Appendix A: Hazard-infrastructure risk matrix

Hazard-infrastructure risk matrix			
Hazard	**Infrastructure**	**Risk**	**Hazard mitigation strategies**
Coastal Flooding	Aerial	Corrosion, structural stress, water damage, electrical short-circuit, grid power failure	• Avoid building in frequent flood areas if possible. • Ensure proper drainage around the base of poles or other components. • Uninterrupted Power Supply (UPS) systems can provide essential backup power during weather-related disruptions. Use generators for larger installations.
Coastal Flooding	Buried	Corrosion, structural stress, water damage, electrical short-circuit, grid power failure	• Use materials and techniques that take into account the possibility of flooding, such as conduit and fiber with waterproofing components (e.g., gel). • Consider replacing with aerial in high-risk flood areas. • Equip underground facilities with UPS systems to mitigate power loss risks, especially from flooding. Consider using generators for larger control buildings.
Coastal Flooding	Wireless	Corrosion, structural stress, water damage, electrical short-circuit, grid power failure	• Avoid building in frequent flood areas if possible. • Ensure proper drainage around the base of poles or other components. • Deploy UPS systems for wireless base stations and access points to ensure backup during power outages. Generators are suitable for larger facilities like data centers. Consider alternative power sources, such as solar panels, for remote installations.
Cold Wave	Aerial	Grid power failure	• Ensure sufficient backup power supply.
Cold Wave	Buried	Grid power failure	• Ensure sufficient backup power supply.
Cold Wave	Wireless	Grid power failure	• Ensure sufficient backup power supply.
Earthquake	Aerial	Structural stress or structural failure, grid power failure	• Use materials and techniques with extra durability and flexibility in earthquake prone areas. • UPS systems can provide essential backup power during weather-related disruptions. Use generators for larger installations.
Earthquake	Buried	Structural stress or structural failure, grid power failure	• Use materials and techniques with extra durability and flexibility in earthquake prone areas. Damage may be more unpredictable and difficult to repair in comparison to aerial. • Equip underground facilities with UPS) systems to mitigate power loss risks, especially from flooding. Consider using generators for larger control buildings.
Earthquake	Wireless	Structural stress, structural failure, or service disruption, grid power failure	• Use materials and techniques with extra durability and flexibility in earthquake prone areas. • Deploy UPS systems for wireless base stations and access points to ensure backup during power outages. Generators are suitable for larger facilities like data centers. Consider alternative power sources, such as solar panels, for remote installations.
Hail	Aerial	Structural Stress, grid power failure	• Use materials and techniques with extra durability and flexibility in hail prone areas. • UPS systems can provide essential backup power during weather-related disruptions. Use generators for larger installations.
Hail	Buried	N/A Negligible risk, grid power failure	• Equip underground facilities with UPS systems to mitigate power loss risks, especially from flooding. Consider using generators for larger control buildings.

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Hazard-infrastructure risk matrix			
Hazard	**Infrastructure**	**Risk**	**Hazard mitigation strategies**
Hail	Wireless	Equipment damage, grid power failure	• Use materials and techniques with extra durability and flexibility in hail prone areas. • Deploy UPS systems for wireless base stations and access points to ensure backup during power outages. Generators are suitable for larger facilities like data centers. Consider alternative power sources, such as solar panels, for remote installations.
Heat Wave	Aerial	Grid power failure	• Ensure sufficient backup power supply.
Heat Wave	Buried	Grid power failure	• Ensure sufficient backup power supply.
Heat Wave	Wireless	Grid power failure	• Ensure sufficient backup power supply.
Hurricane	Aerial	Corrosion, structural stress, structural failure, water damage, electrical short-circuit, equipment damage	• Bury infrastructure in hurricane prone areas if at all possible. • Use water- and wind-hardened hubs and central offices to protect essential equipment. • Use equipment that can withstand significant wind stress (e.g., heavy duty cable brackets, composite or steel poles). Composite and steel poles are mostly used in high-moisture environments, not necessarily stronger than wood. Heavy duty cable brackets may not be a viable/industry standard solution. Better to bury cables where possible. • Keep tree limbs or vulnerable structures clear of infrastructure. • Include backup power in essential network facilities. UPS systems can provide essential backup power during weather-related disruptions. Use generators for larger installations.
Hurricane	Buried	Water damage, electrical short-circuit, grid power failure	• Use materials and techniques that take into account the possibility of flooding, such as conduit and fiber with waterproofing components (e.g., gel). • Equip underground facilities with UPS systems to mitigate power loss risks, especially from flooding. Consider using generators for larger control buildings.
Hurricane	Wireless	Corrosion, structural stress, structural failure, water damage, electrical short-circuit, equipment damage, grid power failure	• Use water- and wind-hardened hubs and central offices to protect essential equipment. • Use equipment with higher weight and durability parameters (e.g., heavy duty cable brackets) • Include backup power in essential network facilities. Deploy UPS systems for wireless base stations and access points to ensure backup during power outages. Generators are suitable for larger facilities like data centers. Consider alternative power sources, such as solar panels, for remote installations. • Ensure point-to-point connections use high-strength brackets and enclosures to prevent being knocked out of alignment by wind.
Ice Storm	Aerial	Structural stress, structural failure, grid power failure	• Use materials rated for the extra weight of anticipated ice buildup. • Include backup power in essential network facilities. UPS systems can provide essential backup power during weather-related disruptions. Use generators for larger installations. • Keep tree limbs or vulnerable structures clear of infrastructure. Adhere to NESC rules and best practices for clearance areas around transmission lines.
Ice Storm	Buried	Structural stress, grid power failure	• Use materials and techniques with extra durability and flexibility in areas where freezing can cause ground shifting. • Equip underground facilities with UPS systems to mitigate power loss risks, especially from flooding. Consider using generators for larger control buildings.

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Hazard-infrastructure risk matrix			
Hazard	**Infrastructure**	**Risk**	**Hazard mitigation strategies**
Ice Storm	Wireless	Service disruption, grid power failure	• Use materials rated for the extra weight of anticipated ice buildup. • Consider equipment or enclosures with heating elements to prevent ice buildup. • Deploy UPS systems for wireless base stations and access points to ensure backup during power outages.
Lightning	Aerial	Fire damage, electrical surge, electrical short-circuit, structural stress, grid power failure	• Use lightning arrestors and/or grounding wires to ensure strike energy is transferred safely to the ground. • Surge protectors can be installed to limit the voltage surge and prevent damage. • Cables should be specified with an appropriately rated grounding conductor. • UPS systems can provide essential backup power during weather-related disruptions. Use generators for larger installations.
Lightning	Buried	Electrical surge or short circuit, grid power failure	• Surge protectors can be installed to limit the voltage surge and prevent damage. • Cables should be specified with an appropriately rated grounding conductor. • Equip underground facilities with UPS systems to mitigate power loss risks, especially from flooding. Consider using generators for larger control buildings.
Lightning	Wireless	Fire damage, electrical surge, electrical short-circuit, structural stress, grid power failure	• Use lightning arrestors and/or grounding wires to ensure strike energy is transferred safely to the ground. • Deploy UPS systems for wireless base stations and access points to ensure backup during power outages. Generators are suitable for larger facilities like data centers. Consider alternative power sources, such as solar panels, for remote installations.
Riverine Flooding	Aerial	Structural stress, water damage, electrical short-circuit conditions, grid power failure	• Avoid building in frequent flood areas if possible. • Ensure proper drainage around the base of poles or other components. • UPS systems can provide essential backup power during weather-related disruptions. Use generators for larger installations.
Riverine Flooding	Buried	Structural stress, water damage, electrical short-circuit conditions, grid power failure	• Use materials and techniques that take into account the possibility of flooding, such as conduit and fiber with waterproofing components (e.g., gel) • Avoid burying conduit in areas at risk of erosion and washouts. • Consider replacing with aerial in high-risk flood areas.
Riverine Flooding	Wireless	Structural stress, water damage, electrical short-circuit conditions, grid power failure	• Avoid building in frequent flood areas if possible. • Ensure proper drainage around the base of poles or other components. Deploy Uninterrupted Power Supply (UPS) systems for wireless base stations and access points to ensure backup during power outages. Generators are suitable for larger facilities like data centers. Consider alternative power sources, such as solar panels, for remote installations.
Strong Wind	Aerial	Structural stress, structural failure, equipment damage, grid power failure	• Use equipment that can withstand significant wind stress (e.g., heavy duty cable brackets, composite or steel poles). Composite and steel poles are mostly used in high-moisture environments, not necessarily stronger than wood. Heavy duty cable brackets may not be a viable/industry standard solution. Better to bury cables where possible. • Keep tree limbs or vulnerable structures clear of infrastructure. • UPS systems can provide essential backup power during weather-related disruptions. Use generators for larger installations.
Strong Wind	Buried	Grid power failure	• N/A

Hazard-infrastructure risk matrix			
Hazard	**Infrastructure**	**Risk**	**Hazard mitigation strategies**
Strong Wind	Wireless	Structural stress, structural failure, equipment damage, grid power failure	• Use equipment that can withstand significant wind stress (e.g., heavy duty cable brackets, composite or steel poles). • Keep tree limbs or vulnerable structures clear of infrastructure. • Ensure point-to-point connections use high-strength brackets and enclosures to prevent being knocked out of alignment by wind. • Deploy UPS systems for wireless base stations and access points to ensure backup during power outages. Generators are suitable for larger facilities like data centers. Consider alternative power sources, such as solar panels, for remote installations.
Tornado	Aerial	Structural stress, structural failure, equipment damage, grid power failure	• Use equipment that can withstand significant wind stress (e.g., heavy duty cable brackets, composite or steel poles). Composite and steel poles are mostly used in high-moisture environments, not necessarily stronger than wood. Heavy duty cable brackets may not be a viable/industry standard solution. Better to bury cables where possible. • Keep tree limbs or vulnerable structures clear of infrastructure. • Include backup power in essential network facilities. UPS systems can provide essential backup power during weather-related disruptions. Use generators for larger installations.
Tornado	Buried	Grid power failure	• Equip underground facilities with UPS systems to mitigate power loss risks, especially from flooding. Consider using generators for larger control buildings.
Tornado	Wireless	Structural stress, structural failure, equipment damage, grid power failure	• Keep tree limbs or vulnerable structures clear of infrastructure. • Use equipment that can withstand significant wind stress (e.g., heavy duty cable brackets, composite or steel poles, reinforced towers and antennas, high strength equipment brackets and enclosures). • Deploy UPS systems for wireless base stations and access points to ensure backup during power outages. Generators are suitable for larger facilities like data centers. Consider alternative power sources, such as solar panels, for remote installations.
Tsunami	Aerial	Corrosion, structural stress, structural failure, water damage, electrical short-circuit, equipment damage, grid power failure	• Bury infrastructure in hurricane prone areas if at all possible. • Use water and wind hardened hubs and central offices to protect essential equipment. • Use equipment that can withstand significant wind stress (e.g., heavy duty cable brackets, composite or steel poles). Composite and steel poles are mostly used in high-moisture environments, not necessarily stronger than wood. Heavy duty cable brackets may not be a viable/industry standard solution. Better to bury cables where possible. • Keep tree limbs or vulnerable structures clear of infrastructure. • UPS systems can provide essential backup power during weather-related disruptions. Use generators for larger installations.
Tsunami	Buried	Water damage, electrical short-circuit, grid power failure	• Use materials and techniques that take into account the possibility of flooding, such as conduit and fiber with waterproofing components (e.g., gel). • Equip underground facilities with UPS systems to mitigate power loss risks, especially from flooding. Consider using generators for larger control buildings.
Tsunami	Wireless	Corrosion, structural stress, structural failure, water damage, electrical short-circuit, equipment damage, grid power failure	• Use water- and wind-hardened hubs and central offices to protect essential equipment. • Use equipment with higher weight and durability parameters (e.g., heavy duty cable brackets). • Ensure point-to-point connections use high-strength brackets and enclosures to prevent being knocked out of alignment by wind. • Deploy UPS systems for wireless base stations and access points to ensure backup during power outages. Generators are suitable for larger facilities like data centers. Consider alternative power sources, such as solar panels, for remote installations.

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Hazard-infrastructure risk matrix			
Hazard	**Infrastructure**	**Risk**	**Hazard mitigation strategies**
Wildfire	Aerial	Fire damage, electrical surge, electrical short-circuit, structural stress, equipment damage, grid power failure	• Bury infrastructure in fire prone areas if at all possible. • Use bigger setbacks and buffers between poles and fire fuel (trees) if possible. • Use fire-resistant coatings on infrastructure such as poles and other equipment. • UPS systems can provide essential backup power during weather-related disruptions. Use generators for larger installations.
Wildfire	Buried	Grid power failure	• Equip underground facilities with UPSsystems to mitigate power loss risks, especially from flooding. Consider using generators for larger control buildings.
Wildfire	Wireless	Fire damage, electrical surge, electrical short-circuit, structural stress, equipment damage, grid power failure	• Use fire-resistant coatings on infrastructure exposed to fire risk. • Deploy UPS systems for wireless base stations and access points to ensure backup during power outages. Generators are suitable for larger facilities like data centers. Consider alternative power sources, such as solar panels, for remote installations.