2019 Small Bridges Conference

Emergency Bridging Strategy

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Main Roads WA

Overview

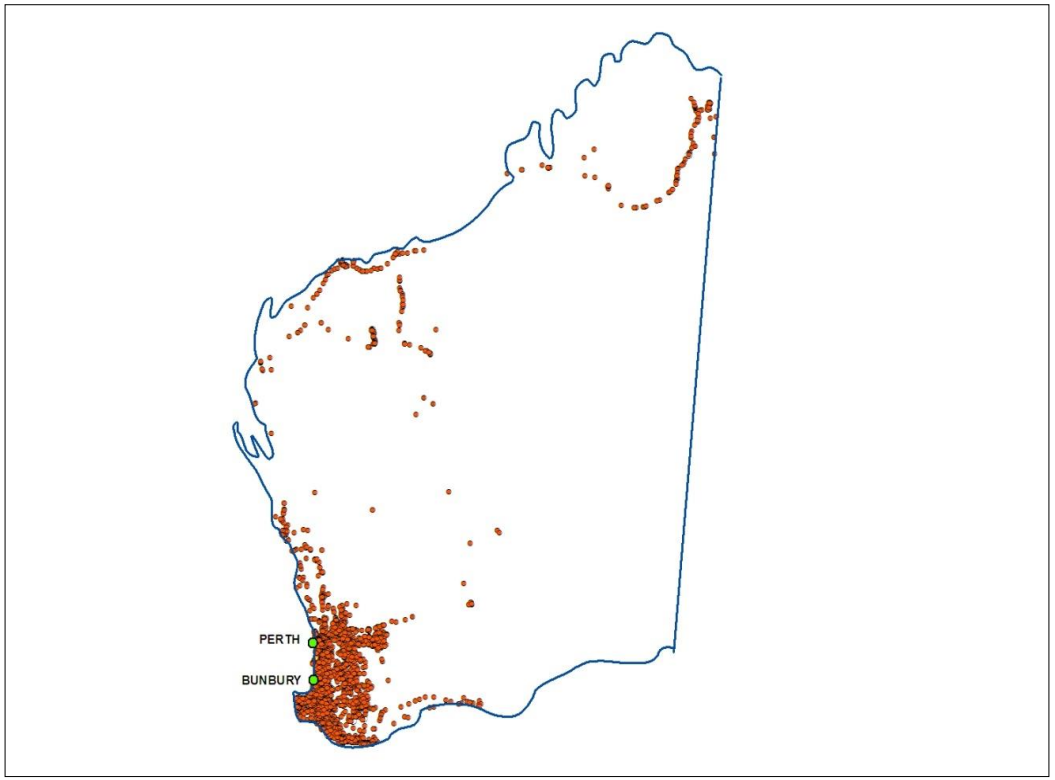
- Introduction
- The Need
- Options Considered
- Adopted Strategy
- Conclusion

Main Roads WA

- Manages network of 18,500 kms of National and State roads
- Load rates all bridges used by the public
- Provides technical advice to other bridge owners
- Programmes significant bridge maintenance/refurbishment/replacement projects for local government

Bridges in WA

- Approx 2900 bridges in the State.
- Majority in the southern regions of WA.



Main Roads' Emergency Management Roles

- Main Roads has roles under State Emergency Management Plan
- Need to respond to the loss /damage to bridges on the road network
- Initial assessment indicated that Main Roads did not have adequate emergency bridging capabilities.

Main Roads' Emergency Management Roles

- Communicate road closures to the public.
- Provide a liaison officer to the SECG, as required.
- Participate in ISG and OASG, as required.
- Provide a liaison officer(s) and other trained staff, as required and appropriate.
- Operate and coordinate control signals for all roads.
- Assist with quarantine and movement control as required (e.g. road blocks and checkpoints).
- Provide and assist in the acquisition of resources and engineering services.
- Participate in post-operational debriefs as required.
- Prepare and implement contingency traffic management plans arising from an emergency.
- To be contactable on a 24/7 basis.

Recovery

- Assist in the recovery process through road infrastructure repair and reconstruction.
- Restore assets for State highways and main roads including signage.
- Restore the Main Roads WA network, including clean-up and construction of bridge assets during recovery operations.
- Provide support as required by the incident controller.

4. SERVICE PROVIDERS

ATCO GAS AUSTRALIA

Role

ATCO GAS Australia provides a gas supply role as an 'infrastructure operator' during a disruption to gas supplies as a result of an emergency situation or state of emergency.

ATCO GAS also is a member of the Essential Services Network Operators Reference Group (ESNROG), which exchanges information to assist or improve operations of essential services and functions in relation to EM for the benefit of the community. ATCO GAS is also represented on the Gas Emergency Planning Committee, which is responsible for non-operational strategic planning relating to gas supply issues in Western Australia and preparing and maintaining State Hazard Plan - Energy Supply Disruption.

Responsibilities

Prevention

- Contribute to prevention through adherence to relevant legislation and good industry practice.
- Prevent and minimise the risk of injury, death or damage to property or the environment.
- Prevent and minimise the disruption to essential network services.
- Assist in the prevention or reduction of the severity and impact of the hazard.

Main Roads' Emergency Management Roles

- Main Road's previous emergency strategy - detour traffic around closed bridges using other roads while bypass road is constructed allowing for the construction of a new structure.
- Emergency bridging has been limited typically to the use of temporary circular steel pipe culverts.
- It can take several years to design and construct a replacement structure. In the meantime, the closed crossing could cause significant disruptions to the road network.

The Need

- In 2005 private bridge at Roelands Village washed away.
- Bailey bridge loaned from Main Roads
- Load capacity unknown.

The Need

- Large culvert in Shire of Augusta/Margaret River
- Washed away in July 2013
- Asked for assistance from Main Roads – unable to help

The Need

- Waroona bushfires in 2016
- Samson Brook Bridge on South Western Highway (Bridge 0149) destroyed
- Two week closure while side track installed

The Need

The Need

"On the evidence available, the Special Inquiry concludes that the essential services performed within their service standards. This, however, should not be reason for complacency. The cost arising from essential service interruptions to commercial businesses and their ability to get back to normal operations is inextricably linked to the resilience of infrastructure and its rapid restoration when damaged. Continually improving and hardening such infrastructure is good crisis management, sound business and is the expectation of customers and the community." (Euan Ferguson - former Vic CFA Chief)

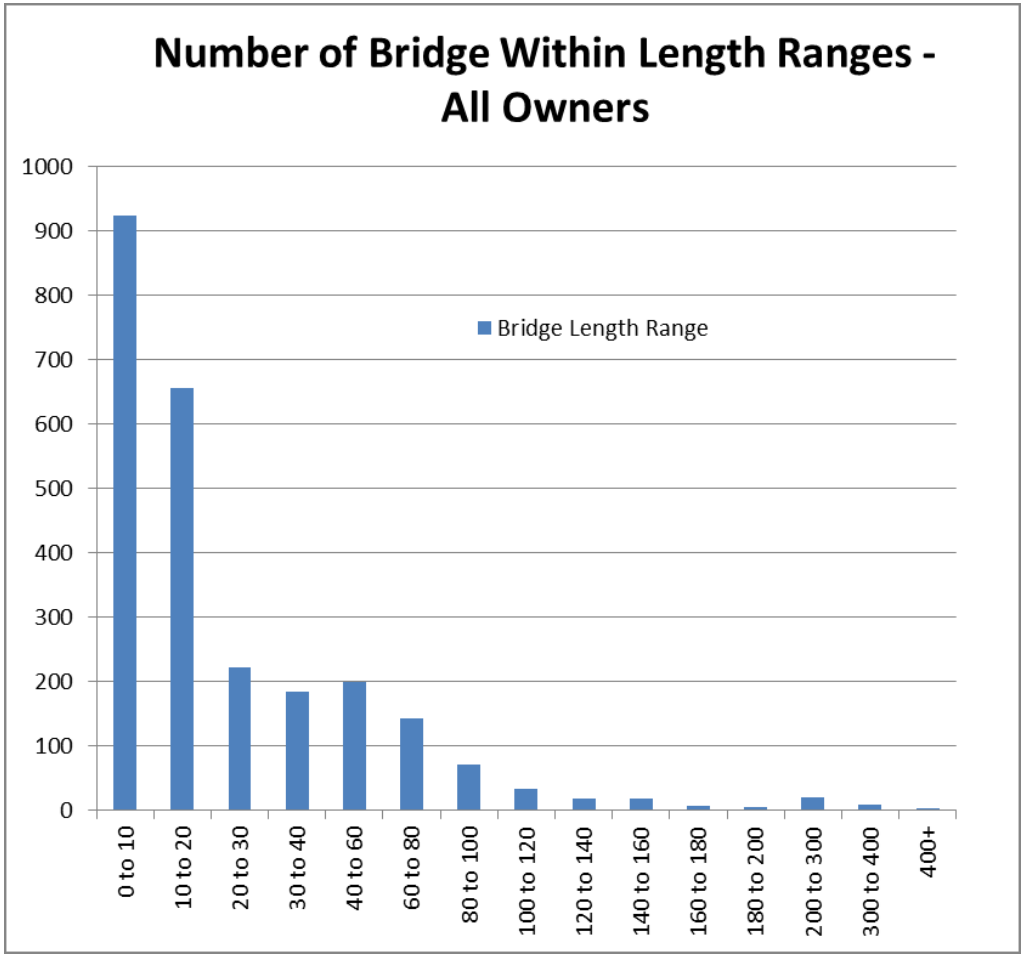
Emergency Bridging Team

- Main Roads' Team convened in August 2012 to oversee the development of the Emergency Bridging Strategy
- consisted of representatives from five regions and Structures Engineering and the Crisis and Emergency Management Manager

Emergency Bridging Criteria

- minimum single span of 21m
- single lane
- VSR load capacity (as of right loads)

Emergency Bridging Criteria



Existing Emergency Bridging Systems Owned By Main Roads

- 1943 Bailey Bridge
- Small Box Girder Bridge

1943 Bailey Bridge

- Designed by Donald Bailey
- Design used prefabricated panel and components
- Can be carried by trucks and assembled using manpower alone
- Erection used simple tools (ropes, pulleys, jacks and hammers)
- Could be moved, rebuilt or replaced in several hours (even under enemy fire!)
- Incredibly versatile
- Generally launched by hand

1943 Bailey Bridge

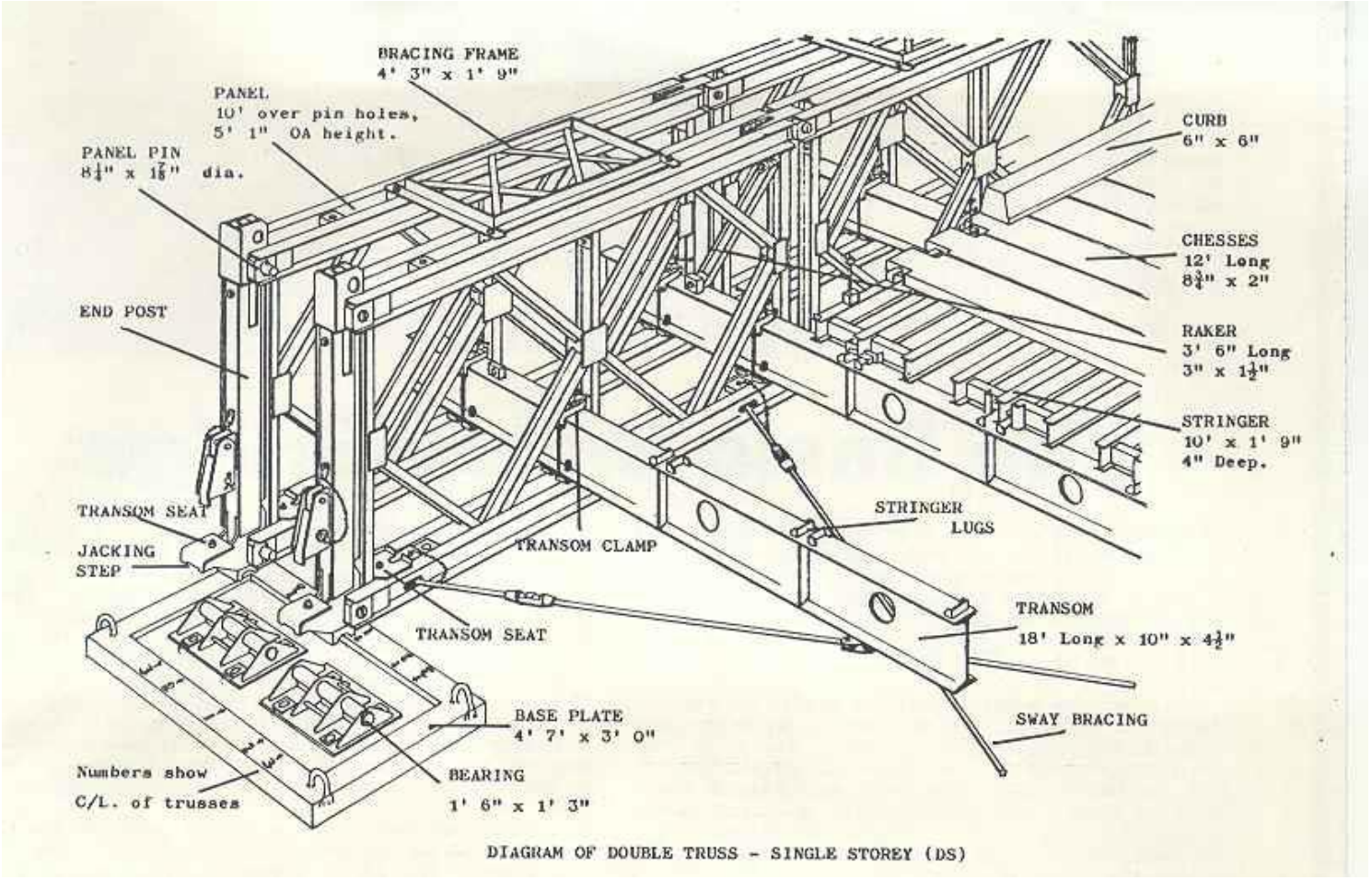
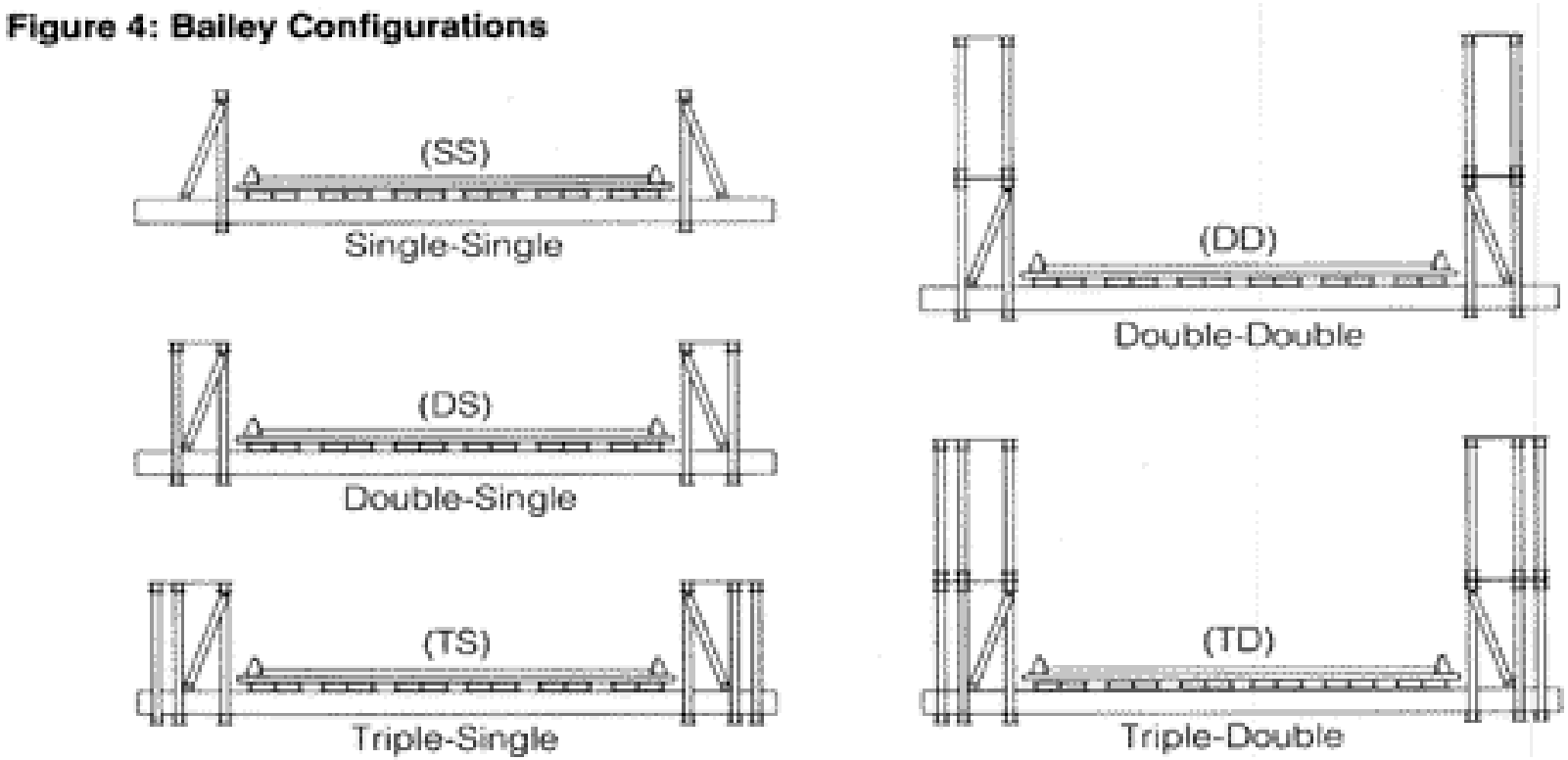


DIAGRAM OF DOUBLE TRUSS - SINGLE STOREY (DS)

1943 Bailey Bridge



Truss panels can be stacked or mated to increase span and/or load capacity

1943 Bailey Bridge

1943 Bailey Bridge

1943 Bailey Bridge

- “Without the Bailey Bridge we should not have won the war. It was the best thing that we ever had.” Field Marshal Montgomery.
- “ … one of the three pieces of equipment that most contributed to our victory in Festung Europa.” General Eisenhower.

Small Box Girder Bridge

- small assault bridge that could be used to span gaps of up to 30 feet.
- typically carried on a tank
- could be deployed without engineers having to expose themselves to enemy fire
- design had been formally adopted by the British Army in 1932

Small Box Girder Bridge

Small Box Girder Bridge

- Australia Army designed its own version of the SBG bridge and it is this type that Main Roads owned
- Under-bridge box girder comprised of end and intermediate sections
- The use of SBG bridges by Main Roads in the past is unknown.

Small Box Girder Bridge

Condition Assessments

- SW Engineering Consultants was engaged in May 2011
- Carried out a broad condition assessment of the 1943 Bailey and Small Box Girder bridging system components
- Assessment examined suitability of these systems for Main Roads

Condition Assessments

- some Small Box Girder bridging components were rusty
- a number of connectors had also been damaged due to incorrect handling/lifting.
- Main Roads has a small number of components for the SBG bridging system.

Condition Assessments

- Bailey bridging system missing some components
- some components modified, others damaged from incorrect handling/lifting
- damage included bent sections and cracked welds
- many components were rusty
- SW Engineering Consultants then carried out a detailed condition assessment of the Bailey bridge components in 2015.

Condition Assessments

Test Table

Condition Assessments

Placing panel on table

Condition Assessments

Measuring depth of corrosion

Condition Assessments

Measuring pin hole wear

Condition Assessments

Panels sorted into Green, Yellow & Red Stacks

Condition Assessments

Transoms in Yellow Stack

Condition Assessments

Galvanised Bracing frames in good condition

Options Considered for Single Spans > 21m

- **Option 1 – do nothing**
- Main Roads unable to fully meet its roles under the State Emergency Management Plan without an emergency bridging system
- Department of Defence advised it was not in a position to provide a reliable emergency bridging service to WA.
- Option 1 was therefore rejected.

Options Considered for Single Spans > 21m

- **Option 2 – refurbish Bailey bridging system**
- Condition assessment by SW Engineering Consultants confirmed the Bailey bridge components could be refurbished.
- Components would enable three 21.3m long bridges to be assembled.
- High flexibility and relatively easy to install using a crane.

Options Considered for Single Spans > 21m

- **Option 3 – refurbish Small Box Girder bridging system**
- Load capacity unknown
- Total length of bridging capability was less than the Bailey bridging system.
- No manuals available for installation and load capacities.
- Option 3 was therefore rejected.

Options Considered for Single Spans > 21m

- **Option 4 – purchase new emergency bridging system**
- A number of off-the-shelf emergency bridging systems investigated.
- Generally more expensive to purchase than to refurbish Bailey bridging system.
- Larger crane capacity required to install.
- Suitable for longer single spans to complement the Bailey bridging system.

Summary of Emergency Bridging Systems Available

Temporary EB System	Supplier	Repair Costs	Purchase Costs (New)	Possible Configurations	Load Capacity	Comments
1943 Bailey Bridge	N/A	$187,000	N/A	3 off x 21.3m span (DS config)	Unknown	Some components are missing. Load capacity is unknown due to deterioration of components.
				1 off x 12.2m span (DS config)	Unknown	Some components are missing. Load capacity is unknown due to deterioration of components.
SBG	N/A	$240,000	N/A	1 off x 21.3m span (3 lines of trusses)	Unknown	No plans available – subject to load rating
				1 off x 17.1m span (2 lines of trusses)	Unknown	No plans available – subject to load rating
				1 off x 12.8m span (1 line of trusses)	Unknown	No plans available – subject to load rating
Compact 200	Mabey and Johnson	N/A	$108,550	12.19m span	T44	4.2m wide Includes launching/erection equipment
			$122,117	15.24m span	T44	4.2m wide Includes launching/erection equipment
			$145,494	18.29m span	T44	4.2m wide Includes launching/erection equipment
Unibridge	Materiere	N/A	$390,000	34.2m span	T44 and MS1600	Single lane
				22.8m span	T44 and MS1600	Two lane
Panel Bridge	Waagner Biro	N/A		Over 70m span	Bridge Class 1 and MLC 30 -70	Uses truss panels, steel cross girders and steel deck. Extra wide single lane width is 4.2m.

Options Considered for Longer Single Spans

- Unibridge
- Mabey Compact 200

Options Considered for Longer Single Spans - Unibridge

- Main Roads installed a 57m long, two span, single lane Unibridge in 2014/15.
- Replaced a timber bridge destroyed in a bushfire.
- Main justification was timeframe.
- Superstructure only took a week to install.
- However, complete construction took 27 weeks.

Options Considered for Longer Single Spans - Unibridge

- 220 tonne crane required
- Unibridge not adopted as part of the Strategy but a good permanent bridge

Options Considered for Longer Single Spans – Mabey Compact 200

- Larger version of Bailey bridge
- Panels are 3.048m long (same as Bailey bridge) but 2.234m high (1.550m for Bailey bridge) enabling longer spans to be achieved at higher loads.
- Similar training requirements to Bailey bridge.
- Mabey Compact 200 bridging system included in the Strategy.

Adopted Strategy – Refurbish existing Bailey bridging system

Item	Cost Estimate
Structural repair of Bailey bridge components	$200,000 (1)
Sandblasting of some components	$10,000 (2)
Galvanising of some components	$30,000 (3)
Purchase of new decking	$50,000 (4)
Provision of suitable storage facility	$230,000 (5)
TOTAL	**$520,000**

Adopted Strategy – Refurbish existing Bailey bridging system

Pin hole reamed out

Adopted Strategy – Refurbish existing Bailey bridging system

panel gusset plate straightened

Adopted Strategy – Refurbish existing Bailey bridging system

panel chord straightened

Adopted Strategy – Refurbish existing Bailey bridging system

- AECOM engaged to design precast concrete abutments
- Also, design of on-bridge W-beam “rub rails” and guardrail design for approaches and departures.

Adopted Strategy – Purchase Mabey Compact 200 Bridging System

- Main Roads purchased 40m Mabey Compact 200 bridging system in 2018
- Used on side track for bridge replacement
- Funded by bridge replacement project.
- T44 load capacity
- Further components purchase in 2019 to enable SM1600 load capacity at 30m span.

Adopted Strategy – Purchase Mabey Compact 200 Bridging System

Precast Concrete Abutment for Mabey Compact 200

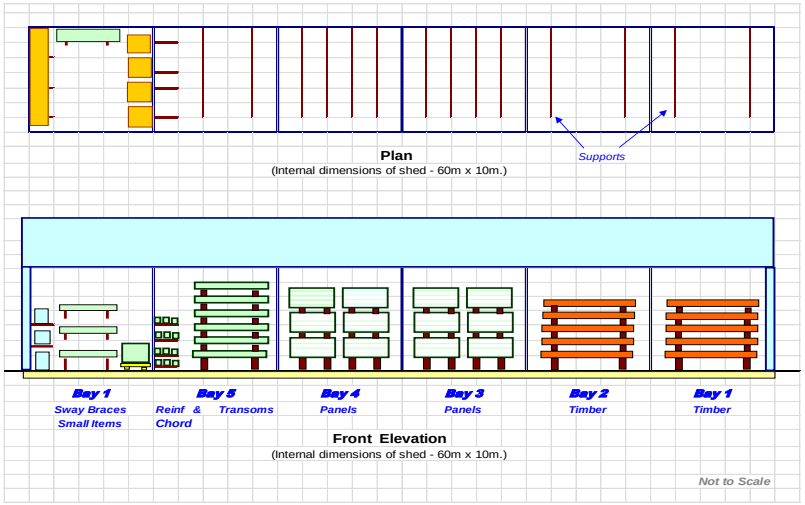
Adopted Strategy – Training

- SW Engineering Consultants to carry out training of in-house Bridge Maintenance Team in June 2019
- Training to include practical and theoretical
- Practical to include all aspects of transportation, assembly and disassembly.

Adopted Strategy – Training

Model Bailey Bridge Set Type A

Adopted Strategy – Storage



- 60m long x 10m deep
- 6 off 10m x 10m bays
- Storage of Bailey and Mabey Compact 200 bridging systems

Adopted Strategy – Storage

Bridgeply decking for Bailey bridging system

Bailey bridge panels stacked on purpose made pallets

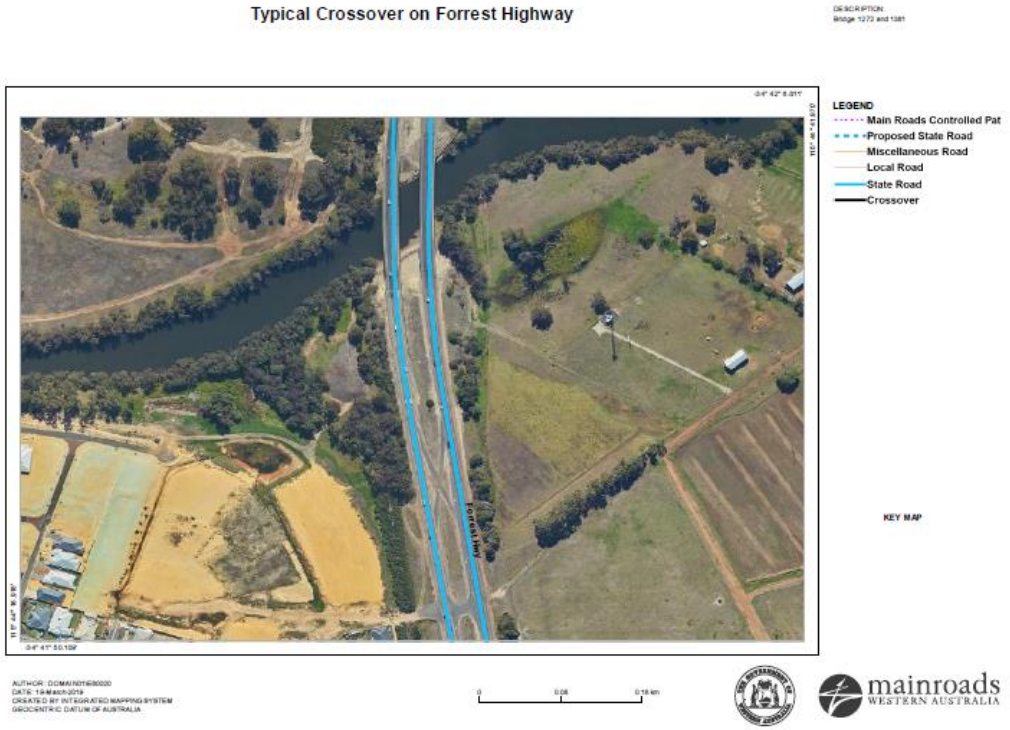
Adopted Strategy – Documentation

- AECOM is currently producing general arrangement drawings and load rating tables for the Bailey bridging system
- SW Engineering Consultants to provide abbreviated Bailey bridge manual.

Adopted Strategy – Other Components

- Stockpiling of precast concrete beams.
- Asset Management Plans including bridge specific contingency plans and traffic management plans. Where possible detours to be identified.
- Cross-overs for dual carriageways to allow contraflow on adjacent bridge.

Adopted Strategy – Other Components



Cross-overs for dual carriageways

Conclusion

- By June 2019, Main Roads should be in a position to install emergency bridging systems in WA for all bridge owners.
- Various spans, configurations and load capacities achievable (e.g. up to 40m T44).
- Asset Management Plans with contingency plans required where use of the emergency bridging systems is not feasible.

The End