

Auckland Transport

Climate Adaptation Framework and Action Plan 2025

Contents

| | |
|---|-----------|
| Introduction | 3 |
| Our Purpose and Ambition | 4 |
| Climate Adaptation | 5 |
| Importance Our Framework and Action Plan | 7 |
| Scope | 8 |
| Improving Climate Planning | 9 |
| Our Approach | 11 |
| Our Approach to Climate Adaptation Planning | 12 |
| Core Approach | 13 |
| AT’s Board Appetite | 14 |
| Strategic Alignment and Positioning | 15 |
| Fiscal Environment | 21 |
| Our Adaptation Framework | 22 |
| Understanding Climate Risks and Impacts | 24 |
| Assessing and Prioritising Infrastructure Vulnerability | 27 |
| Targeted Resilience Approaches by Hazard Type | 30 |
| Adaptation Planning and Infrastructure Design | 33 |
| Collaboration and Operational Integration | 35 |

| | |
|---------------------------------|-----------|
| Our Adaption Action Plan | 37 |
| Action Plan and Timeline | 40 |
| Glossary | 42 |
| References | 42 |
| Acronyms | 42 |





Introduction

Addressing the impacts and hazards of climate change requires a multifaceted approach that includes both mitigation and adaptation strategies. As global temperatures rise, weather patterns shift, and sea levels increase, the necessity for communities, regions, and nations to adapt becomes ever more urgent.

This Climate Adaptation Framework and Action Plan provides Auckland Transport with a foundation for understanding and responding to the challenges posed by a changing climate. It outlines how AT will increase the resilience of the transport network and support Auckland in the face of more frequent and severe weather events. The framework focuses on Auckland Transport assets and operations, and offers a starting point for understanding and communicating the climate challenges posed to the transport network.

Transport infrastructure is vital for Aucklanders. It underpins economic growth, social connections, and access to essential services. Extreme weather, from

storms to droughts, places the robustness of our network under significant pressure. This framework sets out guidance, methods, and approaches AT will use to strengthen network resilience and maintain public confidence in the transport system. It is within this context that the Climate Adaptation Framework sets out the tools, methods and approaches AT is taking to increase network resilience and support increasing patronage.

The Action Plan focuses on understanding the vulnerability of the transport network, from both an asset owner, and asset operator perspective. It defines actionable steps and highlights opportunities to improve resilience through tailored solutions for road-based travel and public transport services. Emphasis is placed on leveraging technology, fostering cross-sector collaboration, and embedding sustainable asset management practices. These approaches will be integrated into AT's asset management systems, operation, and forward works programmes.

This Framework and Action Plan will also inform and align with wider Auckland Council Group initiatives and support a coordinated response to climate challenges. By identifying vulnerabilities and considering a range of options, it ensures decision-making is guided by robust evidence and community needs. The collective effort of government agencies, lifeline utilities, mana whenua, and Auckland communities will be critical to its success.

Ultimately, implementation of the Climate Adaptation Framework and Action Plan is designed to strengthen the resilience of Auckland's transport system, ensuring it continues to support the region's people and economy as they live, work and move about the region.

Our Purpose and Ambition

Our purpose

We tiaki all those who use transport in Tāmaki Makaurau

Our ambition

An efficient and sustainable transport system

The factors which guide our thinking and actions have been drawn from the **Mana Whenua Kaitiaki Forum Strategic Plan 2030, Hīkina te Wero** and **Auckland Transport’s purpose and story.**



Whakapono

We act with integrity in all we do, connecting people and places to improve the lives of Aucklanders.



Kotahitanga

We have a collective voice and approach, fostering our relationships while drawing on knowledge and the past to inform the future.



Te ao Māori

We integrate te ao Māori into everything we do, valuing Auckland’s biodiversity to protect and restore the mauri of our harbours and streams.



Equitable transport future

We will prioritise a just and equitable transition to a low carbon transport future.



Thoughtful stewardship

We prioritise resilience across our networks, assets and services, embracing our role as tiaki of Auckland’s transport system.



Climate Adaptation

Climate Adaptation

The Intergovernmental Panel on Climate Change (IPCC) defines adaptation as “the process of adjustment to actual or expected climate and its effects”¹. The United Nations Framework Convention on Climate Change (UNFCCC) reasons adaptation planning is required through the “need to develop adaptation solutions and implement actions to respond to current and future climate change impacts”².

As the frequency and intensity of extreme weather events rises, the degree of exposure and level of vulnerability for physical, social, and economic systems has become increasingly evident. Floods, droughts, heatwaves, and storms are examples of the increasingly negative climatic possibilities which disrupt the ways in which we live. Our exposure and vulnerability to these possibilities means it is essential to integrate climate risks assessments into all levels of planning.

¹ (Annex I: Glossary, 2018)

² (United Nations Framework Convention on Climate Change, 2025)



Importance Our Framework and Action Plan

Our **Adaptation Framework** establishes a path forward for AT’s long-term approach to addressing increasing climate change hazards. The framework is for use by Auckland Council Group staff when considering climate adaptation challenges and opportunities for the transport system within the Auckland region. It guides asset managers as they seek to improve the resilience of transport assets and operations.

In addition, **Our Action Plan** sets out the activities, tools, and systems AT is developing to understand the vulnerability of our transport assets and systems. These actions seek to build resilience into operational and management processes, and reduce risks to AT’s assets and customer services. The actions also seek to embed the approach outlined by the framework, into asset management practices and decision making processes.

The Auckland region has experienced extreme weather events before and will continue to do so. Understanding where our networks are vulnerable and taking steps to proactively improve asset and operational resilience, are important mechanisms for delivering an effective and reliable transport service to Aucklanders.



Figure 1: History of Extreme Weather Events in Auckland

Scope

For AT, climate adaptation planning seeks to develop a resilient transport system which can respond and recover effectively from climatic hazards. This will ensure the resilience and sustainability of Auckland’s transport infrastructure, so future generations can prosper through regional connection and movement.

Our Adaptation Framework provides the overarching approach and guidance for how AT will respond to climate risks. It outlines the systems, processes, and tools which guide AT’s efforts to build resilience across the transport system. **Our Adaptation Framework** establishes the rationale and structure for climate adaptation, and embeds climate risk into asset management, infrastructure planning, and organisational decision-making.

Our Adaptation Action Plan operationalises this framework by identifying specific actions, timelines, and implementation pathways. It focuses on practical measures to reduce vulnerabilities and prepare Auckland’s transport network for future climate conditions. **Our Adaptation Action Plan** is reviewed regularly to remain responsive to evolving risks, updated data, and lessons learned from ongoing adaptation efforts.

The diagram in Figure 2 illustrates six interconnected spheres of climate adaptation planning – physical, cultural, social, environmental, economic, and governance. While all spheres are vital to building long-term resilience, responsibility for leading action within each is distributed across various entities.

The remit of climate adaptation planning for AT focuses primarily on the physical sphere. This is where climate change poses direct risks to transport assets, networks, and infrastructure performance. This includes the adaptation of roads, rail, ferries, and active mode infrastructure and services to withstand climate-related hazards. Through infrastructure planning, lifecycle asset management, and investment prioritisation, AT will ensure its transport systems are robust and fit for future conditions. The framework also identifies where third-party operators or asset owners play an important role in improving the resilience of Auckland’s transport system.

In contrast, Auckland Council Group (ACG) holds the primary responsibility for adaptation planning in the social and cultural spheres, including community resilience, public wellbeing, and the protection of cultural identity and environment. The ACG leads region-wide adaptation programmes through community engagement, placemaking, and the integration of mana whenua knowledge and values into the regional climate responses. While AT contributes to the economic and governance aspects, these typically reside with the ACG and wider central government entities.

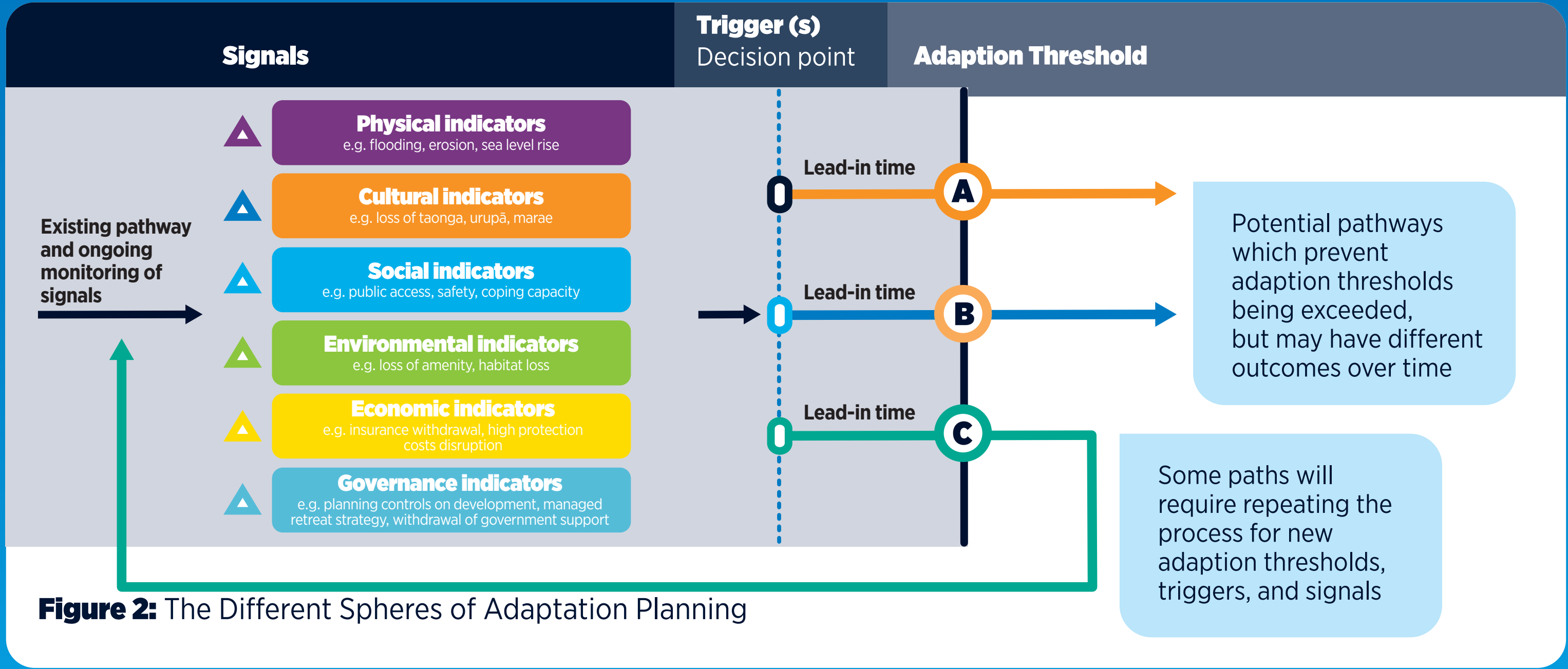


Figure 2: The Different Spheres of Adaptation Planning

Improving Climate Planning



Improving Climate Planning

At a national level, work on climate *mitigation* strategies and approaches has been occurring for almost 20 years. Emissions reduction has been at the centre of the climate challenge for many years. In contrast, climate *adaptation* planning is relatively new. With New Zealand's First National Adaptation Plan being published in 2022, adaptation planning is still maturing.

AT began its own adaptation journey in 2019 (Figure 4). Work started with understanding the hierarchy of roads, climate risks and the Dynamic Adaptation Policy Pathways (DAPP) approach.³

From 2019 onwards, AT has progressed the development of signals, triggers, and thresholds (STATs). These are now being applied and embedded into AT's asset management practices. The development of tools and knowledge has progressed rapidly since 2023, as AT began utilising the landslide data and recovery funding available after Cyclone Gabrielle.

³(Dynamic Adaptive Policy Pathways: A Method for Crafting Robust Decisions for a Deeply Uncertain World, 2013)

Figure 4: Timeline of AT's Adaptation Progress

| | |
|-------------|--|
| 2019 | <ul style="list-style-type: none"> • Road Criticality Assessment |
| 2021 | <ul style="list-style-type: none"> • Climate Change Risk Assessment • Road Criticality update |
| 2022 | <ul style="list-style-type: none"> • Evaluation of Adaptation Decision Making Frameworks • First signals, triggers and threshold (STATs) developed for coastal assets • Pilot study- integrating STATs |
| 2023 | <ul style="list-style-type: none"> • 10 DAPP Prioritization sites – extrapolation of STATs • Pilot detailed DAPP • Landslide Framework developed • Climate Adaptation Portal/GIS layers • Drainage Improvement Works – North and West • Support AC Shoreline Adaptation planning (SAP) - ongoing |
| 2024 | <ul style="list-style-type: none"> • Early flood warning systems • Vector and AT data integration • Machine Learning extrapolation of landslide framework • Detailed DAPP assessments • Integration of STATs into AT's maintenance and conditions assessment plans |
| 2025 | <ul style="list-style-type: none"> • Landslide risk GIS layer • Integration of landslide risk into asset management – identifying landslide STATs and embed landslide data into forward works adaptation planning • Extend detailed DAPP assessments • Expand STATs Portal to seawalls, PT wharves/terminals • Link STATs portal to asset forward work • RAMM capabilities – capture historic data for trend analysis • Evaluation of cost comparison between resilience and recovery work from storm events • Early flood warning systems • Assess community hall access route resilience. |

The image features a blue-to-green gradient background. At the top and bottom, there are decorative horizontal bands containing a series of concentric, semi-circular arcs in shades of blue and green. The text "Our Approach" is centered in the middle of the image in a large, bold, white sans-serif font.

Our Approach



Our Approach to Climate Adaptation Planning

Our Adaptation Framework provides the overarching guide and direction for how AT will respond to climate risks. It outlines the systems, processes, and tools which guide AT’s efforts to build resilience across the transport system. **Our Adaptation Framework** establishes the technical context and current approaches for climate adaptation. Our Framework helps guide AT to embed climate risk into asset management, infrastructure planning, and organisational decision-making.

Our Adaptation Action Plan operationalises this framework by identifying specific actions, timelines, and implementation pathways. It focuses on practical measures to reduce vulnerabilities and prepare Auckland’s transport network for future climate conditions.

Our Adaptation Action Plan is reviewed regularly to maintain AT’s responsiveness to evolving risks, update data, and apply lessons learned from ongoing adaptation efforts.

Core Approach

Climate adaptation planning is grounded in several fundamental factors which are reflected in AT's actions and approach.

- Through **FLEXIBILITY**, AT recognises adaptation is a dynamic process which must evolve in response to new scientific finds, political expectations, and emerging risks.
- AT adopts an **INTEGRATIVE** approach to incorporate climate considerations into existing policies, programmes, and operations across AT's infrastructure.
- **INCLUSIVITY** informs AT's discussions and engagement through Auckland Council with diverse stakeholders, including marginalised communities, mana whenua, and network utilities.
- Climate adaptation planning for AT is **EVIDENCE-BASED**, where measuring, evaluating, and monitoring actions ensures their demonstrable benefits, and their probability of success.



AT's Board Appetite

The AT Board, as part of their climate risk management, have identified a risk appetite of “Cautious” for new infrastructure, redevelopment of existing infrastructure and relocatable/ short term assets. This appetite informs our approach to responding to the climate scenarios and hazard information as set out in the AT Climate Change Technical Policy.

Notes:

- 1. For projects in delivery at the time of policy adoption or amendment, changes to design may be implemented on a case-by-case basis as recommended by the Chief Engineer and approved by the Director, Infrastructure & Place.
- 2. Risk appetite is related to the risks to assets from forecast changes in climatic conditions.
- 4. SSP [number of scenario] - [RCP trajectory] e.g., SSP5 – 8.5 = SSP scenario 5 – RCP8.5. (H+ means considerations are based on the upper end of the range. M means considerations are based on the median of the range.)

Technical Information by Development or Activity Type

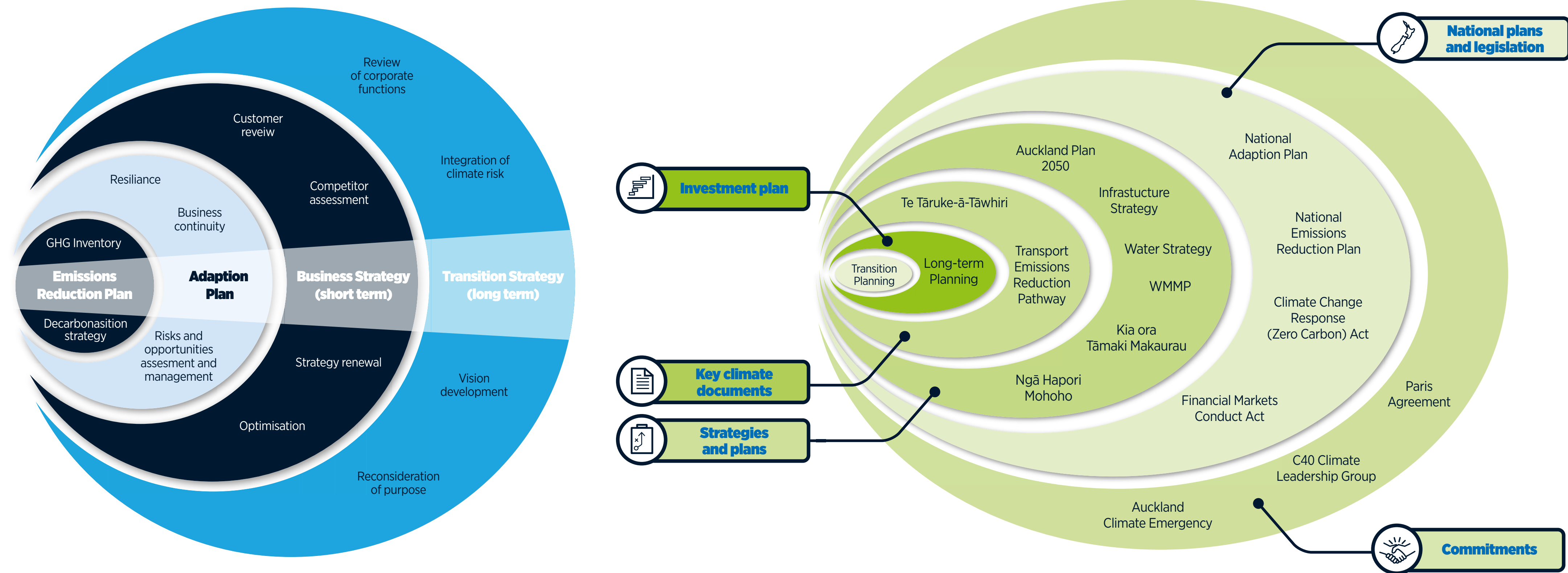
| Development or Activity Type | Risk Appetite adopted by AT Board ² | Must demonstrate adaption to the physical impacts of the changing climate as forecast below, over the lifespan of the asset |
|--|--|---|
| Greenfield development/ major new infrastructure ¹ | Cautious | Avoid hazard risk using SSP5 - 8.5H+ trajectory. |
| Redevelopment (intensification) and existing development and infrastructure ¹ | Cautious | SSP5 - 8.5M or DAPP. Adapt to hazards by conducting a risk assessment using SSP5 - 8.5M or using the DAPP approach. |
| Relocatable activities/ developments/short-lived assets ¹ | Cautious | SSP3 - 7.0M or DAPP. Adapt to hazards by conduction risk assessment using RCP 6M or using the DAPP approach A SSP2 - 4.5M climate trajectory may be considered upon completion of a sensitivity assessment, based on critically and location of assets |
| Trials of activities or assets investigating reductions in environmental impacts on emissions, or climate risks. | N/A | Require an approved project plan or business case demonstrating a balance between a high likelihood of successful delivery and a high degree of reward and value for money. |

Figure 5: Risk Appetite and Climate Scenario for Adaptation Planning

Strategic Alignment and Positioning

Our Adaptation Framework and **Our Adaptation Action Plan** are Intentionally aligned across multiple levels of strategy and governance. This ensures coherence, accountability, and collective action in the face of accelerating climate risks. The diagrams below show the inter-connectedness of adaptation planning to the wider climate change planning tools and processes. The diagrams illustrate adaptation planning within the broader context of national and legislative requirements.

Figure 6: Climate Change Planning Tools and Processes



A close-up photograph of two hands shaking in a firm grip. The hand on the left is wearing a blue and green plaid shirt, while the hand on the right is wearing a white dress shirt. The background is blurred, showing other people in a professional setting.

Global

AT's approach to adaptation is underpinned by global frameworks. The Paris Agreement (2016) commits signatory countries to strengthen adaptive capacity, enhance resilience and reduce vulnerability to climate change⁴. By embedding climate risk into business continuity planning and long-term vision, AT supports the Paris Agreement's goal of ensuring a sustainable development pathway in the context of rising global temperatures. Also, through previous, current, and planned activities, this Adaptation Framework also mirrors the adaptation and mitigation duality promoted by the United Nations Framework Convention on Climate Change (UNFCCC).

⁴ (Paris Agreement to the United Framework Convention on Climate Change, 2015)



National

At a national level, **Our Adaptation Action Plan** align with Aotearoa New Zealand's First National Adaptation Plan (NAP)⁵. The NAP outlines priority actions for the transport and infrastructure sectors, such as improving the climate resilience of land transport infrastructure, integrating adaptation into investment decision-making, and developing local government capabilities to respond to climate risks. AT's adaptation work operationalises these directions through:

- Climate risk integration in corporate and asset management processes.
- Strategic scenario planning and resilience assessments.
- Proactive decarbonisation pathways aligned with national emissions budgets and reduction targets.

Planning tools including hazard data sets and greenhouse gas inventories also directly support the NAP's goal of building system-wide resilience.

⁵(Aotearoa New Zealand's First National Adaptation Plan, 2022)

Regional

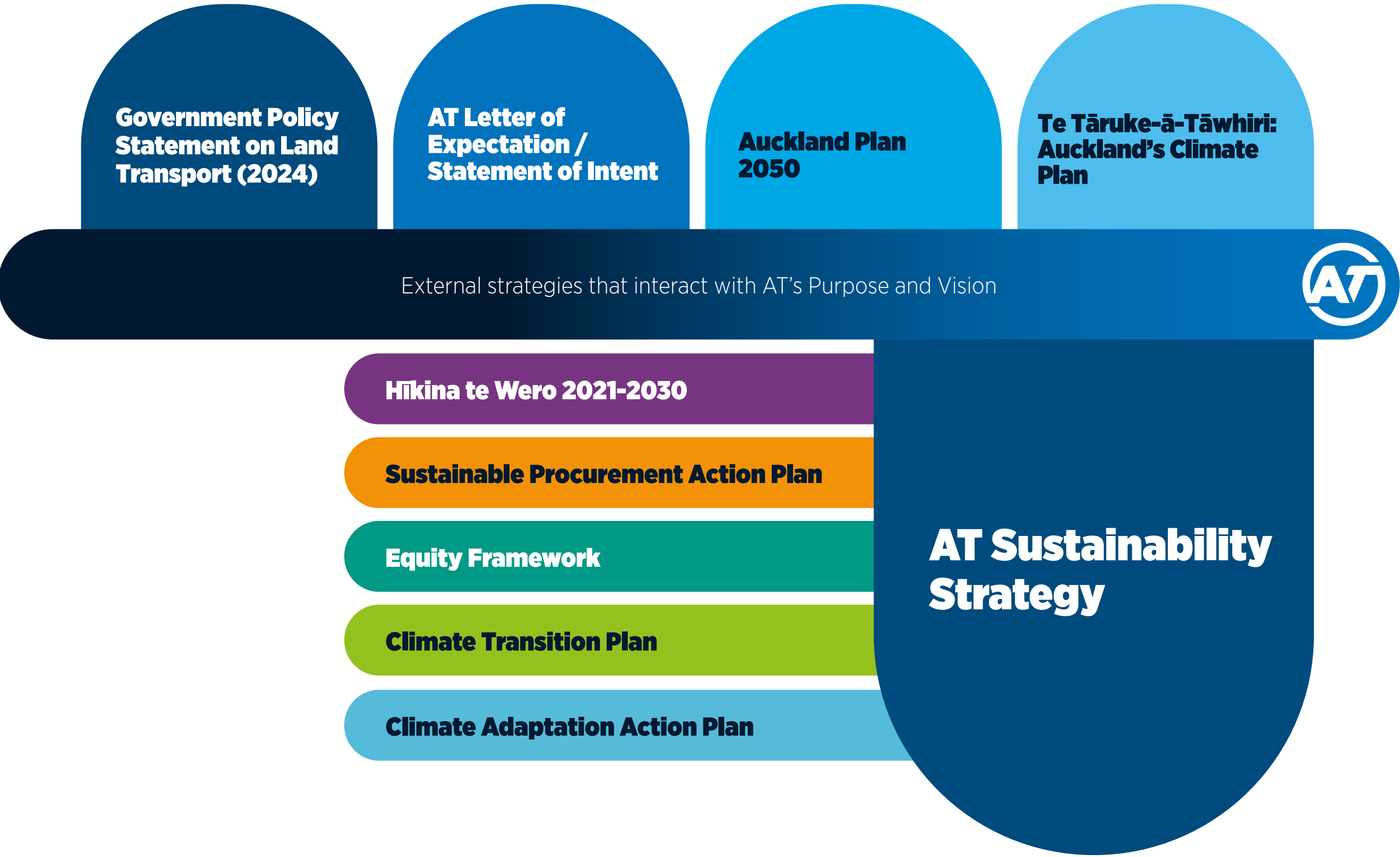
At a national level, **Our Adaptation Framework** and **Our Adaptation Action Plan** are nested within the ACG's Auckland Climate Plan – Te Taruke-a-Tawhiri⁶. The Auckland Climate Plan sets out a regional vision in preparation and anticipation of climate change impacts. AT, as a key infrastructure provider and lifeline organisation⁷, has a critical role in delivering transport-related climate adaptation actions within the regional framework.

Our Adaptation Framework and Our Adaptation Action Plan contribute to ensuring resilience is integrated in high-level policy and day-to-day planning, operation, and renewal of assets across AT's network. This includes working closely with mana whenua and community stakeholders to ensure adaptation pathways are inclusive and equitable.

⁶(Te Tāruke-ā-Tāwhiri: Auckland's Climate Plan, 2020)

⁷(Civil Defence Emergency Management Act 2002)

Sustainability Strategy Cascade



Forming part of the AT Sustainability Strategy⁸, AT's climate adaptation planning sits alongside AT's corporate processes which ensure entity resilience, business continuity, and the effective management of risks and opportunities.

Internally, **Our Adaptation Framework** and **Our Adaptation Action Plan** reinforce AT's strategic shift towards being a low-emissions, climate-resilient organisation. They also drive alignment with AT's vision and asset management practices, ensuring climate adaptation is not treated as a siloed initiative, but rather as an embedded business imperative.

AT's other planning tools and processes support a holistic approach to climate adaptation. AT's Climate Change Technical Policy⁹ and Climate Transition Plan¹⁰ emphasise integrating climate considerations into all aspects of organisational operations. These documents align with adaptation objectives to reduce asset vulnerability and ensure new infrastructure is climate ready.

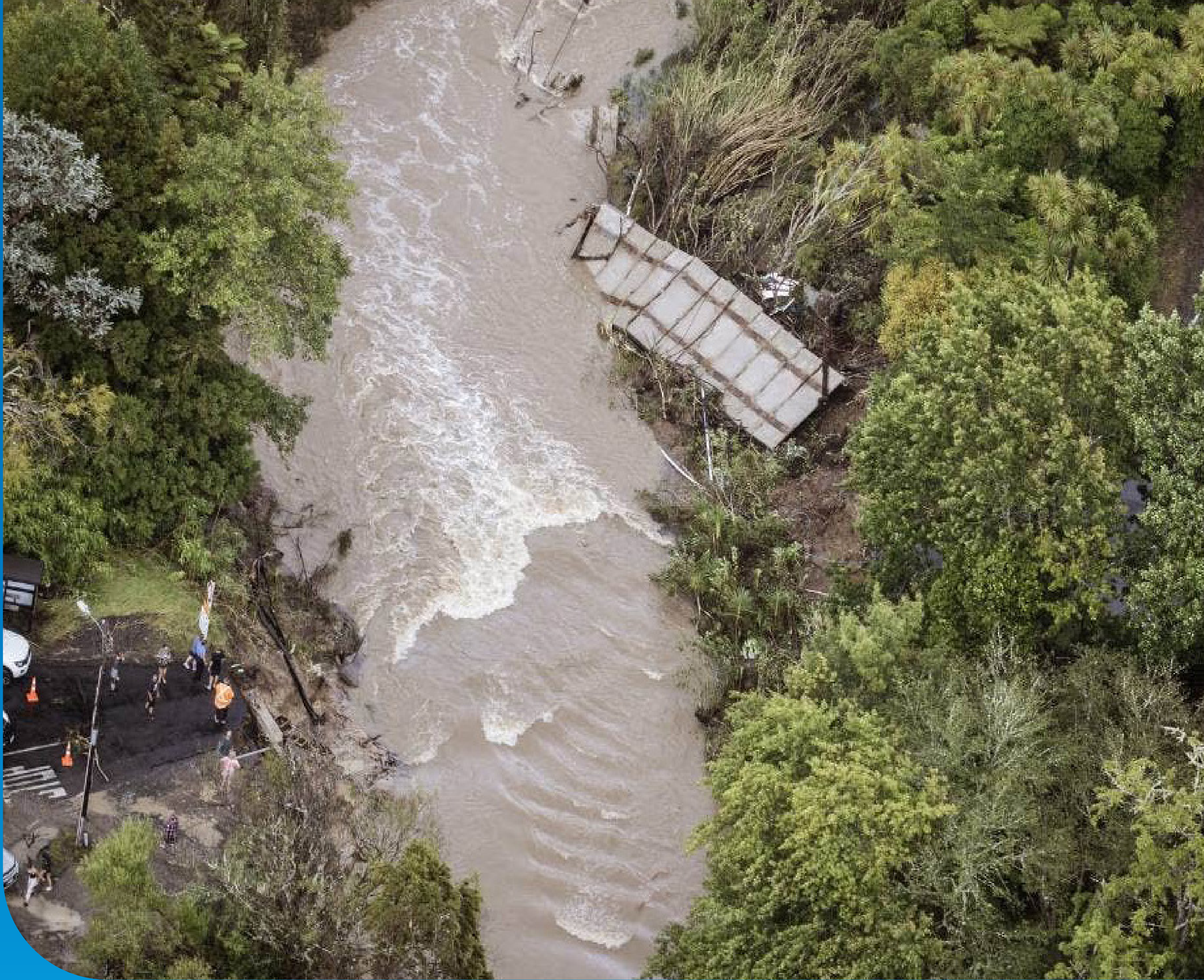
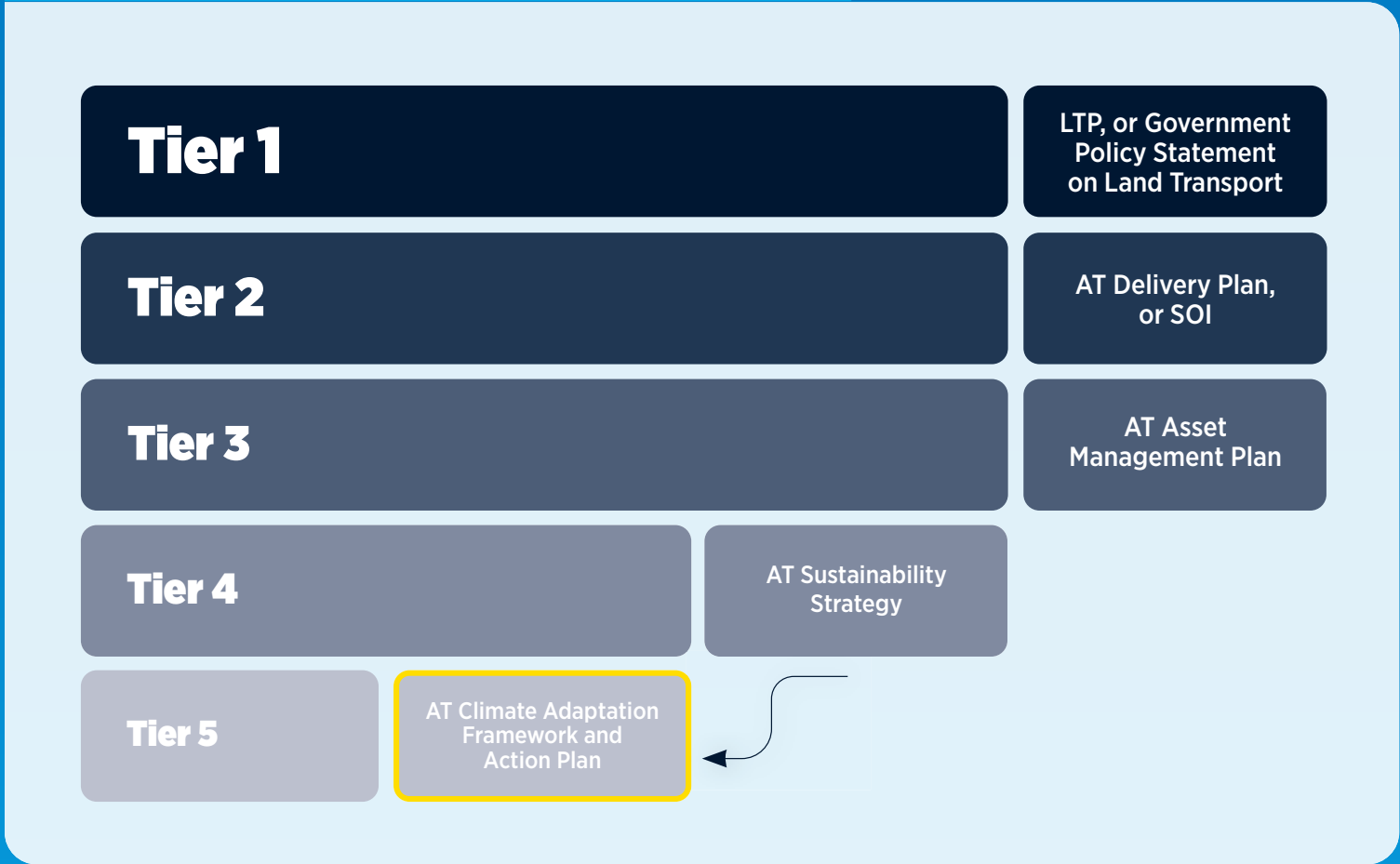
⁸ (Auckland Transport Sustainability Strategy, 2024)
⁹ (Climate Change Technical Policy, 2024)
¹⁰ (Climate Transition Plan, 2025)

Figure 7: AT Sustainability Strategy Cascade

Auckland Transport Strategic Document Architecture

Our Climate Adaptation Framework and Action Plan is a Tier 5 document. It sits under the AT Sustainability Strategy as the parent Tier 4 document. Like other Tier 5 documents, this document translates high-level aspirations, directions and enterprise-level strategies, into practical guidance and operational responses. Activities delivered through the Action Plan directly inform and contribute to ATs asset management practices and organisational reporting required for the Sustainability Strategy and Climate Financial Disclosure.

Figure 8: AT Strategic Document Architecture and Examples





Fiscal Environment

Funding for climate adaptation is through a combination of New Zealand Transport Agency (NZTA), Auckland Council and central government programmes, including the Flood Recovery work The Renewals and Resilience Regional Land Transport Plan (RLTP) line provides for Auckland Council’s contribution, with NZTA funding sourced primarily through the Low-Cost Low-Risk Programme.

One of the significant funding challenges for preventative or resilience works is the lack of a dedicated fund or programme. Traditionally, renewal works are only funded to replace the previous asset to current standards – not necessarily to improve its condition. Improvements are considered capital works and require a different funding category. Consequently, recovery works are usually funded under emergency situations to replace a lost or damaged asset, with little regard as to whether replacement on a like-for-like basis at the current standard is warranted, or whether an improved, more resilient option is required.

AT assessed the effectiveness and cost efficiency of preventative measures versus reactive responses to slope instability from 215 major landslides in the 2023 Auckland Anniversary and Cyclone Gabrielle events. Key findings showed that preventative measures, particularly those targeting drainage and slope stability, could have significantly reduced the extent and cost of damage. In many cases, Level of Service (LoS) interventions cost as little as 15% of the reactive recovery cost, while Factor of Safety (FoS) based designs averaged 30% of the cost

Further assessments of the resilience costs to the Auckland transport network are underway with a view to informing AT’s next 30-year Asset Management Plan. Development of an infrastructure resilience programme of work is also being progressed to support a bid into the next RLTP/LTP, with the intention of creating a longer-term pipeline of resilience funding

Assessment of the cost of recovering from Cyclone Gabrielle showed that:

Preventative resilience improvements cost

\$15-\$30

for every \$100 spent on recovery.





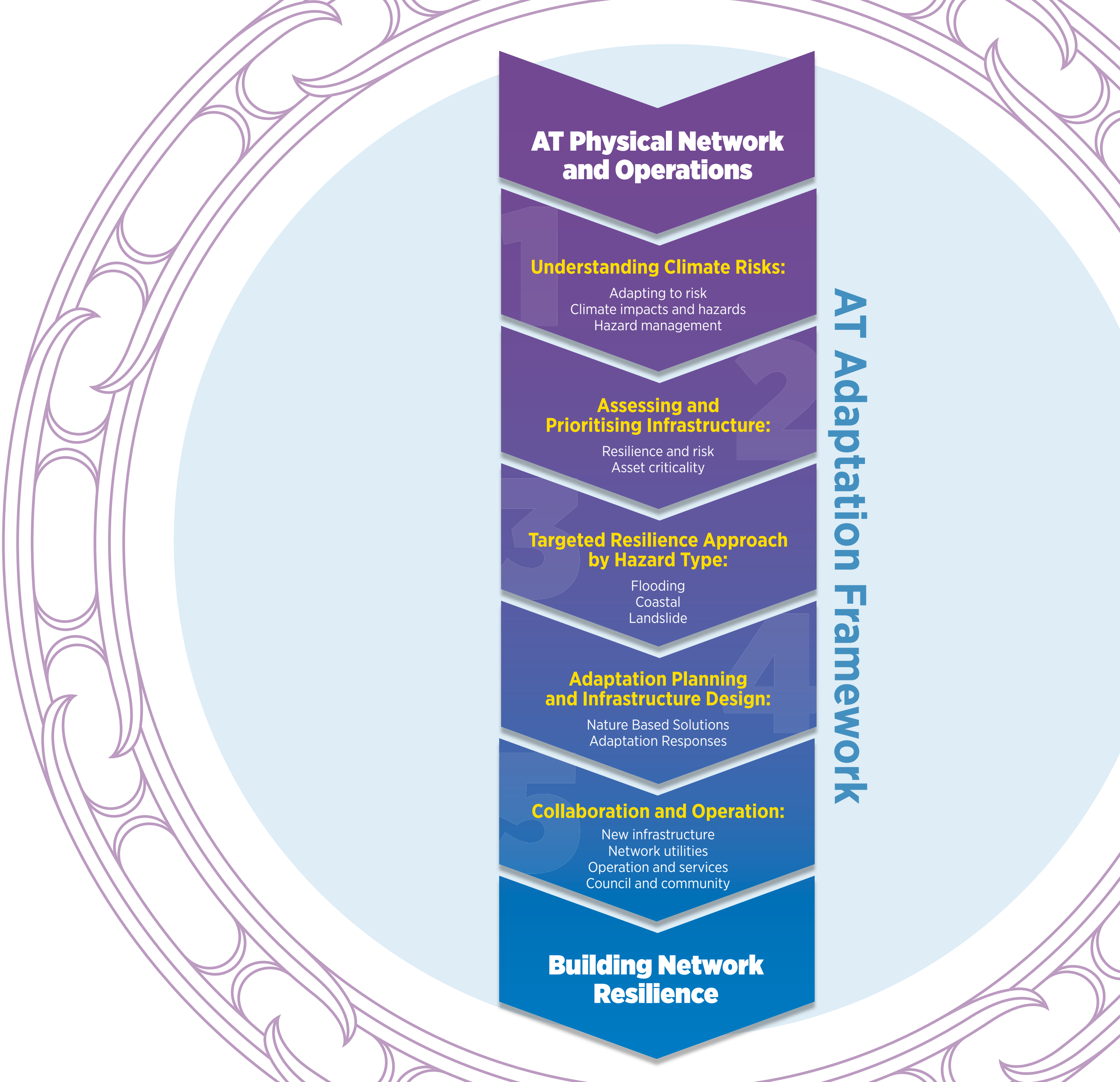
Our Adaptation Framework

Our Adaptation Framework

Our Framework focuses on embedding climate change considerations into the way we manage our assets and operations. The framework is intended to influence our forward works programmes, the way we design and build new assets, and informs the wider community-based discussions led by Auckland Council.

The framework described in this document includes the need to communicate and collaborate with network utility providers, lifeline organisations, stakeholders and partners. AT is excited to share the steps we are taking on this journey.

The Framework guides the process and steps AT is following to shift Auckland’s transport system towards a more resilient future. Each step in the framework is described in greater detail below.





Adapting to Risk

The increasing effects of climate change pose significant risks and hazards that impact the natural environment, infrastructure and our communities. As global temperatures rise, the frequency and severity of weather-related events such as cyclones, floods, droughts, and wildfires intensify, causing widespread disruption and damage across the Auckland region.

For AT, this means our processes and frameworks for adapting to climate risk need to align with the ACG’s methodology for identifying and managing climate-related scenarios, risks and opportunities. The ACG methodology is based on the Task Force on Climate-related Disclosures¹² and promotes consistent, group-wide climate risk integration.

AT supports this approach at the enterprise level by embedding climate risk into decision-making and using scenario analysis to test resilience. This includes aligning with ACG’s scenarios and risk categories (physical and transition), considering both acute and chronic climate hazards, and participating in cross-council regional working groups.

Climate Impacts and Hazards

One of the most immediate and visible impacts of climate change is the increase in extreme weather events. Flooding has become more frequent and severe, driven by rising sea levels and heavier precipitation. Conversely, droughts are also intensifying, leading to water shortages and increased heat stress. These extreme weather events not only threaten lives and property but also disrupt transport services and our ability to move around the region. This was exemplified during, and after, the 2023 extreme weather events.

¹²(Aotearoa New Zealand Climate Standard 1: Climate-related Disclosures (NZ CS 1), 2022)

Case study

Auckland Anniversary Weekend and Cyclone Gabrielle 2023

The potential severity of extreme storms and cyclones became clear in early 2023. Auckland experienced both a substantial storm event (January) and Cyclone Gabrielle (February). Sadly, these events resulted in lost lives, damage to hundreds of homes and over 2000 landslides on the roading network alone. At present, the risk from landslides is high, and this is expected to become extreme in future climate conditions.

Road Networks are susceptible to extreme temperatures causing asphalt to soften and “flush”, leading to increased maintenance costs and service disruption. Heavy rainfall and flooding can undermine road foundations, causing washouts and landslides. High winds bring down trees and powerlines reducing our ability to move around the region. All of these have the potential to disrupt bus routes and schedules.

Train Operations are disrupted when the rail infrastructure is impacted. High temperatures can warp tracks, while heavy precipitation can erode embankments and flood underpasses. AT’s train operations are dependent on the KiwiRail infrastructure being fit for purpose. Power cuts from storm damage also impact these services.

Ferry Services operate in coastal environments that are directly impacted by sea level rise, storm surges, and changing weather patterns. Ferry terminals and wharf structures are susceptible to coastal erosion and inundation while high winds and rough seas can delay or cancel services.



Impact and Hazard Management

Different parts of the transport system are exposed to different hazards and create different challenges for AT. In response, AT has developed a climate change risk assessment for our physical network using the IPCC5 RCP scenarios and these intersect the IPCC6 SSP scenarios used for transition planning and management of climate risks¹³.

AT's response to climate hazards and impacts has typically been retrospective through renewals, maintenance and recovery works. With more recent extreme weather events, our understanding of the impacts of a changing climate, and the importance of improving our network resilience has grown. In this way, AT seeks to take a more proactive approach to protecting its network.

¹³(Climate Change 2023: Synthesis Report (AR6), 2023)

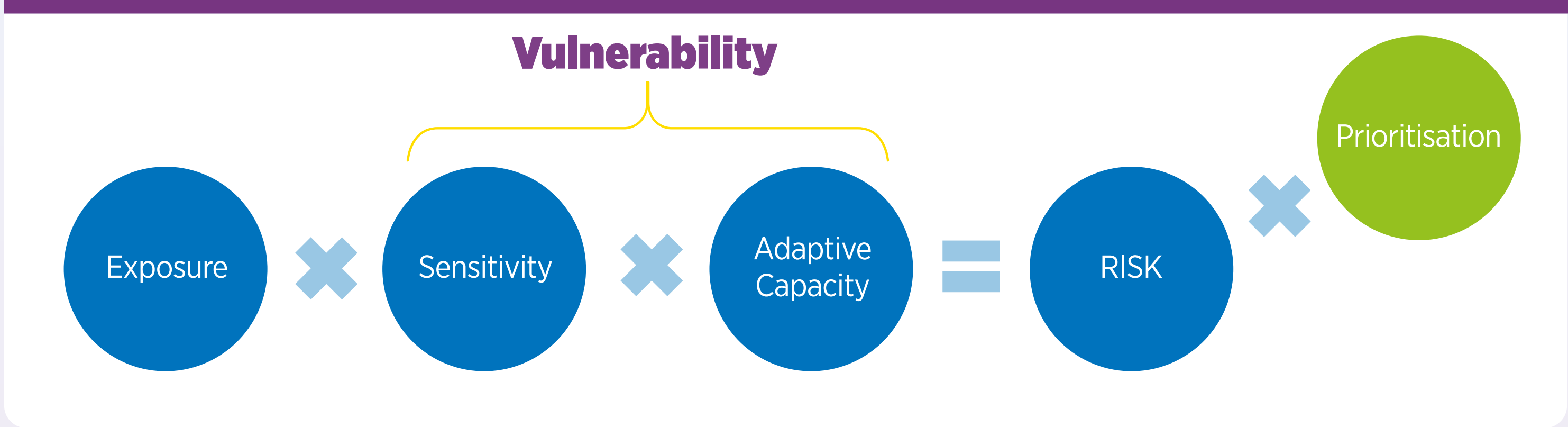


Assessing and Prioritising Infrastructure

Asset Resilience and Risk

To build resilience against climate hazards, AT is seeking to integrate climate projections into the road design and maintenance programme for existing assets. AT has developed a GIS platform, which overlays all our critical assets and known climate hazards, identifying the most vulnerable areas and assets on our network.

Figure 9: Risk Assessment Framework for Adaptation Planning



AT’s Climate Change Risk Assessment Report (ATCCRA) (2021) was undertaken to assess AT’s climate risk exposure and to understand priority climate risks for the organisation. Physical risks were categorised into one of three risk areas (Assets, Service Delivery, and Health & Safety). A total of one hundred and seventy physical risks were identified as part of the ATCCRA with the top risk being “risk to road formations due to increasing landslides”.

Adaptive asset management practices follow Ministry for the Environment guidance on dynamic adaptive planning pathways (DAPP). Asset management involves regular condition assessments, and tracking the progression of climate hazard impacts, using signals, triggers and thresholds. Asset improvements are planned through the forward works programmes as asset tolerances are approached. This will enable AT to integrate climate change into the 2027 AT Asset Management Plan (AMP). Adaptation planning is then undertaken for these vulnerable assets.

A total of 170 physical risks were identified as part of the ATCCRA with the top risk being “risk to road formations due to increasing landslides”.



Asset Criticality

The Auckland Network Operating Plan (ANOP) applies strategic intent to how roads and streets operate in Auckland. The ANOP provides a reference for the optimal operation of the existing network in terms of prioritising the movement of people, goods and services based on the strategic modal significance of the network by location.

AT applies a network-level importance assessment to streamline forward work planning and prioritisation.

For the road corridors and structures, the primary assessment criteria are based on the following factors:

- **ONRC classification:** Provides an established functional classification covering traffic volumes, economic criteria, accessibility, connectivity and the like
- **Lifeline routes:** Access to lifeline utilities (such as water, wastewater, power and telecoms) or a lifeline evacuation route for Auckland to respond and recover from hazard events
- **Essential services:** Access to facilities and services that are essential to the social well-being of the community.

A secondary criterion is needed to assess road corridors as described below to consider the freight network and traffic volume impacts on the network.

- **The Regional Freight Network:** This criterion recognises the importance of freight movements within the region in supporting the economic well being of the region and the nation. This criterion increases network importance by one level if a section of the road corridor is part of the Regional freight network.

- **Traffic Volumes:** This criterion has been added to give significance to the traffic movements so that more sensible results are generated in recognising a road corridor’s traffic flow.

Figure 10: Network Importance Levels (based on the potential economic and social repercussions of their failure)

| Network Importance (level) | Description |
|----------------------------|---|
| Vital (level 5) | A road corridor, public transport facility, or parking facility whose failure would have an extremely significant economic or social impact |
| Major (level 4) | A road corridor, public transport facility, or parking facility whose failure would have a major economic or social impact |
| Significant (level 3) | A road corridor, public transport facility, or parking facility whose failure would have a moderate economic or social impact |
| Local (level 2) | A road corridor, public transport facility, or parking facility whose failure would have a low economic or social impact |
| Minor (level 1) | A road corridor, public transport facility, or parking facility whose failure would have a very low economic or social impact |



NB5915



100% electric

This bus is
100% electric

mission
electric^e

GEELY

C136

QQA227

Targeted Resilience Approach by Hazard Type

Flood Resilience

The most frequent service outage on the road network has been through flooding. AT’s flood resilience work has been classified according to the road criticality. For “Vital” and “Major” roads, AT expects safe and continuous service, despite the possibility for inclement conditions. These roads are being identified where they are vulnerable to flooding and resilience work is being prioritised.

Using the depth and velocity data provided by Auckland Council’s Healthy Waters team, AT can now assess where flood waters are unsafe for vehicle access and how much the roads need to be raised by to ensure safe passage. These works are being integrated into asset management plans.

For all other roads, assessments are made on the level of service outage and alternate routes, if available. Due to current funding conditions, AT makes decisions on resilience improvements on a case-by-case basis. For lower criticality roads, some level of service outage is considered acceptable.

AT has prioritised resilience works on some low criticality roads where they connect between a community and their emergency retreat shelters or Marae. Alternative routes to NZTA state highway closures are also being prioritised for flood resilience.

For some roads, flooding is a catchment wide problem. Raising the road above the flood levels does not benefit the community who live within flood prone areas. In these cases, AT has installed early flood warning systems. These warning systems indicate where flooding has occurred to allow road users to avoid the affected area.



AT has prioritised resilience works on some low criticality roads where they connect between a community and their emergency retreat shelters or Marae.





Coastal Asset Resilience

Coastal resilience work has progressed under the Coastal Hazards and Climate Change Guidance from Ministry for the Environment¹⁴. Most of these planning decisions have been made under high levels of uncertainty. This requires a DAPP approach to plan for assets impacted by coastal hazards.

AT has made pathways for its physical assets in these locations. These will be presented to the local communities and Auckland Council as options when the conversations for adaptation start with communities. For most coastal assets, AT has made the decision to “protect” and/or “accommodate” in the short term to allow for business as usual, while longer term plans for the communities and expected services continue in the background.

¹⁴(Coastal Hazards and Climate Change Guidance, 2024)



Landslide Framework

Using the data collected from the 2000+ slip locations resulting from the Auckland Anniversary weekend storm and Cyclone Gabrielle in 2023, AT developed a landslide framework. The framework evaluated 30 different parameters which may contribute to a landslide at 12.5m transects along the road. This included obvious aspects such as overland flow paths and drainage, underlying soil, adjacent slopes and vegetation, as well as less obvious parameters such as geologic fault lines and fractured rock. The framework was refined using actual slip data and extrapolated across the whole AT road network using a random walk methodology via machine learning.

The extrapolated model was imported into a GIS layer and the risk at each 12.5m section of the road network identified using red for high-risk locations and blue for low-risk areas. The risk layer was assessed for accuracy and is being used to inform AT's forward works programme to support landslide prevention through early intervention.

Case study

Manukau Heads Road

The original Manukau Heads Road, access to the renowned Manukau Heads Lighthouse, was rendered impassable after a significant landslip during Cyclone Gabrielle in 2023. The landslide displaced 90,000 cubic metres of soil, equivalent to 36 Olympic swimming pools, down an 80-metre hillside. With the old route assessed as unstable and too costly to repair, AT has constructed a new section of road 20 metres away from the slip site to ensure safe and reliable access. The area has been reconnected while addressing long-term safety and resilience to future climate hazards.



Adaptation Planning and Infrastructure Design

Nature-Based Solutions

Nature-based solutions (NBS) are increasingly recognised as vital components of climate adaptation strategies within transport networks. By harnessing the intrinsic resilience of natural systems, these approaches include restoring wetlands, planting native vegetation along corridors, and enhancing green infrastructure to absorb excess stormwater and reduce flood risk. Such measures not only buffer infrastructure against extreme weather events but also foster biodiversity, sequester carbon, and improve the overall health of surrounding environments. Integrating nature-based interventions alongside traditional engineering creates adaptable, multi-functional landscapes that help communities and transport assets better withstand the evolving challenges of climate change.

AT incorporates NBS through the inclusion of bioretention rain gardens and swales in the road corridor to treat and/or convey stormwater. These devices are designed to slow and retain stormwater, helping to reduce flooding. Street trees also play an important role through the provision of habitat, increased biodiversity, clean air, shade for pedestrians, and reducing the volume of rainfall reaching the ground. Green roofs are also an important NBS as they retain rainfall, regulate temperature, and improve biodiversity pathways and habitats. AT has trialed 15 bus shelters with green roofs and is looking to include this as a business-as-usual design option.



Adaptation Responses

AT is following the Ministry for the Environment approach and framework to understanding climate risk and then addressing it through adaptation planning. Adaptive actions and options are being considered using the Protect, Accommodate, Retreat, Avoid (PARA) framework and language with the transport network context.



Avoid

Plan new transport routes away from hazard-prone areas.



Accomodate

Elevate roads and bridges, strengthen structures to withstand extreme weather. An integrated “accommodate” approach includes technology like early flood warning systems



Protect

Build flood barriers and retaining walls to protect roads and railways. This includes the development of infrastructure like seawalls to protect coastal roads.



Retreat

Relocate critical transport infrastructure from high-risk areas or realign road



Using our framework to guide our adaptation efforts, AT is developing network resilience plans for vulnerable locations which align with the PARA approach. This includes adaptation response plans for parts of the public transport network. The potential PARA-aligned options AT is considering are:

- **Management response options to reduce service disruption. This may look like diversifying bus route options, flexible scheduling of ferry operations, and developing emergency response plans.**
- **Utilising novel approaches like heat-resistant materials, nature-based solutions, enhancing drainage systems, and implementing real-time monitoring technologies to detect and respond to climate-related threats.**
- **Investing in elevated carriageways and flood barriers to protect critical road corridors from rising waters. Upgrading wharf infrastructure and improving early warning systems also mitigates the impacts of extreme events.**

Collaboration and Operation

Case study

Deciding not to gold plate it

The construction of the new Mill Flat Road bridge followed the Climate Change Policy. This means the design of the bridge is now suitable for the present and future conditions it is likely to be exposed to. The bridge has been designed to practical, sensible standards, rather than excessive levels of robustness.



Building New Infrastructure

In 2021, AT developed a Climate Change Technical Policy which identified the different hazards likely to impact our network and services.¹⁵ The policy was updated in 2024 and requires all new projects resulting in the construction of new assets to consider these hazards in relation to the location of the new asset and design for the impact of climate hazards in the future. The policy identifies the different climate scenarios (in accordance with IPCC5, IPCC6) and provides links

to the latest hazard information to support the assessment. The goal is to ensure AT assets are designed with climate change hazards in mind given that most assets have design lives of 25 to 100 years. While there is a temptation to assume that designing for climate resilience will result in gold-plated and expensive assets, practically, the policy provides the opportunity to take a modular and flexible approach – designing for the next 25 to 50 years

and supporting the extension or removal of the asset as climate change hazards shift or change in intensity. This more flexible approach reduces the risk that blind adherence to design standards creates by enabling assets to be designed with short lifespans, to reflect the changing context of climate impacts.

¹⁵(Climate Change Technical Policy, 2024)



Connecting with Utility Network Providers

During the 2023 storm events, it became apparent the ability of lifeline services and network utility providers to access their critical infrastructure locations was important to ensuring on-going electricity and telecommunications.

While AT had a critical road GIS layer (classified in accordance with NZTA asset criticality requirements), this did not reflect the access requirements to the critical locations of other providers.

AT and various network utilities have now shared data on critical asset locations and routes, and this is being factored into building resilience across the broader set of networks in Auckland. AT is working to connect with other service and utility providers to ensure we understand their access needs and requirements to improve the resilience of Auckland communities in emergency events.



Operations and Services

AT's focus to date has been primarily on understanding what the vulnerability and climate hazard implications are for our physical network. While this is still important, building resilience for our operations and public transport services is important too.

AT is keen to work with third-party operators such as bus and ferry companies, and KiwiRail and Auckland One Rail, to better understand how climate hazards might impact their assets and services and how we can work together to build resilience. Sharing our adaptation framework and actions with parties such as KiwiRail, builds a foundation of common language and approach, supporting our collaborative work.

AT and NZTA have a joint approach for managing the network and incident response. This includes assessment of operational infrastructure, eg. traffic signals. Further work with the NZ Transport Authority is also proposed to better understand the vulnerabilities of the State Highway network in the Auckland region and where diversions to local roads are likely to occur. AT can then begin the work to ensure those local road locations are fit-for purpose and resilient.



Working with Council and the Community

Bringing together key elements of AT's climate adaptation work helps build a clearer picture of the transport network's resilience needs. This integrated approach enables AT to assess the feasibility of adaptation options and supports a broader, system-wide response to climate hazards across the Auckland region.

AT has been providing support to Healthy Waters for their programme of works in response to the Severe Weather Emergency Recovery Act.

As Auckland Council leads communities through local adaptation planning processes, the work undertaken by AT contributes essential transport-related insights and tools to inform decision-making. AT recognises its efforts represent part of a wider, collaborative response. Input and leadership from mana whenua, local communities, Council, utility providers, and businesses are all critical to shaping equitable and effective adaptation pathways.

Solving the complex challenges of climate adaptation will require integrated consideration of financial constraints, cultural values, biodiversity and environmental protections, and social and equity outcomes.



Our Adaptation Action Plan

Our Adaptation Action Plan

AT continues to build knowledge and develop options to improve asset resilience. As mentioned, there is also a focus on collaborating with Auckland Council to support community planning and engagement. AT’s asset management work will contribute to long-term adaptation planning with communities, businesses, and utility providers, and will also inform emergency management decisions related to access to critical facilities.

A key challenge lies in ensuring solutions are appropriate and aligned with long-term network resilience objectives. Rather than defaulting to full replacement or rebuilding to the latest standard following asset failure, AT is placing greater emphasis on assessing whether alternative routes exist, whether road sections remain vulnerable or unviable, and whether previous interventions have repeatedly failed. These considerations are essential for optimising investment decisions and ensuring a strategic use of funding across the network.

AT’s design responses are increasingly expected to reflect anticipated changes in land stability and exposure. This includes ensuring assets are not located in areas likely to be damaged within their design life and favouring flexible or modular designs which accommodate changing climate conditions. Avoiding over-engineering is also important. Interim or lower-cost options may be appropriate where shorter asset lifespans are expected or where long-term solutions remain uncertain.

Further work is underway to support more informed decision-making around the relative costs of adaptation and resilience measures compared to reactive asset recovery, as well as the long-term costs of inaction. AT is developing a programme to establish a longer-term pipeline of adaptation-focused projects for inclusion in the Regional Land Transport Plan (RLTP), the Long-Term Plan (LTP), and the next 30-year Asset Management Plan.

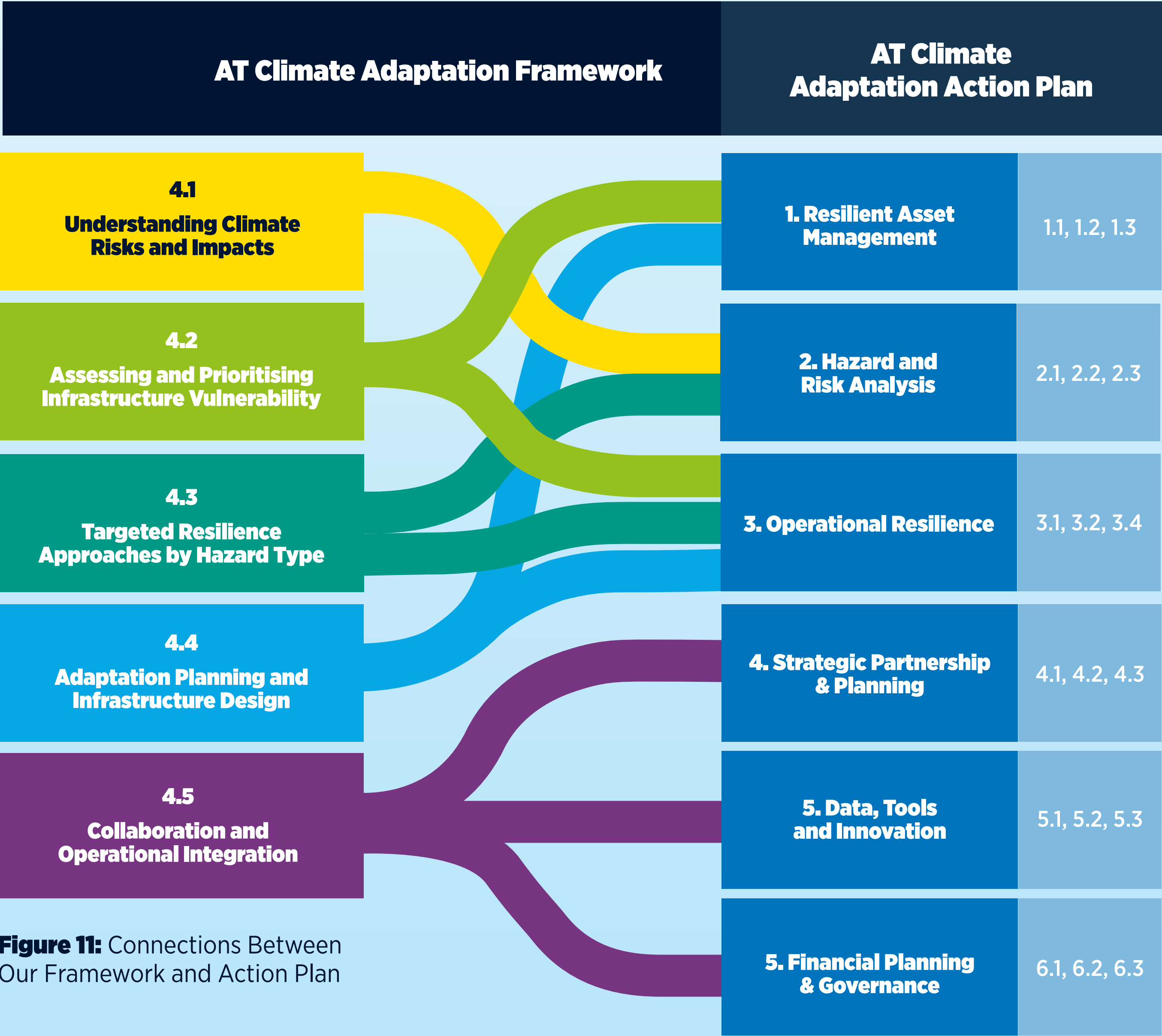


Figure 11: Connections Between Our Framework and Action Plan

Under the current RLTP, AT is funded to deliver resilience and asset planning work through to 2026/27. Looking ahead, AT intends to develop or complete a range of targeted activities which advance its adaptation agenda. There is always the risk that funding will be insufficient, that storm events like Cyclone Gabrielle will impact Auckland before AT has had the opportunity to improve network resilience or Council priorities will be directed elsewhere. As with climate change, the process of building resilience operates in a context of high uncertainty. The core approach to adaptation planning includes the need to be flexible and responsive. The actions are presented at an overview level to permit that flexibility without requiring the plan to be rewritten or updated.

The **Action Plan and Timeline** is intended to be reviewed and updated every three years, to ensure it remains relevant to the requirements of a changing climate. The core approach to adaptation planning is reflected in the way we have themed the actions, cutting across AT divisions and activities.

ATs approach requires:

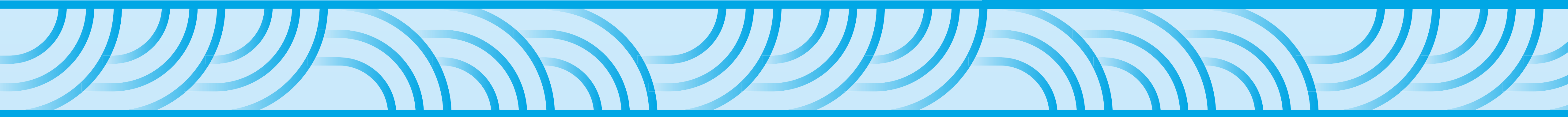
- *flexibility* – to respond to the rapidly changing legislative or physical environment,
- *integration* – there are many pieces of the puzzle to bring together when understanding and embedding climate hazards, risk and actions into managing transport assets
- *collaboration* – recognising that there are many people involved, often at different stages of readiness and knowledge
- *evidence-based* – using real information and data to inform our actions and decisions

Many of the actions listed in the table below reflect year-long programmes of work, involving a cast of many people, both internal to AT and across with wider Council group. Details of each of the steps and stages of the projects are not provided here as they often change as new information comes to light or legislation and regulations shift. At times the results or findings of one stage offer a new avenue to explore or expose an aspect we had not previously considered material, and we adjust the work to accommodate this.

The success of our actions is seen in the:

- tools and platforms that AT develops and shares to support decision making,
- relationships that we build as we collaborate with others
- increasing resilience of vulnerable locations as the tools and information developed are embedded into asset forward planning
- growing opportunities to share our work and learnings to help other communities and authorities increase resilience
- Increasing funding and number of network improvement projects to provide greater asset resilience

Ultimately the success of the Action Plan will show through the improving resilience of the transport systems in Auckland to withstand the increasing intensity and frequency of climate hazards. Programmes work resilience related work are recognised and funded through the RLTP and are planned for in the AMP. Where once we might have had a landslide, the next time we have a storm, this land now remains stable. We say “improving” because building resilience is on-going work and often in uncharted territory.



Action Plan and Timeline

The actions presented below are themed, and they align with Our Adaptation Framework (Figure 11). The timeline only reflects the next three years, while acknowledging much of the work may continue and extend well beyond this time horizon. This is also subject to the outcome of the Auckland Transport Reform occurring across 2025 and 2026.

Figure 12: Timeline of AT's Adaptation Actions

| Theme | Action | Team/Division Responsible | 2025/26 | 2026/27 | 2027/28+ |
|--------------------------------------|--|---|---------|---------|----------|
| 1. Resilient Asset Management | 1.1 Embed adaptation into business-as-usual asset planning: on-going | Sci&Sus with Asset Management I&P | x | x | x |
| | 1.2 Incorporate climate projections into AMP (for Feb 26) and design standards (on-going) | Sci&Sus with AMP Planning and Design Standards I&P | x | x | x |
| | 1.3 Expand use of nature-based solutions for resilience: on-going | Sci&Sus with teams across I&P and PTAM | x | x | x |
| 2. Hazard and Risk Analysis | 2.1 Complete detailed risk assessments at priority sites: on-going | Sci&Sus with Capital Delivery and Design teams I&P | x | | |
| | 2.2 Develop and apply STATs across asset types: on-going | Sci&Sus with Asset Management I&P | x | x | |
| | 2.3 Implement early warning systems for extreme events: as funding permits | Sci&Sus with Flood Recovery and PT Facilities I&P | x | | |
| 3. Operational Resilience | 3.1 Develop operational response plans for all transport modes, working with AT Network Operations for short-term and long-term resilience: on-going | Sci&Sus with ATOC, AEM, Network Operations and PT modes I&P, CNP | x | x | x |
| | 3.2 Strengthen road networks and identify alternative routes: on-going | Sci&Sus with Network Operations and NZTA, I&P and CNP | x | x | x |
| | 3.3 Collaborate with transport operators and service providers to identifyvulnerabilities: on-going | Sci&Sus with PTAM and NZTA, Kiwirail, Fullers, +other operators, I&P, PT | x | x | x |
| 4. Strategic Partnerships & Planning | 4.1 Collaborate with ACG and utility providers on adaptation planning: on-going | Sci&Sus with HW, Resilience and Infrastructure (AC), CSO, network utilities, I&P | x | x | x |
| | 4.2 Identify areas on the network at risk of long-term realignment or retreat: on-going | Sci&Sus with Asset Management and ACG, I&P | | x | x |
| | 4.3 Support Council to work with Auckland communities as we adapt to climate hazards: on-going | Sci&Sus with ACG, Asset Management and Renewals and Maintenance, I&P | x | x | x |
| 5. Data, Tools and Innovation | 5.1 Expand GIS tools and integrate hazard data: on-going | Sci&Sus with AT Analytics and Data, I&P and BT | x | x | x |
| | 5.2 Use machine learning and data platforms to improve forecasting: on-going | Sci&Sus with Asset management, AT Data Sci and AI team, Tetrattech Coffey, I&P and BT | x | x | |
| | 5.3 Develop appropriate designs for climate impacted infrastructure – reduced design life or LOS: on-going | Sci&Sus with Design Standards, AT design team, Asset Management, I&P | x | x | x |
| 6. Financial Planning and Governance | 6.1 Develop cost-benefit tools to compare resilience vs. recovery: 25/26 and on-going | Sci&Sus with Funding and Analytics, I&P and F&C | x | x | x |
| | 6.2 Build business cases for RLTP and central government funding: 25/26 for 2027 RLTP | Sci&Sus with Asset management, Finance, Strategy and Gov, I&P, F&C, S&G | x | x | x |
| | 6.3 Build collaborative relationships with utility providers to support long-term funding options: on-going | Sci&Sus with Asset Management, I&P | x | x | x |



Glossary

- **Adaptation measures:** Actions taken to adjust to new conditions and reduce potential damage caused by climate change.
- **Alternate route planning:** The process of identifying and establishing alternative routes for transportation in case of disruptions.
- **Carbon footprint:** The total amount of greenhouse gases produced directly and indirectly by human activities, usually expressed in equivalent tons of carbon dioxide (CO₂e).
- **Central government policy direction (NAP):** National Adaptation Plan or similar governmental policies aimed at addressing climate change adaptation.
- **Climate Adaptation Action Plan:** A strategic plan that outlines actions and measures to adapt to the impacts of climate change.
- **Climate risk assessment:** The process of identifying and evaluating risks associated with climate change to inform decision-making and planning.
- **Community adaptation planning:** Strategies and actions taken by communities with Council, to adjust to climate change and its impacts.
- **Managed retreat or realignment:** The strategic relocation of infrastructure or communities away from areas vulnerable to climate hazards.
- **Nature based solutions (NBS):** using natural resources or designs to improve resilience
- **Network resilience:** The ability of a transport network to withstand and recover from climate hazards.
- **Renewable energy sources:** Energy sources that are replenished naturally, such as solar, wind, and hydroelectric power.
- **Sustainable infrastructure:** Infrastructure designed to be environmentally friendly and resource-efficient throughout its lifecycle.

References

Auckland Council. (2020). *Te Tāruke-ā-Tāwhiri*: Auckland’s Climate Plan. Auckland: Auckland Council.

Auckland Transport. (2024). *Auckland Transport Sustainability Strategy*. Auckland: Auckland Transport.

Auckland Transport. (2024). *Climate Change Technical Policy*. Auckland: Auckland Transport.

Auckland Transport. (2025). *Climate Transition Plan*. Auckland: Auckland Transport.

External Reporting Board. (2022). *Aotearoa New Zealand Climate Standard 1: Climate-related Disclosures (NZ CS 1)*. Wellington: External Reporting Board.

Haasnoot, M., Kwakkel, J., Walker, W., & Maat, J. (2013). Dynamic Adaptive Policy Pathways: A Method for Crafting Robust Decisions for a Deeply Uncertain World. *Global Environmental Change*, 23, 485-498.

Intergovernmental Panel on *Climate Change*. (2023). *Climate Change 2023: Synthesis Report (AR6)*. Geneva: Intergovernmental Panel on Climate Change.

International Panel on Climate Change. (2018). *Annex I: Glossary*. Cambridge/ New York: International Panel on Climate Change.

Ministry for the Environment. (2022). *Aotearoa New Zealand’s First National Adaptation Plan*. Wellington: New Zealand: Ministry for the Environment.

Ministry for the Environment. (2024). *Coastal Hazards and Climate Change Guidance*. Wellington: Ministry for the Environment.

United Nations Framework Convention on Climate Change. (2015). *Paris Agreement to the United Framework Convention on Climate Change*. Cambridge/New York: United Nations.

United Nations Framework Convention on Climate Change. (2025, 07 25). *United Nations Framework Convention on Climate Change*. Retrieved from Adaptation and Resilience: <https://unfccc.int/topics/adaptation-and-resilience/the-big-picture/introduction#adaptation>

Acronyms

- ACG – Auckland Council Group
 - AR6 – Assessment Report 6 (Intergovernmental Panel on Climate Change)
 - CSO – Chief Sustainability Office (part of Auckland Council)
 - DAPP – Dynamic Adaptive Planning Pathways
 - IPCC – Intergovernmental Panel on Climate Change
 - LTP – Long Term Plan
 - MFE – Ministry for the Environment
 - NAP – National Adaptation Plan
 - NBS – Nature Based Solutions
 - NZ CS 1 – New Zealand Climate Standard 1
 - NZTA – New Zealand Transport Agency
 - RCP – Resource Concentration Pathway (scenario description used in AR5)
 - RLTP – Regional Land Transport Plan
 - UN – United Nations
 - UNFCCC – United Nations Framework Convention on Climate Change
- AT Divisions:**
- Sci and Su -: Science and Sustainability Group
 - I&P - Infrastructure and Place
 - PTAM - Public Transport & Active Modes
 - CNP - Customer and Network Performance
 - F&C - Finance and Corporate Services
 - BT - Business Technology

