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DEVELOPMENT OF CAPABILITY TARGETS FOR THE NSW EMERGENCY MANAGEMENT SECTOR

FINAL REPORT

RISK FRONTIERS

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INTRODUCTION

In 2020 the NSW State Emergency Management Committee (SEMC) developed and launched a Capability Development Framework for the NSW Emergency Management Sector (the Framework). The Framework has been developed to ensure that the sector has a collaborative, coordinated and capable emergency management system. It will identify and prioritise capabilities needed to manage severe-to-catastrophic disasters that require a multi-agency effort across the prevention, preparedness, response and recovery stages.

The Framework operates within the context of the Australian Disaster Preparedness Framework developed by the Australian Government, which is focused on supporting a national effort to develop the required capability to effectively prepare for and manage severe-to-catastrophic disasters. A key consideration highlighted in the Australian Disaster Preparedness Framework is the need to identify the amount of capability required to ensure it can be effectively applied and sustained, including the identification of capability thresholds. Jurisdictions have been encouraged to undertake a risk-based assessment to test against severe-to-catastrophic disaster scenarios to identify jurisdictional capability requirements and to measure against requirements to identify capability gaps.

Through the utilisation of the Capability Maturity Assessment Tool developed by Risk Frontiers with the support of the BNHCRC and in collaboration with Macquarie University[1], the NSW SEMC Capability Sub Committee achieved a first pass understanding of the sector's capability maturity and priority areas for further action in 2020.

An area recommended for further action was the establishment of collective whole-of-sector capability targets. Capability targets are the objectives that each capability is planned to achieve considering measures of impact and time. They are vital in understanding future capability planning requirements. The capability maturity assessment tool facilitators guide also recommends that further validation be undertaken of priority capabilities to identify the specific extent of gaps.

As illustrated in Figure 1, understanding and estimating capability requirements, including defining capability targets, forms part of the overall NSW capability development model.

Figure 1: NSW Capability Development Model

[1] Gissing, A. (2021) Capability Maturity Assessment Facilitators Guide [Available Online] https://www.bnhcrc.com.au/sites/default/files/managed/downloads/capability_maturity_assessment_facilitators_guide.pdf

PROJECT SCOPE

Resilience NSW, through the support of the BNHCRC, engaged Risk Frontiers to undertake research into capability target definition. The research question was:

> *What are the capability targets (including measurable impacts, objectives and timeframe metrics) for the NSW Emergency Management Sector?*

Sub questions were defined as:

- *What is the risk appetite (risk-based principles) of the NSW SEMC to guide the level of preparedness of the NSW Emergency Management Sector?*
- *What are the standard capability target parameters and descriptions for each capability?*
- *What is a best practice process for defining capability targets and assessing capability gaps?*
- *What standard capability metrics exist to guide the estimation of the effect of different human and physical resources?*

This research report focuses on addressing each of these questions.

The research builds on the previous capability maturity assessment of the NSW emergency management sector, completed in 2020, utilising the BNHCRC capability maturity assessment tool[2]. Outcomes of the research will inform capability prioritisation and investment decision making.

[2] Gissing, A (2021) Capability Maturity Assessment Facilitators Guide. [Available Online] www.bnhcrc.com.au/sites/default/files/managed/downloads/capability_maturity_assessment_facilitators_guide.pdf

CAPABILITY DEVELOPMENT APPROACHES

BACKGROUND

Severe-to-catastrophic disasters pose unique challenges and are inevitable. Response strategies that work for smaller, more frequent events will be quickly overwhelmed and prove ineffective. Previous reviews have highlighted gaps in Australia's preparedness to withstand high consequence and catastrophic disasters. Recent BNHCRC research concludes that emergency management preparedness efforts are often focused on frequently occurring and common hazards (e.g., floods and fires)[3].

It is not cost effective to have significant investments of resources that might be only employed in the most extreme or catastrophic events. However, the inevitability of extreme events that can overwhelm local and regional, and even national, resources means that it is worth considering where additional surge capacity might be sourced if and when needed or how operating models may be adjusted. No one organisation alone is capable of responding to all aspects of a catastrophe.

Often the success of the response is reliant upon the capacities already present in communities. Recognising the capacity of the community itself to respond, it is essential to adopt a more flexible and collaborative approach to inspire, integrate, support and coordinate community efforts and allow for improvisation. The business and community sectors offer significant capabilities that could be integrated in an improved fashion through the adoption of a 'whole of community approach'. In addition, international assistance arrangements exist but are not well integrated broadly with Australian emergency management arrangements or experience for capabilities that may be required.

Planning should identify the demands that a severe-to-catastrophic event or a series of parallel or consecutive high consequence events would impose, and the approach and resources needed by agencies. The planning should seek to establish the points of limitation within the existing arrangements and what would be required to augment capability and capacity. Plans should also outline arrangements for collaboration and information with the business sector, community organisations and the community more broadly.

The post-disaster review of Hurricane Katrina stated:

> *Substantial resources and capabilities marshalled by state local and federal governments and non-government organisations were insufficient to meet the immediate challenges posed by the unprecedented degree of damage and resulting number of hurricane victims caused by Hurricane Katrina and Rita. Developing the capabilities needed for catastrophic disasters should be part of the*

[3] Gissing, A., Eburn, M. and McAneney, J., (2022) Planning and capability requirements for catastrophic and cascading events. In Disaster Risk Reduction in Asia Pacific (pp. 175-186). Palgrave Macmillan, Singapore.

> *overall national preparedness effort that is designed to integrate and define what needs to be done, where, based on what standards, how it should be done, and how well it should be done. (p. 7)*[4]

The Royal Commission into National Natural Disaster Arrangements investigated national capability issues. It concluded that:

> *Jurisdictional approaches to capacity and capability development have served fire and emergency services well in the past. However, climate and demographic changes are likely to increase the demand on fire and emergency services. The ability of individual jurisdictions to meet this demand at peak times is likely to become increasingly difficult, prompting a need for increased resource sharing. There is a need to consider capabilities nationally, and for a more consistent and connected approach to capability planning across jurisdictions. (Section 6.25)*[5]

The Royal Commission recommended that:

> *State and territory governments should have a structured process to regularly assess the capacity and capability requirements of fire and emergency services, in light of both current and future natural disaster risk. (Recommendation 6.1)*[6]

What is capability?

Capability is defined as: *the collective ability and power to deliver and sustain an effect within a specific context and timeframe*[7]. Capability consists of five different elements of people, resources, governance, systems and processes[8].

The NSW Capability Development Framework outlines 25 core capabilities for the NSW Emergency Management sector (Table 1).

[4] US Government Accountability Office (2006) Catastrophic Disasters – Enhanced Leadership, Capabilities and Accountability. [Available Online] https://www.gao.gov/assets/gao-06-618.pdf

[5] Royal Commission into National Natural Disaster Arrangements (2020) Final Report [Available Online] https://naturaldisaster.royalcommission.gov.au/publications/html-report

[6] Royal Commission into National Natural Disaster Arrangements (2020) Final Report [Available Online] https://naturaldisaster.royalcommission.gov.au/publications/html-report

[7] Department of Home Affairs (2019) Australian Disaster Preparedness Framework [Available Online] https://www.homeaffairs.gov.au/emergency/files/australian-disaster-preparedness-framework.pdf

[8] NSW Government (2020) A capability development framework for NSW Emergency Management Sector

Table 1: NSW Capability Development Framework Core Capabilities

Before, During and After		
Emergency Management Planning		
Community Information, Alerts and Warnings		
Situational Intelligence, Information Sharing and Interoperability		
Risk and Threat Assessment		
Community Engagement, Planning, Capacity and Resilience		
Public Order and Community Safety		
Lessons Management		
Organisational Resilience		
Research and Learning		
Private Sector and NGO Engagement (Public Private Partnerships)		
Before and during		
Emergency Response		
Operations Management and Coordination		
During and after		
Fatality Management		
Essential Service and Infrastructure Maintenance and Restoration		
Impact Assessment		
Crisis Leadership		
Logistics and Supply Chain Management		
Before	**During**	**After**
Land-use Planning	Mass Search and Rescue	Economic Recovery
	Evacuation and Support	Social Recovery
	Biosecurity Management	Natural Environmental Recovery
	Mass Care	

CAPABILITY DEVELOPMENT AND ASSESSMENT APPROACHES

International

United States

The United States utilises the Threat and Hazard Identification and Risk Assessment (THIRA) and Stakeholder Preparedness Review (SPR) processes to understand capability maturity. The process is focused on answering five key questions:

1- What do we need to prepare for?

2- What level of capability do we need to be prepared?

3- What are our current capabilities?

4- What gaps exist between the capabilities we need and the capabilities we currently have?

5- How can we address our capability gaps?

The process is used to establish capability requirements (capability targets), which involves determining the specific level of capability that best addresses a community's risk profile. These are then used to measure the current level of capability and identify capability gaps. Capability targets are also implemented through:

- Investment in areas that address capability gaps
- Developing and updating of plans based on capability targets and gaps
- Use of capability targets when assessing performance in real-world incidents and as evaluation criteria in exercises.

The THIRA process consists of three parts:

1- Identify Threats and Hazards of Concern

2- Give Threats and Hazards Context

3- Establish Capability Targets.

The first two steps are similar to the NSW State Emergency Risk Assessment process. The establishment of capability targets involves defining the desired capability to address the consequences of identified risks. Capability targets are established for each core capability defined in the National Preparedness Goal.

Capability targets are specific and measurable: they are built by combining impact measures which represent the size of the capability requirement, and timeframe metrics, which represent the timeframe in which the action must be undertaken. Targets are established utilising standardised descriptions for example:

a) Within (#) hours of an incident, provide emergency sheltering for (#) people; maintain sheltering operations for (#) days.

b) Within (#) hours of an incident, provide security and law enforcement services to protect (#) people affected.

c) Within (#) hours, extinguish (#) structure fires.

d) Within (#) hour(s) of an incident, identify and recover (#) fatalities.

e) Within (#) hours of an incident, clear (#) kilometres of road affected, to enable access for emergency responders, including private and non-profit.

The SPR process is an annual self-assessment process that examines current levels of capability based on capability targets identified in the THIRA. The process is utilised to compile the US National Preparedness Report. The SPR is a requirement under the Post-Katrina Emergency Management Reform Act of 2006. The SPR assists to answer the following questions:

1- What are our current capability levels and how have our capabilities changed over the last year?

2- What gaps exist between the capabilities we want to achieve and the capabilities we have?

3- What do we need to do to close the capability gaps or sustain capabilities?

4- What impact did different funding sources – including grants – have on building or sustaining the capabilities assessed by the capability targets over the last year?

The SPR process acknowledges that assessing capabilities, while important, is challenging, and often situation dependent. It also states that, for some capabilities, necessary data may be difficult to access or otherwise unavailable.

Current levels of capability are expressed in the same standardised descriptions utilised in the capability targets. For example, if a capability target says a community will perform a capability in one week, the capability assessment will determine the extent to which the emergency management sector can actually perform the capability in one week. The difference between the capability target and estimated current capability is referred to as the capability gap.

The guide supporting the SPR provides little guidance on how the assessment should be performed to estimate current capability but does mention that real-world incidents, exercises, consultation with subject-matter experts, plans, policies, modelling or tools could be sources of information. An example of a completed SPR for the New Jersey is provided here[9].

The SPR process appears focused primarily on measuring people and resource components of capability rather than broader governance, systems and process elements, though the SPR guide does ask for commentary regarding planning, organisation, equipment, training and exercising. The process also does not examine specific aspects of people or resources that may be deficient: for example, if gaps are identified, what specific roles or resources are their gaps present. There are limitations in the use of the process to measure preparedness for severe-to-catastrophic disasters if capability targets are not set in the context of such events. For example, in respect to fatality management, the 2021 National Preparedness Report identified that 46% of communities had set their capability targets significantly below their worst-case scenario impacts[10].

The SPR approach replaces a previous 1 to 5 scale for assessing maturity of each capability where 1 was no/minimal capability and 5 was full capability. An example for the State of Oregon is provide here[11].

[9] State of New Jersey (2019) State Preparedness Review [Available Online] https://static1.squarespace.com/static/54d79f88e4b0db3478a04405/t/5fd90c499a235b11c5e3c82e/1608059979607/NJ_spr-presubmission-2020-01-15-10.15.58.950.pdf

[10] FEMA (2021) National Preparedness Report [Available Online]fema.gov/sites/default/files/documents/fema_2021-national-preparedness-report.pdf

[11] Oregon Office of Emergency Management (2017) State Preparedness Report [Available Online] https://www.oregon.gov/oem/Documents/2017_State_Preparedness_Report.pdf

New Zealand

In 2014, New Zealand published the Civil Defence Emergency Management (CDEM) Capability Assessment Tool[12]. The tool is described as a self-assessment tool for any organisation involved in CDEM to assess its capabilities to manage emergencies. The tool consists of a set of nationally consistent performance indicators and measures covering reduction, readiness, response and recovery components linked to National CDEM Strategy. The tool utilises a 6-point qualitative scoring approach to measure capability relevant to each criteria outlined in the tool. The tool assisted to complete the New Zealand CDEM National Capability Assessment Report[13].

Australia

Not all Australian jurisdictions have developed collective capability development or assessment approaches. NSW, Victoria and Western Australia are the only jurisdictions to have established collective capability development models. Tasmania has drawn on the Australian Disaster Preparedness Framework and undertaken a maturity assessment analysis.

AFAC has published the National Statement of Capability for Fire and Emergency Services, outlining the number of people and resources nationally to fulfill key emergency management functions[14].

Victoria

Victoria has developed the Victorian Preparedness Framework[15], which outlines the Victorian approach to assessing capability maturity and development. The framework outlines 21 core capabilities and a series of critical tasks relevant to each core capability.

Capability targets have been developed for each of the defined capabilities and critical tasks. Victoria is currently progressing the measurement of capability maturity for a selection of capabilities via exercises and scenario activities.

[12]NZ Civil Defence (2014) Capability Assessment Tool [Available Online] civildefence.govt.nz/cdem-sector/monitoring-and-evaluation/cdem-capability-assessment-tool-/
[13] NZ Civil Defence (2014) Capability Assessment Tool [Available Online] civildefence.govt.nz/assets/FINAL-National-Capability-Assessment-Report-2015.pdf
[14] AFAC (2021) National Statement of Capability for Fire and Emergency Services [Available Online] afac.com.au/docs/default-source/nrsc/afac-national-capability-statement.pdf?sfvrsn=2
[15] EMV (2018) Victorian Preparedness Framework [Available Online] https://files.emv.vic.gov.au/2021-08/Victorian%20Preparedness%20Framework%20May%202018.pdf

The Victorian approach is based upon the FEMA Threat and Hazard Identification and Risk Assessment (THIRA)[16] approach. Specifically, capability targets are established though the THIRA to provide specific and measurable metrics that describe capabilities needed to manage potential catastrophes. The targets are utilised to establish a benchmark that can be measured against overtime to track preparedness. The method involves the use of standardised target language. Each target describes a critical task which relates to the core capability. Targets are collective in their nature, reflecting the all-hazards, all-agencies approach.

Western Australia

The Western Australian State Emergency Management Committee maintains a capability framework[17]. The framework consists of three levels:

- Seven overarching capability areas including: governance, analysis and continuous improvement, community involvement, planning and mitigation, resources, emergency response and impact management and recovery coordination
- Thirty-three core capabilities including: legislation, policies, EM plans, risk assessment, horizon scanning, lessons management, alerts and warnings, public information, risk awareness and understanding, shared ownership, sector information sharing, land use planning, ecosystem management, infrastructure protection, essential services protection, minimise single points of failure, remoteness planning, business continuity, community activities, people, volunteering, finance and administration, equipment/ critical resources, command, control and coordination, situational assessment, evacuation, public protection, agency interoperability, mass casualty management, mass fatality management, welfare, impact assessment and recovery coordination
- Forty-seven achievement objectives.

Capability maturity is assessed through an annual questionnaire survey of the emergency management sector and local governments. Results are published as an annual Emergency Preparedness Report[18].

Tasmania

In 2021, the Tasmanian State Emergency Management Committee undertook an emergency management sector capability assessment of capabilities listed in the Australian Disaster Preparedness Framework. The methodology utilised the BNHCRC Capability Maturity Assessment approach that was also utilised by

[16] FEMA (2019) National Threat and Hazard Identification and Risk Assessment (THIRA) [Available Online] www.fema.gov/emergency-managers/risk-management/risk-capability-assessment

[17] WA State Emergency Management Committee (2021) Capability Framework [Available Online] https://semc.wa.gov.au/capability-and-preparedness/capability-framework

[18] WA State Emergency Management Committee (2021) Emergency Preparedness Reports [Available Online] https://semc.wa.gov.au/capability-and-preparedness/emergency-preparedness-reports

NSW. The assessment was completed for two capabilities planning and hazard response. The tool was provided to agencies to undertake a self-assessment and was subsequently analysed for the State Emergency Management Committee[19].

BNHCRC Capability Maturity Assessment Tool

The BNHCRC Capability Maturity Assessment Tool is an evidence-based tool that was developed as part of the BNHCRC research into planning and capability requirements for catastrophic disasters. The tool utilises a series of criteria to measure capability maturity based on input by capability subject matter experts (SMEs). The outputs of the tool enable the ranking of capability maturity by capability element and overall capability. Further information can be found here.

[19] PersCom (2022) Tasmania State Emergency Service

METHOD

RISK BASED CAPABILITY PRINCIPLES

It is impossible to resource the emergency management sector to deal with the largest and most damaging types of events; so called severe-to-catastrophic disasters. In guiding sector capability planning, however, it is important to define risk-based principles to inform capability investment decision making. Such principles assist to define what level of effect capability should achieve and key considerations in doing so.

The risk-based capability principles were originally titled risk appetite; however, after discussion with stakeholders, they were re-titled to risk-based capability principles to ensure a sound understanding throughout the sector of their purpose. They now form part of the methodology for establishing capability targets.

To inform the development of the risk-based capability principles, a discussion paper was written. The discussion paper was presented to the Capability Targets Working Group on 11 March 2021 for feedback. The discussion paper was then circulated and discussed in interviews with the following stakeholders:

- Gary Worboys (NSWPF)
- Aimee Templeman (NSW PF)
- Shane Fitzsimmons (Resilience NSW)
- Paul Baxter (FRNSW)
- Carlene York (SES)
- Andrew Coghlan (Red Cross)
- Rob Rogers (RFS)
- Navin Subash (EUSFAC)
- Martin Dwyer (EngFAC)
- Kenna Ackley (Treasury NSW)
- Kalina Koloff (Canberra Joint Organisation of Councils)
- Leigh Pilkington (DPI)
- Jacqui Bell (FRR)
- Shauna Coffey (IAG)
- Georgia Whitbread (IAG)
- Melinda Curtis (Hunter Joint Organisation of Councils).

A draft of the principles was presented to the capability targets workshop conducted on 20 May 2021. This workshop included representation from TelcoFAC, EngFAC, EUSFAC, Resilience NSW, SES, FRNSW, RFS, NSW Ambulance, Marine Rescue, Health and NSWPF. Based on feedback, the principles were

further refined before being used to assist in the formation of capability targets with stakeholders listed in Table 2. The final principles were presented to the NSW SEMC Capability Development Sub-Committee for feedback in November 2021.

CAPABILITY TARGETS

Capability targets describe the desired outcome to be generated by core capabilities. The development of capability targets has been informed by the FEMA THIRA methodology[20], risk-based capability principles and a series of workshops with Australian jurisdictions hosted by Home Affairs and the BNHCRC in June 2021.

In NSW, targets are established to inform planning for severe-to-catastrophic disasters; they are not intended to act as performance targets. Each target is designed to assist in measuring the extent of capability available to respond to a severe-to-catastrophic disaster and hence provide an indication of preparedness.

In general, planning- and preparedness-related targets reflect existing NSW emergency management policy objectives, where defined, whilst response and recovery targets attempt to comprise three components:

(1) An impact, which represents the size of the capability requirement

(2) A critical task which represents a specific action that is required to achieve the capability target

(3) A timeframe metric which represents the timeframe in which the action needs to be performed.

For example:

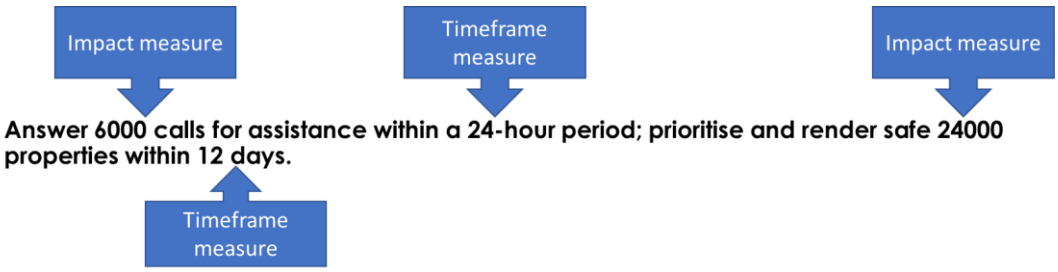

Figure 2: Capability target format. Emergency Response (Storm damage) example.

The overall methodology utilised for establishment of the capability targets is illustrated in Figure 3.

[20] FEMA (2019) National Threat and Hazard Identification and Risk Assessment (THIRA) [Available online] www.fema.gov/emergency-managers/risk-management/risk-capability-assessment

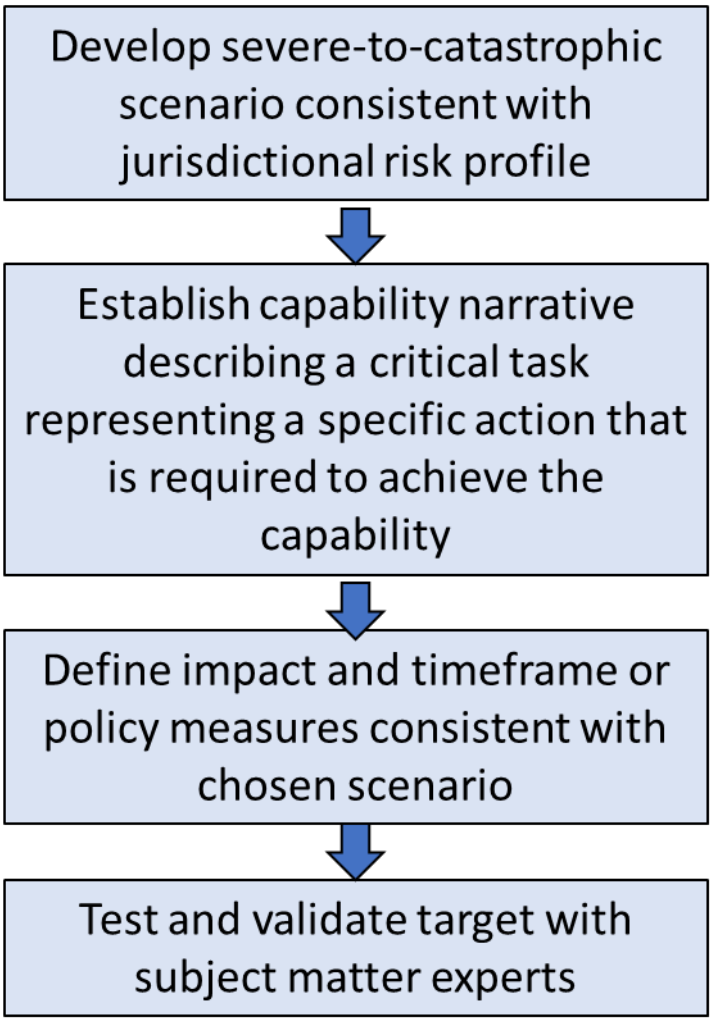

Figure 3: Capability target definition methodology

An initial workshop was conducted on 20 May 2021 to develop capability target narratives for a selection of core capabilities. This workshop included representation from TelcoFAC, EngFAC, EUSFAC, Resilience NSW, SES, FRNSW, RFS, NSW Ambulance, Marine Rescue, Health and NSWPF. Workshop participants were provided with capability target examples from the United States to assist discussions. Eight follow-up interviews were held with a selection of SMEs to further develop target narratives.

Twenty-eight workshops were then held with SMEs to develop draft impact and timeframe measures for each target. Agencies represented in each of the workshops are listed in Table 2. Follow-ups with key SMEs were undertaken as required following workshops. These activities were focused on validating an initial target narrative outlining a critical task and then selecting impact and timeframe scenarios based on the selected scenario.

One-on-one discussions were held with DPI to establish plant and animal biosecurity targets. Given the COVID-19 pandemic, the development of capability targets relating to human biosecurity were deferred.

The establishment of targets were informed by a series of severe-to-catastrophic disaster scenarios, provided in Appendix 1. Similar scenarios were utilised in the previous NSW emergency management sector capability maturity assessment and are consistent with NSW's emergency risk profile as established by the 2017 State Level Emergency Risk Assessment. Scenarios utilised subject matter expertise, historical information and risk modelling to inform their development. Scenarios were validated by workshop participants.

It is anticipated that the draft targets will further mature over time as they are utilised in the measurement of the state's preparedness for severe-to-catastrophic disasters. They should be reviewed in line with evolving knowledge of the state's risk profile.

Capability Targets were presented to the NSW SEMC Capability Development Sub-Committee for feedback in November 2021. Limited feedback was provided by members following the meeting as part of subsequent research activities.

Table 2 – Capability Target Workshops

Capability	Agency Participation	Workshop Date (2021)
Natural Environment Recovery	EPA	8 October
Public Order and Community Safety	NSWPF	28 September
Social Recovery	Resilience NSW	22 September
Lessons Management	Resilience NSW	10 September
Research and Learning	Resilience NSW	10 September
Private and NGO Sector Engagement	Resilience NSW	10 September
Organisational Resilience	Resilience NSW	10 September
Emergency Response - Bushfire	RFS, FRNSW	9 September
Emergency Response – HAZAMT	FRNSW, RFS	9 September
Emergency Response - Urban Fire	FRNSW, RFS	9 September
Risk and Threat Assessment	Resilience NSW, FRNSW, OLG, DPI, DPIE, RFS, SES	6 September
Emergency Management Planning	Resilience NSW, FRNSW, OLG, DPI, DPIE, RFS, SES	6 August & 6 September
Evacuation Support	DPI, Resilience NSW	6 September
Mass Care	NSWPF, Health, NSW Ambulance, Resilience NSW, DPI	6 September
Fatality Management	NSW Health Pathology, NSWPF	17 August

Capability	Agency Participation	Workshop Date (2021)
Mass Search and Rescue	NSWPF, SES, EICU, DPI, FRNSW, RFS, Resilience NSW	16 August
Operations Management	NSWPF, SES, EICU, DPI, FRNSW, RFS, Resilience NSW	16 August
Crisis Leadership	NSWPF, SES, EICU, DPI, FRNSW, RFS, Resilience NSW	16 August
Economic Recovery	Resilience NSW	10 August
Situational Intelligence	FRNSW, EICU, NSWSES, RFS	10 August
Impact Assessment	FRNSW, EICU, NSWSES, RFS	10 August
Logistics and Supply Chain Management	FRNSW, EICU, NSWSES, RFS	10 August
Essential Services and Infrastructure Maintenance and Restoration	TelcoFAC, EUSFAC, EngFAC	9 August
Community Engagement, Planning, Capacity and Resilience	SES, NSWPF, FRNSW, RFS	9 August
Community Information, Alerts and Warnings	RFS, SES, NSWPF, NSWFR	9 August
Land Use Planning	Resilience NSW and DPIE	6 August
Emergency Response – Storm Damage	SES	6 August

BEST PRACTICE APPROACH TO CAPABILITY MEASUREMENT

This component of the project involved testing two methods to quantitatively measure capability. These were:

1. ***Desktop exercise scenario*** where agencies accountable for a given capability were provided with a scenario and SMEs allocated the people and resources that would be required to achieve the capability target. The exercise assumed that resource allocations would not be constrained by existing capacities. The facilitator recorded the number of people and resources that were said to be required for different roles so that they could be compared with the number of people and resources that would be available given current sector capacity.

2. ***Quantitative assumptions-based analysis*** where the facilitator worked with agencies to identify the effect that could be achieved by people and resources specific to a capability. These assumptions were then utilised to estimate the people and resources required to meet the capability target and could then be compared to people and resources that would be available given current sector capacity.

Five capabilities were chosen to trial these assessment methods, including Emergency Response (Storm Damage), Fatality Management, Emergency Response (HAZMAT), Mass Search and Rescue and Community Information and Alerts and Warnings.

To facilitate the measurement, the following approach was utilised for both methods:

- An initial interview was undertaken with a SME from the agency accountable for the capability subject to measurement to explore the process and identify initial assumptions.

- A workshop was undertaken comprising of key SMEs from the accountable agency and supporting emergency services and functional areas to undertake the measurement activity (See Table 3).

- Follow-up interviews were undertaken with key SMEs from the accountable agency and supporting emergency services to validate the results and collect additional data regarding the extent of capability available so that it could be compared with the amount of capability required. To finetune analysis of available capability, SMEs were also consulted to identify the extent to which capability would still be required for business-as-usual core business responses such as fire and road crash rescue responses. Where possible, results were compared with other previous historical events within Australia or internationally to sense-check results. For example, for Mass Search and Rescue, a literature research of previous large scale mass search and rescue responses was performed to identify the scale of resources that had been required. This step, however, was difficult to complete across all capabilities due to the limitations of historical experience and data. Data was not available from all agencies within the timeframe of the project but could be further followed up by Resilience NSW to provide a more complete comparison of existing and required capability.

- Results capture the key roles required to implement the capability in the context of the scenario, although other supporting roles such as liaison officer might also be required. Scenarios can also relate to other capabilities: for example, in exploring the Emergency Response (HAZMAT) capability, considerations regarding the Mass Care capability were raised. The approach adopted only considered the capability of interest but could be widened in future to also consider other associated capabilities.

- People and resource requirements were tested for their sensitivity by adding an additional 10% to their requirements to factor in uncertainties that may not have been captured in the approach.

A third method involving the validation of the previous results derived from the BHNCRC Capability Maturity Assessment Tool based on the experiences of the 2022 North Coast floods was proposed but not scheduled due to ongoing operational commitments of NSW emergency services and functional areas.

Table 3 – Capability Measurement Workshops

Capability	Agency Participation	Workshop Date (2022)
Fatality Management	NSW Health Pathology	16 May
Community Information, Alerts and Warnings	NSW SES, RFS, FRNSW, Transport	11 May
Mass Search and Rescue	FRNSW, SES, RFS	6 May
Emergency Response (Storm Damage)	SES, FRNSW, RFS	4 May
Emergency Response (HAZMAT)	FRNSW, EngFAC, Sydney Ports, EPA, NSW Police, SES	29 April
Fatality Management	NSW PF, Ministry of Health	27 April

Limitations and observations

In trialing the methods, the following observations were made:

- Not all capability elements including systems, governance and processes can be quantitatively measured. Hence, the methods trialed were restricted to measuring capability elements of people and resources.

- Whilst some rules of thumb (assumptions) can be defined regarding the effect that capabilities can deliver, there is a degree of uncertainty in them, particularly in regard to their application to severe-to-catastrophic disasters. Uncertainties relate to the nature of the scenario to which capabilities are being utilised. For example:

    - the speed at which storm damage teams can complete requests for assistance largely depends on the complexity of the request for assistance

    - the speed at which rescue teams could complete Mass Search and Rescue tasks could be slowed by earthquake aftershocks

    - the speed at which a disaster victim can be identified depends on the state in which a body is recovered. Which can be influenced by time and temperature

  In any given scenario, the variation in key attributes can alter the effect that capabilities can deliver. Limitations in previous data analysis by agencies also means that the assumptions were largely based on SME experience.

- Given that the analysis is scenario-based and that different assumptions can result in different levels of capacity being required, the results of the analysis have limited transferability to other scenarios.

- It is advisable to model the capacity of people and resources required utilising different assumptions relating to shifts and rest breaks as it is not realistic to assume that people and resources will be utilised in an optimal fashion. At a minimum a factor should be applied to results to reflect their overall uncertainty.

- Results utilising assumptions derived from SME experience can also deviate from previous historical events as illustrated in the analysis of the Fatality Management capability. Here comparisons between the analysis and data from the Black Saturday bushfires shows more people and resources might be required than results calculated in the quantitative assumptions-based analysis show. A similar result has occurred with the Emergency Response (Storm Damage) analysis. This may occur as the quantitative assumptions-based analysis may assume a greater degree of efficiency in resource use than may occur in reality. In essence in estimating the speed at which a given number of resources can achieve a target we should assume that Hofstadter's law applies, *that is that it will always take longer than you expect, even when you take into account Hofstadter's Law*[21]. For example, in relation to the Emergency Response (Storm Damage) assuming less efficient resource allocations and lower productivity of storm damage teams would have provided a result that more accurately matched the limited knowledge of historical storm damage team deployments during large scale events such as the Sydney 1999 hailstorm.

- It can be difficult for SMEs to conceptualise scenarios that they have not previously been faced with and to think about what capabilities might be required without being limited by existing capacity constraints. For example, on occasions, SMEs would nominate levels of capacity based on their existing capacity limitations rather than the level of capacity that would likely be required.

- Different SMEs may have different opinions on the number of resources that might be required when utilising the desktop scenario-based analysis. It is important to involve a number of SMEs in the analysis to consider diverse perspectives.

- In some instances, such as Mass Search and Rescue a combination of the two methods needed to be utilised to adjust to the knowledge of SMEs.

- Not all capabilities (for example Research and Learning) can be measured quantitively utilising the methodologies trailed in this research. Other techniques such as qualitative ratings and post-event validation are likely better suited.

- Concern was raised regarding the measurement of capability gaps; instead, it was proposed that measurement focus on the extent of capability that could be delivered. This is like the way in which the FEMA SPR approach provides results.

[21] en.wikipedia.org/wiki/Hofstadter%27s_law

STANDARD CAPABILITY METRICS

The standard capability metrics were identified through the trial of the capability measurement approaches. These were the assumptions that were utilised to estimate the extent of capability required.

RESULTS

RISK-BASED CAPABILITY PRINCIPLES

The following risk-based capability principles are recommended:

We partner with communities.

Emergency management is a shared partnership. Communities must be aware, connected and empowered. It is critical that community capability is mobilised to build resilience. We partner with communities and will take risks to explore new ways of working to maximise the effectiveness of how we work together.

Our work is focused on resilience.

Communities should have the capability and capacity to withstand, recover, adapt, strengthen and thrive. Some level of consequence from emergencies will be inevitable, although we strive to ensure impacts do not overwhelm communities.

We take a whole-of-community approach.

It is not cost effective to maintain capabilities for severe-to-catastrophic emergencies. To maximise our preparedness, we work in a proactive and seamless partnership with the Australian Government, other states and territories, local government, NGOs, businesses and industry, media and the broader community to support our capabilities and capacity.

We invest wisely.

We ensure:

- Capability and risk management treatments are targeted and prioritised based upon the level of risk
- Investments are directed to capabilities that will best manage risk
- Capability and risk management treatments are cost effective and do not pose downsides (externalities) that outweigh benefits
- A base level of capability exists across NSW that can be mobilised to respond to risks statewide and to support other states and territories
- Where possible, capabilities offer flexibility and adaptability.

We innovate to improve community safety outcomes.

We have a high appetite to innovate and take risks to explore new ways of working to improve outcomes with the community. We embrace a sector-wide approach to capability development, acknowledging that strength comes from working together and partnering with elected representatives.

Safety is our number one priority.

We work to ensure members of the emergency management sector are safe and healthy, both physically and mentally. We have a zero appetite for serious work, health and safety harm.

CAPABILITY TARGETS

Suggested capability targets are outlined in Table 4.

Table 4: Suggested Capability Targets

NSW Core Capabilities	Suggested target	Assumptions	Scenario
Before, During and After			
Emergency Management Planning			
The ability to systematically plan for and engage with the whole of community and implement scalable, strategic, operational and tactical level approaches across PPRR to deal with major to catastrophic emergencies.	At-least every 5 years, after activation, when lessons are learnt, or the risk profile changes update State EMPLAN and sub-plans in accordance with emergency planning policies ensuring that relevant stakeholders are involved in the planning process. At-least every 3 years, after activation, when lessons are learnt, or the risk profile changes update Local and Regional EMPLANS and/or sub-plans in accordance with emergency planning policies ensuring that relevant stakeholders are involved in the planning process.		
Community Information, Alerts and Warnings			
The ability to deliver coordinated, prompt, reliable and actionable information to the community using clear, consistent and accessible methods to elicit appropriate responses.	Within 30 minutes deliver timely, targeted, actionable and credible information to 1.5m people at-risk. Over a continuous period of six months maintain public information and warning capability (24/7) across 20 LGAs to reach greater than 95% of people at-risk within at-least 1 hour.		Regional Tsunami Bushfire

NSW Core Capabilities	Suggested target	Assumptions	Scenario
Situational Intelligence, Information Sharing and Interoperability			
The ability to combine situational awareness inputs from all sources with predictive analysis of consequence, risk, capability and capacity. Raw information must be translatable into intelligence products accessible and appropriate for the needs of stakeholders and decision makers at all levels. This includes the mechanisms for timely information broadcast and transfer (such as operational communications), and systems of data interpretation (including geospatial information systems and electronic common operating picture applications).	Establish information and intelligence-gathering priorities; identify and gather information to support priorities; and share intelligence products to relevant agencies within 15 minutes of notification of a credible threat.		East Coast Low
Risk and Threat Assessment			
The ability to plan, manage and minimise the impact of future risks within the urban environment. The ability to undertake risk and threat assessments of individual and collective hazards across PPRR, to identify and prioritise current and future risks.	At-least every 3 years undertake region and local emergency risk and threat assessments to inform EMPLANs in accordance with established standards and guidance and involving relevant stakeholders. At-least every 5 years undertake state emergency risk and threat assessments to inform EMPLANs in accordance with established standards and guidance and involving relevant stakeholders.		

NSW Core Capabilities	Suggested target	Assumptions	Scenario
Community Engagement, Planning, Capacity and Resilience			
The ability to collaboratively plan for response and recovery through partnering with the community and building capacity for local plan implementation and recovery management. It encompasses empowerment of local leaders and stakeholders to improve recovery and resilience outcomes for individuals and the communities. This includes program support and funding for planning and capacity building initiatives and wider community preparedness programs.	Increase community preparedness index by 3% annually in priority communities.		
Public Order and Community Safety			
The ability to provide a safe, secure and orderly society by following regulations and laws that prevent serious emergencies, and ensure a safe environment for those communities affected by an emergency and any responding personnel engaged in emergency operations.	Establishment of appropriately resourced NSWPF command structure to support / or lead as combat agency as required within 4 hours. Safety of declared area achieved through restriction of access and maintenance of law-and-order, utlising legislation through appropriate acts and declarations, within 36 hours of serious incident.		
Lessons Management			

NSW Core Capabilities	Suggested target	Assumptions	Scenario
The ability to collect and analyse information and data (including, but not limited to data from operations, exercises, programs and reviews) to develop, implement, validate, provide assurance and share changes intended to improve efficiency and promote good practice.	After Action Reviews are undertaken within 6 months of Level 3 incidents. Outputs are analysed and collectively shared to inform multi-agency lessons management processes; agreed recommendations are implemented in accordance with approved action plans; and change is monitored so that learning is verified.		
Organisational Resilience			
The ability of organisations to deliver business as usual (or return to business as usual) while responding to shocks and stresses including natural hazards and emergencies.	All government departments, agencies and key partners have business continuity plans. Plans are tested and reviewed annually.		
Research and Learning			
The ability to analyse key events, emerging risks and scientific information. This includes transferring information to others to improve emergency management across PPRR spectrum of activities underway, and into the future.	Continually conduct reviews into current and emerging risks and scientific information and incorporate findings into continual improvement processes to enhance capability development and emergency policy.		
Private Sector and NGO Engagement (Public, Private Partnerships)			
The ability to engage with private sector and non-government organisations to increase capacity and facilitate information sharing for a holistic response.	Scalable whole-of-government arrangements for the engagement and coordination of non-government organisations and businesses across all key sectors are in place at state, regional and local levels.		
	Local, regional, and state NGO and business		

NSW Core Capabilities	Suggested target	Assumptions	Scenario
	networks are proactively mapped, and collaborative partnerships developed.		
Land-use Planning			
The ability to plan, manage and minimise the impact of future risks within the urban environment.	Regional and local strategic plans consider natural hazards; are updated within statutory timeframes; and when updated consider any new information relating to natural hazards.		
Before and During			
Emergency Response			
The ability to respond appropriately to the emergency and its consequences in a scalable manner.			
Urban Fire Suppression	Within 24 hours of an incident, conduct firefighting operations to preserve life; and contain and suppress a major fire at a metropolitan major hazard facility, whilst reducing associated impacts.		Port Botany Incident
Bushfire Suppression	80% of bushfires contained within 10 hectares.		Bushfire
HAZMAT	Within 24 hours of an incident, identify, assess and contain major complex HAZMAT release. Render safe within two weeks.		Port Botany Incident
Storm Response	Answer 6000 calls for assistance within a 24-hour period; prioritise and render safe 24000 properties within 12 days.	Metropolitan circumstance On average during campaign storm response (hail) can achieve 2000 RFA completions per day. This	Sydney Hailstorm

NSW Core Capabilities	Suggested target	Assumptions	Scenario
		is based on a single storm event with damage spatially concentrated. Maximum call volume based on 2018 hailstorm experience. Maximum call volume unlikely to be achieved in the initial 24-hour period.	
Operations Management and Coordination			
The ability to maintain and implement command and control systems, incident management systems and operational tasking processes practiced in emergency management.	Within 6 hours of potential or actual incident establish and maintain a state-wide Level 3 integrated and coordinated incident control structure; and maintain operations for six months in support of an emergency.		Bushfire / Pandemic
Mass search and rescue			
The ability to deliver traditional and new search and rescue capabilities, including people and resources, with the goal of saving the greatest number of lives in the shortest period of time.	Complete search and rescue in the urban environment from 3000 collapsed low density residential structures for all live or deceased victims within 10 days. Complete search and rescue from within three collapsed 20 storey buildings for all live or deceased victims within 10 days.	Assumes access to properties Assumes limited bio-hazards present Assumes there is no one jurisdiction that could handle major mass search and rescue event	Local tsunami

NSW Core Capabilities	Suggested target	Assumptions	Scenario
Evacuation Support			
The ability to move and support a high volume of displaced or at-risk people and provide immediate life sustaining services including food, shelter, water, healthcare and sanitation.	Within 12 hours' notice of a major incident evacuation facilities are ready to receive 25000 people and their companion animals (5000 animals). Sustain capability for two weeks.		East Coast Low
Biosecurity management			
The ability to protect the economy, environment and community from the impact of biological threats, such as animal and plant pests, and diseases and contaminants, through a deliberate and systematic approach to protecting our borders from pests and diseases.	Contain a level 5 biosecurity incident within three months	A level five incident is where one or more jurisdictions are involved in managing the response to a biosecurity incident. The national resources are insufficient for the response and the National Coordination Centre is required to coordinate international support to affected jurisdiction/s[22].	Foot and Mouth
Mass care			

[22] National Biosecurity Committee (2012) Biosecurity Emergency Management – Biosecurity Incident Management System [Available Online] https://www.agriculture.gov.au/sites/default/files/sitecollectiondocuments/animal-plant/pihc/bepwg/biosecurity-emergency-management-biosecurity-incident-management-system.pdf

NSW Core Capabilities	Suggested target	Assumptions	Scenario
The ability to meet essential needs and provide care to high volumes of affected citizens and evacuees, both in and away from impacted areas. This includes health, psychological, aged, pharmaceutical and disability care. The ability to coordinate and manage services to meet the immediate needs of affected livestock and companion animals.	Within 12 hours of an incident triage 2000 injured people and commence treatment and transfer to appropriate facilities.		Local Tsunami
During and After			
Fatality Management			
The ability to provide fatality management services including: decedent remains recovery and victim identification; work with partner organisations to provide mortuary processes, temporary storage or permanent internment solutions; share information with mass care services to reunite family members and caregivers with missing persons or remains; and provide counselling to the bereaved.	Within 12 months of an incident, complete the scene, mortuary (4800 fatalities) ante-mortem and reconciliation phases (3600 fatalities).	Scenario drawn from GA analysis for catastrophic disasters working group Constraints that there will still be missing people Some deceased may never be identified or claimed Assumes resources will be available 30 to 50 deceased recovered per day	Local Tsunami

NSW Core Capabilities	Suggested target	Assumptions	Scenario
		Deceased are death by drowning and identification can be taken via facial recognition and fingerprints initially	
Essential Services and Infrastructure Maintenance and Restoration			
The ability to stabilise critical infrastructure functions, minimise health and safety threats, and efficiently restore and revitalise systems and services (social and physical) to support a viable, resilient community.	Stabilise priority essential services to 99% of availability, including hospitals, emergency response facilities, local water service, telecommunications and electric utilities services for residents and businesses, to support response efforts and life sustainment within one week of an incident.	Assumes a state-wide disruptive event	Solar Storm
Impact Assessment			
The ability to provide all decision makers with relevant information regarding the nature and extent of the hazard. This includes any potential consequences during and after an emergency to ensure efficient, timely and appropriate support for communities.	Within 24 hours following an emergency complete wide area first pass impact assessment of impacted areas comprising 1/3 of the state area (utilising station/brigade/unit networks). Within three days following an emergency complete wide area impact assessment of impacted areas comprising 1/3 of the state area completed (utilising imagery and field	Various stage of impact assessment completed by different methods (e.g. remote sensing v. field teams) Wide area assessment conducted utilising satellite, air photography etc.	East Coast Low

NSW Core Capabilities	Suggested target	Assumptions	Scenario
	resources). Within 1 week following an emergency complete a rapid damage assessment of impacted areas comprising 1/3 of the state area. Within 1 month following an incident complete a detailed building and infrastructure impact assessment of impacted areas comprising 1/3 of the state area.	Targets utilise USAR definitions	
Crisis Leadership			
The ability to lead and manage a response or recovery to a crisis or emergency, including the activation of political emergency response and community leadership.	Within 3 hours of actual or imminent crisis, support arrangements to be in place to support Cabinet Crisis Policy Committee and maintained for 3 months.	Within three hours initial structure established which will be improved over time	Local tsunami
Logistics and Supply Chain Management			
The ability to establish, sustain and adapt an appropriate supply chain. This will support response and recovery to deliver essential services, materials, equipment, and to establish emergency power, telecommunications and fuel support including: alternative routes, emergency permits and escorts for responders, clearing and restoration of damaged roads.	Commence logistics and supply chain planning within 3 hours for emergency management response. Mobilise commodities, resources and services to support 5000 responders. Maintain distribution system for 6 months.	5000 responders are deployed at any one time	Bushfire
Economic recovery			

NSW Core Capabilities	Suggested target	Assumptions	Scenario
The ability to return economic and business activities (including food and agriculture) to a healthy state and restore livelihoods, businesses, tourism, productive land, development of business and employment opportunities, that result in a sustainable and economically viable community.	Rapid assessment of economic impacts of affected businesses across 1/3 of the state completed within 1 week of an incident. Detailed assessment of economic impacts of affected businesses across NSW completed within 1 month of an incident. 50% of affected businesses registered for support within 1 month.	Assumes assessment of direct and indirect impacts	East Coast Low
Social recovery			
The ability to provide assistance and access to services that allow individuals, families and communities to effectively function after an emergency event. This includes safety, security, shelter, health and psychosocial welfare and re-establishment of elements of society necessary for well-being.	Access to recovery supports established within 48 hours to service 100000 people for three months. Within one week of a disaster declaration agree initial NSW recovery models to meet the safety, security, shelter, health and psychological welfare needs of 100000 people. Maintain capability for three months. Establish recovery support services to provide case management services support to meet the needs of 10000 households for 18 months.		East Coast Low
Natural environment recovery			
The ability to restore the natural environment, such as water, air, land, soil, plants and animals.	Environmental risk and impact assessment completed, and management plans established within 1 month of an incident commencing involving a Level 3 or above incident.		Bushfire

NSW Core Capabilities	Suggested target	Assumptions	Scenario
	Develop a disaster waste management plan within 14 days of an incident commencing involving a Level 3 or above incident.		

CAPABILITY MEASUREMENT AND METRICS

Note before use in planning activities: this analysis is experimental and resource requirements may be greater or less than results indicate. The analysis is assumptions based, utilising different assumptions will result in different estimated resource requirements.

Capability metrics are described in assumptions sections of each table.

Emergency Response (HAZMAT)

Scenario: Port Botany Fire and HAZMAT

Method: Desktop exercise scenario

Table 5: People requirement

Role	People required	People required plus 10%	Assumptions
FRNSW (IMT)	54	59	9 people. 12hr shift. 5 days on then complete rotation. Two weeks effort required.
FRNSW (SOC)	30	33	5 people. 12hr shift. 5 days on then complete rotation. Two weeks effort required.
FRNSW Pumpers - HAZMAT response	320	352	20 Pumpers. 4 people per pumper at peak of response. 12hr shifts. Crews each spend 1 shift in 48hr period on site (Result represents peak resourcing for initial 48hrs)
FRNSW – Specialist HAZMAT	24	26	3 specialist HAZMAT teams. 2 people per specialist HAZMAT team at peak of response. 12hr shifts. Each team spends 1 shift in 48hr period (Result represents peak resourcing for initial 48hrs)
Scientific Officer	4	5	1 person. 8hrs shifts. 5 days on 2 days off. Two weeks effort.
FRNSW Pumpers – evacuation response support	48	53	4 Pumpers. 4 people per pumper. 8hr shifts. 12hrs between shifts. (Result represents peak resourcing for initial 48hrs)
RPAS Pilots	4	5	1 pilot per 8hr shift. 5 days on 2 off. Two weeks effort
Port Authority	42	46	10 people. 8hr shift. 5 days on 2 off. Two weeks effort.
NSW Ambulance Paramedics	40	44	20 Ambulances at peak of response. 2 paramedics per Ambulance (Peak resourcing

Role	People required	People required plus 10%	Assumptions
			three hours)
EPA	11	12	2 people. 6hrs shifts. 12hrs between shifts.
EngFAC	22	25	4 people structural assessment team. 6hr shifts. 12hrs between shifts. Two weeks effort.
Police – evacuation response	100	110	50 police teams of 2x Officers at peak of the event
Police Operations Centre	60	66	30 people at peak of the event. Night and day shift
Police site command	9	10	3 people. 6hrs shifts. 12hrs between shifts. (Result represents peak resourcing for initial 48hrs)

Table 6: Resource requirement

Resource	Resources required	Resources required plus 10%	Assumptions
NSWFR Pumpers	92	101	Pumpers rotated at change of shift (Peak resourcing for 48hrs = 4 shifts)
NSWFR Specialist HAZMAT	8	9	Rotated at change of shift (Peak resourcing for 48hrs = 4 shifts)
NSWFR Major Control Vehicle (MCC)	1	1	
FRNSW RPAS	1	1	
EPA air monitoring equipment	5	6	

Assumptions

The following assumptions were made in the analysis:

- 100 pumpers are available in the Greater Sydney Area
- 2 pumpers are allocated per alarm level
- Port Authority would be the combat agency for ship fire but use FRNSW resources for fire fighting
- Port Authority hold a copy of the ship manifest
- Resulting plume from shipboard fire is hazardous to human health. People report respiratory symptoms
- Decontamination would only be required on site using a crude wet decontamination process
- Evacuation of surrounding area would be required. Messaging would be supported by Emergency Alert and PIFAC
- Fire suppressed within two days

Mass Search and Rescue

Scenario: Wollongong Tsunami

Method: Desktop exercise scenario and qualitative assumptions-based analysis

Table 7: People requirement

Role	People required	People required plus 10%	Assumptions
CAT 2 Operators	599	659	1 Heavy USAR Team per major multistorey structural collapse x3. 72 operators per team. Assumes full rotation after 5 days and resources operational for 10 days. An additional 167 CAT 2 Operators required to assist rescue from residential structural collapse, based on 20% of rescues requiring tech rescue support and teams comprising of 2 operators working 12hr daytime shifts only for 72 hours. Assumes average rescue time is 5hrs per collapse.
CAT 1 Operators	1278	1406	Assumes operators for residential collapse plus operators to support multi-story collapse rescue. 6 per team plus paramedic. 72 hours for completion to search and rescue from 3000 residential buildings (40% have someone trapped). Assumes 30 mins for structures where no one is trapped. 5 hours per structure where someone is trapped. Teams work 12hrs shifts daytime only due to need for lighting. 128 operators to support multi-story structural collapse. 4th Alarm per site
FRNSW HAZMAT	24	26	4 specialist HAZMAT. 8hr shifts.
Paramedics	198	217	1 paramedic per CAT 1 team. Plus 1 paramedic per CAT 2 team at multi-story collapse.
Engineers	6	7	2 per major structural collapse. Would utilise builders to assist. Builder required for every collapsed residential structure with someone trapped

Table 8: Resource requirement

Resource	Resources required	Resources required plus 10%	Assumptions
Technical rescue vehicle	300+	330+	Residential structural collapse response would require resources equivalent to 300 technical rescue vehicles. Assumes 1 technical vehicle required for 2 structural collapses
USAR cache	6		Based on deployment of six USAR teams

Assumptions

The following assumptions were made in the analysis:

- Most survivors will be rescued by relatives or neighbors (60 to 100%)
- There is a need to also maintain firefighting and rescue accountabilities state-wide
- There will be significant disruption to local self-responders – assume greater than 50%
- Access limitations will provide operational constraints
- Structural triage important to prioritise where resources are needed the most
- Collapsed structures are distributed evenly across sectors and the need for resources also
- 40% of buildings had someone trapped (1200)
- 20% of total collapses require tech rescue vehicle support
- Most HAZMAT incidents would be within the capabilities of general fire fighters
- Mixed teams made up of different agencies could be utilised.

Historical Analysis

An analysis of people and resources reported to have been involved in historical mass search and rescue incidents was conducted. The results are shown in Table 9.

Table 9: Historical analysis

Event	Task	Resources
Florida Building Collapse 2021	Partial collapse of a 12-story apartment block. The collapse involved 55 apartments. 97 people were killed. Event occurred during summer with hot temperatures. There were no survivors after the early hours of the incident.	Some 450 SAR personnel from the state of Florida and another 400 SAR personnel from DHS/FEMA worked 24/7 for 13 days to locate survivors and remove victims. International support was provided by Israel and Mexico. Reports were that the Mexican team were not utilized. The Israel team was specifically used to address the needs of Jewish victims. Rescuers worked 12 hr. shifts[23].
Christchurch Earthquake 2011	Assessed buildings in CBD area and over 750 private homes. At-least four large multi-story structures suffered collapses including the catastrophic failure of a six-story building killing 115 people (CTV building)	NZ Domestic Response – 130 persons. International response – 441 persons. Most teams deployed for 8 to 10 days. Nearly all successful rescues were achieved prior to arrival of international teams. Teams were utilised to locate and extract deceased; and search damaged buildings for injured or deceased. Some teams were deployed regardless of the need for their services. Australia deployed two teams that were rotated with a single team. Minimal use of local volunteer rescue teams 40 fire appliances were utilised[24].
Japanese EQ and Tsunami	Approx. 20000 dead and 27000 injured. 125000 buildings ruined.	The Japanese response was aided by an international response consisting of 890 USAR specialists and 37

[23] Fire Rescue 1 (2021) The Surfside condo collapse: An operational play-by-play, from deployment to AAR.
The Palm Beach Post (2021) Miami condo collapse: Rescue team travels from Mexico to sit on the sidelines

[24] Review of the Civil Defence Emergency Management Response to 22 February Christchurch Earthquake

Event	Task	Resources
		rescue dogs from 15 countries Some 100,000 members of the Japanese Self-Defense force were mobilised to respond[25].
Nepal Earthquake 2015	Damage was widespread and entire villages destroyed including thousands of buildings. Close to 9000 people were killed and 22000 injured USAR teams' task to locate, extract and provide initial medical support to victims.	Some 76 international USAR teams consisting of 1871 personnel and 118 rescue dogs. Teams came from 31 different countries. About 90% of the Nepalese Army was involved in the response (approx. 90,000 people)[26].

[25] Centre for Excellence In Disaster Management and Humanitarian Assistance (2011) Japan Earthquake and Tsunami Update Britannica – relief and rebuilding efforts
[26] OCHA (2015) USAR Nepal Earthquake Response – Technical Evaluation Wikipedia – April 2015 Nepal Earthquake

Community Information Alerts and Warnings

Scenario: 2019/20 Bushfires

Method: Desktop exercise scenario

Table 10: People requirement

Role	People required	People required plus 10%	Assumptions
State resources			
State Public Information Unit	23	25	Assumes 12 people required at peak. 3 people at night and low periods. This includes the roles of Coordinator, SPIO, SDMO, WUO, Major Fire Updates and Media Officers). 4 days on 2 days off with 12-hour shifts.
NSW SES	2	2	Public information supporting - including re-posting and PIFAC
NSWFR	2	2	Public information supporting - including re-posting and PIFAC
RFS	2	2	Public information supporting - including re-posting and PIFAC
NSW Police	2	2	Public information supporting - including re-posting and PIFAC
Transport	2	2	Public information supporting - including re-posting and PIFAC
NSW Ambulance	2	2	Public information supporting - including re-posting and PIFAC
NSW Health	2	2	Public information supporting - including re-posting and PIFAC
NSW Families and Justice	2	2	Public information supporting - including re-posting and PIFAC
Resilience NSW	2	2	Public information supporting - including re-posting and PIFAC
Department of Premier and Cabinet	2	2	Public information supporting - including re-posting and PIFAC
Multicultural NSW	2	2	Public information supporting - including re-posting and PIFAC
Bushfire Inquiry Line	90	99	At peak 40 during day 20 at night. 4 days on 2 days off
PIC	45	50	At peak 20 during day 10 at night. 4 days on 2 days off
000 takers providing bushfire info	24	26	4 at peak at each centre (x2). 4 days on 2 days off
Regional resources			
ICC	108	119	Assumes 4 people required at the peak during day. 2 at night. 1 at non peak times. At-least 12 ICCs. 4 days on 2 days off

Role	People required	People required plus 10%	Assumptions
Local resources			
Door knocking teams	48	53	Assumes 24 teams of two

Fatality Management

Scenario: Wollongong Tsunami

Method: Quantitative Assumptions Based Analysis

Table 11: People requirement

Role	People required	People required plus 10%	Assumptions
Body recovery			
NSW PF DVI	309	339	**Scenario A - 1 week completion**. Assumes 1 team can recover 10 bodies in 12hr shift. No night shift worked as bodies most effectively recovered during day light. Assumes 4 days on 2 days off - working seven days. Three people per team.
NSW PF (Scene coordination)	26	28	**Scenario A - 1 week completion.** Assumes span of control of 1 supervisor for 4 teams. Assumes 4 days on 2 days off - working seven days. Assumes 69 teams required
NSW PF DVI	154	170	**Scenario B - 2 week completion**. Assumes 1 team can recover 10 bodies in 12hr shift. No night shift worked as bodies most effectively recovered during day light. Assumes 4 days on 2 days off - working 14 days. Three people per team.
NSW PF (Scene coordination)	13	14	**Scenario B - 2 week completion.** Assumes span of control of 1 supervisor for 4 teams. Assumes 4 days on 2 days off - working 14 days. Assumes 34 teams required
Postmortem			
NSWPF DVI	100	110	**Scenario 1 - 4 month completion.** Assumes 50% of bodies recovered are a simple identification process taking 1hr and 50% of bodies recovered are complex identification process taking 8 hrs. Assumes 5 days on 2 days off - working 8hr shifts. Postmortem

Role	People required	People required plus 10%	Assumptions
			completed in 120 days. Assumes three people per team. Assumes 1 week of leave per person. Operational seven days per week until completion.
Health Pathology (Pathologist)	33	37	**Scenario 1 - 4 month completion.** Assumes 50% of bodies recovered are a simple identification process taking 1hr and 50% of bodies recovered are complex identification process taking 8 hrs. Assumes 5 days on 2 days off - working 8hr shifts. Postmortem completed in 120 days. Assumes 1 week of leave taken per person. Operational seven days per week until completion.
Health Pathology (Technician)	33	37	**Scenario 1 - 4 month completion.** Assumes 50% of bodies recovered are a simple identification process taking 1hr and 50% of bodies recovered are complex identification process taking 8 hrs. Assumes 5 days on 2 days off - working 8hr shifts. Postmortem completed in 120 days. Assumes 1 week of leave taken per person. Operational seven days per week until completion.
NSWPF DVI Supervisor	8	9	**Scenario 1 - 4 month completion.** Assumes span of control of 1 supervisor for four teams. Assumes 5 days on 2 days off - working 8hr shifts. Postmortem completed in 120 days. Assumes 1 week of leave taken per person. Operational seven days per week until completion.
Health pathology mortuary supervisor	2	2	**Scenario 1 - 4 month completion.** 1 supervisor required across all teams. Assumes 5 days on 2 days off - working 8hr shifts. Postmortem completed in 120 days. Operational seven days per week

Role	People required	People required plus 10%	Assumptions
			until completion.
Health pathology supervisor	2	2	**Scenario 1 - 4 month completion.** 1 supervisor required across all teams. Assumes 5 days on 2 days off - working 8hr shifts. Postmortem completed in 120 days. Operational seven days per week until completion.
Health pathology administration assistant	2	2	**Scenario 1 - 4 month completion.** 1 admin support required across all teams. Assumes 5 days on 2 days off - working 8hr shifts. Postmortem completed in 120 days. Operational seven days per week until completion.
NSWPF DVI	50	55	**Scenario 2 -8 month completion** - Assumes 50% of bodies recovered are a simple identification process taking 1hr and 50% of bodies recovered are complex identification process taking 8hrs. Assumes 5 days on 2 days off - working 8hr shifts. Postmortem completed in 240 days. Assumes 2 weeks of leave taken per person. Operational seven days per week until completion.
Health Pathology (Pathologist)	17	20	**Scenario 2 -8 month completion** - Assumes 50% of bodies recovered are a simple identification process taking 1hr and 50% of bodies recovered are complex identification process taking 8hrs. Assumes 5 days on 2 days off - working 8hr shifts. Postmortem completed in 240 days. Assumes 2 weeks of leave taken per person. Operational seven days per week until completion.

Role	People required	People required plus 10%	Assumptions
Health Pathology (Technician)	17	18	**Scenario 2 -8 month completion** - Assumes 50% of bodies recovered are a simple identification process taking 1hr and 50% of bodies recovered are complex identification process taking 8hrs. Assumes 5 days on 2 days off - working 8hr shifts. Postmortem completed in 240 days. Assumes 2 weeks of leave taken per person. Operational seven days per week until completion.
NSWPF DVI Supervisor	4	5	**Scenario 2 -8 month completion** - Assumes span of control of 1 supervisor for four teams. Assumes 5 days on 2 days off - working 8hr shifts. Postmortem completed in 240 days. Assumes no leave taken. Assumes 2 weeks of leave taken per person. Operational seven days per week until completion.
Health pathology mortuary supervisor	2	2	**Scenario 2 -8 month completion** - 1 supervisor required across all teams. Assumes 5 days on 2 days off - working 8hr shifts. Postmortem completed in 240 days. Operational seven days per week until completion.
Health pathology supervisor	2	2	**Scenario 2 -8 month completion** - 1 supervisor required across all teams. Assumes 5 days on 2 days off - working 8hr shifts. Postmortem completed in 240 days. Operational seven days per week until completion.
Health pathology administration assistant	2	2	**Scenario 2 -8 month completion** - 1 admin support required across all teams. Assumes 5 days on 2 days off - working 8hr shifts. Postmortem completed in 240 days. Operational seven days per week until completion.
Ante Mortem			

Role	People required	People required plus 10%	Assumptions
Forensic or missing person social worker	8	9	Interviews required for 60% of fatalities. 2 interviews completed per team per day. Assumes 5 days on 2 days off working 8hr shifts. Ante Mortem completed in 1 year. 1 social worker per interview team. Operational seven days per week until completion. 4 weeks of leave taken.
NSW PF	15	17	Interviews required for 60% of fatalities. 2 interviews completed per team per day. Assumes 5 days on 2 days off working 8 hr shifts. Ante Mortem completed in 1 year. 2 NSWPF per interview team. Operational seven days per week until completion. 4 weeks of leave taken.

Table 12: Resource requirement

Resource	Resources	Resources plus 10%	Assumption
Body Recovery			
DVI Backpacks	800	880	Assuming 2/3 of fatalities are adults and 1/3 children. Each DVI backpack has resources for 4 adults and 4 children.
Body storage spaces	4800	5280	Assuming 80% recovered - maximum capacity
Post Mortem			
Tables and associated equipment	33	37	Scenario 1 - 1 table and associated equipment per team
Tables and associated equipment	17	18	Scenario 2 - 1 table and associated equipment per team

Assumptions

The following assumptions were made in the analysis:

- Some deceased may never be found, identified or claimed
- 50% of deceased are death by drowning and identification can be taken via visual identification and fingerprints initially. Further challenges if bodies are not recovered in a timely manner
- 50% of deceased cannot be readily determined as drownings or identified via visual means. Bodies may be dismembered. Further challenges if bodies not recovered in a timely manner
- Event occurs during summer. Quick recovery processes utilised due to risk of body deterioration
- Body recovery more complex if fatality is suspicious
- Complex case could take 1 team 8 hours, simple case 1 team 1 hour to identify
- Disaster Victim Registration process will not be complete and not all victims will be from NSW. Not all countries will participate
- Most body recoveries will occur during daylight hours
- Coroners court can set specific standards for the event
- Additional body storage can be arranged via health infrastructure or by utilising refrigerated containers.

Historical Analysis
NSWPF provided the following information in regard to fatality management following the 2009 Black Saturday Bushfires:

Initial challenges

- Search area – sites were remotely located from Melbourne
- Multiple sites over a large area
- Ongoing fire/s
- Pressure from communities and media
- Roads blocked by fallen trees, electricity lines etc.

Body Recovery

- 293 personnel utilised in scene recovery
- 18 DVI teams at scenes
- All bodies recovered within 6 days

Ante Mortem

- 130 staff including investigators and analysts

- 52 interview teams (2 police and counsellor)
- 165 Ante Mortem interviews completed

Emergency Response (Storm Damage)

Scenario: Sydney Hailstorm

Method: Quantitative Assumptions Based Analysis

Table 13: People requirement

Role	People (6 RFA per day across day and night shift)	People plus 10%	People (11 RFA per day across day and night shift)	People plus 10%	Assumptions
Storm damage (SES, FRNSW & RFS)	3733	4107	2036	2240	4 people per storm damage team. Assumes five days on and two days off. Day and night shift worked. 12 days to complete all RFAs. Two teams required to complete day and night shifts.
Storm damage (SES, FRNSW & RFS)	4533	4987	2473	2720	4 people per storm damage team. Assumes five days on and two days off (50% of teams). Assumes 2 days travel, 3 days on and 2 days off (50% of teams). Day and night shift worked. 12 days to complete all RFAs. Two teams required to complete day and night shifts.
Storm damage (SES, FRNSW & RFS)	5280	5808	2836	3120	4 people per storm damage team. Assumes five days on and two days off (50% of teams). Assumes 2 days travel, 3 days on and 2 days off (25% of teams). Assumes 2 days travel, 2 days on and 3 days off (25% of teams). Day and night shift worked. 12 days to complete all RFAs. Two

Role	People (6 RFA per day across day and night shift)	People plus 10%	People (11 RFA per day across day and night shift)	People plus 10%	Assumptions
					teams required to complete day and night shifts.
IMT	42	46.2	42	46.2	12 people - 12hr shifts - 4 days on 3 days off - day and night. 12 days to complete all RFAs.
Division	84	92.4	84	92.4	8 people x 3 divisions - 12hr shifts - 4 days on 3 days off - day and night. 12 days to complete all RFAs.
SCC	28	30.8	28	30.8	8 people - 12hrs shifts - 4 days on 3 days off - day and night. 12 days to complete all RFAs.

Table 14: Resource requirement

Resource	Resources required (6 RFA per day across day and night shift)	Resources required plus 10%	Resources required (11 RFA per day across day and night shift)	Resources plus 10%	Assumptions
Vehicles (equipped or with trailer)	333	367	182	200	Assumes that day and night shift utilise same vehicle, and that vehicles are not rotated on change of shift. 1 vehicle per team.
Tarps	16008	17609	16008	17609	2/3 of damaged properties require tarping. Where requiring

Resource	Resources required (6 RFA per day across day and night shift)	Resources required plus 10%	Resources required (11 RFA per day across day and night shift)	Resources plus 10%	Assumptions
					tarping 1 tarp per property.
Rope (m)	800400	880440	800400	880440	2/3 of damaged properties require tarping. Where requiring tarping 50m of rope required per property.
Tubes of silicon	7992	8791	7992	8791	Where not requiring tarping 1 tube of silicon required per property.
Sandbags	96048	105653	96048	105653	2/3 of damaged properties require tarping. Where requiring tarping 6 sandbags required per property.
Black plastic	7992	8791	7992	8791	Where not requiring tarping 1m of black plastic per property.
Elevated work platforms	17	18	9	10	Assumes 5% of RFAs require EWP

Assumptions

The following assumptions were made in the analysis:

- Storm impacts area of Sydney with a significant proportion of tiled roofs >90%
- Damage to solar panels could slow completion rates
- Presence of asbestos unlikely to slow completion rates significantly

- Assume <5% of RFAs require elevated work platform
- Emergency services would need to maintain primary fire and rescue accountabilities
- Teams can be mixed: for example, comprising SES, FRNSW and RFS.

Historical Analysis

1999 Sydney Hailstorm

At the peak of the response some 3000 personnel were deployed in the field. In all some 44,000 calls for help were attended involving around 20,000 properties, requiring 12,450 personnel in all to deal with[27]. Some 200,000 tarpaulins, 280000 sandbags and 9600 km of rope was reported to have been used[28].

2007 Blacktown Hailstorm

Over the ten days of the operation teams from all NSW SES Regions plus ACT SES were deployed. This resulted in 550 team shifts over this period of time. NSWFR reported deploying 60 fire engines to assist NSW SES on a daily basis. During the first week up to 150 teams from various services were in the field each day. This figure grew to 220 per day in the second week with more than 1000 personnel in the field at a time. At the conclusion of the operation close to 6000 RFAs had been responded to.

In responding the event the SES used large quantities of consumable materials and small equipment items. Some of these were already in storage and more than one million dollars was spent on additional consumables during the operation. The following quantities were used:

- 10600 tarpaulins
- 1730 km of rope
- 8900 rolls of gaffer tape
- 35500 tubes of silicon
- 5500 sandbags
- 336 km of SES barrier tape
- 800 pairs of gloves
- 330 pairs of safety goggles
- 90 rolls of black plastic[29]

[27] Gissing (2019) Australia's largest hailstorm disaster
[28] SES (2008) The Western Sydney Hailstorm 2007
[29] SES (2008) The Western Sydney Hailstorm 2007

DISCUSSION AND CONCLUSIONS

There are a variety of approaches utilised internationally and within Australia to assess the maturity or readiness of capability. There is no standard of best practice, and all approaches are associated with uncertainties and limitations including:

- Lack of data
- Lack of SME experience with severe-to-catastrophic disasters
- They are assumptions based and assumptions can vary across different scenarios and management decisions.

There are, however, principles that can be utilised to guide capability maturity analysis. These include that capability maturity maturity should:

- Focus on collective capability maturity, not just the capability maturity of an individual organisation
- Explore all capability elements of people, resources, governance, systems and processes
- Involve a diversity of different organisations that might be involved in the delivery of the capability including all levels of government (Local, State and Commonwealth), businesses and NGOs.
- Be collaborative and promote sharing of information between organisations about capability
- To the extent possible be supported by data
- Enable temporal comparison of capability maturity
- Be informed by capability targets to provide a baseline to measure against
- Be designed to suit the expertise and resourcing available within a jurisdiction to undertake it
- Be regularly reviewed and validated
- Be linked to planning and capability enhancement initiatives.

Given the need for Australia to utllise a nationwide approach to capability as articulated in the Australian Disaster Preparedness Framework, it is important that a consistent approach to capability maturity assessment be utilised in the future suited to the Australian context.

SUGGESTED APPROACH

The existing BNHCRC Capability Maturity Assessment Tool is being encouraged for use nationally. Home Affairs are also utilising the tool to assess capability at a national level. The tool specifically connects with capability targets through the criteria utilised. It is suggested that the approach undertaken already by NSW

utilising the BNHCRC Capability Maturity Assessment Tool be repeated in the future to establish an ongoing assessment of capability maturity.

A self-assessment approach as utilised in some jurisdictions does not provide for the significant benefit of diverse group discussions between stakeholders that often lead participants to identify other sources of capability and to develop richer relationships between partners. Stakeholders who were involved in this project and the previous NSW Capability Maturity Assessment noted these benefits.

Some refinements to the BNHCRC Capability Maturity Assessment Tool and process could be made through the utilisation of findings from this research. These include:

- Validating and utilising the capability targets to provide a defined benchmark to measure against. Further research into the impacts of severe-to-catastrophic disaster scenarios will assist to refine capability targets[30]
- Introduction of a confidence assessment component of the BNHCRC Capability Maturity Assessment Tool
- Introduction of a component of the assessment approach which explores the reasons for any changes in capability maturity from previous assessments
- For a selection of higher risk/ priority capabilities that a validation process be introduced to validate the results of the qualitative based assessment. This could include:
    - Undertaking reviews of specific capabilities after they have been deployed during real events (AARs)
    - Comparison with a collection of known events where capability and capacity data are available
    - Testing capability maturity via targeted exercises like what has been undertaken in this research
    - Quantitative assumptions-based analysis like what has been undertaken in this research.

    It is important to note as has been found in this research that results from exercises and quantitative analysis based on SME opinion may not always accurately estimate the effect a capability can deliver and hence underestimate or overestimate the number of people and resources needed. To this point there is no substitute for data. To improve the accuracy of validation activities agencies should collect data on the number and type of people and resources required across the timeframe of major incidents to which capabilities relate to. Ultimately, real world events are the best validation of capability maturity.

[30] For example BNHCRC Scenarios Project [Available Online] bnhcrc.com.au/research/disasterscenarioanalysis

- To improve buy-in from stakeholders it will be important for the State Emergency Management Committee to develop a policy on capability maturity assessment and annual preparedness reporting.
- The approach for a sample of capabilities could also be trialed at a regional level and linked to emergency planning and risk assessment activities.

Overall model

The overall suggested model is illustrated in Figure 4 and comprises the following elements:

1. Risk – all capability maturity analysis should be based upon likely severe-to-catastrophic disaster risk scenarios that face a jurisdiction. The risk-based capability principles can assist to identify the extent of risk that capability should be retained for.
2. Capability Targets – based upon the risk profile of the jurisdiction capability targets that provide planning benchmarks that represent the desired effect that capabilities aim to deliver should be established across each core capability.
3. Capability Maturity Analysis – utilising the capability targets as a planning benchmark a capability maturity analysis should be performed analysing collective capabilities in a manner that promotes information sharing between agencies involved.
4. Validation and review – the results of the capability analysis should be regularly validated and reviewed. Validation can be performed utilising data from real world incidents. Exercises and modelling can assist to validate but should be supported by data as well as subject matter expertise. The capability maturity analysis should be updated based upon validation and review activities on an annual basis.
5. Emergency planning and investment decision making - the results of capability maturity analysis should inform emergency planning.

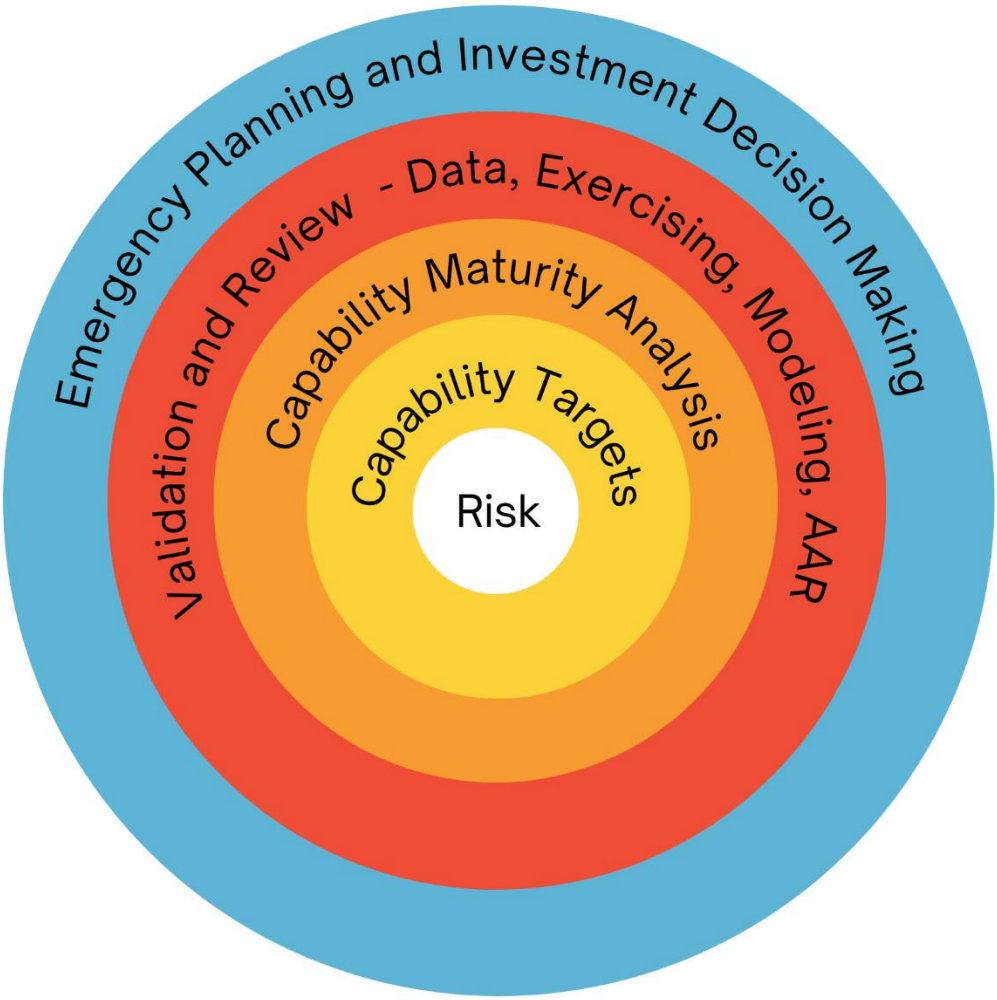

Figure 4: Suggested approach

APPENDIX 1 – SCENARIOS

2019/20 BUSHFIRES

Fires burn across the entirety of the bushfire season, burning 6.9% of the state. In total, 11,400 bushfire incidents are recorded. 2448 homes, 284 facilities and 5469 outbuildings are destroyed. There are more than 280,000 NSW RFS fire-fighter deployments, plus support from other agencies from NSW, interstate and internationally. There are an average of 90 aircraft deployed daily. A total of 26 lives are lost directly and there are some 400 excess deaths as a result of bushfire smoke.

SEVERE EAST COAST LOW

Heavy rainfall from a severe East Coast Low first drenches the city's impervious streets and small creek and river catchments, resulting in significant stormwater and flash flooding. This event is the fifth East Coast Low to impact the NSW coast this year. Flash flooding occurs with little specific warning, but rapidly subsides. Areas impacted include the Northern Beaches, Eastern Suburbs (Randwick and Rose Bay), the Inner West (Marrickville, Strathfield, Canterbury and Annandale), Parramatta, Ryde, Woronora and Fairfield. The impacts significantly disrupt the city's transport systems and lead to countless flood rescues. Some 1000 properties are flooded. (The Greater Metropolitan Area has seen significant flash flooding before, as a result of severe rainfall, in 1984, 1986 and 1988.)

Following initial flash flooding, rivers rise to severe levels, threatening communities along the Georges, Hawkesbury and Nepean rivers, necessitating large-scale evacuations across the southwest and western parts of the city. Over 20,000 properties are flooded in western and southwestern Sydney. Some 90,000 people require evacuation and temporary accommodation. Some homes are destroyed. Essential infrastructure is damaged, resulting in disruption to transport, energy, water supply, schools and businesses for days to weeks following. (These areas were hit by severe flooding in 1867, and experienced major flooding in the 1980s and 1990.)

Other communities outside of Sydney are impacted too: Wollongong's coastal creeks and the Shoalhaven, Moruya, Namoi, Macquarie, Lachlan and Murrumbidgee rivers (similar to the 1867 flood event). In these areas, flooding affects low-lying farmland, closes major roads and floods low-lying communities, including North Wagga, Cooma and Terara and parts of Forbes, Goulburn, Shellharbour, Gundagai, Tumut, Narrandera, Bathurst and the Central Coast. 2250 properties are flooded. Over 1.3 million hectares of crop and some 400,000 hectares of pastures are inundated and destroyed. Hundreds of properties remain isolated for several weeks.

As a result of high winds, NSW SES receives 20,000 calls for storm damage assistance. Trees have fallen across major roads, powerlines and railway tracks. Coastal erosion is reported along the Central Coast and Northern Beaches, with some 20 homes severely damaged.

A bulk carrier has grounded on a beach near Montague Island with some 320 tonnes of bunker fuel estimated to have leaked and now threatening the surrounding environment. Searches are underway for two small vessels missing at sea.

There have been 31 confirmed fatalities with a further 73 people missing feared dead. Hospitals have reported 450 injuries, 50 of which have required hospitalisation.

REPEAT OF APRIL 1999 SYDNEY HAILSTORM

The April 1999 Sydney Hailstorm pelted thousands of homes and vehicles in Sydney's eastern suburbs with cricket ball- and grapefruit-sized hailstones, along with heavy rain and strong winds.

The storm occurred outside the typical "storm season", which is taken to occur between September and March, but is Australia's most expensive insured natural disaster to date, with an estimated loss, in today's terms (2017), of around AUD 5.6 billion. This surpasses recent extreme insured loss events such as Queensland's 2011 floods and the Black Saturday Bushfires of 2009 in Victoria.

Over 100,000 people were affected: one person died and several were injured and attended hospitals.

Where large hailstones had fallen, there was substantial damage to roofing tiles and building windows. In the worst hit areas, including Rosebery and Kensington, almost every dwelling in whole street blocks had been damaged. Some hailstones were confirmed to have had diameters of more than nine centimetres.

Slate, tile and fibre cement roofs were particularly vulnerable. Some 12 million terracotta tiles needed to be replaced, with supplies quickly depleted.

Damaged roofs and windows resulted in torrential rain entering homes. In the most extreme cases, ceilings collapsed under the weight of saturated insulation batts. Hailstones punched holes through pergolas and outdoor furniture, often shredding gardens. Vehicles, too, suffered denting to body work and broken windows, and some motorists became trapped in floodwaters.

Many homes became uninhabitable and some remained so for months: the construction industry was placed under great stress and interstate resources were needed to meet demand. An unusually wet and windy autumn and winter slowed the emergency response and the completion of repairs.

In total, around 24,000 homes, 70,000 vehicles, 60 schools and 23 aircraft were damaged. Some 10 million dollars' worth of tarpaulins and 9600 km of rope were used to effect make-shift repairs.

At the peak of the response around 3,000 emergency personnel were deployed in the field and in total 44,000 calls for help were made to emergency services, requiring 12,450 personnel.

SOLAR STORM

A solar storm event impacts Southern Australia, infringing on power infrastructure, including a major transformer failure, resulting in major initial disruption and future load shedding. Disruption to satellite communications and transport signals occurs.

There has been physical damage to power transformers and sewerage overflows and food spoilage is significant, with a devastating impact on the economy. Industry has suffered significant impacts and is likely to experience major consequences, particularly in the sectors of finance, smelters, nuclear reactors, water/ sewerage, gas, telecommunications and logistics.

LOCAL TSUNAMI

During a February heatwave, a 3.9 magnitude earthquake occurs offshore of Wollongong, triggering a landslide on the edge of the continental shelf. The landslide results in a large, localised tsunami which impacts the Illawarra Region with no warning. Reports indicate at least four waves separated by 30 minutes, the first striking the area at 11am.

Severe damage has occurred from Austinmer to Shoalhaven Heads, with moderate impacts (strong rips, inundation of beaches and low-lying infrastructure and sinking of small vessels) experienced north to Gosford and south to Batemans Bay. There are over 3000 buildings impacted in the Wollongong region with at least 1800 building collapses. At least 6000 people have died. Over 2000 people have been injured. Many people remain in the upper sections of buildings or have fled to higher ground. Several thousand people are displaced.

At the time of the disaster, beaches are full and a local surf carnival is being held at North Wollongong beach. Hundreds of people are feared washed into nearby lagoons and streams.

Several large ships moored off Port Kembla and other smaller watercraft are missing.

Several fires are burning in residential areas. A ship is also on fire in Port Kembla after sustaining damage and bunker fuel is leaking, threatening the local marine environment.

Infrastructure (roads, rail, power, telecommunications) in coastal areas have been destroyed, with communication and power outages impacting much of the region. Three sewage plants have been destroyed and are now discharging raw sewage into the ocean. The Albion Park airport is inoperable due to tsunami debris on the runway.

There are hundreds of dead and injured animals. Hundreds of cows along the lower reaches of the Shoalhaven River have been washed into the sea. Many are left injured along beaches.

BUSHFIRE/PANDEMIC

Following a long period of drought and higher-than-average winter temperatures, an early start to the fire season occurs in August, with bushfires in the North and Mid-North Coast regions. Some 150 homes and structures are destroyed. Bushfires then subsequently occur around Port Stephens in October, resulting in a further 400 homes and structures being destroyed. Fires continue to burn throughout November, impacting the Hunter, Mid North Coast and North Coast area, resulting in further rural losses and threatening towns and villages.

In early November, an emerging virus with flu-like symptoms is reported overseas. There is no reported sustained human-to-human transmission, and the disease has not spread beyond the borders of the country of origin. However, three weeks later. Human-to-human transmission becomes widespread, with NSW reporting some 45 cases. The Australian government moves to close borders and works with jurisdictions to implement social distancing restrictions.

In early December, the virus is declared a global pandemic. A significant global economic shock is expected. At this time, NSW has experienced over 3000 cases and 100 deaths, with cases continuing to rise.

By mid-December, NSW is experiencing catastrophic fire conditions because of sustained record heatwave conditions. Fires break out around the Hunter Valley, Central Coast, Northern Sydney, the Blue Mountains, the Royal National Park, Illawarra, Shoalhaven, South Coast and Southern Highlands. Losses total 28 deaths and 2500 homes and structures destroyed (including six schools). The impacts of the heatwave and bushfire smoke see significant increases in triple zero calls and hospitalisations whilst the health system was already stretched. Damage to transmission lines in the Hunter result in some 200,000 customers losing power for over a week.

With the absence of heavy rain, fires continue to burn and spread until late February, consuming further property and threatening towns and villages. Significant wildlife losses are reported and water supply catchments impacted.

Fire activity ceases with heavy rain and storms in early March, which are also associated with landslides in fire-affected communities. In total, some 5.5m ha are burnt as a result of some 11,000 fire incidents across the season.

Virus cases peak in NSW at 120,000, with 3000 deaths in April. The state's unemployment rate reaches 7.5%.

URBAN FIRE/HAZMAT

Over summer, severe to extreme fire danger is experienced across the state due to heatwave conditions. FRNSW has activated its Bushfire Major Incident Management Plan and actioned the pre-emptive move-up of stations into the bushfire interface, reducing some of the immediate response capability across the Greater Sydney Area. Temperatures are forecast to reach 43 degrees centigrade on the coast in Sydney before a southerly change.

The *MV Macquarie*, a large container ship moored at a Port Botany Stevedores, experiences a large explosion, causing an on-board fire and sending debris hundreds of metres in surrounding directions. Burning debris lands heavily around the neighbouring Bulk Liquid Berth, rupturing a major Jet Fuel pipeline servicing Sydney Airport as well as an LPG pipeline. The section of Jet Fuel pipeline is able to be repaired and isolated, although the service disruption is significant.

The LPG pipeline leak, however, quickly escalates, and an escaping cloud of LPG runs for ten minutes before being ignited by nearby burning debris. An explosion occurs, resulting in a blast wave of close to 500 metres. Closest to the blast there is extensive damage to other facilities and subsequent fires. Damage to nearby chemical storage tanks results in the escape of chemicals into bunds, some of which ignites. Immediately following the incident there are at least 25 deaths and 150 casualties.

With the arrival of a strong southerly change, winds shift to the southeast, and the smoke plume from the container ship and chemical fires blows over the residential areas of Botany, Alexandria and Sydney Airport. Gusts reach close to 70 km/h. Flights require diversion and General Homes Drive is closed. Within several hours, hundreds of triple-zero calls and hospital emergency department visits are registered, with people complaining of severe nausea and headaches. Many on social media are reporting smelling a foul odour.

Although fires in the vicinity of the port are extinguished within 48 hours, it is expected the fire aboard the *MV Macquarie* will continue to burn, with the hazardous smoke plume drifting across residential areas and the airport. The ships Manifest advises 20% of the containers on board contain dangerous goods.

As a result of the significant amount of firefighting water being pumped onto the ship from both land-based appliances (FRNSW and Aviation Rescue Fire Fighting ARFF) and Port Authority Firefighting Vessels, it begins to affect the ship's stability as its draft at the stern has reached a critical depth. At the next low tide there is a risk it will ground on the seabed and capsize. To mitigate the risk of a catastrophic failure of the ship, the decision is made to pump out the firefighting water, which contains firefighting foam and contaminated runoff,

thus creating a water-based HAZMAT in State Waters, threatening ecological and recreational assets within Botany Bay.

The fire onboard the ship takes some four weeks to extinguish. Port Operations reopen when the fire is extinguished. There are significant economic disruptions to the Port Botany precinct until the ship is salvaged (note: the *Iron Chieftain* was moved from its dock for salvage nine months after the fire).

REGIONAL TSUNAMI

A 9.0 magnitude earthquake results in a land-threat tsunami impacting the entire NSW coastline. It results in mass casualties, and damage and disruption to utilities, buildings and infrastructure. The population potentially at risk is 1.5 million people. There are less than three hours available to warn those at risk.

FOOT AND MOUTH DISEASE

In mid-September, there was a report of signs in pigs and cattle highly suggestive of Foot and Mouth Disease (FMD) at Camden Sale Yards, Sydney NSW. The Consultative Committee on Emergency Animal Disease has just met and learnt that there are two other properties (one a piggery) with suspicious signs and that testing at the Australian Animal Health Laboratory at Geelong has confirmed that samples from the suspect pigs and cattle at the sale yard are positive for FMD.

Tracing has found that the likely source of the outbreak is a piggery that has been swill feeding and that infection has spread to adjacent cattle holdings. A number of movements of cattle, sheep and goats from the vicinity of the infected premises have been traced to Goulburn, Dubbo, Maitland and peri-urban lots around Sydney.

A national livestock standstill is initiated for the next 72 hours meaning no livestock can move off property; livestock already in motion must cease transportation.

A state of emergency is declared. By the next day, there are over 80 suspected cases.

Day 7 – Over 200 animals at Parkes, Moonbi, Berry, Wiberforce, Cattai and Wyong are confirmed as being infected. On these properties, all animals on the property are euthanised and quarantine orders placed on adjoining and nearby properties. Approximately 10,000 animals are slaughtered and disposed of within the first week of the outbreak.

Day 14 - Animals on 200 properties in NSW are showing signs of disease and have been quarantined. Approximately 50,000 animals have been slaughtered across NSW within the first two weeks of the outbreak. To ensure that disease risks from newly identified infected or high-risk properties are addressed, NSW requests mobilisation of the ADF to assist with destruction and disposal.

1 month - Major outbreaks are determined in Mid North Coast, Northern Tablelands, Central West and Southern Tablelands. A major vaccination program of 500,000 animals in strategic areas outside restricted areas commences.

6 weeks - FMD is discovered in the feral deer population around the Illawarra and Shoalhaven. Sick animals are seen in the streets and a cull on crown and public land commences.

2 months - 1,000,000 animals on 437 properties have been destroyed. Large disposal sites are identified for mass animal graves. Heavy rainfall across the North West of the state has resulted in moderate to major flooding resulting in the need for AASFA support.

4 months - Unemployment in rural NSW has jumped to 17% from between 5% and 8%. Reported suicide in rural NSW has increased, with reports of persons presenting for mental health issues.

6 months - Surveillance indicates that no animals within the original restricted areas are diseased but Australia is still not recognised as free of disease by trading partners.