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FUTURE SCENARIOS FOR THE SHOALHAVEN REGION

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CREATING THE SCENARIOS

Traditional planning commences with the creation of a vision of a desired future, which is used to guide the development of a plan and its policies for achieving that vision from the current state along a predicted trajectory. However, when there is a high degree of uncertainty about the future, it can be useful to consider a number of alternative, plausible futures and evaluate plans and policies in light of those futures.

Plausible alternative futures can be developed by considering major drivers of change, and the impacts that these drivers may have on key trends (e.g. economic, social, environmental, technological, and political).

The most significant drivers of change for the future of the Shoalhaven region were identified in the first scenario planning workshop by participants. Two were voted as being the most significant, namely:

1. *Occurrence of Natural Hazard Events*; and
2. *Global Technological Collapse.*

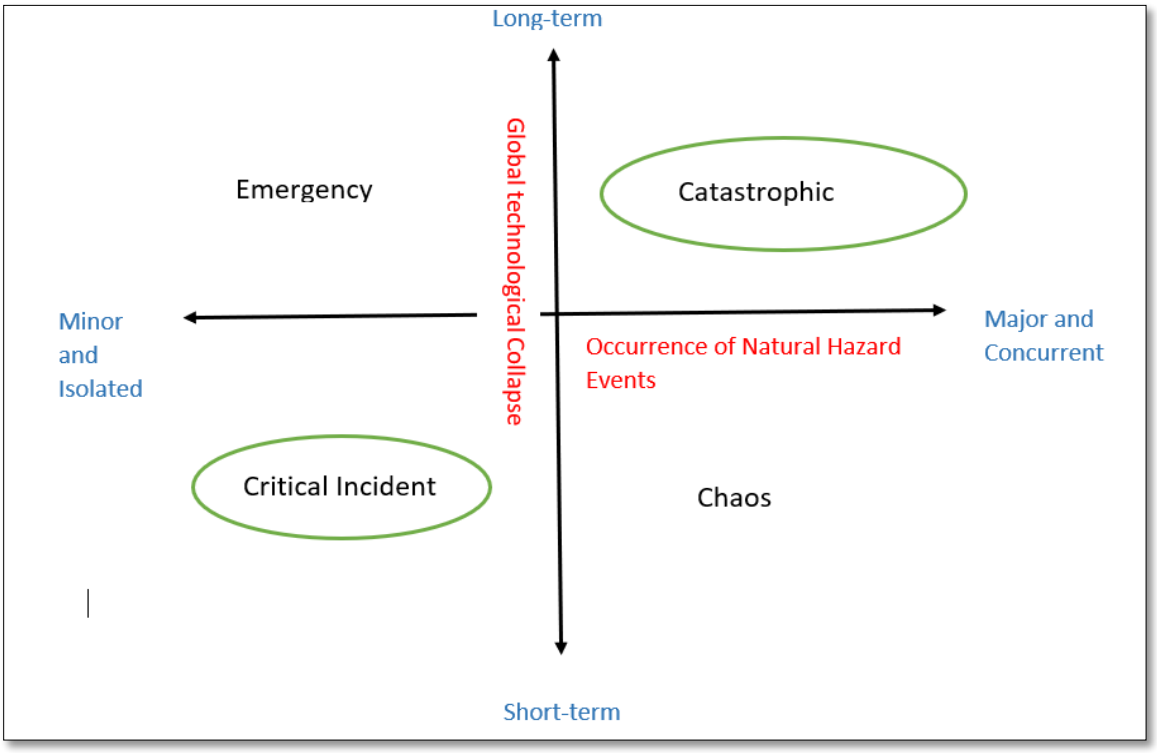

Figure 1. Scenarios derived from the key drivers represented on x and y -axes

These key drivers of change formed the two axes of the scenario matrix shown in Figure 1. Each axis is defined by two extreme forms of change. For example, the y -axis concerns Global Technological Collapse. It ranges from a long-term, world-wide collapse across all technologies which leads to a breakdown of modern society as we know it, to a short-term disruptive event that sees certain technological systems malfunctioning. The x -axis describes the occurrence of one or more natural hazard events, such as a tsunami or an earthquake. It ranges from the occurrence of major and concurrent events to the opposite

end where the event is relatively minor and is isolated to a small geographical area. The two selected scenarios "Catastrophic" and "Critical Incidents" will provide the basis for testing selected policies relevant to achieving the desired vision for the development of a community led adaptation and resilience strategy for Shoalhaven.

CURRENT AND FUTURE TRENDS- SHOALHAVEN SPECIFIC

LOCATION

- The Shoalhaven region is located on the south coast of NSW, approximately 200km south of Sydney.
- The Shoalhaven region covers 4531 square kilometres extending from Berry in the north down to North Durras in the south. The western boundary is the Morton National Park.
- The Shoalhaven LGA is comprised of a network of 49 towns and villages, with the majority of the existing population located along the coastal fringe in the major centres of Nowra-Bomaderry, Milton-Ulladulla, Huskisson-Vincentia, St George's Basin District, Culburra Beach and Sussex Inlet.
- Large areas of Shoalhaven are contained in NSW Forests, National Parks and Crown Lands.
- The Shoalhaven River provides major water resources to both Shoalhaven Water and Sydney Water.

ENVIRONMENT & BIODIVERSITY

- The City of Shoalhaven is considered one of the most ecologically diverse areas of NSW. The Shoalhaven region is characterised by a broad range of geographical features including: coastal plains; coastal, riverine and plateau wetlands; and sandstone escarpment country in the hinterland areas. According to the State of the Environment Report (2004), the Shoalhaven region supports a large number of animals' species including 50 species of mammals, 300 birds, 50 reptiles and 25 frog species.
- The Shoalhaven region supports an estimated 1,800 native plans species, including over 40 threatened plant species and over 90 threatened animal species. Threats to biodiversity include vegetation removal and disturbance, and pest animals and plants.
- Climate change is expected to exacerbate existing stressors to biodiversity, with studies already showing the impacts that higher temperatures and changing rainfall patterns have on different plant and animal communities.
- Shoalhaven has a vast network of National Parks and reserves which provides some protection for the region's diverse ecosystems. However, habitat and biodiversity conservation on private land remain a challenge. Development applications in Shoalhaven City Council have to comply with the NSW Office of Environment and Heritage (OEH) flora and fauna assessment guidelines and a range of relevant Acts and policies.

CURRENT CLIMATE

- Climate conditions across the region are considerably varied. The region has a mostly cool temperate climate, with an average annual rainfall along the coast of around 1200 mm. The region experiences slightly more rain in summer and autumn.
- Summers are mild throughout most of the region, although temperatures have been increasing since the 1960s. Average maximum temperatures during summer along the coast range from 26-28°C, whereas the average minimum winter temperatures range from 8-10°C.

PROJECTED CLIMATE

- Climatic conditions across NSW are expected to change over the coming decades as a result of climate change.
- Climate projections for 2030 and 2070 indicate that the Shoalhaven region will experience a gradual increase in temperature over that period.
- Rainfall models predict an overall decrease in rainfall during spring and an increase in rainfall during autumn.
- Many parts of the Shoalhaven region are flood prone. The flood vulnerability of these areas increases with climate change due to more erratic rainfall patterns.
- Sea level rise projections adopted by the City of Shoalhaven are: 100mm sea level rise by 2030, 230mm by 2050, and 360mm by 2100. These projections will see more areas in Shoalhaven vulnerable to permanent or periodical inundation.
- Parts of the Shoalhaven region are highly vulnerable to coastal erosion, tidal inundation and flooding as a result of projected sea level rise and increased storm activity.
- Bushfires in NSW are going to become more frequent and more dangerous and are likely to occur outside of the expected 'bushfire danger season'. More than 90% of the Shoalhaven region is identified as Bush Fire Prone Land.
- Climate change is expected to exacerbate existing stressors to biodiversity.
- The projected increase in temperatures and extreme weather events such as heatwaves, droughts, storms and floods are likely to have direct and indirect effects on people's health and wellbeing, as well as placing pressure on water and food production systems.

POPULATION AND DEMOGRAPHICS

- The region has a population of 107,857 residents distributed across 49 towns and villages, with most of the population inhabiting the coastal fringe.
- By 2051, the Shoalhaven's population is expected to increase by almost 30% to 137,673.
- The region has a significantly higher than average proportion of ageing population and the largest population increase between 2016 and 2031 is projected to be in people aged 75 to 79.
- In 2016, Shoalhaven supported a labour force of 38,914 persons of which 50.8% were employed full time and 36.7% part time, while 6.7% were unemployed.
- Manufacturing, Public Administration and Safety, Construction and Accommodation & Food Services represent the core income generating economic activities for Shoalhaven.

- Rental, Hiring & Real Estate Services ranked as the highest contributors to the economy in terms of value added ($875 M) in 2016.
- In 2018 the Shoalhaven was the second most visited tourist destination in NSW.
- Shoalhaven City has a rich Aboriginal cultural heritage, with nearly one in 20 residents identifying as Aboriginal or Torres Strait Islander.
- Aboriginal groups of Shoalhaven include: the Bhwerawerri, Budawang, Jerrinja, Murramarang, Tomikin, Wandi wandandian, Wodi wodi, Yuin and associated clans of which many are Dhurga and Dharawal language speakers.

URBANISATION TRENDS

- The Shoalhaven region is expected to experience modest population growth over the next 25 years.
- The largest growth in residential development in the next 20 years is projected to occur in Bangalee and surrounds, followed by Milton, Mollymook, Narrawallee & surrounds and Nowra. Moderate growth in dwellings is projected between 2016 and 2036 for Sussex Inlet, Swanhaven, Berrara, Cudmirrah & surrounds (15.8%) and for St George Basin (28.5%).
- Peri-urban development is restricted to some extent in the Shoalhaven LGA. However, ongoing pressure from rural land owners who wish to rezone their land to enable rural-residential development has pushed Council to establish a review of the existing stock of rural residential zoned land throughout the Shoalhaven. The public has been encouraged to comment on this issue.
- Shoalhaven's Growth Management Strategy 2019-2041, which guides the future growth of the Shoalhaven is currently under review.

ECONOMICS

- The Shoalhaven economy is growing. In 2017 the Gross Regional Product for Shoalhaven was in the order of $5.7 billion, a $1.6 billion increase since 2011. Manufacturing, public administration and safety, construction and accommodation & food services represent the core income generating economic activities for Shoalhaven. Rental, hiring & real estate services ranked as the highest contributors to the economy in terms of value added ($875 M) in 2016.
- In 2016, Shoalhaven supported a labour force of 38,914 persons of which 50.8% were employed full time and 36.7% part time, while 6.7% were unemployed. Unemployment rates in 2016 were higher in Shoalhaven than in New South Wales (6.3%) but slightly lower than Australia (6.9%).
- Industries that employ the majority of people include: Health care & social assistance, retail, trade and construction. These sectors are projected to continue to grow rapidly over the next 10 years.
- The 2017-2026 Economic Development Strategy identifies a number of key industry sectors that generate high value in terms of wages and value add to the local economy. These sectors include: Defence and public administration, manufacturing, professional

and technical services, transport, logistics and wholesale trade, agriculture and aquaculture, health care and human services, education and training, tourism, accommodation and food services, and retail trade. Accordingly, the strategy proposes a range of actions that aim at supporting and promoting the growth of these industries.

KEY GLOBAL TRENDS

- The world population will continue to grow in the 21st century and is expected to push the 10 billion mark by 2050.
- The global population will be increasingly urban, with 90% of this growth occurring in Asia and Africa.
- By 2050, the world's population of people aged 60 years and older will double (2.1 billion). The number of persons aged 80 years or older is expected to triple between 2020 and 2050 to reach 426 million. An ageing population will place greater demands on government services and the economy.
- A growing population coupled with economic growth will place considerable burdens on natural resources, such as minerals, water, energy and food.
- The extent and impacts of climate change will be considerable. The world is likely to experience higher temperatures, increased frequency and severity of extreme weather events, decline in water and food security, destruction of existing ecosystems and loss of biodiversity.
- Economic dominance will shift from the West to the East and Southwards, and new players will have more power, some of them states, some of them non-state actors (such as multinational enterprises and NGOs) and others newly emerging megacities.
- Rapid growth of emerging economies will see billions of people transition out of poverty and into the middle income classes. However, the divide between rich and poor and rising inequality in developing countries will continue to present challenges.
- There will be exponential growth in computing power, device connectivity, data volumes, internet users, artificial intelligence and technological capabilities will continue to transform the way we live.
- Digital technology transformation combined with globalisation will reshape organisational designs, governance systems and employment models.
- There will be Increased number of resistant strains of bacteria, posing a serious threat to human health. A rise in non-communicable and neurological diseases is also projected in line with demographic ageing and globalisation of unhealthy lifestyles.

THE GLOBAL COVID-19 PANDEMIC

The Covid-19 pandemic is likely to have ripple effects for many years to come. It exposed key vulnerabilities in current socio-economic, political, and cultural structures; accelerated some existing and emerging trends; and triggered other major disruptions.

A summary of the likely long-term impacts of the Pandemic are highlighted below[1].

- In the wake of the crisis, many companies will look to increase the resilience of their supply chains by reducing complexity and embracing diversity and redundancy, not just efficiency.
- physical lockdown has accelerated the digitalization of many parts of the economy.
- Some governments appear to be using the crisis as an opportunity to override resistance to surveillance measures, introducing emergency regulations that are likely to outlast the emergency.
- Some authoritarian rulers are using this crisis as an opportunity to consolidate power and suspend democracy.
- The rate of urbanization may decrease as higher infection risk in cities makes them less attractive places to live and work.
- Some industries (eg., travel and tourism) may never fully recover as certain temporary behavioural shifts endure. This is especially likely to be true of industries that rely on discretionary consumer spending (which will almost certainly be lower for years to come) and/or where the behavioural changes required during lockdown have other social or environmental benefits.
- Trust in science and experts has received a temporary boost during the pandemic and the value of competent government has been highlighted. This may take the wind out of certain populist leaders' sails, though it is unlikely to turn the tide on populism as a whole.
- A newfound appreciation for low-paid "key workers" may translate into a political shift in favour of egalitarianism.
- Urban populations' experience of cleaner air during lockdown may lead to longer-term pressure on municipal and national governments to cut air pollution permanently.
- Popular uprisings that lead to regime change as real economic hardship bites and populaces turn on governments perceived to have handled both the health and economic crises poorly.
- A tipping point for the global energy transition (some analysts now believe that fossil fuel demand may have peaked in 2019) that in turn triggers a sudden correction in the way financial markets price climate risk.
- A societal and regulatory "techlash" later in the decade prompted by the fact that Big Tech will almost certainly emerge from the current crisis even more dominant relative to (potential) competitors.
- A Global Green (New) Deal made more likely by a shift in citizens' expectations about the role of government in responding to crises and the need for major public investment to stimulate economic recovery.

[1] This information was extracted from a report titled: *"The consequences of COVID-19 for the decade ahead: Vision 2050 issue brief",* prepared by the World Business Council for Sustainable Development (2020).

TECHNOLOGICAL NARRATIVE FOR BOTH SCENARIOS

- By 2050 technological advancements are deeply entrenched in all aspects of human lives. Technology effects the way people work, communicate, travel, shop, access, and process information and even care for their health. Technology is used to gather and interoperate data across all sectors of the economy, including in the manufacturing, transport, education, defence and service sectors.
- In 2050, computational machines have surpassed the processing power of all the living human brains on Earth, improving efficiency across a range of businesses, industries and organisations. Artificial Intelligence is used widely in the health care system in prevention, detection, and treatment of diseases. Digital technologies enable hyper-personalised experiences based on established patterns of behaviour and preferences, and everyday interactions are a mix of humans, AI-enabled machines and hybrids. Social interactions are largely occurring in the virtual sphere.
- The emergency management sector utilises technological advancements throughout its entire operation, from the planning phase to the response and recovery processes. The use of social media, drones, satellite imagery through GIS, real-time disaster modelling, and widespread connectedness provides constant information flow and improves efficiency. Immediate information and real-time data allows emergency management to develop more targeted response plans. Internet of Things (IoT) devices provide advance warning of danger wherever it arises – giving emergency services a crucial head start in cutting response times. Connected devices can even take action themselves, such as turning off power or water.
- IoT has also revolutionised every other aspect of our lives, from Smart Homes and Cities to Smart Offices and healthcare. Houses are filled and connected with sensors which track the movement of their owners and respond accordingly. Smart cities use information and communication technology ('ICT'), and various physical devices connected to the IoT network to optimize the efficiency of city operations and services and connect to citizens. This includes data collected from citizens, devices, buildings and assets. These data is processed and analysed to monitor and manage traffic and transportation systems, power plants, utilities, water supply networks, waste, crime detection, information systems, schools, libraries, hospitals, and other community services.
- On the downside, technological disasters, or events caused by a malfunction of a technological structure and/or some human error in controlling or handling the technology, are on the rise and a number of serious incidents were recorded over the years[2]. Similarly, Cyber safety concerns become more ubiquitous as the number of malicious cyber-attacks is growing and there are certain voices in the community that caution about the world's increased vulnerability to technological disasters. Concerns are also raised about the impacts associated with big data analytics, which some argue, could serve to manipulate people, distort their perception of reality and influence their choices. This could potentially undermine the foundations of modern democratic societies.

[2] Some examples include: the Fukushima Nuclear disaster (2011), oil spills in Mauritius (August 2020) and Russia (June 2020), two dam collapses in Brazil (January 2019 and November 2015), and Beirut explosion (2020).

FUTURE SCENARIOS

"CATASTROPHIC"

THE CITY OF SHOALHAVEN IS DEVASTATED BY A POWERFUL TSUNAMI, COUPLED WITH A SEVERE EAST-COAST LOW AND A POWERFUL GEOMAGNETIC STORM

The "Catastrophic" Scenario is characterised by the sudden occurrence of a large tsunami, coupled with a severe East Coast Low pressure system that generates gale force winds and heavy widespread rainfall. The timing of these events coincides with a significant global technological collapse due to a powerful geomagnetic storm, which causes all power grids, computers, and telecommunication systems to shut down. Satellites are impacted and their ability to communicate with earth via radio waves is compromised. Authorities and communities are taken by surprise as the Australian Bureau of Meteorology is unable to broadcast timely warning and updates and the Tsunami Warning System and all backup systems fail to activate. The confluence of these major events results in mass casualties and infrastructure damage as well as an unprecedented social backlash due to panic and confusion and the rise of unauthorised reports and spread of fake news. Efforts to assess and respond to the damage caused by these events are hampered by the breakdown of all regular communication channels, and the sudden nature of these events and their magnitude means that relevant agencies are overwhelmed and have insufficient assets and resources to deal with the scale and impacts of these events.

+ Positive Trends/Outcomes

- Enhanced cultural bonds through shared experience and strengthen community ties.
- Renewed interest in volunteerism
- Emergence of localised and creative solutions to building community resilience.
- Increased focus on building system adaptability and flexibility by government and response agencies.
- Improved risk analysis processes and assessments, taking into consideration convergence of stresses.
- Enhanced appreciation and understanding of the power of nature and the vulnerability of man-made systems.
- Global collaboration around safeguarding tech-based systems and investment in developing alternative and creative solutions to reduce systems vulnerability.
- Emergence of community champions and leaders who rise to the challenge during the emergency and its aftermath.

- Negative Trends/Outcomes

- Displacement of large groups of people and long term pressure on accommodation and social services.

- Long-term disruptions of global supply chains due to extreme space weather events leading to immense economic losses.
- Large number of stranded assets due to their incompatibility with existing failed technological systems.
- Limited access to clean drinking water, food, shelter, and medical care as authorities are caught unprepared for events of this magnitude.
- Emotional aftershock experienced in the community as well as emergency response personal.
- Growing distrust in government and emergency response mechanisms
- Major infrastructure damage leading to long-term recovery efforts and ongoing disruptions in supply chains.
- Rise in conspiracy theories and pseudoscience.
- Increased poverty and crime.

By 2050, the population of the Shoalhaven region has grown significantly, largely from migration and people living longer. Much of the population is located along the coast, despite repeated warnings about the impacts of sea-level rise, and the increased risk of flooding. Over many decades now, the Shoalhaven community and emergency response services have been experiencing the impacts associated with increased weather related events, such as flooding, bushfires, and mega storms.

To cope with these ever increasing events, government and emergency response authorities have invested heavily in advanced warning systems and communication mechanisms, as well as in hard infrastructure such as seawalls and tide gates. The possibility of planned retreat, or shifting key vulnerable infrastructure to safer areas, has been repeatedly rejected by politicians and some sections of the community despite the increasing costs associated with cleaning up after disruptive events.

On January 15, 2050, the East Coast of NSW was impacted by a severe east coast low-pressure system. Gale force winds and intense rainfall were battering the coast and emergency services were in the process of responding to a large number of calls for help, when a class X solar flare triggered a powerful geomagnetic storm. The storm paralysed grid systems across Australia and caused serious damage to satellite and radio-wave communication systems that lasted for many weeks. Unfortunately, at the same time of these events taking place, a powerful underwater landslide occurred along the edge the continental shelf, generating a tsunami that hit the east coast of NSW with little warning time. Due to satellite disruption from the geomagnetic storm, the Australian Tsunami Warning System failed to activate and warn coastal communities to evacuate.

The culmination of events described in this scenario was unprecedented and have exposed the vulnerability of existing systems to cope with events of such magnitude and scale. It plunged the Shoalhaven (and other regions) into a period of intense economic, social, and environmental catastrophe due to a failure of existing mechanisms to prepare and respond to the threat and its aftermath in a timely manner.

The Shoalhaven experienced mass casualties and unprecedented damage to property and infrastructure as a result of the tsunami. More than 2000 people were injured, some badly, and 140 people lost their lives. More than 3000 homes were completely destroyed by the powerful tsunami waves, and close to 10,000 vehicles were washed away. Essential infrastructure and facilities were badly damaged, including water and sewage plants, and back-up systems were unable to be utilised due to their reliance on power and computer-based operating systems. This was compounded by the inability of emergency services to coordinate their response and provide updates and advice to affected communities in a timely and efficient manner due to communication system failure.

> *"Solar flares, eruptions and other sun storms can have catastrophic impacts to technological systems around or on the earth. They have been known to knock out satellites, power supplies, communications and navigation systems. Damage to these systems can result in secondary effects that can disrupt virtually every major infrastructure dependent on them, including transportation, security and emergency response systems, telecommunications and other wireless networks and electronic equipment which can lead to significant economic losses."*
>
> Source: Omatola & Okeme (2014), *"Impacts of solar storms on energy and communications technologies"*

The legacy of inadequate funding to hospitals over many decades was evident, as hospitals were ill equipped to cope with mass casualties and provide the necessary care. Evacuation efforts of the injured and dead were hampered due to do significant damage to all access roads and air rescue was deemed unsafe under the existing weather conditions. Shock, panic and confusion dominated the initial response by the community and many expressed frustration and anger about the perceived inadequacy of government and emergency response authorities to the situation. This anger was further fuelled by the prolonged shortages in emergency accommodation for displaced people and ongoing disruption to supply chains due to road closures. The limited capacity of social services to deal with such high volume of people in need was strongly felt and many people seeking assistance were turned away. Suicide rates in the region have reached records high in the months following these catastrophic events, and in many cases were attributed to trauma associated with these events, loss of income, increased poverty, and homelessness.

The lack of updates and information from authorised sources during and after these events has left an information vacuum and fertile ground for the rise of fake news, conspiracy theories and pseudoscience. At the same time, there was a resurgence in grassroots responses to the crisis, and some communities began exploring and implementing creative solutions in their local areas. Although this resulted in some positive outcomes in certain locations, it also highlighted the differences across the Shoalhaven communities and the variation in their capacity to respond. Tensions were building between communities, government and emergency response authorities as the boundaries around who is responsible for what became increasingly blurry, giving rise to more confusion and frustration. In some instances, this translated into physical conflict between residents and the authorities, triggering fears that the situation is spiralling out of control.

The already vulnerable coastal ecosystems were damaged so badly, that even a partial recovery was likely to take many years. What was once a region that attracted the second

largest number of visitors in the whole State due to its unique environmental values has turned overnight into a disaster zone. A consistent decline in investment in environmental conservation initiatives over many decades resulted in a society that had little capacity to address the environmental devastation caused by these events. All available resources were channelled towards fixing the physical damage to infrastructure and technology, and the environment was, once again, pushed further down the priority list.

The region's economy has also been severely impacted by these events. The widespread devastation to the coastal areas and the long-term accessibility issues saw the tourism sector and associated businesses fully collapse. Reconstruction efforts of major infrastructures were underway, but were slowed down by accessibility issues, high costs and impacts to the global supply chains due to the extreme space weather event. Existing resources spread thin as local and state government struggled to meet competing demands. The widespread and long-term technological collapse lead to a significant decline in efficiency across services and infrastructure that rely on digital connectivity.

The mass casualties, total destruction of homes and infrastructure, and the astronomical costs associated with reconstruction ignited renewed political and public discussion around risk and vulnerability. There was a strong acknowledgement of the power of nature and an understanding that existing land use practices are incompatible with the ever-increasing risks to coastal communities. The possibility of retreat to less vulnerable locations has started to be considered seriously and plans regarding how this can be done are being drafted.

These events also highlighted the vulnerability associated with the world's heavy reliance on technology and generated a global collaboration around safeguarding tech-based systems and rapid investment in developing alternative and creative solutions to reduce systems vulnerability.

The Shoalhaven community, once again, demonstrated its core values of caring for the vulnerable and assisting in any way it could. But the community capacity to respond in this instance was limited due to the magnitude and scale of the events and the declining number of volunteers over the preceding decades.

"CRITICAL INCIDENT"

THE CITY OF SHOALHAVEN IS IMPACTED BY A CONFLUENCE OF TWO DISRUPTIVE EVENTS: A RELATIVELY MINOR TSUNAMI AND A SHORT TERM TECHNOLOGICAL GLITCH DUE TO A M- CLASS SOLAR FLARE EVENT

The "Critical Incident" Scenario is characterised by a confluence of two unprecedented events: a relatively minor tsunami along the east coast of NSW, and a global technological glitch due to a moderate (M-class) solar flare. Despite its relatively small scale, the tsunami causes serious flooding in coastal areas and significant damage to infrastructure and utilities. Due to the high density of population along the east coast, a large number of people are affected by the tsunami and emergency response teams are swamped with requests for assistance. To make matters worse, the solar flare causes power grids to shut down temporarily, damaging some computers and telecommunication systems. Authorities and communities are attempting to work collaboratively to address the impacts generated by the tsunami, but the response is slowed down by technological challenges, the lack of preparedness to such events, and the scale of the impacts. The confluence of these two events also mean that response agencies lack the necessary resources and experience to address all impacts in a timely and effective manner, triggering criticism from affected communities and raising questions about the efficacy of current response mechanisms.

+ Positive Trends/Outcomes

- Improved understanding of the capacity of society to adapt in response to disruptive events
- Improved capacity to withstand future disruptive events based on lessons learned from these events
- Enhanced understanding around safeguarding technology from unexpected events
- Revision of emergency preparedness and response protocols considering recent events
- Increased focus on building system adaptability and flexibility by government, response agencies and communities.
- Emergence of community champions and leaders who rise to the challenge during the emergency and its aftermath.

– Negative Trends/Outcomes

- High costs associated with restoring and building new infrastructure that meets the required new safety standards
- All resources are directed towards resolving immediate issues related to infrastructure at the expense of addressing emerging socio-economic issues.
- Housing shortages due to large scale impact to housing stock along the east coast.

- Inequality between communities depending on their capacity to respond (depending on social capital and material resources).
- Significant damage to marine and terrestrial ecosystems.
- Dangerous rip and currents offshore impact marine based industries.

Extreme weather events, such as storms, heatwaves, floods and cyclones have battered the Shoalhaven coast for many decades with increased frequency and severity. Unfortunately, on January 15, 2050, coastal communities were once again confronted with the forces of nature in the form of a relatively minor tsunami that hit the east coast of NSW, following an earthquake in the Puysegur Trench, south of NZ.

The tsunami resulted in waves of up to 3 meters high along the Shoalhaven coast, and generated dangerous rips and strong ocean currents. The tsunami waves caused significant flooding and structural damage to many buildings and infrastructure, and triggered a state of emergency for the whole of the NSW east coast region.

Fortunately, Australia received a 2-hour warning, which enabled emergency services to issue evacuation orders for coastal communities and travellers, and just sufficient time to close all beaches- potentially saving the lives of many people.

The rarity of tsunamis in Australia found emergency services and communities unprepared. Despite repeated warnings that tsunamis could impact the east coast of NSW (see insert), most emergency management resources over the last few decades focused on preparing and responding to increased incidents of floods and bushfires. Nonetheless, some of the response protocols initiated during extreme weather related events were abled to be utilised to some extent in response to the tsunami; but the short lead time for this event exposed many deficiencies in the system. For example, evacuation centres were unable to open and absorb the large number of evacuees in a timely manner, leaving many people stranded and confused as to where to go and what to do during and after the event. Similarly, the relatively sudden nature of the tsunami and its novelty meant that response authorities were struggling to identify priorities and allocate relevant and sufficient resources to support affected communities.

"Vulnerability to tsunami is greatest between the Shoalhaven coast and the Newcastle coast, reflecting the high population density in this area. This vulnerability is expected to increase as a consequence of expanding coastal development in response to; continuing population growth, population ageing and the coastal retirement trend. Vulnerability is also seasonal and peaks during the summer months, especially during school holidays from December through to the end of January."

Source: NSW SES (2007), *"Anticipating Waves of Destruction - Preparing the New South Wales Tsunami Emergency Management State Plan"*

To make matters worse, the entire east coast of Australia plunged into darkness only a few hours after the tsunami due to a moderate solar flare event that shut down power grids. The solar flare caused significant damage to many computerised systems, including the Internet of Things and telecommunication networks, damaging the capacity of the authorities and communities to evaluate the damage and coordinate their responses in an efficient and timely manner. Access roads were badly congested due the failure of the automated traffic

control system and the high volume of traffic- further hampering the accessibility of emergency personal into affected areas.

Residents and visitors impacted by these events became increasingly frustrated by lack of communication and by what seemed to be a disorganised, slow and inadequate response. Common communication channels (phone, radio, tv, social media platforms) were not available due to the technological glitch, and this vacuum in information was filled in by fake news and personal interpretations of the events. Attempts to curb the rise of misinformation were made through visits from high officials to affected communities, but their ability to provide regular and timely updates was compromised by logistical issues and their own limited access to live updates.

The region's economy has suffered a significant blow from the confluence of these two events. Much of the coastal infrastructure that supports the tourism, fishing and aquaculture sectors was badly damaged, and reconstruction was prohibitively expensive and long-term. This was compounded by the loss of revenue from the tourism sector and other affected industries, and by the limited emergency funds available to a region that is so frequency impacted by extreme weather related events. The cost associated with repairing many of the automated computerised systems that were damaged by the solar flare were extraordinarily high and required high levels of expertise that were not readily available. This caused additional delays and losses that threatened the economic viability of many sectors that rely heavily on technology for their daily operations.

The tsunami badly affected coastal morphology and ecosystems. Tsunami waves resulted in extensive changes in coastline topography due to considerable erosion and subsequent deposition of large quantities of sediment in relatively short time spans. The waves also introduced large amounts of salt into surface and ground water, substantially impacting coastal ecosystems like mangroves, coral reefs, and coastal vegetation.

There was a flow of good will from community members offering their skills and knowledge to assist with the response and recovery efforts. Over the many months that followed, various community groups have organised social, logistical and financial support for those impacted by these events. The success experienced by some of these groups and their immense contribution to the response and recovery efforts has lead governments and emergency response agencies to recognise their value. Consequently, communities were invited to be involved in decision-making; a move that marked a gradual, yet consistent shift towards a model of empowered deliberative democracy.

The significant impacts on technological systems caused by the solar flare have highlighted substantial vulnerabilities in many areas of modern lives. Even a relatively short-term glitch in these systems managed to paralyse many operations and caused major social and economic disruptions. Calls to reassess our heavy reliance on technology are starting to emerge and grassroots initiatives are growing, especially around returning to a more personalised engagement and communication methods. Authorities are no longer able to ignore the potential impacts cause by severe space weather events, and are pressured to address the risks they pose to vulnerable infrastructure and operation areas; from power grids, to telecommunication towers and emergency warning and response systems.

The culmination of these two powerful events also marked a tipping point in relation to continued development of coastal regions. The colossal economic and social toll caused by

the tsunami and the ever increasing frequency of extreme weather events triggered a very sombre realisation that high risk homes and infrastructure must be relocated into safer areas. The scale of the damage caused by the tsunami and the anticipated astronomical costs associated with reconstruction provided an opportunity for retreat, with less political resistance to doing so. Communities, government, educational institutions and the private sector were all working collaboratively to develop, support and execute a plan that will reduce the vulnerability of the Shoalhaven to future disruptive events and strengthen its capacity to withstand and recover from events that are unavoidable.

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