulnerable population not addressed, a technology not considered, a coordination challenge not acknowledged, additional perspectives are welcomed.

This plan reflects the region's voice. Help us make it better.

To contribute perspectives or request additional information, contact:

resilientwnc@itdrc.org.

Final Word

Helene showed how quickly a modern region can be pushed back to pen and paper, runners, and word of mouth when communications lifelines fail. This plan exists so that, when the next disaster comes, Western North Carolina's residents, responders, and communities can rely on a resilient, equitable, and coordinated communications system built in partnership across counties, sectors, and neighborhoods.

Although this plan is rooted in the specific geography, history, and partnerships of Western North Carolina, its core lessons about over-reliance on single systems, the power of regional coordination, and the role of community-controlled hubs are relevant to any region facing compounding climate and infrastructure risks. By acting on these lessons here, Western North Carolina can both protect its own communities and offer a practical model that others can adapt to their own contexts.

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About the Partners

This plan was developed through the collaboration of three organizations: a regional convener, a national field response organization, and a consulting firm that authored the plan on their behalf.

Information Technology Disaster Resource Center

ITDRC is a national, volunteer-driven nonprofit organization that connects communities in crisis through collaboration and coordination with all levels of government and with tribal, industry, and other nonprofit partner organizations. ITDRC accomplishes its mission by harnessing the collective power of the greater technology community to eliminate connectivity and technology infrastructure barriers before, during, and after disasters.

In response to Hurricane Helene, ITDRC responded to 309 total requests for communications and technology support, of which 200 were in Western North Carolina. Of these WNC requests, 182 were actioned (assessed and/or opened), and 135 sites were opened with technology deployed. Currently, forty (40) of these locations have been classified as Long-Term Recovery or Resiliency sites.

ITDRC is a registered 501(c)(3) nonprofit and member of the National and North Carolina Voluntary Organizations Active in Disaster (VOAD) communities.

Land of Sky Regional Council

Land of Sky Regional Council is a multi-county, local government planning and development organization serving Buncombe, Henderson, Madison, and Transylvania counties. Land of Sky serves as the regional convener for this communications resiliency planning effort, bringing together emergency management agencies, municipal governments, and community partners.

The Ruckus Group, LLC

The Ruckus Group is a single-proprietor strategy and operations consulting firm founded by Rodney Cooper. Its work focuses on emergency communications, disaster response, and mission-driven program development. Ruckus served as the contracted author for this plan - conducting stakeholder engagement, structuring findings, and drafting the document under a scope funded through the Land of Sky Regional Council via the Appalachian Regional Commission.

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A path from post-Helene recovery to regional coordination.

In September 2024, Hurricane Helene knocked 75% of cell sites offline across Western North Carolina, severing communications for hundreds of thousands of residents during the most consequential emergency the region has faced in living memory. This plan, built from 113 stakeholder testimonies collected across four counties in the aftermath, documents what failed, why it failed, and forty-two actionable solutions the region can implement to prevent a repeat.

The Regional Communications Resiliency Plan is a coordination framework, an implementation roadmap, and a call to action - grounded in the direct experience of the emergency managers, industry practitioners, and community partners who lived through the storm's communications collapse.

A collaboration of

To contribute perspectives or request additional information: resilientwnc@itdrc.org