

Obstruction Management

Resilience Study for Auckland Motorway
Network

Vicky Li – Transportation Conference 2026

**make
everyday
better.**

Objectives of the Study:

- Identify hot spots susceptible to loss of movement on the Auckland state highway network from unplanned natural hazard events.



Water



Earth



Wind



Fire

- Explore ways to improve highway resilience to reduce reliance on detour routes and maintain movement for socioeconomic opportunities.



General Traffic



Freight



Outcomes from the Study:

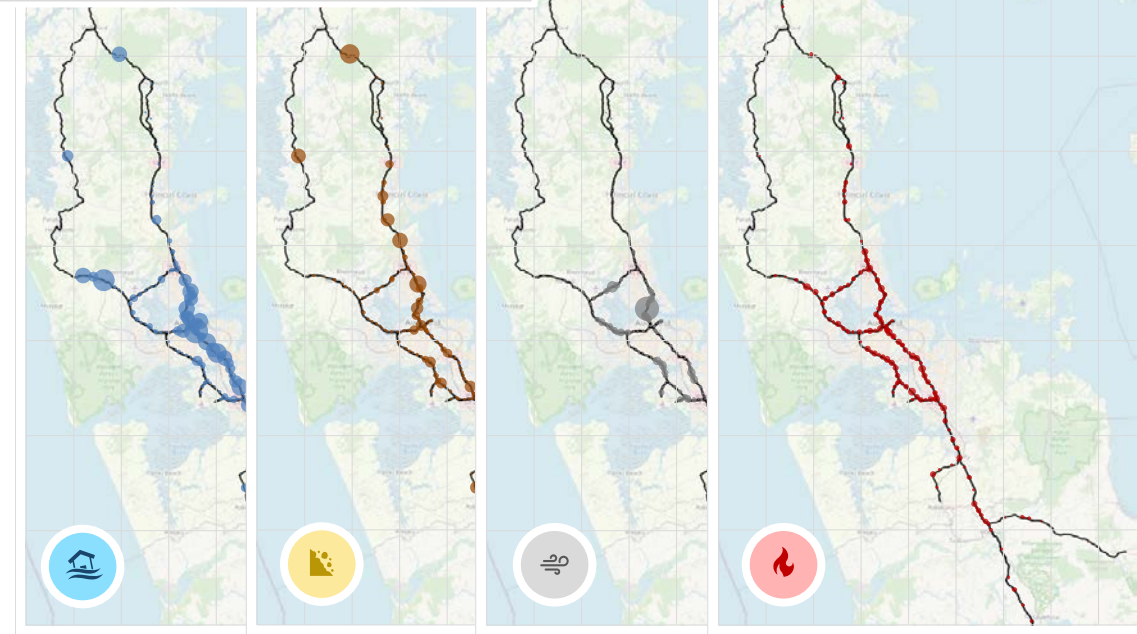
- Identify **hot spots** susceptible to loss of movement on the Auckland state highway network from unplanned natural hazard events.



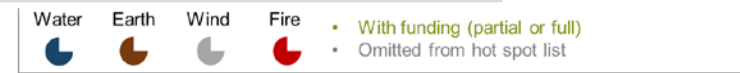
- Explore ways to improve highway resilience to reduce reliance on detour routes and maintain movement for socioeconomic opportunities.



High Risk Sections



Countermeasures

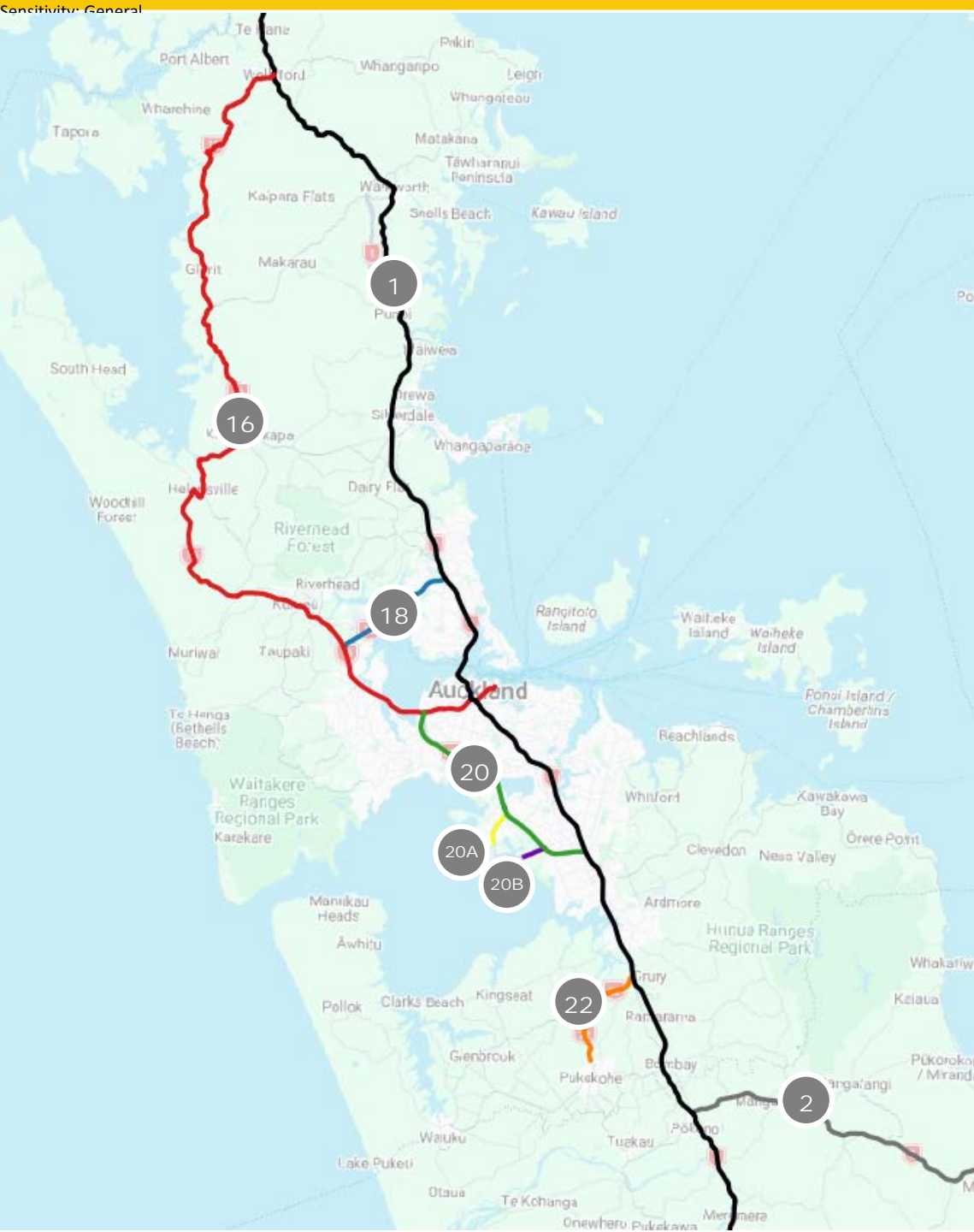


| Rank | Countermeasure Descriptions |
|------|---|
| 1 | AHB, vulnerable to high winds, with incidents like true significant disruptions. Wind management strategy is to install, value in improving customer education, post replacement (if strike were to happen again). Potent |
| 2 | Khyber Pass Underpass, lack of viable surface water system, reliant on existing soakage assets (limited capacity upgrades and new soakage bores—which have a long next financial year. Upgrading inlet capacity could offer high-flow bypass solution is expensive and offers different recovery measures: better warning and clearing of drains, better mobilisation of response crew for blocked drains |
| 3 | Dome Valley, currently outside of ASM network, most post 2023 floods. Require investigation and consistent treatment in the area. Could consider ground shaping potential for nature based solution. |
| 4A | SEART, flooding due to development intensification and climate change. Partnership with Auckland Council for hydrological assessment, 2 – design + delivery). Co-unknowns (adding to the technical difficult of delivering readiness / response / recovery measures. |

Countermeasure Themes

GENERAL | **EARTH** | **WATER** | **WIND**

- Water:** Stormwater asset improvement (e.g. enlarged culvert), Stormwater asset replacement (e.g. replace culvert with bridge), Concrete barrier drains, Out-of-cycle asset maintenance (e.g. weather warnings), Slope strengthening (e.g. soil nails, shear locks, mesh coverings), Slope drainage enhancements, Road realignment, Nature-based solutions, Elevate critical roadways, Future-proof policies and regulations (prohibit areas).
- Earth:** Pumping profile improvements and ground reworking, Slope strengthening (e.g. soil nails, shear locks, mesh coverings), Slope drainage enhancements, Road realignment, Nature-based solutions, Elevate critical roadways, Future-proof policies and regulations (prohibit areas).
- Wind:** Vehicle management and restrictions, Wind barriers and screens, Advanced VMS, Driver awareness campaigns, Emission and management protocol, Ground network monitoring, Drain and debris clearance, Earthquake communications, Signal optimisation and access control, Windfinding (debris), Temporary monitoring of road space.
- Fire:** Cross-government collaboration on interaction of stormwater systems, Stormwater asset investigations, Digitalisation of records, Actions: weather station, Smart monitoring systems, Flood hazard risk assessments, Smart monitoring systems, Coordination of IT and NZTA response crews, Standby resources for predicted events, Signal optimisation and access control, Windfinding (debris), Temporary monitoring of road space.



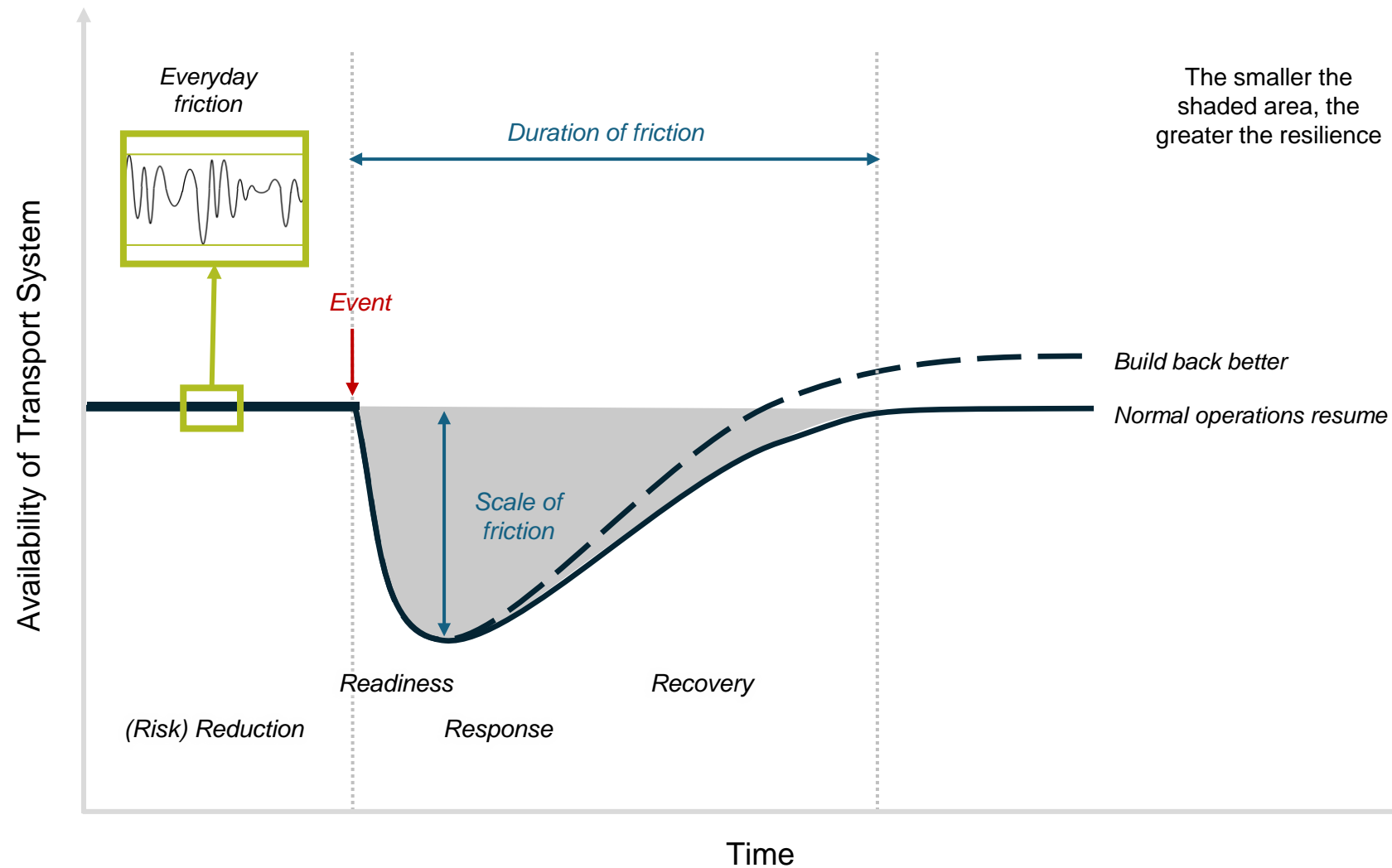
■ Research Methodology

■ Risk Assessment

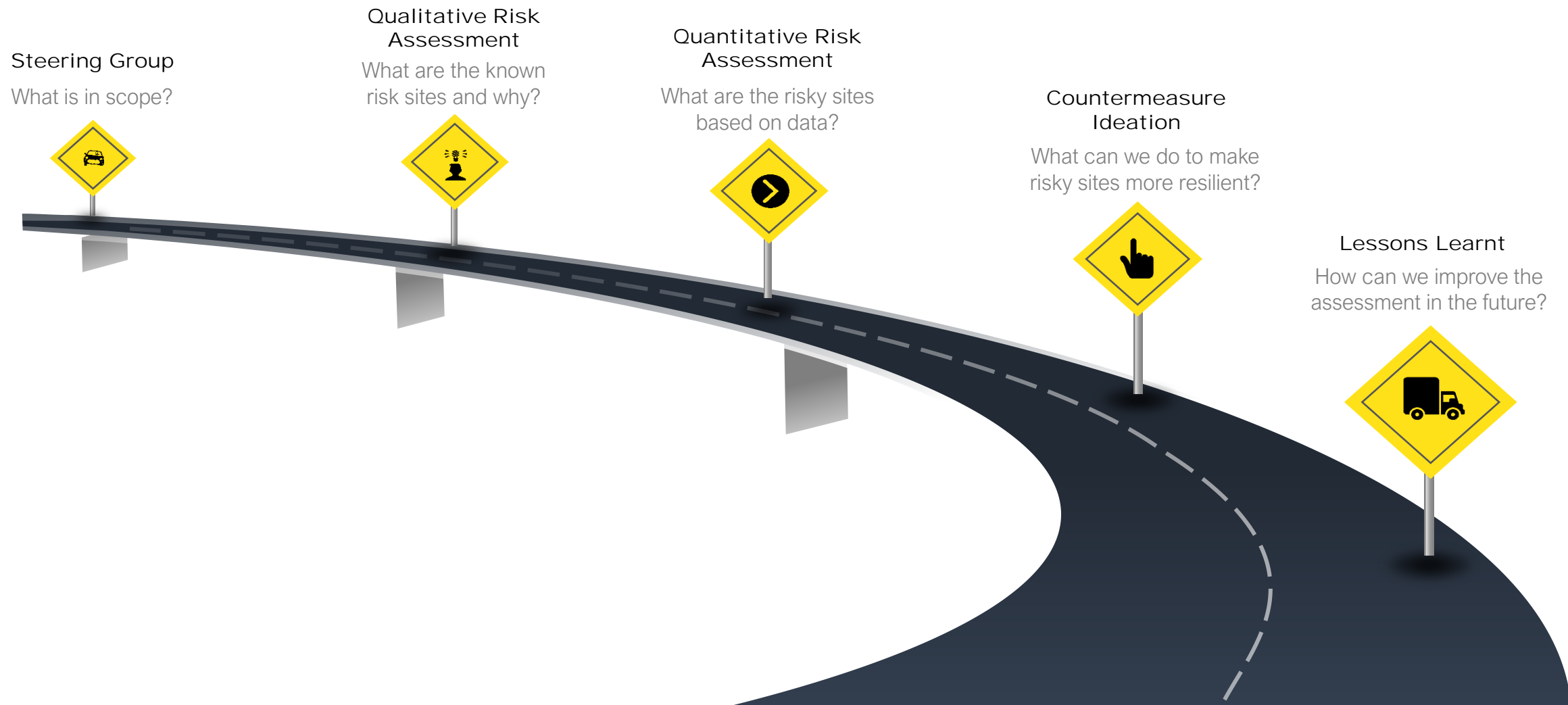
■ Strategies and Countermeasures

■ Lessons Learnt

Resilience Definition

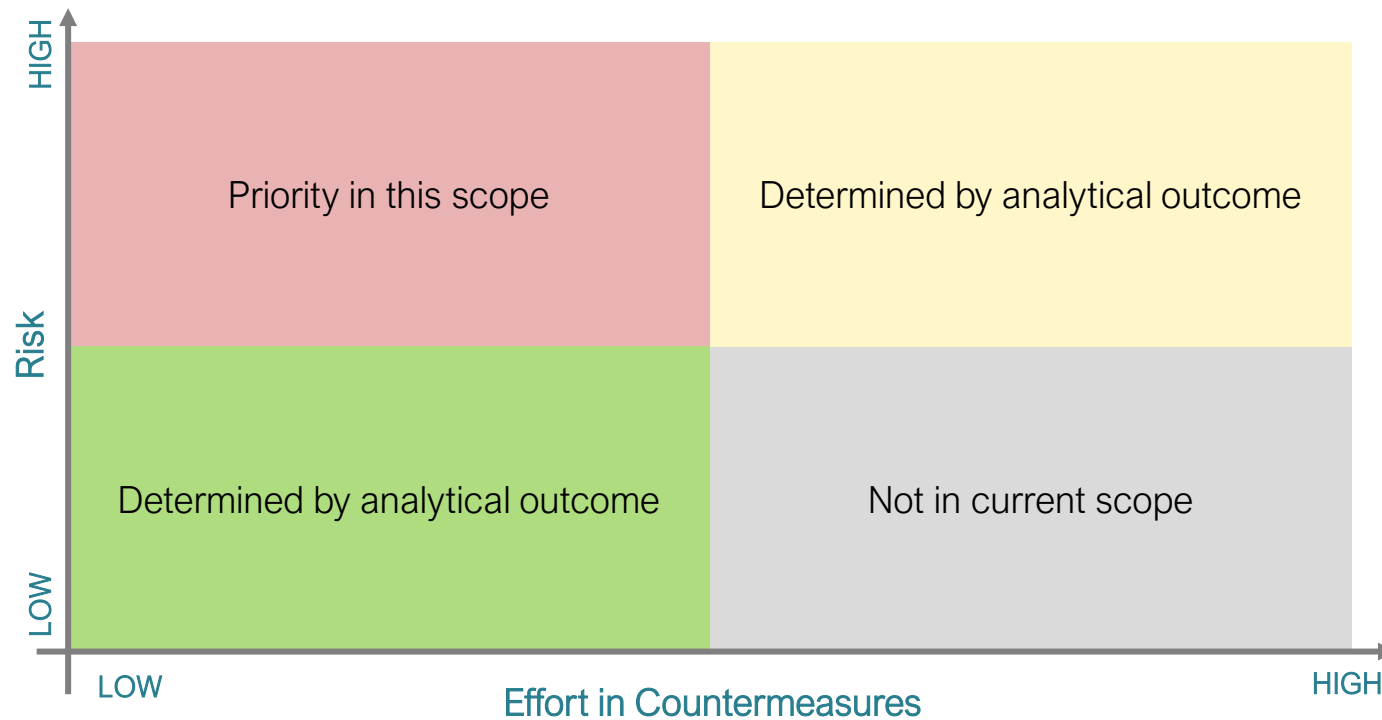


Our Journey



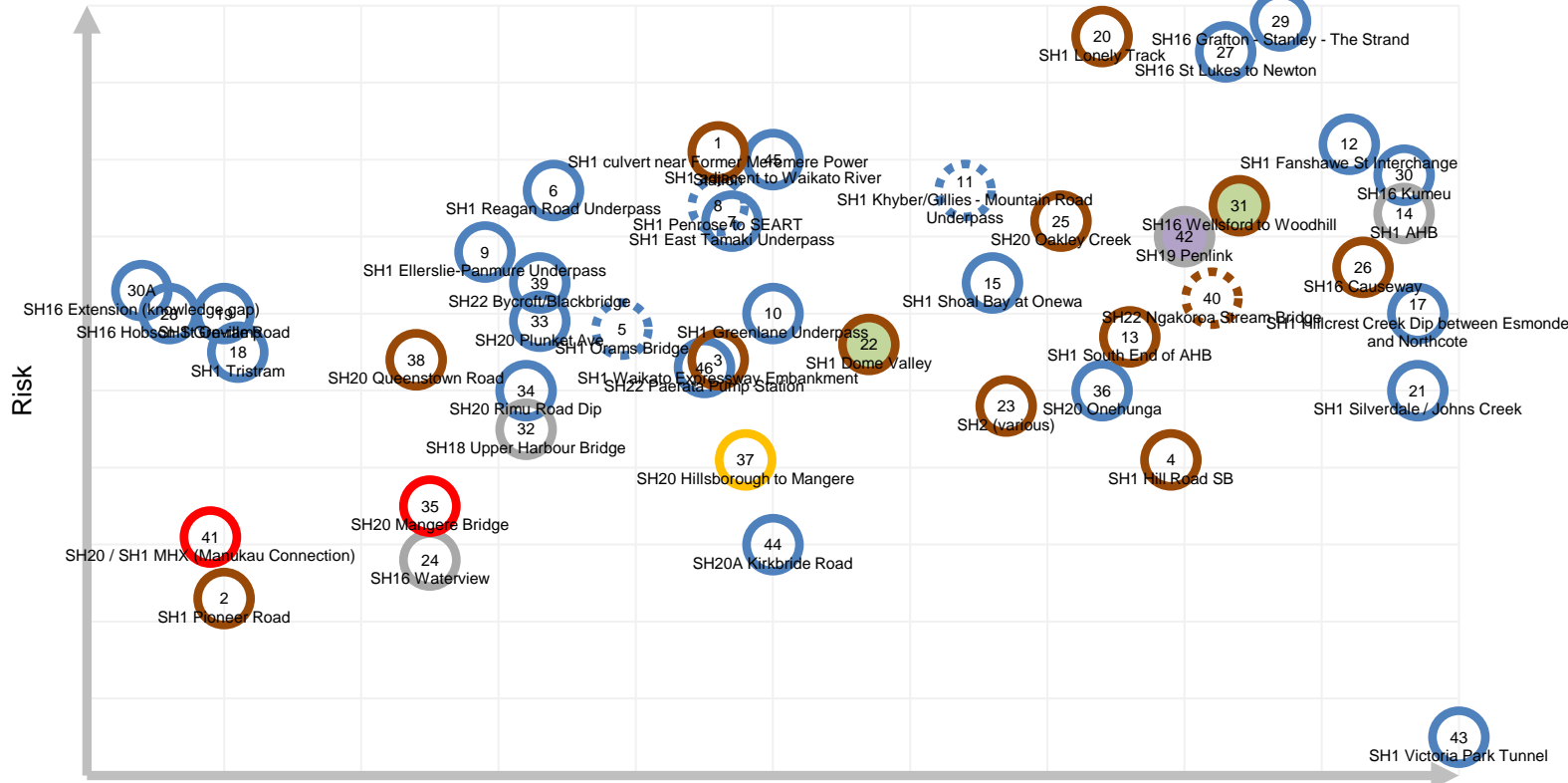
Qualitative Assessment Framework

- Interview with SMEs – gather sites and inform criteria
- Workshop with SMEs – define site relative ranking



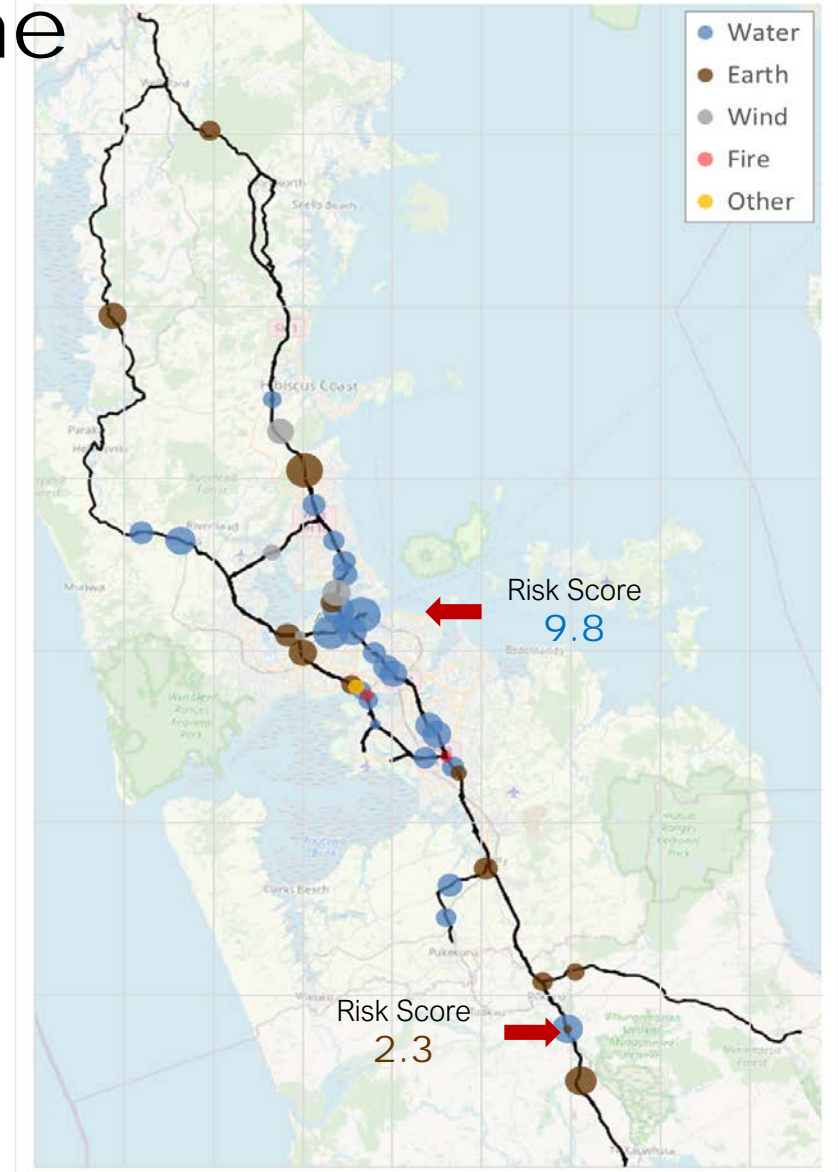
Qualitative Assessment Outcome

Site Risk / Effort in Countermeasures Matrix
(from Workshop 1)



| Obstruction type | | | | | Secondary flags | | |
|---|--|--|---|---|---|---|--|
| ● Water | ● Earth | ● Wind | ● Fire | ● Other | ● Existing project/funding | ● Outside current ASM network | ● Future state highway |

Site Risks by Obstruction Type
(from Workshop 1)



Quantitative Assessment Considerations

NRAT Criteria (Starting Point)

| ONRC | Lifeline Criticality | Detour Length if Closed | AADT | Scale of Outage | Duration of Outage | Likelihood |
|------|----------------------|-------------------------|------|-----------------|--------------------|------------|
|------|----------------------|-------------------------|------|-----------------|--------------------|------------|

Additional Criteria

Informed By (supplemented by SMEs)

Residual Capacity Index

- *Is the highway section already operating close to capacity?*
- *Does it have spare capacity to take on additional traffic?*

TMS (Traffic Counts) against capacity assumptions:

- Mid-Block Highway Section: 25,000 vehicles per day
- Interchange Ramp Section: 16,000 vehicles per day

Residual Road Width

- *Is the highway section wide enough to accommodate shoulder closures without impacting traffic lanes?*

SH 1 - Warkworth to Puhoi



SH 1 - Grand Dr Interchange



SH18 - Greenhithe



SH1 - SH16 - CMJ

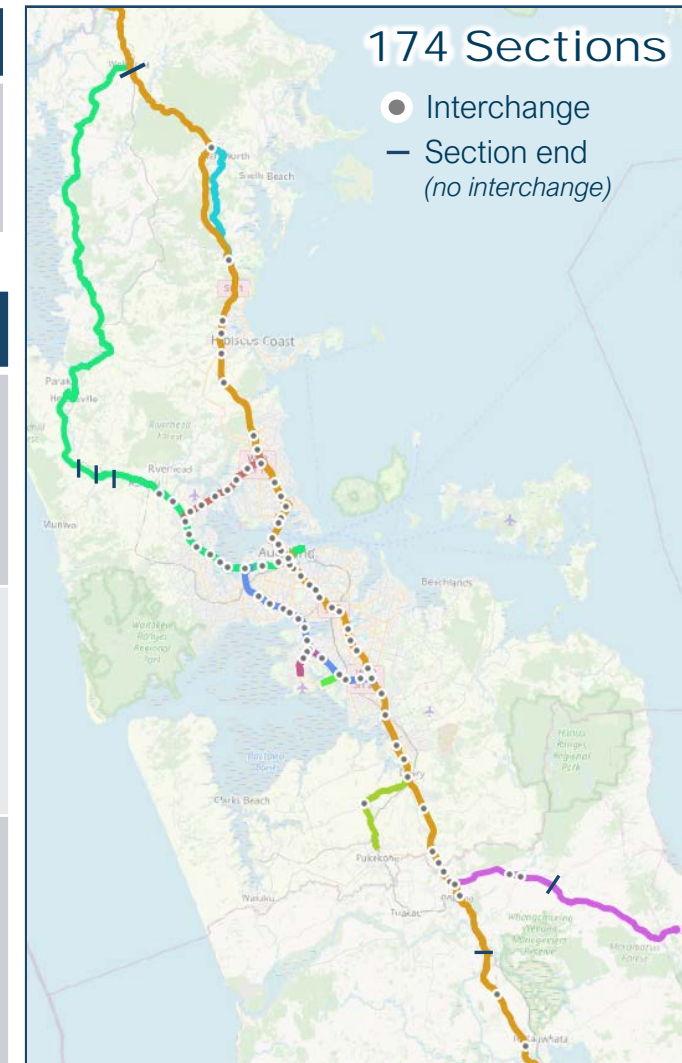


SH1 - Tristram

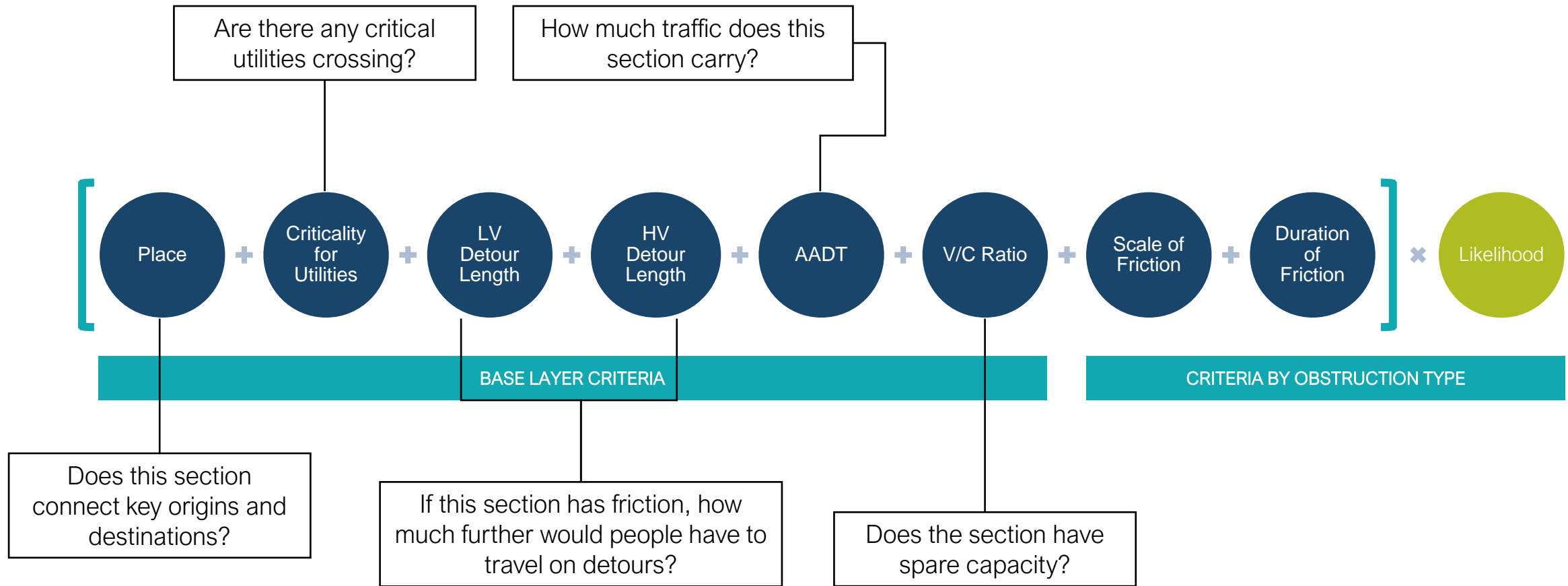


Interchange Type Flag

- *Is the interchange full access or limited access?*
- *Is the intersection at the end of the on-ramp and off-ramp controlled by signals?*



Quantitative Assessment Framework



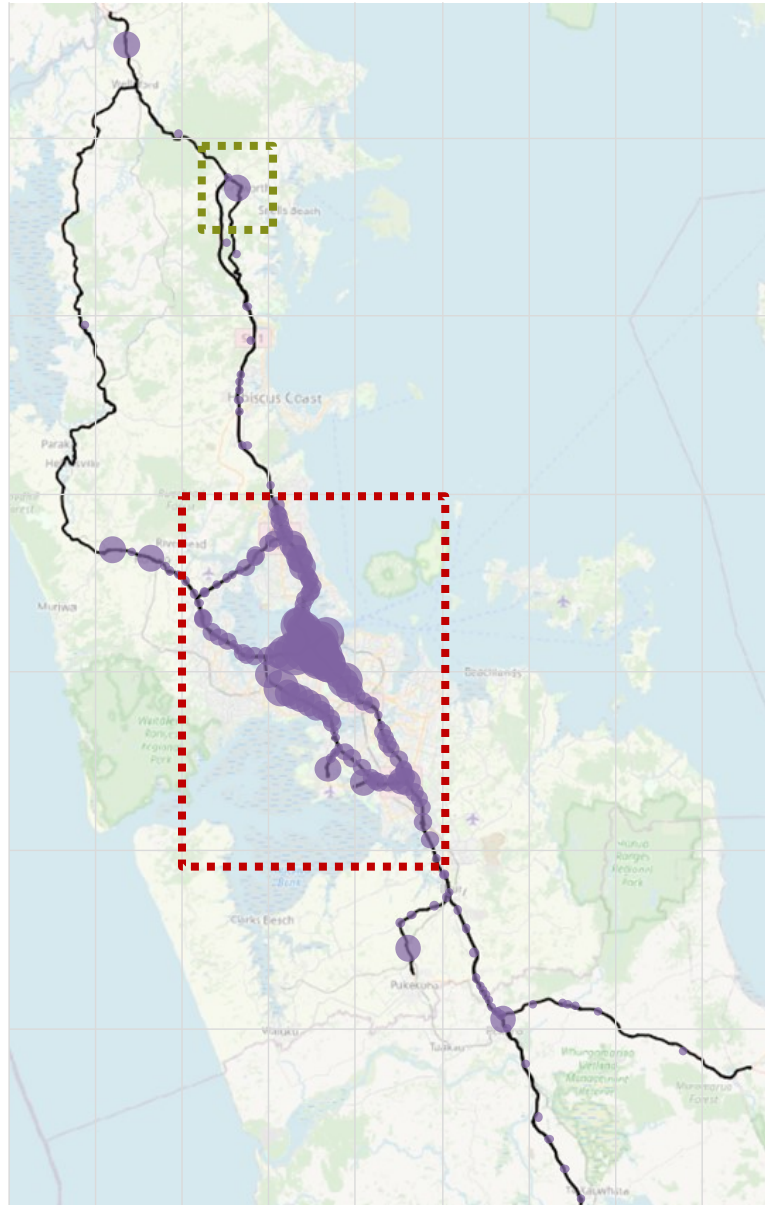
Methodology

Risk Assessment

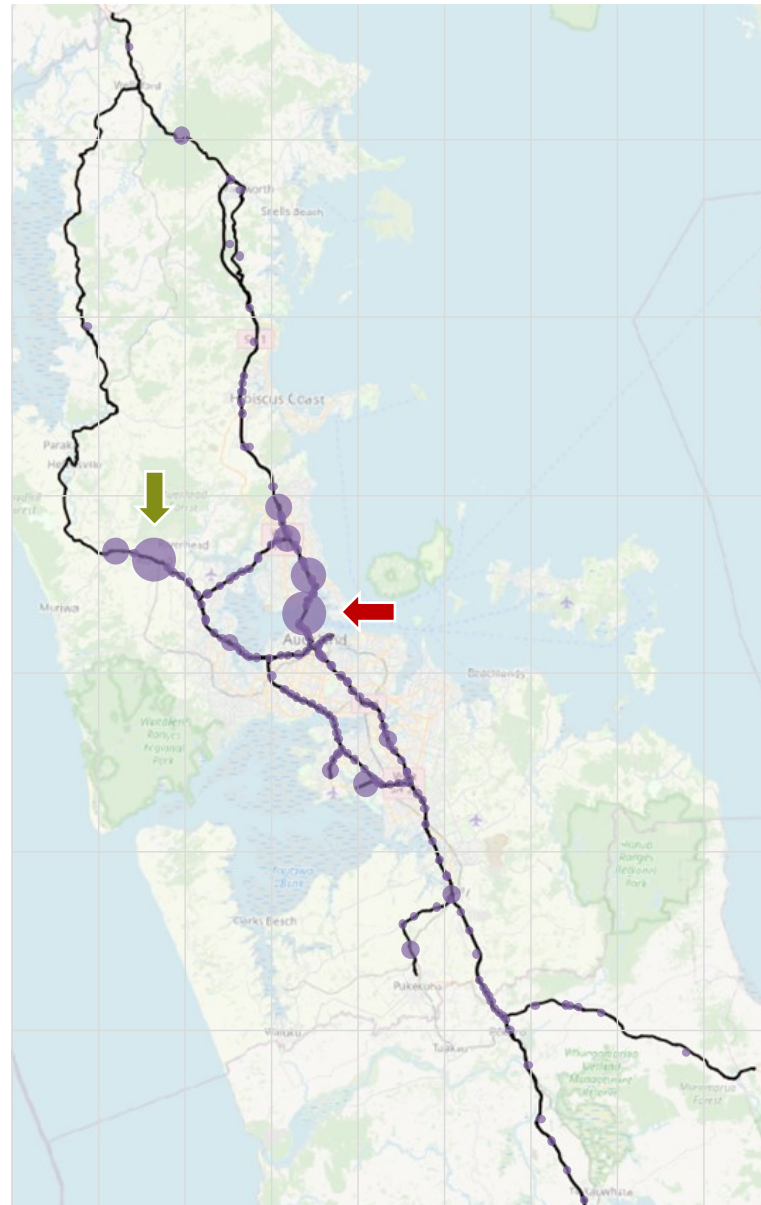
Strategies & Countermeasures

Lessons Learnt

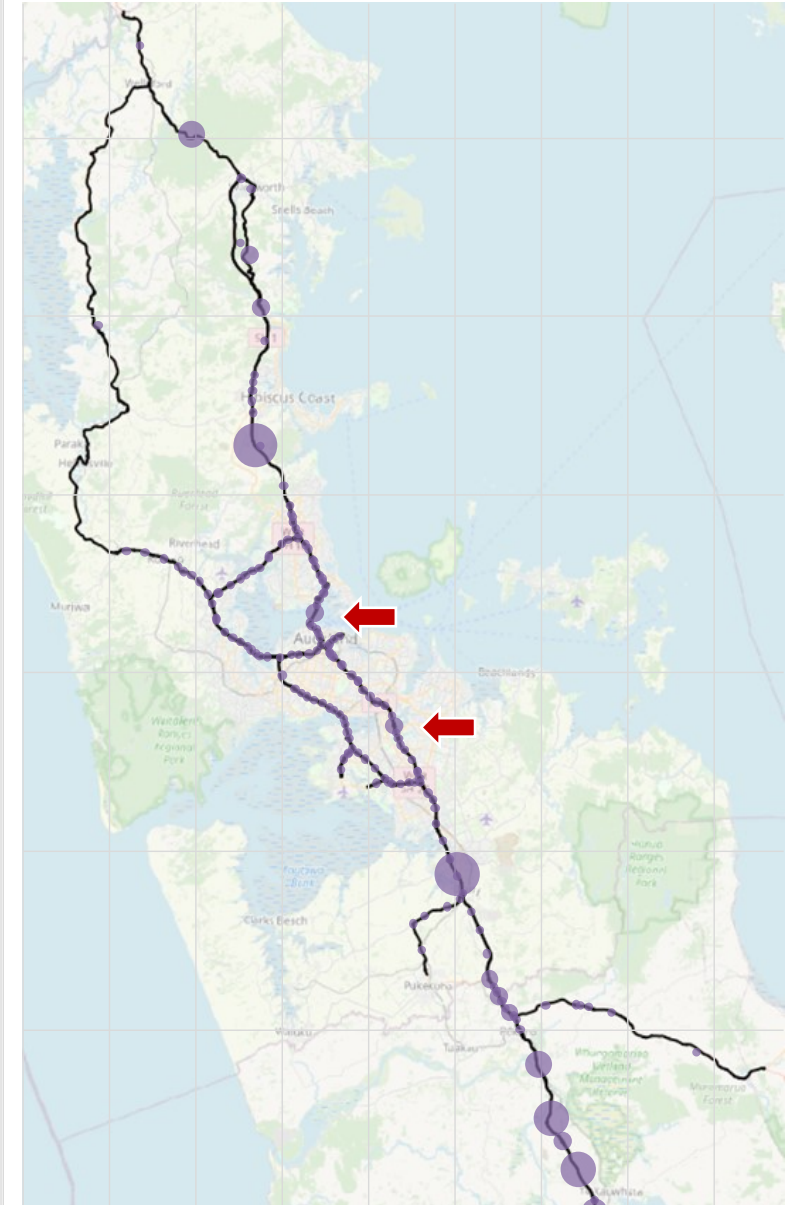
Place Score



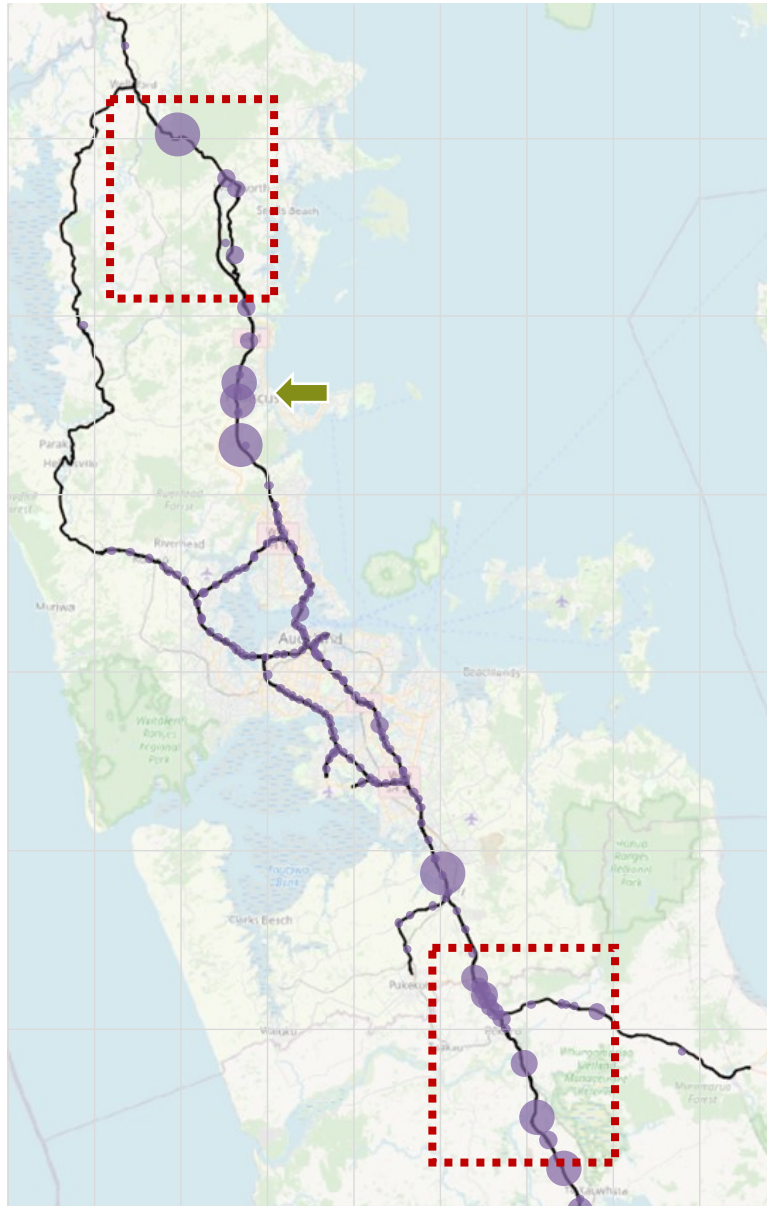
Criticality Score



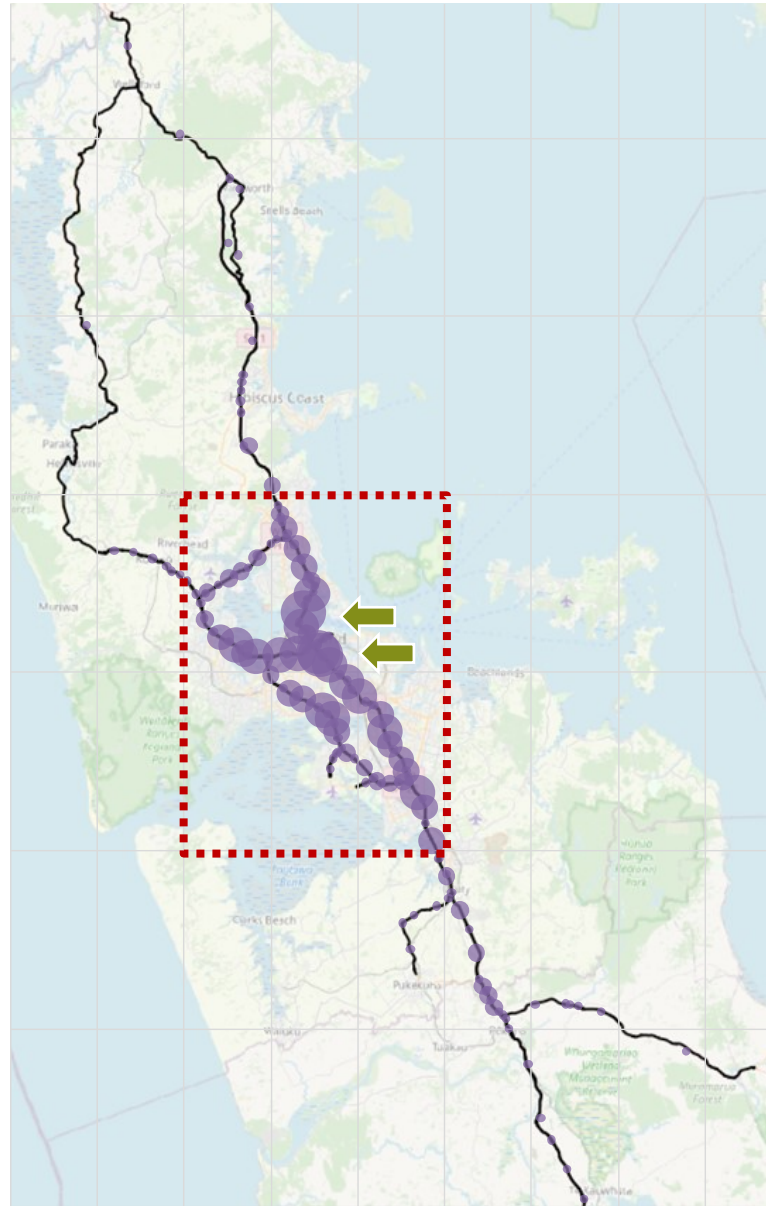
Light Detour Score



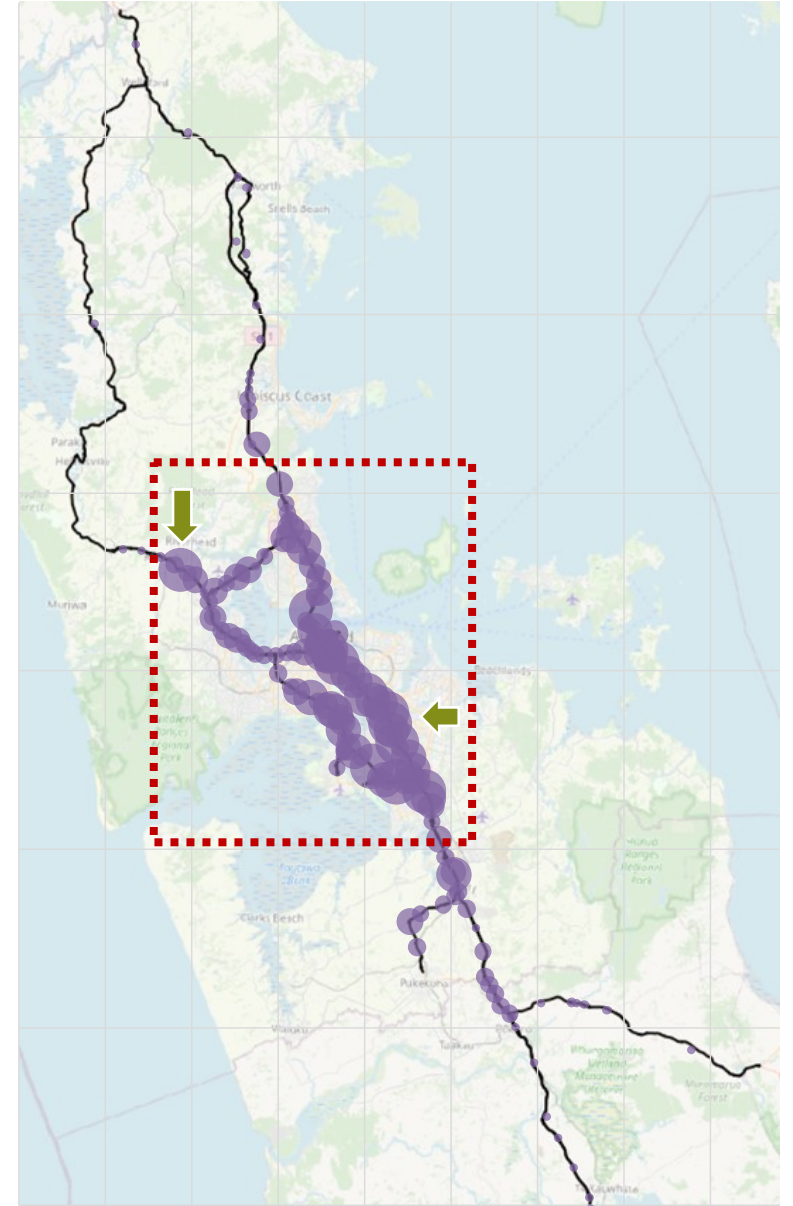
Heavy Detour Score

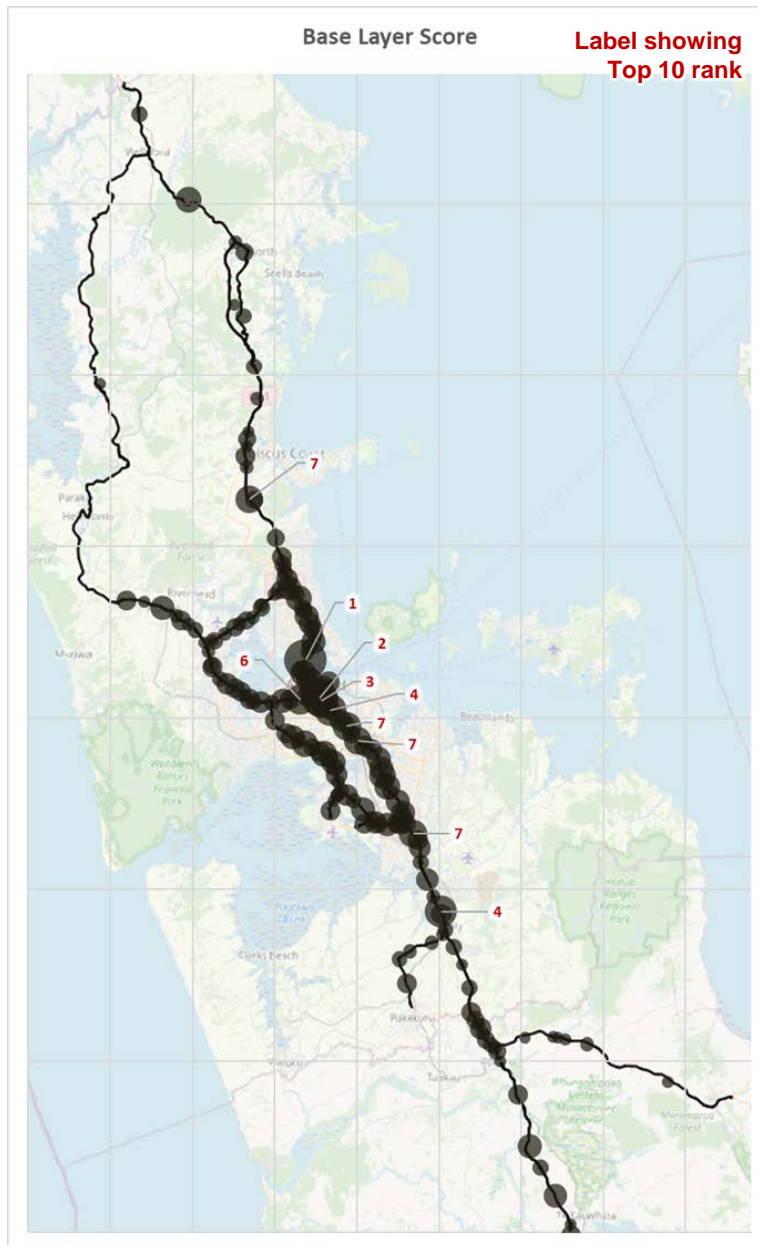


AADT Score



V/C Score

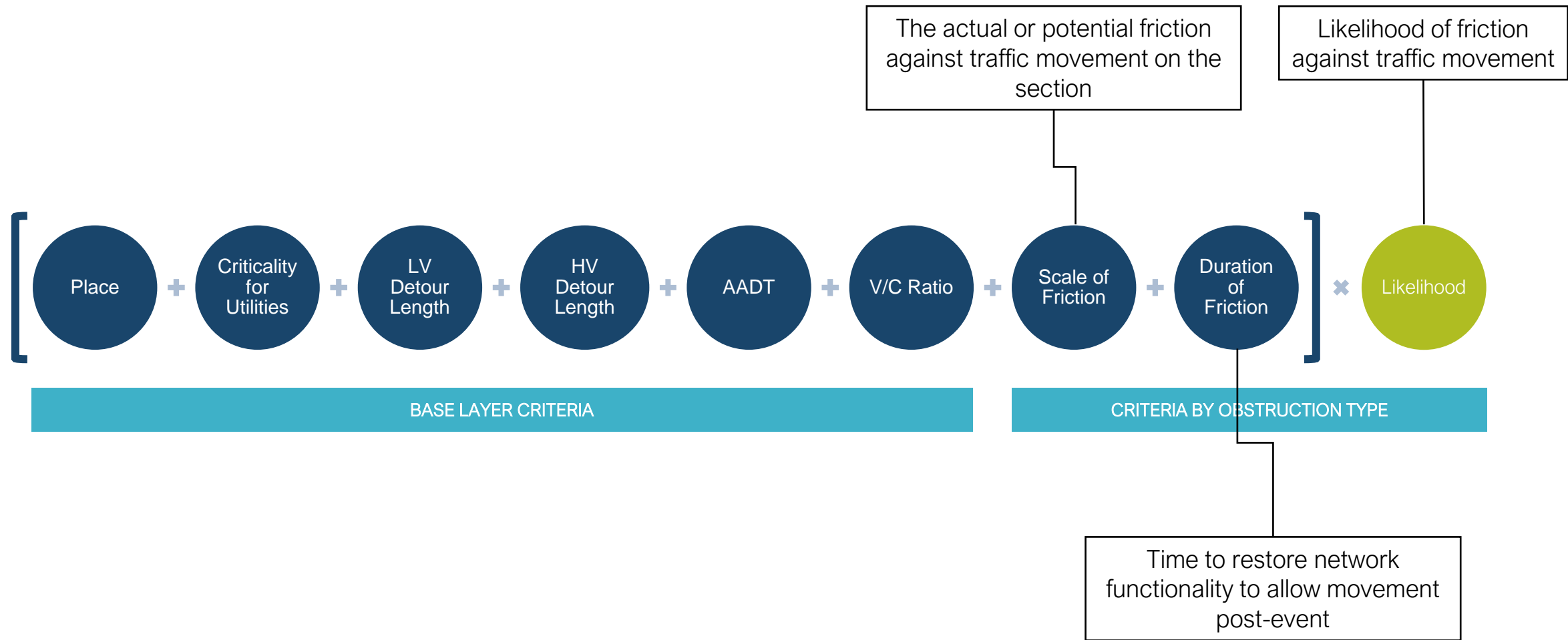




Base Layer Summary

- **AHB** - Auckland Harbour Bridge (SH1 – Onewa Rd to Shelly Beach Rd) ranked highest. Scored high for most of the base criteria.
- **SH1** - 9 out of top 10 sections are on SH1, one on SH16 (St Lukes Rd to Newton Rd).
- **Traffic Volume** - 8 out of top 10 sections are both high in traffic volume and low in spare capacity (i.e. high in V/C).
- **Detour Length** – Only 2 out of top 10 sections are high in extra detour route length.
- High place, traffic volume, and V/C ratio scores frequently overlap for **locations in densely populated areas**, whereas detour length and criticality are more commonly associated with rural areas and tend to have less overlap. As a result, densely populated areas generally receive higher base layer scores.

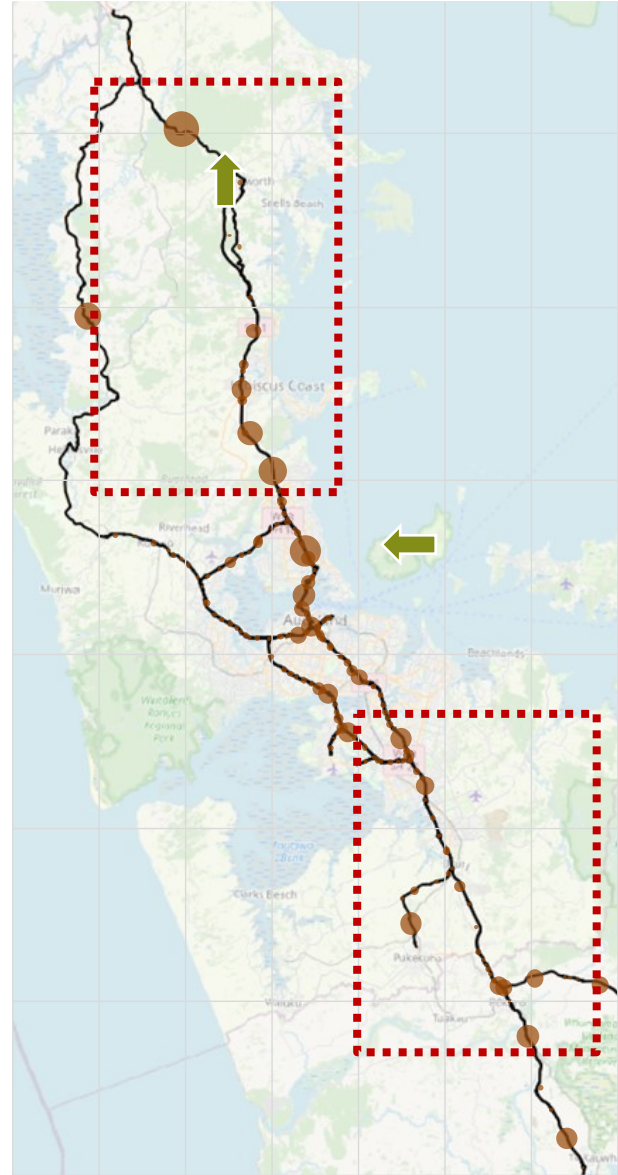
Quantitative Assessment Framework



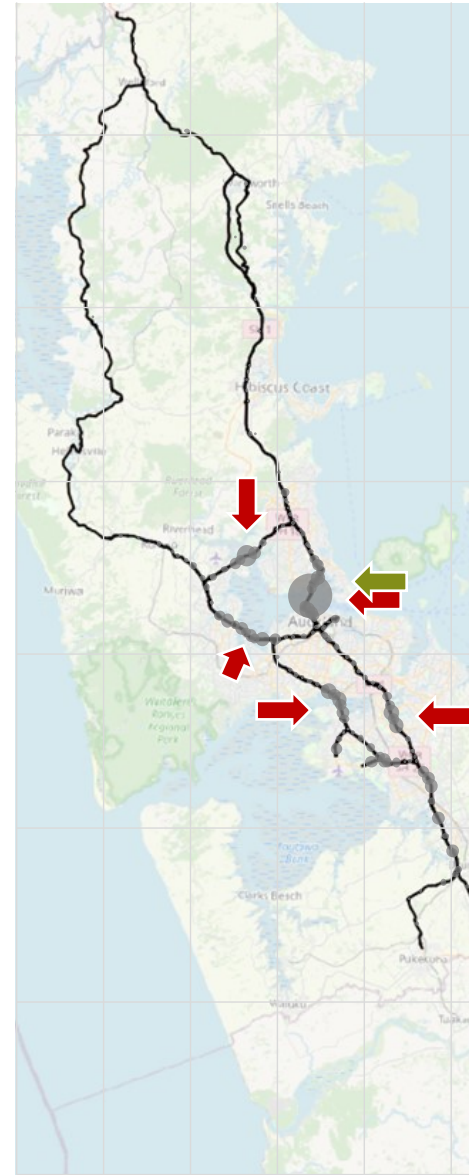
Water Obstruction Score



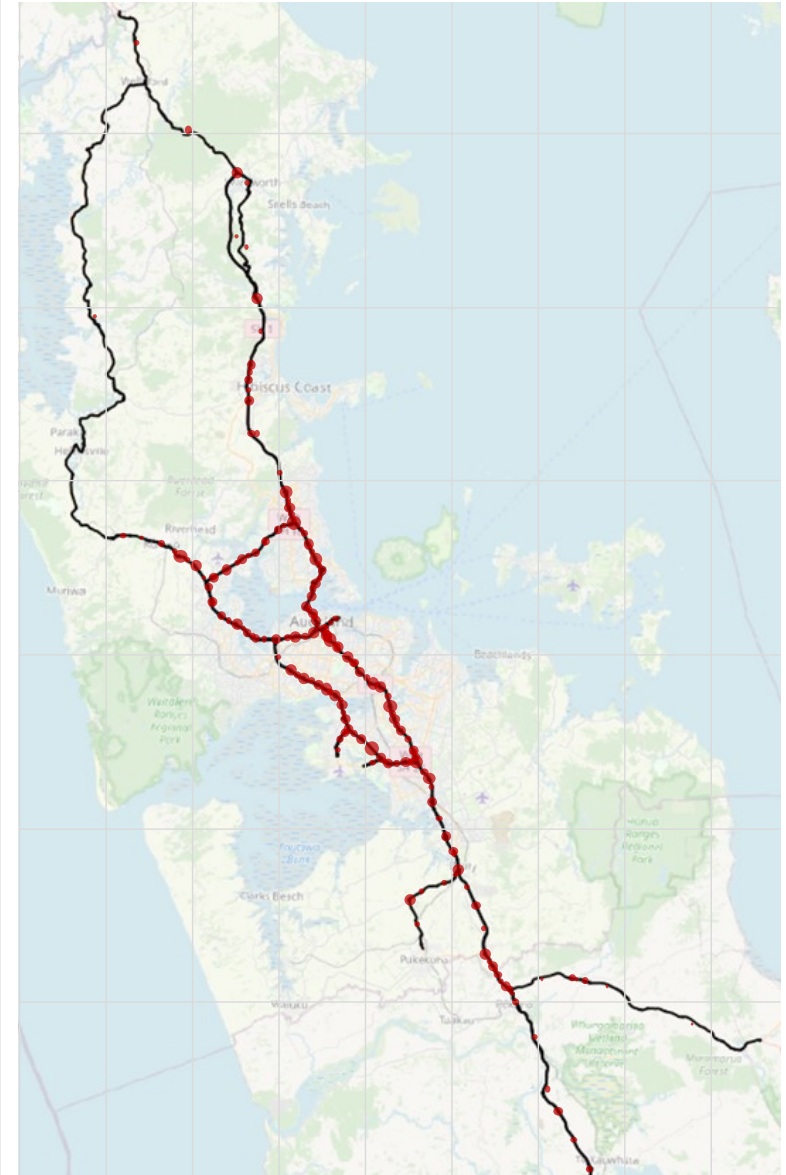
Earth Obstruction Score



Wind Obstruction Score



Fire Obstruction Score



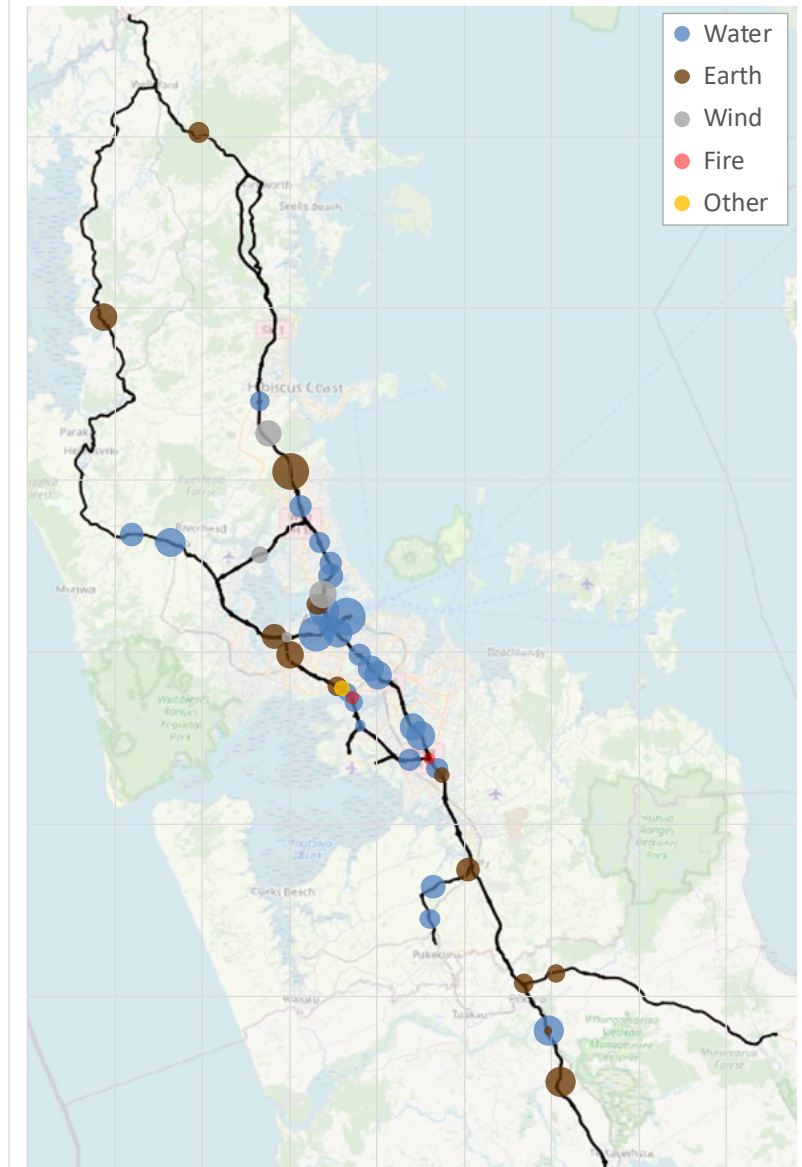
Total Obstruction Score (Quantitative)



Total Risk Score

- SH1** - Most sections with high risk scores are on SH1 (driven by water in urban, earth in rural), with AHB having the highest risk score overall.
- SH16** – Urban section at the Strand and rural section at Kumeu are in the top 10 most risky (both water driven). Helensville north of Waimauku has tricky terrain with lots of unknowns (earth driven).
- SH20 & 22** – SH20 - Nelson St interchange (earth driven) and Mangere bridge (water and wind driven), SH22 – Pukekohe (water and earth driven)

Site Risks by Obstruction Type (from Workshop 1)



Strategies and Countermeasures

OBSTRUCTION TYPE

- Water
- Earth
- Wind
- *Fire*

4R RESILIENCE FRAMEWORK

- Reduction
- Readiness
- Response
- Recovery

EFFORT IN COUNTERMEASURE

- Restoration Time
- Cost
- Technical Difficulty
- Disruption to Network
- Sustainability Impact
- *Other Schemes*
- *Long Term Plan*
- *Design Life*
- *Residual Risks*

Legend

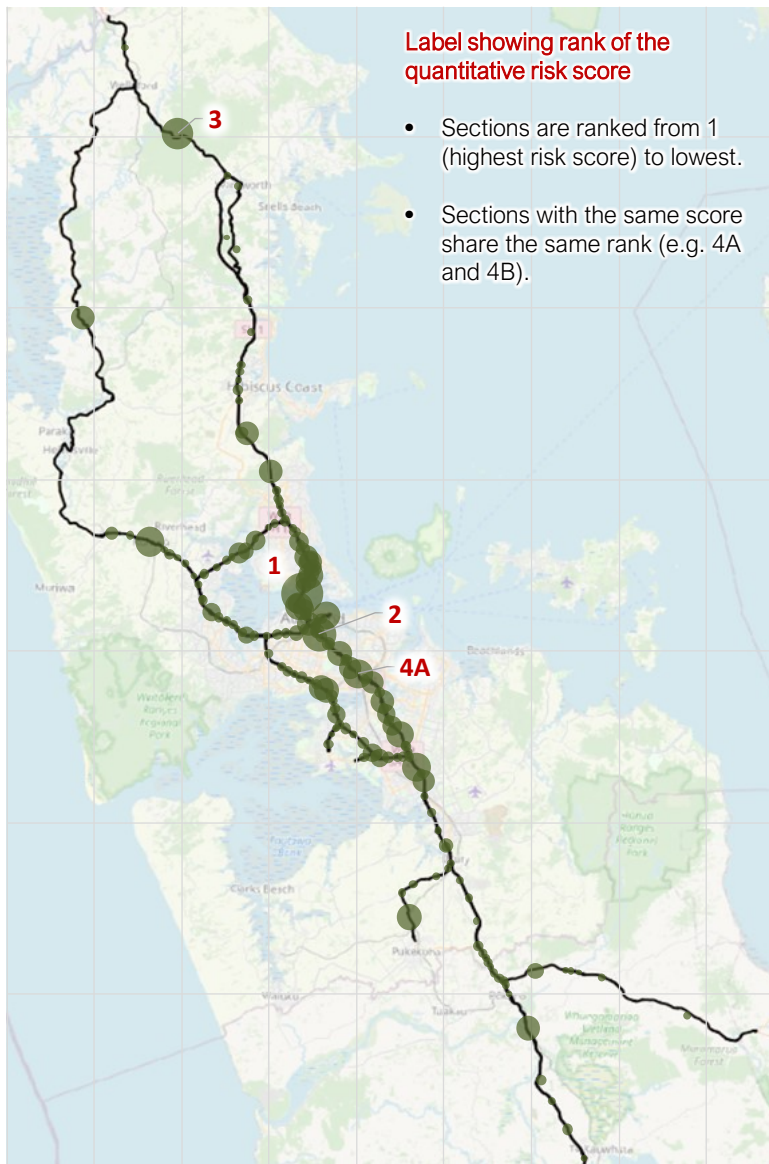
- Primary
- *Secondary*

- **Interplay** between obstruction types (e.g. slips induced by flooding)
- **Circular** nature of the resilience framework
- For a given type of countermeasure (e.g. reduction), there are various options available, each with different **design life** and **levels of residual risk**.
- **Collaboration** between different stakeholders is key to achieve optimum results for various key sections

Total Obstruction Score (Quantitative)

Label showing rank of the quantitative risk score

- Sections are ranked from 1 (highest risk score) to lowest.
- Sections with the same score share the same rank (e.g. 4A and 4B).



Legend

Water



Earth



Wind



Fire



• With funding (partial or full)

• Omitted from hot spot list


| Rank | Countermeasure Descriptions |
|--------|---|
| 1 | <p>AHB, vulnerable to high winds, with incidents like truck rollovers leading to lane closures and significant disruptions. Wind management strategy in place, wind prevention barriers very difficult to install, value in improving customer education, potentially worth investigating around parts replacement (if strike were to happen again). Potentially address with a second harbour crossing.</p> |
| 2 | <p>Mountain Road Underpass, lack of viable surface water outfall and discharge from highway system, reliant on existing soakage assets (limited capacity). The report recommends sand filter upgrades and new soakage bores—which have a lower design life, with delivery planned for the next financial year. Upgrading inlet capacity could address most of the risks, whereas the ultimate high-flow bypass solution is expensive and offers diminishing returns. BAU readiness / response / recovery measures: better warning and clearing of drain inlets prior to major weather events; better mobilisation of response crew for blocked drainage assets.</p> |
| 3 | <p>Dome Valley, currently outside of ASM network, many unknowns. New retaining walls installed post 2023 floods. Require investigation and consolidation of information to better understand treatment in the area. Could consider ground shaping, retaining walls / barrier systems, and potential for nature based solution.</p> |
| 4A | <p>SEART, flooding due to development intensification, aging infrastructure, of limited capacity and climate change. Partnership with Auckland Council for staged project already started (1 – hydrological assessment, 2 – design + delivery). Countermeasure costs increased due to unknowns (adding to the technical difficult of delivery), but likely to address most of the risks. BAU readiness / response / recovery measures.</p> |


Methodology


Risk Assessment


Strategies & Countermeasures


Lessons Learnt


Provision of alternative routes (i.e. redundancy)



Stormwater asset improvement (e.g. enlarged culvert)


Stormwater asset replacement (e.g. replace culvert with bridge)



Concrete barrier breaks



Out-of-cycle asset maintenance (extreme weather warnings)


Paving profile improvements and ground reshaping


Slope strengthening (e.g. soil nails, shear lock piles, mesh coverings)


Slope drainage enhancements



Vehicle management and restrictions



Wind barriers and screens



Advanced VMS



Driver awareness campaigns



Establish wind management protocol



Ground investigations (e.g. drone LiDAR, geotechnical assessment)

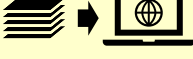

Ground hazards monitoring



Cross-government collaboration on interaction of stormwater systems



Stormwater asset investigations (e.g. soakage testing)



Flood hazard risk assessments



Guidelines for incident reporting (D4H)



Digitisation of records



Additional weather station



Smart monitoring systems



GENERAL



WATER



EARTH



Future-proof policies and regulations (no-build zones)



Relocate towns out of flood plains



Elevate critical roadways



Road realignment



Nature-based solutions



Protective infrastructure (e.g. retaining walls)



Asset repairs



Mandate wind-resilient design standards



Enforce variable speed limits



Enact wind management protocol



Post-strike asset assessment



Debris clearance and infilling



Bailey bridges



Temporary traffic lights or stop-go systems



Drain and debris clearance



Effective communications



Pumps


Coordination of AT and NZTA response crews


Standby resources for predicted events

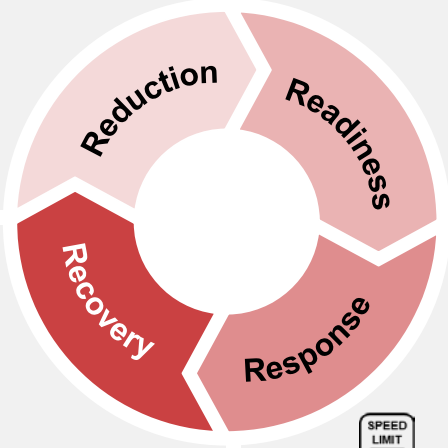

Signal optimisation and access control


Wayfinding (detours)


Temporary repurposing of road space


WIND





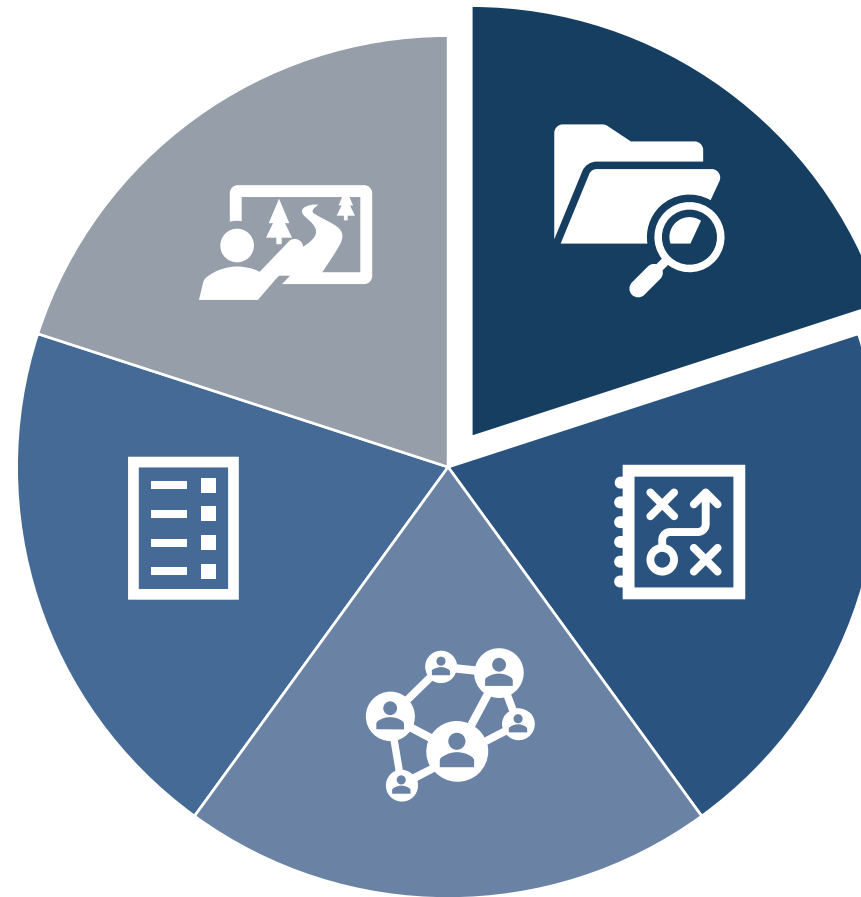
Lessons Learnt

Study Area & SME Selection

Discrepancies between qualitative and quantitative assessments stem from limited or uneven data coverage, especially outside areas currently managed by ASM.

Criteria Weighting

Nine risk criteria were scored on a 1–5 scale to deliberately show prioritised risks clearly using Auckland-specific data. Percentile-based categories allow flexibility, enabling adaptability to different datasets and study contexts.



Data Limitations

Data inconsistency across regions and contractors makes it difficult to collect equivalent datasets, especially for obstruction-type risk criteria.

Detour Routes

Limitations include no evaluation of detour route performance under hazard stress or traffic absorption capacity.

External Considerations

Acknowledge the influence of iwi and local communities on funding approvals and achieving outcomes, but did not include in this study.

Acknowledgements

Thanks to the members of the steering group:

- Malcolm McAulay, NZTA Senior Project Manager
- Deb Young, NZTA Principal Resilience Specialist
- Andrew Stevens, Beca Technical Director

Thank you to the subject matter experts:

- David Withers, ASM Structures Asset Manager
- Dylan Gould, ASM Projects Manager
- Peter Mitchell, ASM Stormwater Asset Manager
- Phil McLarin, ASM Senior Area Engineer
- Roderick Hadiwibowo, ASM Network Operations Manager
- Vi Hausia, ASM Senior Stormwater Asset Engineer
- Zane Davidson, ATOC Real Time Operations Manager
- Nicola Ridgley, Beca Senior Technical Director – Geotechnical

And thanks to the lovely research project delivery team:

- Andrew Stevens
- Alyka Yac
- Celine Malaluan
- Sophie Thompson
- Vicky Li



**make
everyday
better.**