Resilience of Three Waters Networks: A Framework for Decision Making on Asset Management

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Objectives

Guideline to facilitate decision makers and asset managers to:

- Define the technical resilience of three waters systems at city/district level, taking into account the localised requirements of level of service
- Assess the technical resilience of three waters systems in the event of natural hazards
- Improve system resilience by use of effective design and management strategies
- Embed system resilience into asset planning and management as business-as-usual programme

Structure of the Guideline

Part 1

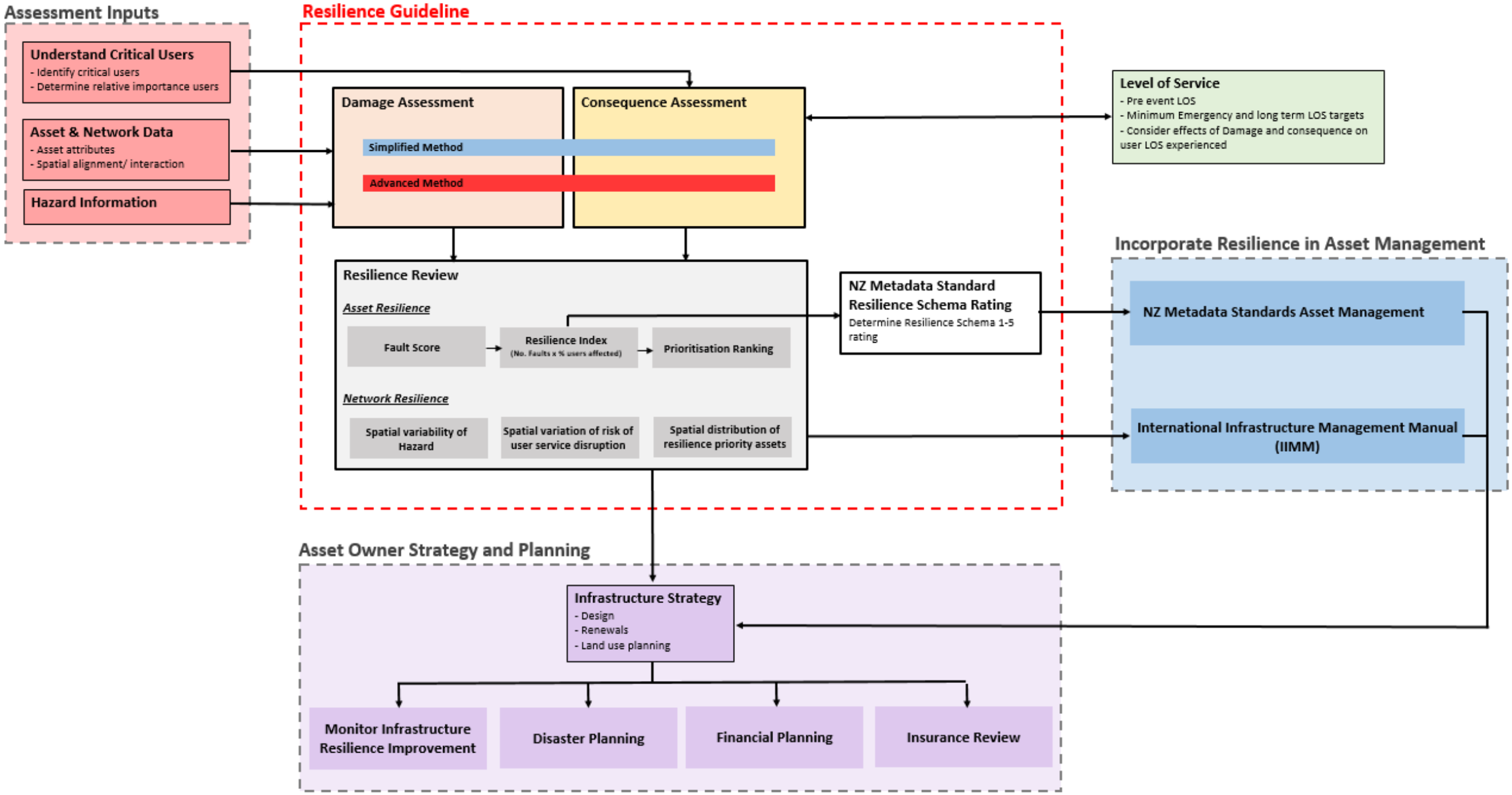
- Technical Resilience Assessment Framework

Part 2

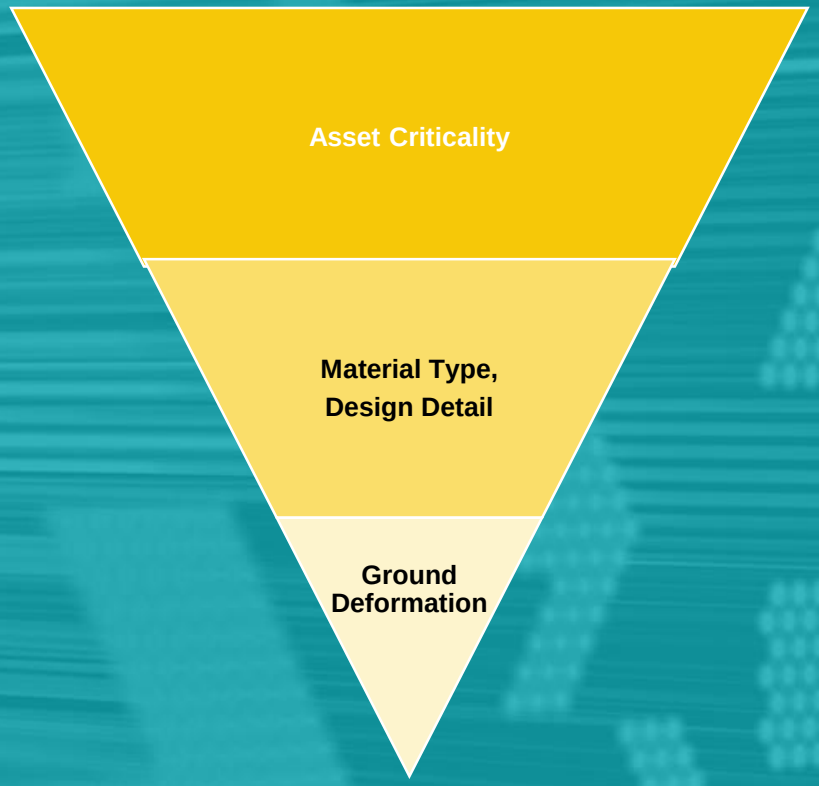
- Improving System Resilience

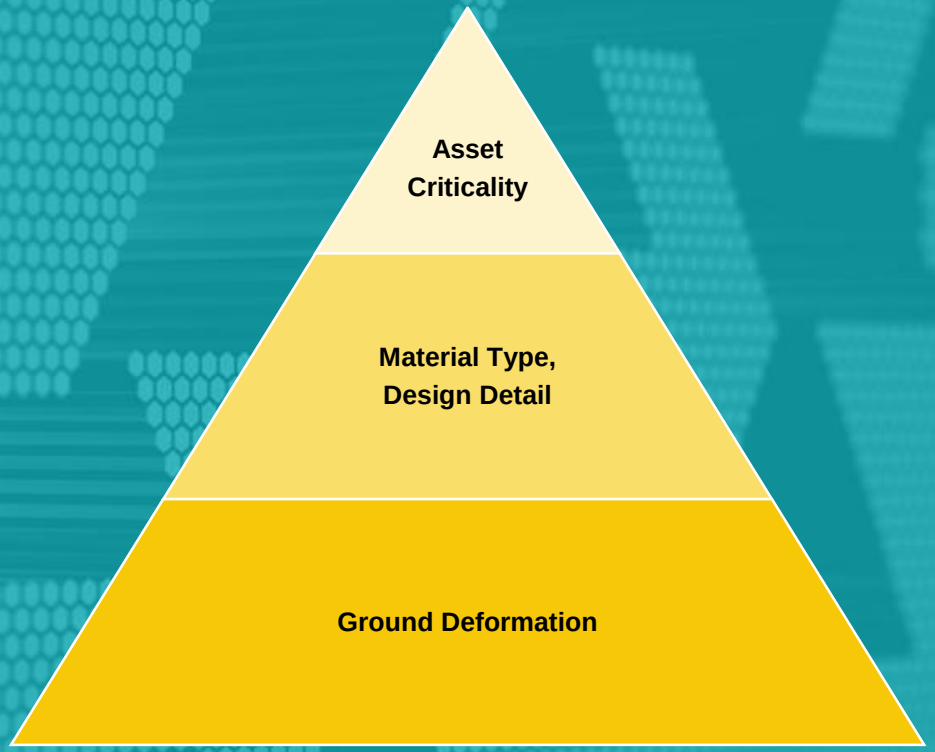
Part 3

- Monitoring System Resilience


Assessment Inputs
Understand Critical Users
- Identify critical users
- Determine relative importance users
Asset & Network Data
- Asset attributes
- Spatial alignment/ interaction
Hazard Information
Resilience Guideline
Damage Assessment
Simplified Method
Advanced Method
Consequence Assessment
Level of Service
- Pre event LOS
- Minimum Emergency and long term LOS targets
- Consider effects of Damage and consequence on user LOS experienced
Resilience Review
Asset Resilience
Fault Score
Resilience Index
(No. Faults x % users affected)
Prioritisation Ranking
Network Resilience
Spatial variability of Hazard
Spatial variation of risk of user service disruption
Spatial distribution of resilience priority assets
NZ Metadata Standard Resilience Schema Rating
Determine Resilience Schema 1-5 rating
Incorporate Resilience in Asset Management
NZ Metadata Standards Asset Management
International Infrastructure Management Manual (IIMM)
Asset Owner Strategy and Planning
Infrastructure Strategy
- Design
- Renewals
- Land use planning
Monitor Infrastructure Resilience Improvement
Disaster Planning
Financial Planning
Insurance Review

Relative influence of elements on resilience assessment





Relative influence on Assessment Outcome

Level of resource required for reliable output

Assessment Inputs:

- Hazard Scenarios
- Spatial Network Data with Attributes
- Understanding of Service user Demands, with Consideration of Critical Users

Example of definition of Equivalent Standard User

High Demand User	Number of Equivalent Standard Users
Hospital	1000 - 5000
Medical centre	150
Rest home/ Aged care facility	100 - 500
School/ Preschool	20 - 200
Emergency Services/Civil Defence	500
Industry * >1000 employees	300
Industry * >300 employees	30
Industry * >100 employees	10
Industry * >10 employees	5
Commercial Business >300 employees	30
Commercial Business >100 employees	10
Commercial Business >10 employees	3
Food distribution organisation (e.g. supermarket)	50
Townhouse/ Apartment complex	No. units within complex
Vulnerable community members (aged, chronically sick, disabled etc)	5
Standard Residential Property	1
Notes: * Industry that is reliant on three waters operation to manufacture/process [1] Where a range is provided variability is expected with different tiers of importance or size.	

Selection of Assessment Method

- Quality and completeness of input data
- Natural hazard profile
- Complexity, size and spatial arrangement of three waters systems
- Vulnerability of three waters assets to damage and anticipated duration of repair
- Ability for the community to adjust and respond to loss of services - varies with the size of community and population density
- Resources available for resilience assessment and renewals

Two Resilience Assessment Method

- Simplified Assessment Method
- Advanced Assessment Method

Simplified Assessment Method

Characterise Hazard

- Compile available hazard assessments
- Site inspection to review existing and past hazards influencing network assets (e.g. walkover, review aerial images)
- Review regional geology, geomorphology and compile available geotechnical investigation data and assessments
- Establish characterisation of hazard and anticipated consequences to land performance and post event asset functionality
- High level assessment to spatially quantify hazard

Damage Assessment

- Review local through to international experience of performance of assets of different type, design detailing in response to hazard
- Focus assessment on relative risk of adverse change in level of service. Utilise knowledge developed from wider experience to establish relative risk ratings (e.g., 1-10) for different asset attributes (such as pipe material type) and land performance.
- Allocate relative risk rating appropriate for each asset and anticipated land performance across the network

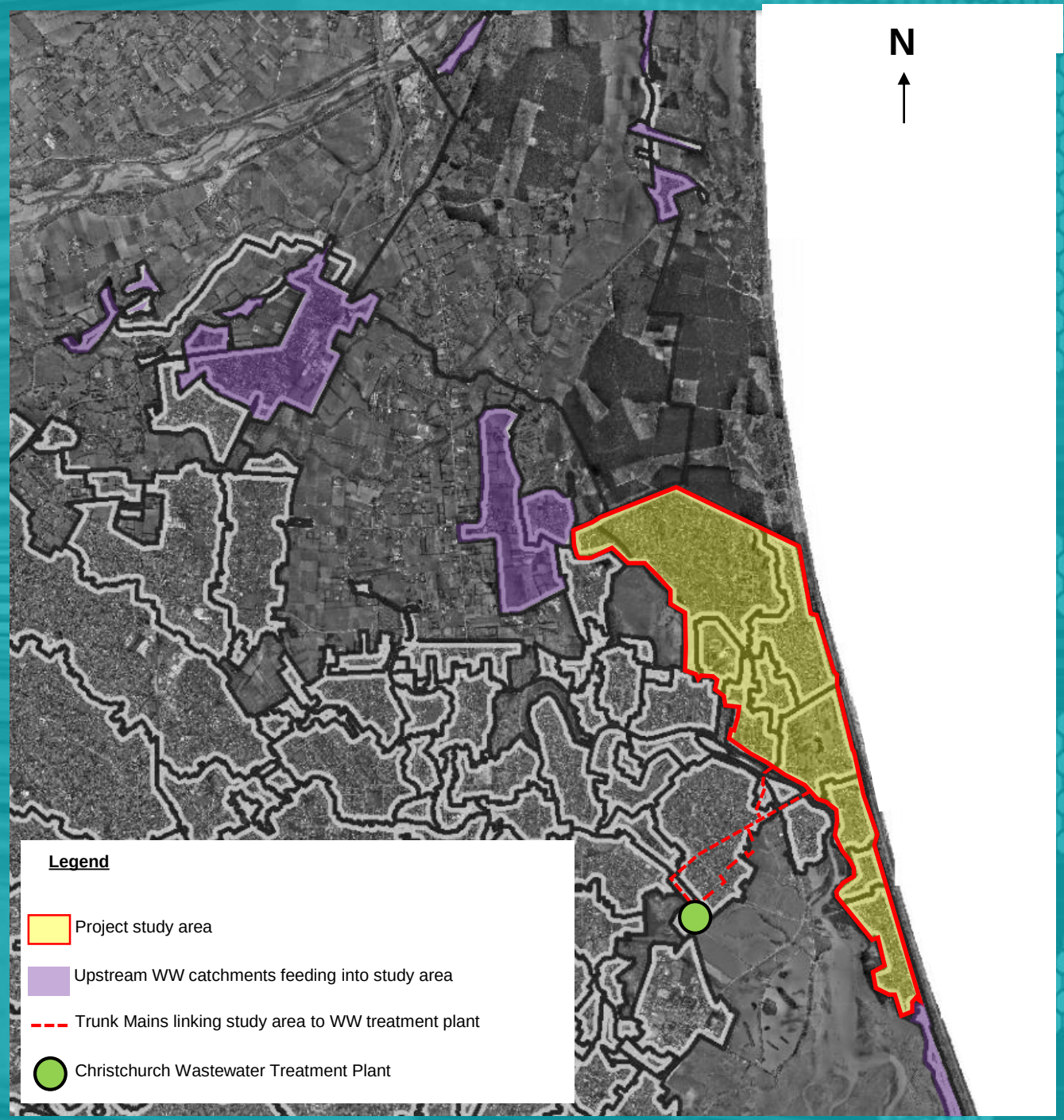
Consequence Assessment

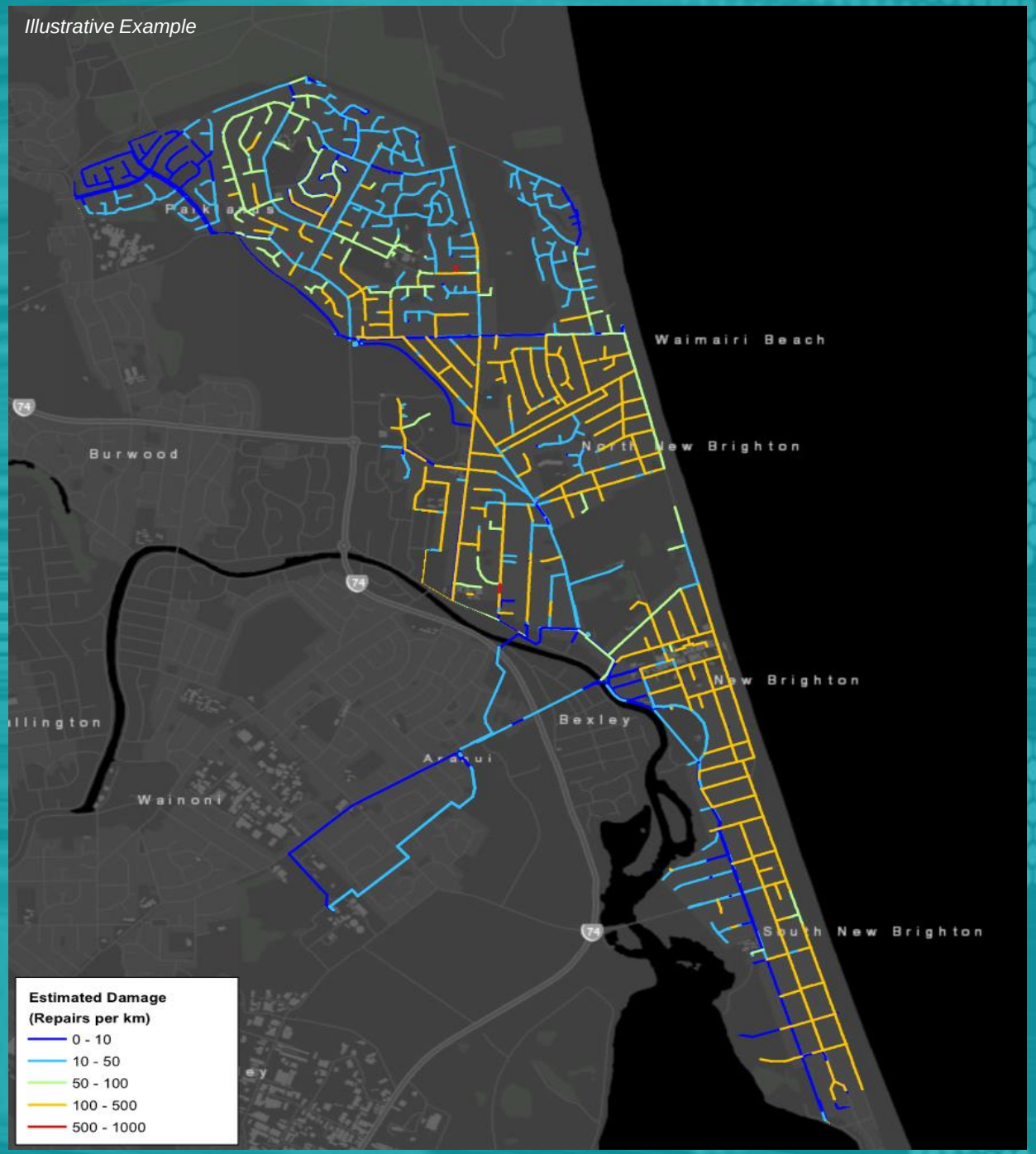
- Rank assets on a 1-5 scale within network based on either the proportion of the network the asset supports or based on the diameter of pipeline to identify broad priority of asset within the network. Incorporate equivalent users into index where this information is available.
- Develop and apply simplified resilience index for assessment of different assets across the network
- Rank assets within network based on simplified resilience index, to create simplified prioritisation ranking

Resilience Review

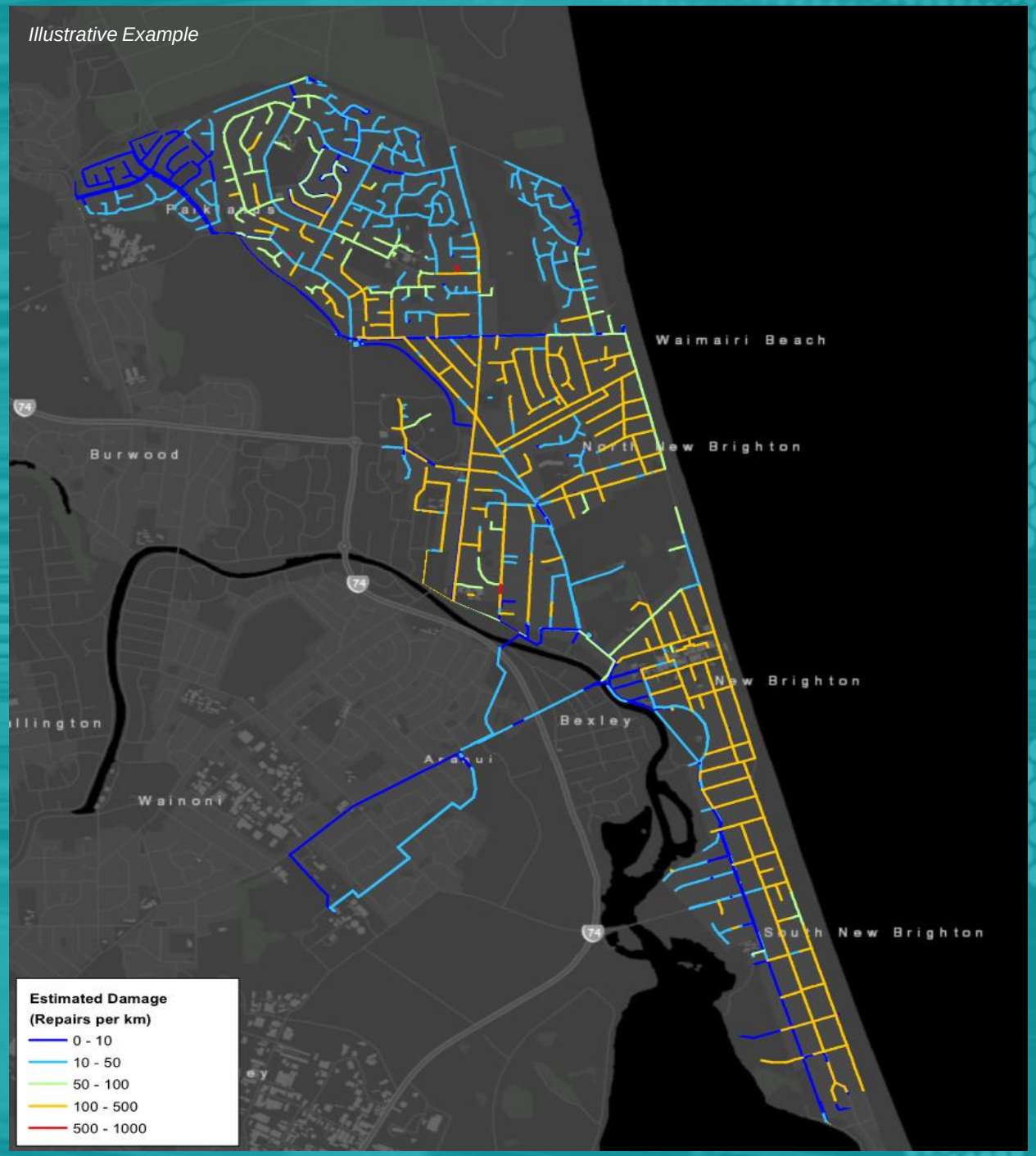
- Rank assets within network based on simplified resilience index, to create simplified prioritisation ranking
- Spatial mapping (e.g. hazard characterisation, network layout, venerable assets, prioritisation ranking)

Advanced Assessment Method



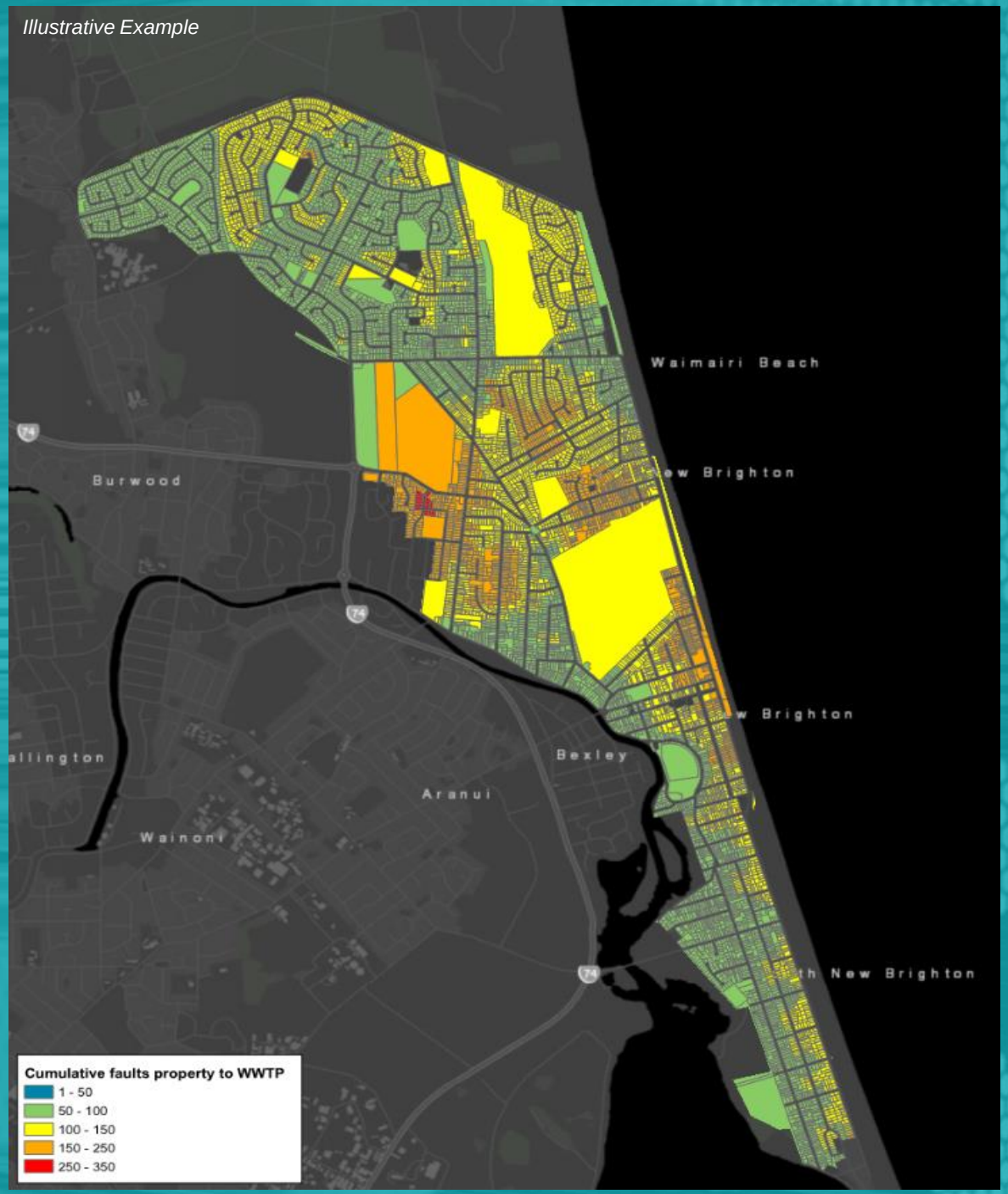


Estimated Pipe Faults

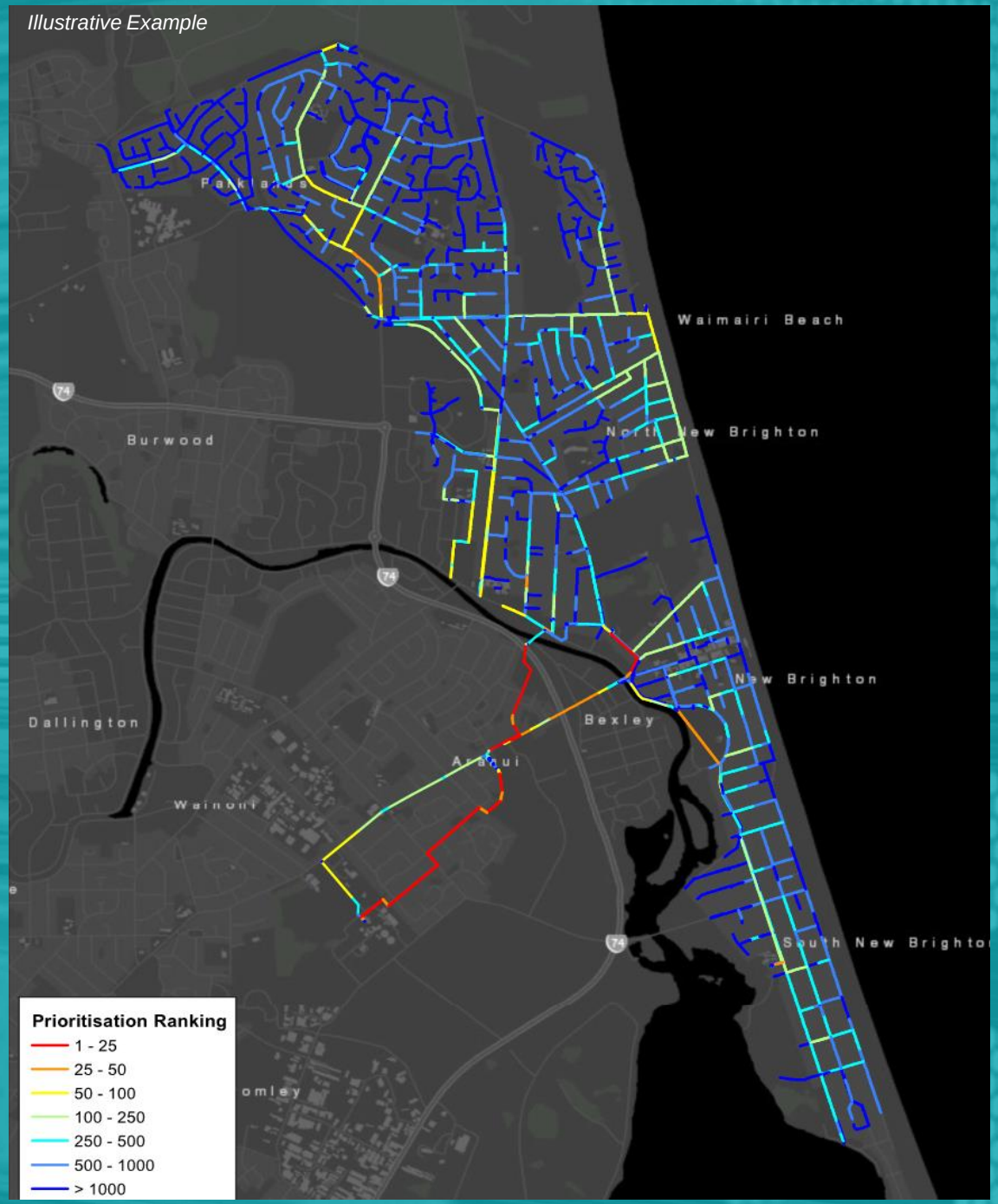


Properties reliant on Asset

Illustrative Example



Cumulative faults property to WWTP



Asset Prioritisation Ranking

Discussion