

# Resilience based design of transportation systems

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*Equity in Transportation 2020  
Christchurch – 12 March 2020*





Wenchuan  
Earthquake  
China 2008





Kumamoto  
Earthquake  
Japan 2016





Kaikoura  
Earthquake  
NZ 2016





Canterbury  
Earthquakes  
NZ 2010-2011





Canterbury  
Earthquakes  
NZ 2010-2011



Equity in Transportation ??

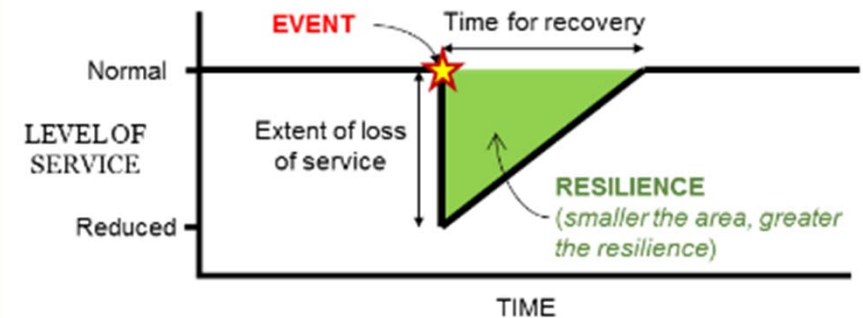
# Transport outcomes framework



# Resilience

*Resilience is the ability to continue to function or return to functionality quickly after a range of adverse events.*

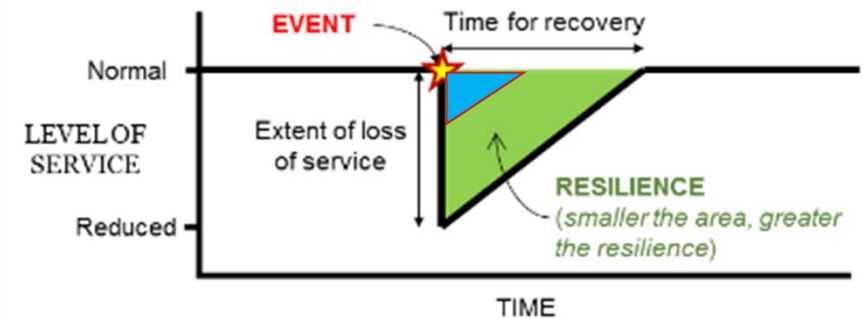
- **resilience** - important for performance of built environment





## Resilience based design

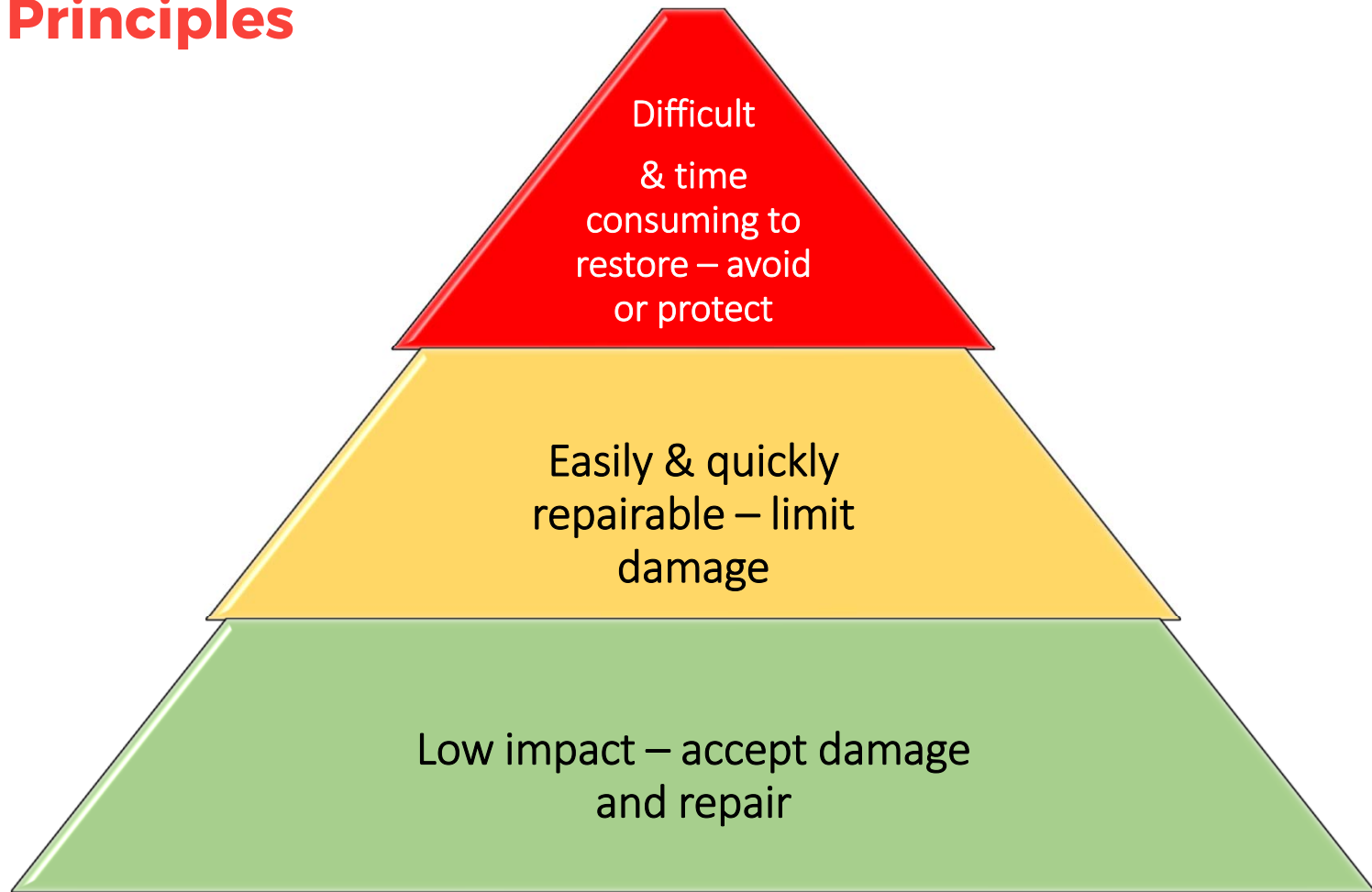
- **resilience** – focus on functionality and time for recovery.



*Shrink the green triangle towards blue triangle.*



## Principles



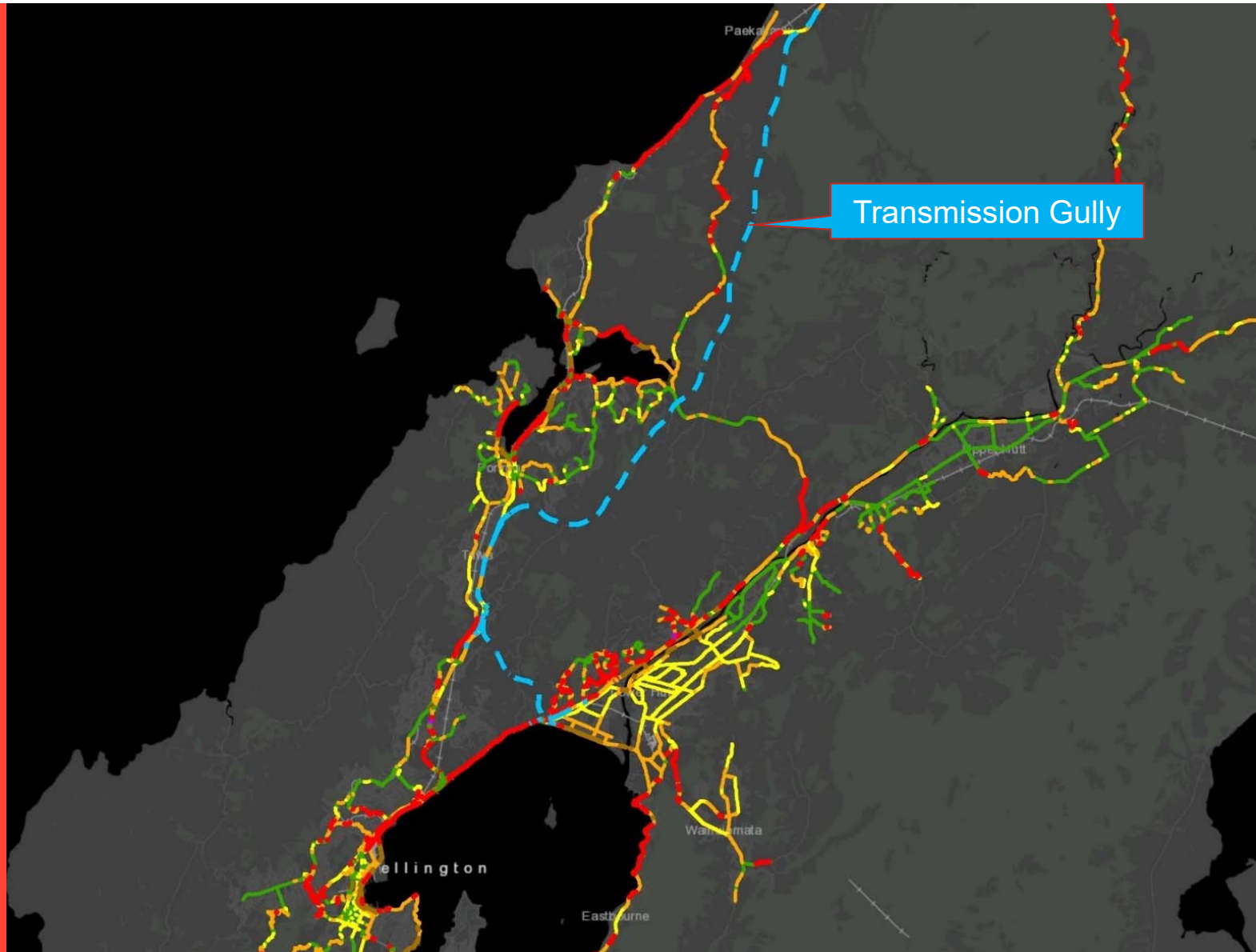


# Transmission Gully Expressway, Wellington

*Scheme development,  
2007-2008*

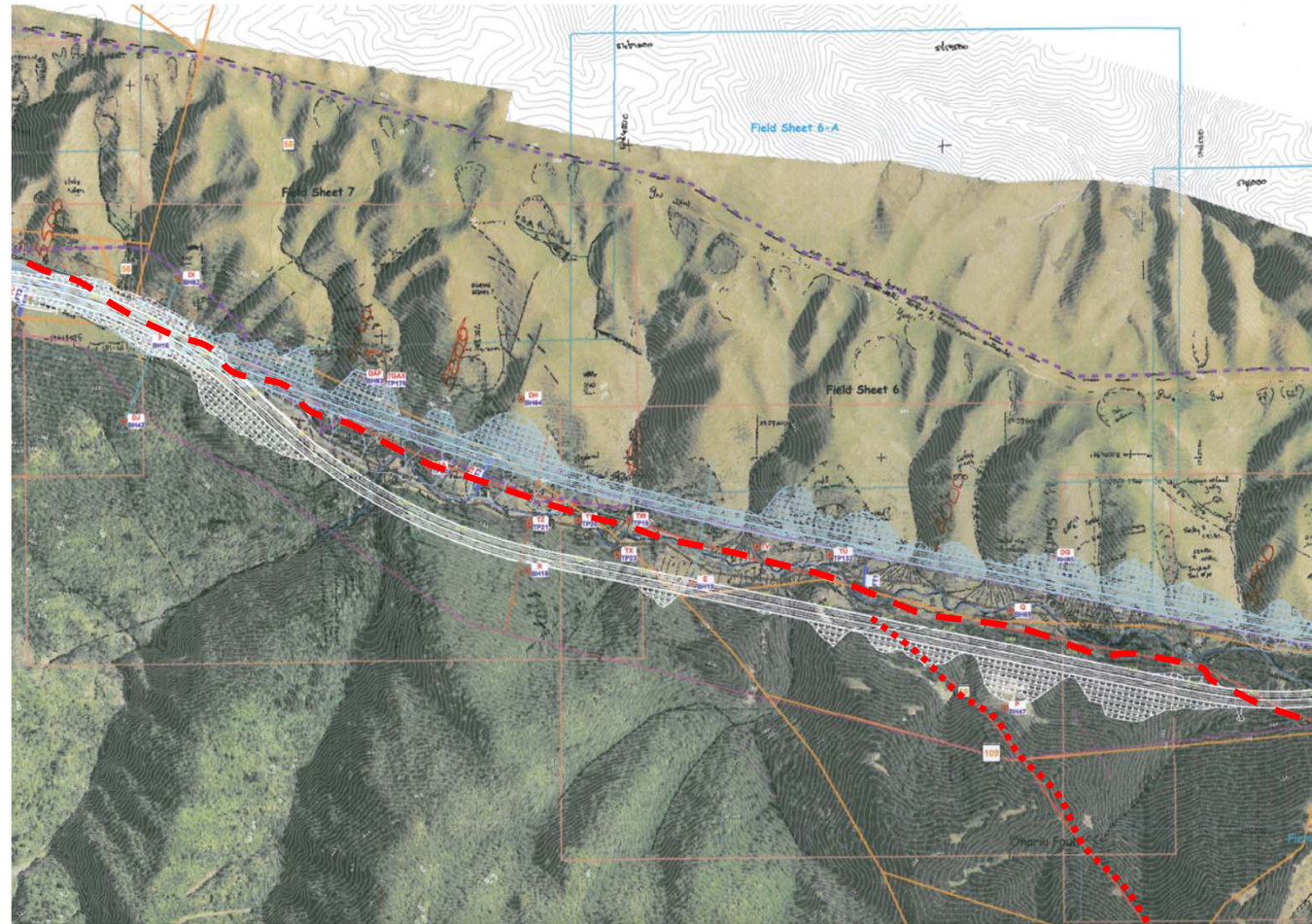
*AEE, 2009*

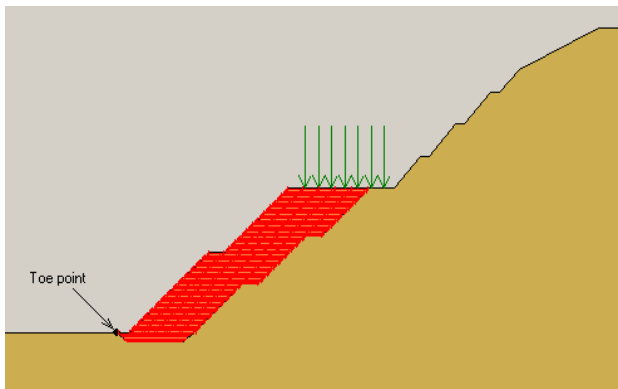
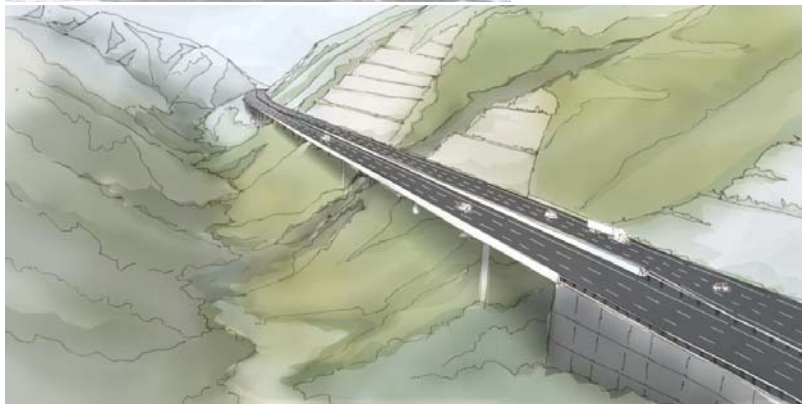
wsp





# Transmission Gully Expressway . . Resilience





## Resilience based Design

- Early focus on resilience
- Cross fault on embankment rather than viaduct
- Replaced half bridges with reinforced embankments
- Substantially enhanced resilience
- Cost savings of \$ 300M on the \$1 Billion project





## **SH2 Muldoon's Corner**

wsp

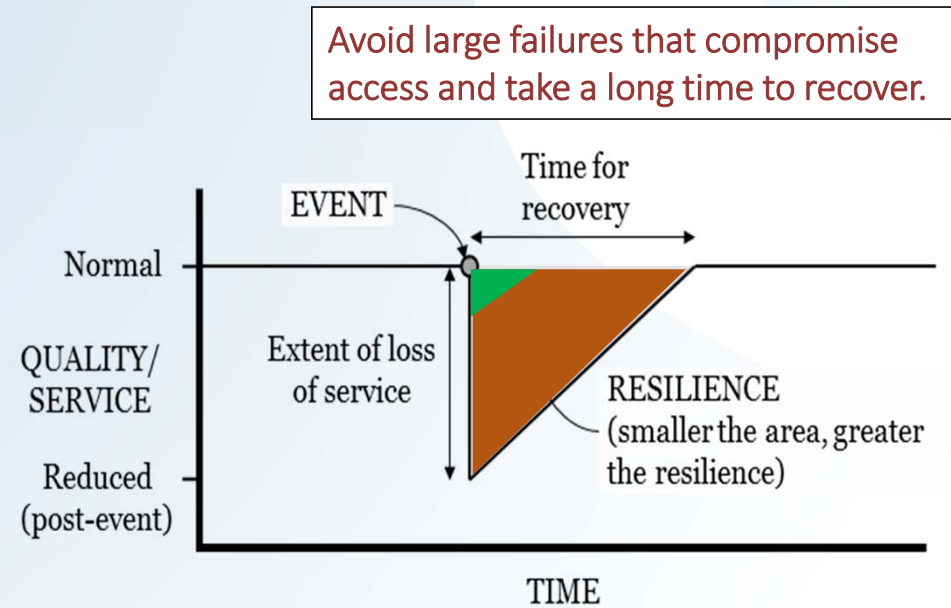
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# Resilience based Design



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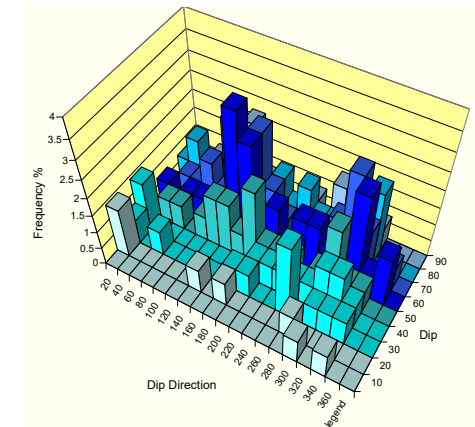
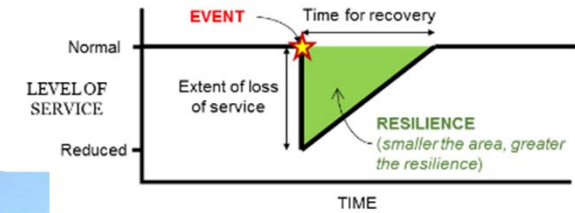
Substantial cost savings  
using the approach



Accept small failures which do not significantly affect access level of service, and can be quickly restored.



# Resilience based design



Substantial cost savings  
using the approach

# Ferrymead Bridge, Christchurch

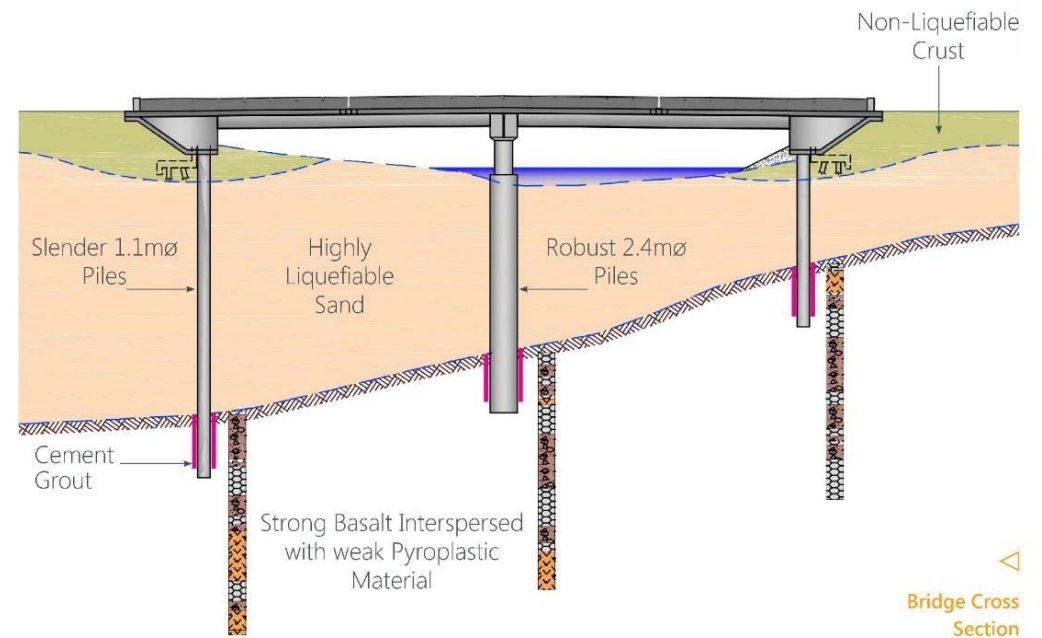
*2011-2013*

wsp





## Resilience based design



**Substantial cost savings of >\$ 3 M**

# Resilience based Design

## Understand resilience Context

expectations and needs for different parts of the system

## Design for functionality and return to service

different levels for parts of system based on identified criticality

## Focus on principles of resilience

## Early focus on resilience



Design for Resilience



# Resilience based design

Provides equity in transportation when really needed

Functionality of access for communities

By product . . . Substantial cost savings possible.





# Thank you



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