

TCC RESILIENCE PROJECT

PREPARED FOR TAURANGA CITY COUNCIL

7/7/2020

This document has been prepared for the benefit of Tauranga City Council. No liability is accepted by this company or any employee or sub-consultant of this company with respect to its use by any other person.

This disclaimer shall apply notwithstanding that the report may be made available to other persons for an application for permission or approval to fulfil a legal requirement.

QUALITY STATEMENT

PROJECT MANAGER

§ 7(2)(a) - Privacy

PROJECT TECHNICAL LEAD

§ 7(2)(a) - Privacy

PREPARED BY

§ 7(2)(a) - Privacy

.....

...../...../.....

CHECKED BY

§ 7(2)(a) - Privacy

.....

...../...../.....

REVIEWED BY

§ 7(2)(a) - Privacy

.....

...../...../.....

APPROVED FOR ISSUE BY

.....

...../...../.....

AUCKLAND

Level 3 Stantec House, 111 Carlton Gore Road, Newmarket, Auckland 1023

PO Box 13-052, Armagh, Christchurch 8141

TEL +64 9 580 4500

REVISION SCHEDULE

Rev No.	Date	Description	Signature or Typed Name (documentation on file)			
			Prepared by	Checked by	Reviewed by	Approved by
1	14.07.20	Final	§ 7(2)(a) - Privacy			

Tauranga City Council

TCC Resilience Project

CONTENTS

1.	Introduction	1
2.	Area Characteristics	1
2.1	Assets	1
2.2	Natural Hazards	4
3.	Common Concepts and Solutions	10
3.1	Background	10
3.2	Common Concepts & Solutions	12
4.	Planned Projects	14
4.1	Project ID 503	14
4.2	Renewals	14
5.	Recommended Solutions	14
5.1	Priority Project One – Project ID 506	14
5.2	Project Priority Two – Project ID 567	16
5.3	Project Priority Three – Stormwater outfalls	17

- Rising mains transferring wastewater to the Te Maunga WWTW
- Several local pump stations

A high percentage of wastewater pipes in the area are still old Asbestos Cement (AC) pipes. The mere fact that these pipes are older¹ mean that they have a high likelihood of being leaky and allowing infiltration into the wastewater system.

2.1.2 Water Supply

There are two reservoirs located in the eastern area which are fed by three main supply lines. The two reservoirs are located on Mount Maunganui (Mauao) and at Mangatawa. The Eastern Reservoir and Poplar Lane Reservoir complexes sit just outside the boundary of the eastern area but forms a critical part of water supply in the area. One main supply pipeline enters the eastern area by crossing Maungatapu Bridge (supply from Welcome Bay trunkmain). Another enters the area to the east from Welcome Bay East and a third one crosses the Tauranga Harbour Bridge. These larger main supply lines run through the eastern area like a main artery, with the reticulation feeding from it.

Several of the water supply pipes, including main trunk lines, are still AC pipes. The age of these pipes suggest that they are more likely to fail. AC pipes also do not perform as well as some other modern materials, such as PE or PVC which are more flexible during ground shaking events.

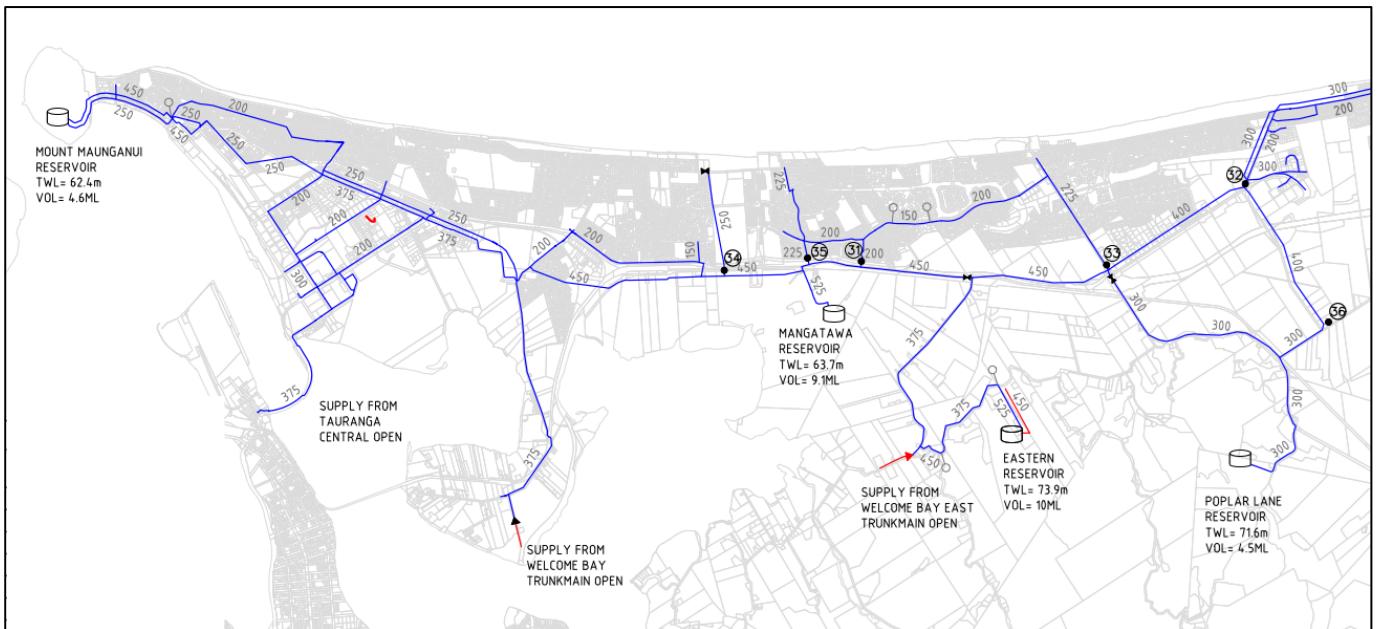


Figure 2: Eastern Area main supply pipelines (Stantec, 2017²)

2.1.3 Stormwater

Stormwater in the area is mostly managed by gravity drainage to the coast or harbour. The densely populated Mount Maunganui residential, commercial and industrial areas discharge to the coast or harbour through piped outfalls (Figure 3). To the east in Papamoa Beach, where developments are low lying, stormwater is managed through long stormwater ponds (Figure 4) that discharge to the sea and harbour through a combination of piped outfalls and channels.

¹ Manufacturing and installation of AC pipes was ceased in 1986. (Water New Zealand, 2017)

² This image reflects the water supply trunk mains and reservoirs as existing in 2017. This may vary from current existing infrastructure and is shown for illustrative purposes only.



Figure 3: Piped stormwater outfalls to harbour



Figure 4: Stormwater ponds in Papamoa

2.2 Natural Hazards

The natural hazard overlays assessed during this study were provided in a GIS platform by TCC. The maps shown in the following sections are extracts from the GIS platform set up for the Natural Hazards Mitigation Projects Definition Study.

2.2.1 Sea Level Rise and Inundation

The risk posed to council assets by sea level rise and inundation should not be considered in isolation. The long-term viability of occupation of the area needs to be considered as higher sea levels and inundation impose on habitable areas.

The dunes along the north-eastern edge of the area largely protect the 3-waters assets from the inundation and sea level rise along the open coast. It does however impact on some private properties. The south-western boundary is lower lying and does not have the same protection. Higher sea levels and inundation therefore poses a high risk to the area. Areas of high risk are Mount Maunganui, the industrial area around the port and airport and the area surrounding Baypark Stadium and the Sewage Treatment Plant.

Sea level rise and inundation pose different risks to different assets. The outfalls that discharge the stormwater to the coast or harbour work mostly on gravity. Higher sea levels at the outfalls impede their ability to discharge water and reduce their capacity. This affects the system's ability to convey stormwater away from developed areas.

Water assets (pipes and valves) are unlikely to be affected by short duration inundation, but longer-term sea-level rise increases the risk of infiltration of seawater into the potable water system.

Gravity wastewater networks are not designed to deal with high levels of inflow and infiltration. Inundation from the coast or harbour increases the chances of surface water entering and overwhelming the wastewater system. Overwhelmed wastewater systems will eventually spill to the environment. Higher sea levels could also raise the groundwater level. Pipes, especially older ones, can become leaky and allow groundwater to infiltrate, placing additional pressure on the capacity of wastewater systems.

In general, higher sea levels can also result in more frequent exposure of infrastructure to sea water which may cause erosion or siltation of the infrastructure. Electrified assets, such as pump station electronics, are also at risk when exposed to water.



Figure 5: Inundation hazard



Figure 6: Sea Level rise hazard

2.2.2 Liquefaction

There are large areas exposed to liquefaction risks across the eastern area. These coincide with locations where high groundwater levels are expected. The main areas of concern are:

- **Mount Maunganui beach front**
- **Port, industrial area and airport**
- **Te Maunga wastewater treatment plant**
- **Papamoa Beach, especially areas surrounding stormwater ponds**

Assets supported by liquefied ground can subside or tilt as the soil loses strength. Underground structures, such as pipes and tanks, can rise out of the ground or move around due to buoyance or ground movement. Unrestrained joints at structures or between pipes can become loose as differential settlement occurs. In general, flexible pipe materials such as PE and PVC perform better than rigid pipe materials such as AC and concrete pipes when the ground around it moves.

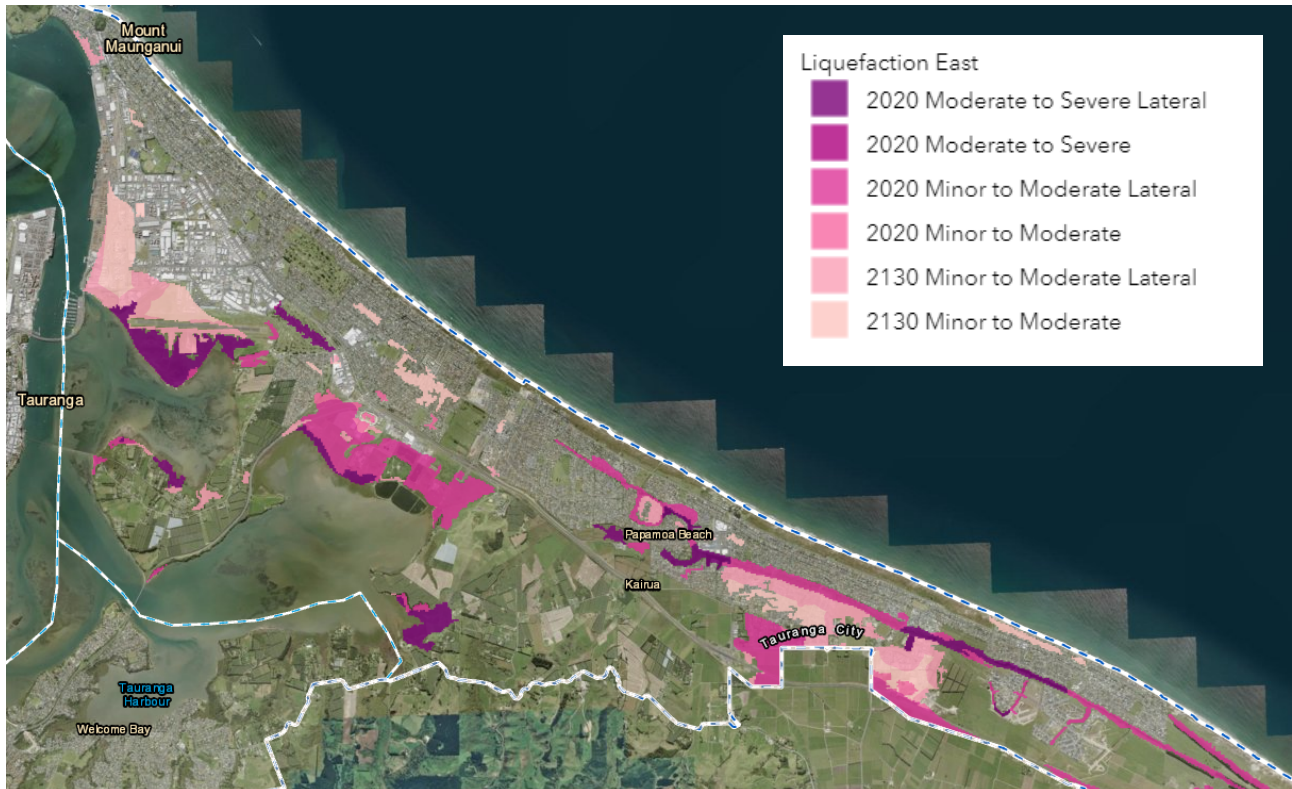


Figure 7: Liquefaction hazard

2.2.3 Flooding

Due to the relatively flat topography, widespread flooding risk is prevalent in the eastern area. This flooding is managed through constructed stormwater infrastructure and allowance for overland flow paths to direct flooding away from habitable floor areas.

Flooding poses a similar risk to assets as sea level rise and inundation in that it has the potential to overwhelm the wastewater infrastructure and poses a contamination risk to the water supply system. Flooding can also result in erosion of the support structures of the assets. Electrified assets, such as pump station electronics, are also at risk when exposed to flooding.

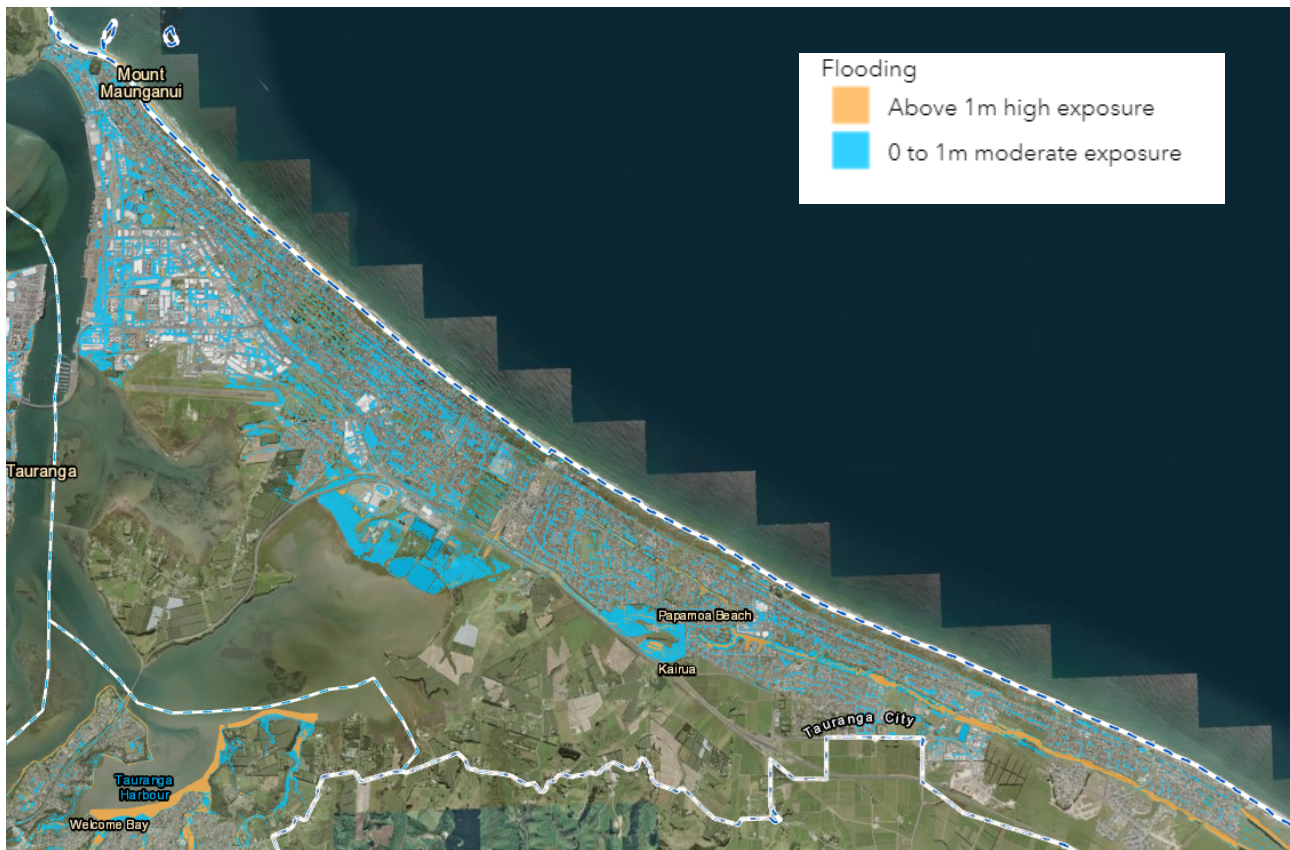


Figure 8: Flooding hazard

2.2.4 Tsunami

Due to the area's exposure to the open coast and it being low lying, a large part of the eastern area is within the tsunami hazard zones.

Although an unlikely occurrence, a tsunami is expected to affect assets over a large area if it were to occur. The actual effect of a tsunami on the assets is hard to determine due to the widespread damage that could accompany such an event. However, expected impacts include:

- **Salt water flooding**
- **Electrical equipment flooding/failure**
- **Siltation of ponds and pipelines**
- **Physical damage to buildings/structures/services**
- **Power outages**
- **Scouring of ground supporting assets**

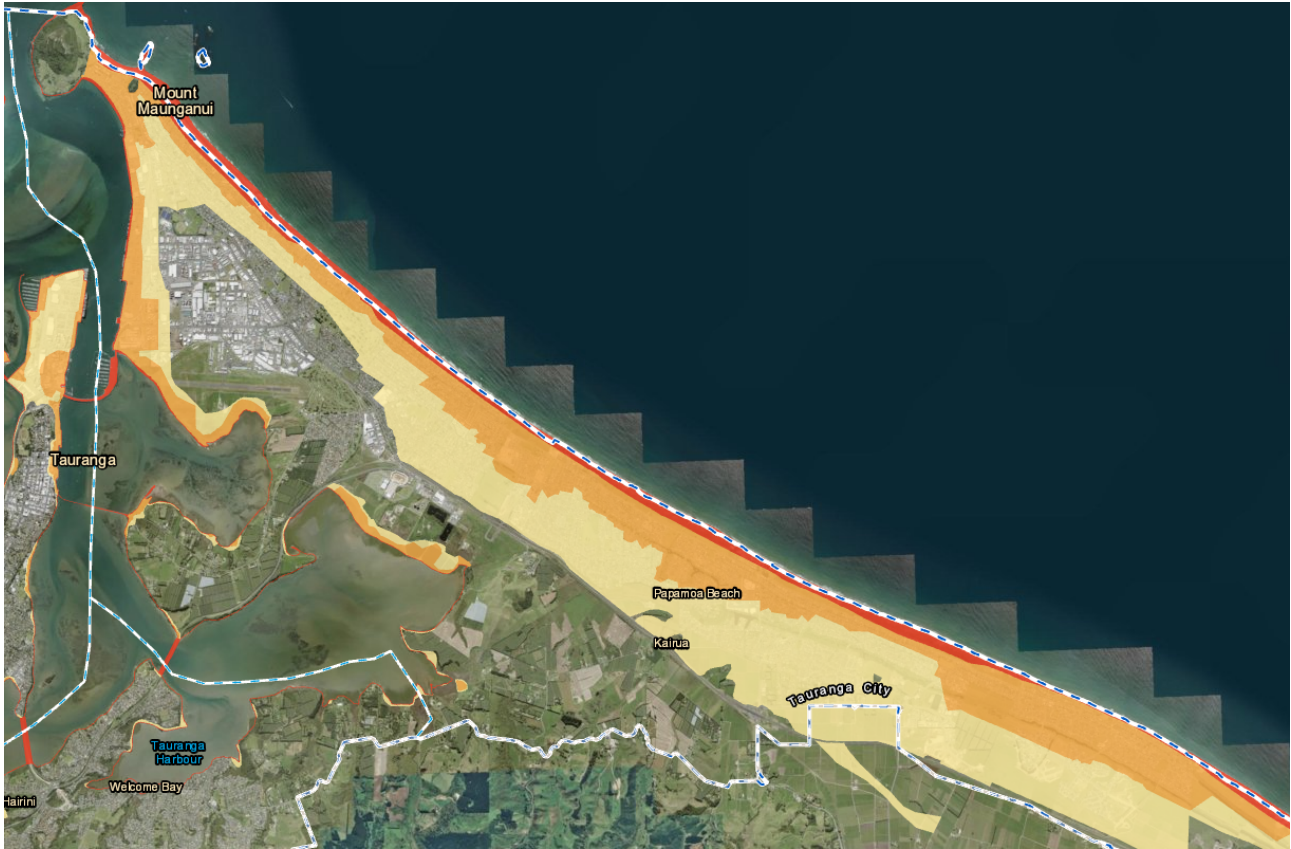


Figure 9: Tsunami Hazard Zones

2.2.5 Geotech Slopes

The geotech slopes hazards in the area are associated with steep slopes. Since the coastal area is mostly flat, the geotech slopes hazards are concentrated at the steep harbour embankments at Matapihi and the steep slopes at the Mangatawa reservoir complex. Assets founded in ground with geotech slopes hazard can become damaged when ground movement occurs.



Figure 10: Geotech Slopes Hazard

2.2.6 Harbour and Coastal Erosion

Erosion of the coastal and harbour shorelines pose a risk to assets where the ground around the assets can erode. Few assets apart from the stormwater outlets are close enough to the shoreline to be at risk. The risk of assets to this hazard is concentrated around a few isolated areas.

The two most notable areas where it impacts on 3-waters assets are at Maungatapu Bridge and along The Mall road in Mount Maunganui. It also affects private properties along the open coast.

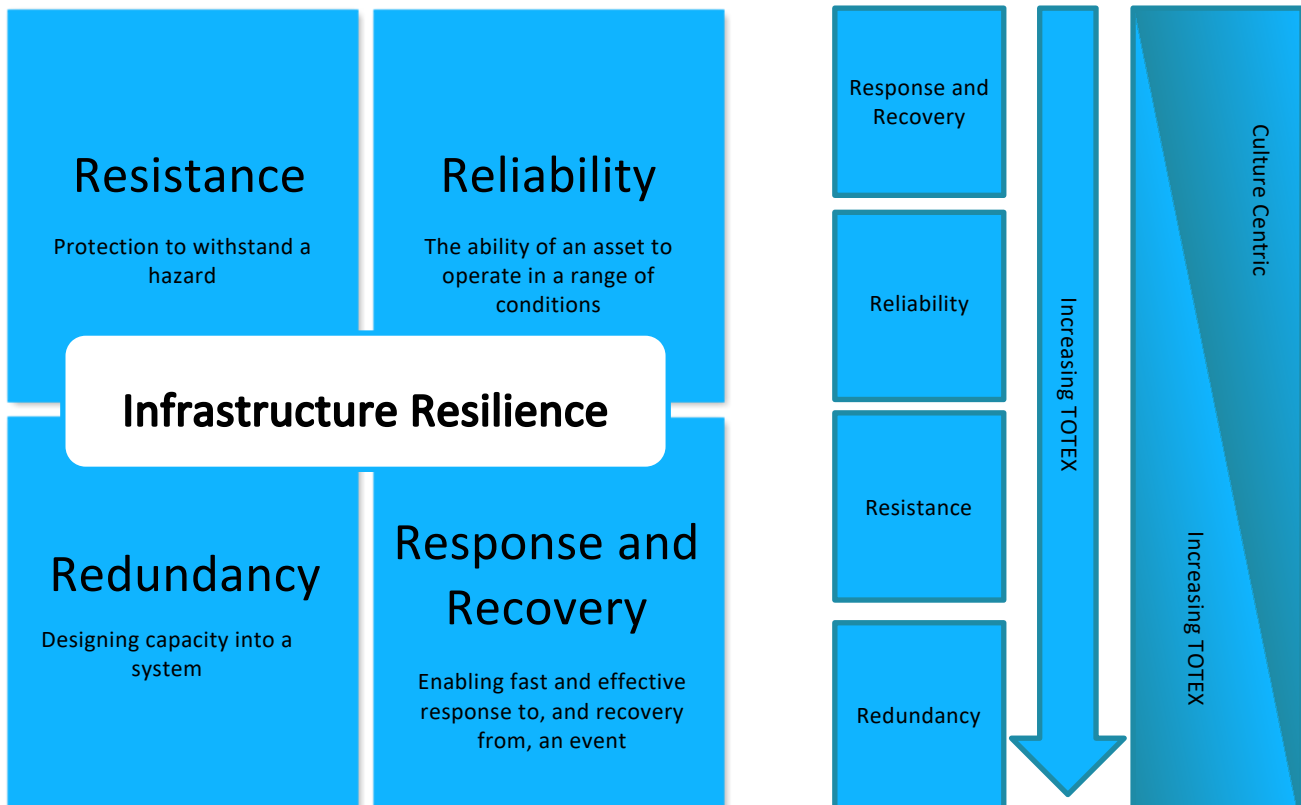
3. Common Concepts and Solutions

3.1 Background

When identifying intervention projects to reduce the asset risk scores, we have approached each asset through a ‘4R’ lens. The four “Rs” are:

- Resistance
- Reliability
- Redundancy
- Response and Recovery

Resistance and Reliability form the underlying foundations for resilience at an individual asset or component level. Resilience is further strengthened by building Redundancy at a network and ecosystem level. In the face of extreme events, where it is not economically viable to design or construct a solution, the last of the 4Rs is Response & Recovery – where contingency planning and rapid recovery from events may be the most cost effective and appropriate action.



We believe there are a few key considerations that drive the interventions put forward for inclusion in the Long-Term Plan (LTP) and the level of investment (TOTEX) proposed to improve the resilience of Tauranga City Council's 3-waters network. Some of these are:

- **Design epoch**
- **Budget for resilience upgrades**
- **TCC's 3-waters network risk tolerance for natural hazards**
- **Existing emergency response plans**
- **Scale and uncertainty of event**

With the considerations above taken into account, we believe that TCC will get the most benefit out of this process if a low cost / low risk reduction solution is considered against a high cost / high risk reduction solution.

For a number of project areas, both short-term and long-term interventions have been identified. We believe the low cost / low risk reduction solution should in most cases be considered in the short-term, while larger capital expenditure should be considered over the long-term. The long-term solution is inherently less certain, but has been included to offer TCC the opportunity to include it in the LTP if deemed necessary.

3.2 Common Concepts & Solutions

Throughout the area there are repeating themes of hazards impacting assets in similar ways. Some of the common hazards and the interventions applied to them are listed in Table 1 below. The interventions can be grouped into whether it addresses the concepts of resistance, redundancy, reliability or response and recovery.

Table 1: Common hazards/risks and interventions

Common Hazard/Risk	Intervention	Infrastructure resilience benefit
Sea level rise, inundation or flooding resulting in an increase of inflow and infiltration into the wastewater network	Seal manhole lids to prevent inflow from overland flow	Improve resistance
	Raise gully traps or other ingress points above flood levels to prevent inflow of overland flow	Improve resistance
	Conduct CCTV inspections to determine need for repairs of pipes. Repair where necessary to prevent infiltration of groundwater	Improve resistance
	Increase conveyance capacity to deal with increase of inflow and infiltration	Increase reliability
Sea level rise, inundation or flooding resulting in more frequent exposure of potable water system to sea water and flood water	Review water supply asset condition, back-siphonage and backflow prevention requirements. Provide additional backflow prevention if necessary, to reduce risk of contamination.	Improve resistance
	Raise air valves above flood levels	Improve resistance
Sea level rise, inundation or flooding resulting in more frequent exposure of electrical equipment to water	Provide protection of electrical equipment to inundation	Improve resistance
Assets located in liquefaction or geotech slopes hazard zones	Replace old AC pipe with more resilient material like PE or PVC.	Improve resistance
	Provide alternative water supply sources/routes	Add redundancy
	Provide alternative pump routes for wastewater to allow the system to operate in the event of failure of a primary route	Add redundancy
	Provide additional storage at wastewater pump stations to allow for downtime of conveyance routes and storage of peak flows	Improve reliability
	Duplicate assets into areas not affected by hazards	Add redundancy
	Slipline/CIPP pipes to provide additional strength	Improve resistance
	Provide more isolation points to contain spills, prevent loss of water supply and allow for faster recovery in the event of failure of a pipeline	Better Response and Recovery
	Develop emergency response plans for making safe, rapid repairs and temporary diversion.	Better Response and Recovery

	Replace pipeline sections located below residential properties with pipelines located in roads and reserve to allow easier access for repairs and maintenance.	Better Response and Recovery
	Review easements for access to facilitate rapid repairs to pipelines in private properties.	Better Response and Recovery
	Flexible connections at structures/pump stations to allow for flexibility where differential settlement is likely to occur	Improve reliability
	Dispersion valves on significant underground structures	Improve resistance
	Strengthen banks of channels to improve liquefaction and lateral spread resilience	Improve resistance
	Ground improvements through ground dewatering, retaining or anchoring systems	Improve resistance
Hazards affect critical stormwater conveyance links' performance or ability to operate	Provide appropriate overland flow paths for stormwater	Add redundancy
High sea levels affect hydraulic capacity of outfalls	Non-return valves/gates on stormwater outfalls to prevent ingress of seawater at high tide	Improve resistance
	Temporary pumping of stormwater	Add redundancy
	Provide storage for when rainfall coincides with high tides	Add redundancy
	Widen channel to improve hydraulic performance	Improve reliability
	Sediment removal in channels to improve hydraulic performance	Improve reliability
Coastal or harbour erosion affecting the ground supporting assets	Restoration/stabilization of beach to protect assets against erosion	Improve resistance
Sea level rise and inundation impacting on a wide range of council and private assets, possibly threatening viability of occupation of the area	Sea wall, revetments and/or wave attenuators to protect assets from sea level rise and inundation	Improve resistance
	Managed retreat	Improve resistance

4. Planned Projects

There are planned projects already underway that increases the resilience of the 3-waters network. Some of these impacts the assets that have been identified as high risk by the EWOC analysis. Two significant projects are:

- **Repair of the existing Te Maunga ocean outfall**

- **The new Waiari water supply scheme and transfer main**

Due to the planned works already being undertaken on the Te Maunga ocean outfall, additional projects have not been proposed to increase the resilience of the outfall structure.

The new Waiari water supply scheme is in construction and will be extended to supply the Mount Maunganui area in the future. The addition of the Waiari supply as a water source for the area will reduce the criticality of the current water supply pipelines. This Waiari water supply project will be critical to the resilience of the supply network in the area. Commentary on the impact of the planned project has been provided in the study's GIS platform. Suggestions have also been made in the GIS platform to be included in the design of the Waiari water supply scheme.

4.1 Project ID 503

Project ID 503, construction of a dedicated inlet or outlet to the reservoir, is a critical project, but it is assumed the planned Waiari water supply scheme will already add resilience to the assets flagged through the EWOC analysis. Further short-term interventions have therefore not been developed.

It is understood that a new dedicated inlet main (450mm) is proposed for Mangatawa Reservoir in parallel to the existing AC inlet/outlet main, and that the existing AC main will remain as a dedicated outlet main.

It is recommended that this design include:

- **Fast closing valves onto reservoir inlets and outlets**
- **Flexible connections onto reservoir inlets and outlets**
- **Consider daylighting a section of the pipeline running along the hillside and mounting the pipe onto suitable flexible pipe supports. Install flexible joints at intervals along the exposed daylighted pipe.**

Ultimately, we believe the existing AC pipe needs to be replaced. It is proposed that geotechnical assessment be conducted to understand the hazards better. It is proposed that the existing pipeline be relocated or slope stability measures (eg. slope drainage) be introduced, should risk be unacceptable following geotechnical assessments. Other interventions could include:

- **Introducing water main isolation valves where the pipeline enters and leaves residential areas.**
- **Develop an emergency response plan for making safe, rapid repairs, temporary diversions etc.**

4.2 Renewals

A lot of the water supply and wastewater network in the area still consists of old AC pipe. Replacement of these have been proposed where pipes have been flagged by the EWOC analysis process. The projects where replacement of AC pipes are proposed may be able to be used to prioritise renewals in the network, but ultimately these pipes are reaching the end of their useful life and should be replaced as part of a city-wide renewals programme.

5. Recommended Solutions

5.1 Priority Project One – Project ID 506

Project ID 506 entails improving the resilience of one of the main water supply pipelines that feeds the Mount Maunganui area from Welcome Bay. This pipeline crosses the Maungatapu Bridge. The main hazards that pose a risk to the asset are:

- **Geotech slopes hazard**
- **Liquefaction hazard**
- **Harbour erosion**

It is proposed to install failsafe mechanisms such as fast closing valves to avoid loss of supply in case of failure of the pipeline as well as installing flexible connections at the bridge abutments where differential settlement can occur. The planned Waiari water supply scheme will result in this pipeline becoming less critical to the Mount Maunganui water supply, but critical for resilience, nonetheless.

It is proposed to combine this project with Project ID 507 that involves geomorphological assessments of the ground the pipe is buried in on the northern side of the bridge. The outcome of the geomorphological assessments may result in further assessment being required, doing nothing, or implementing remedial measures such as slope drainage.

Another risk to this asset is its exposure to vehicles breaking the traffic barrier. The pipe is fully exposed on the western edge of the bridge and vehicles breaking through the traffic barrier could damage the pipe severely. Consideration should be given to traffic calming measures to reduce this risk.

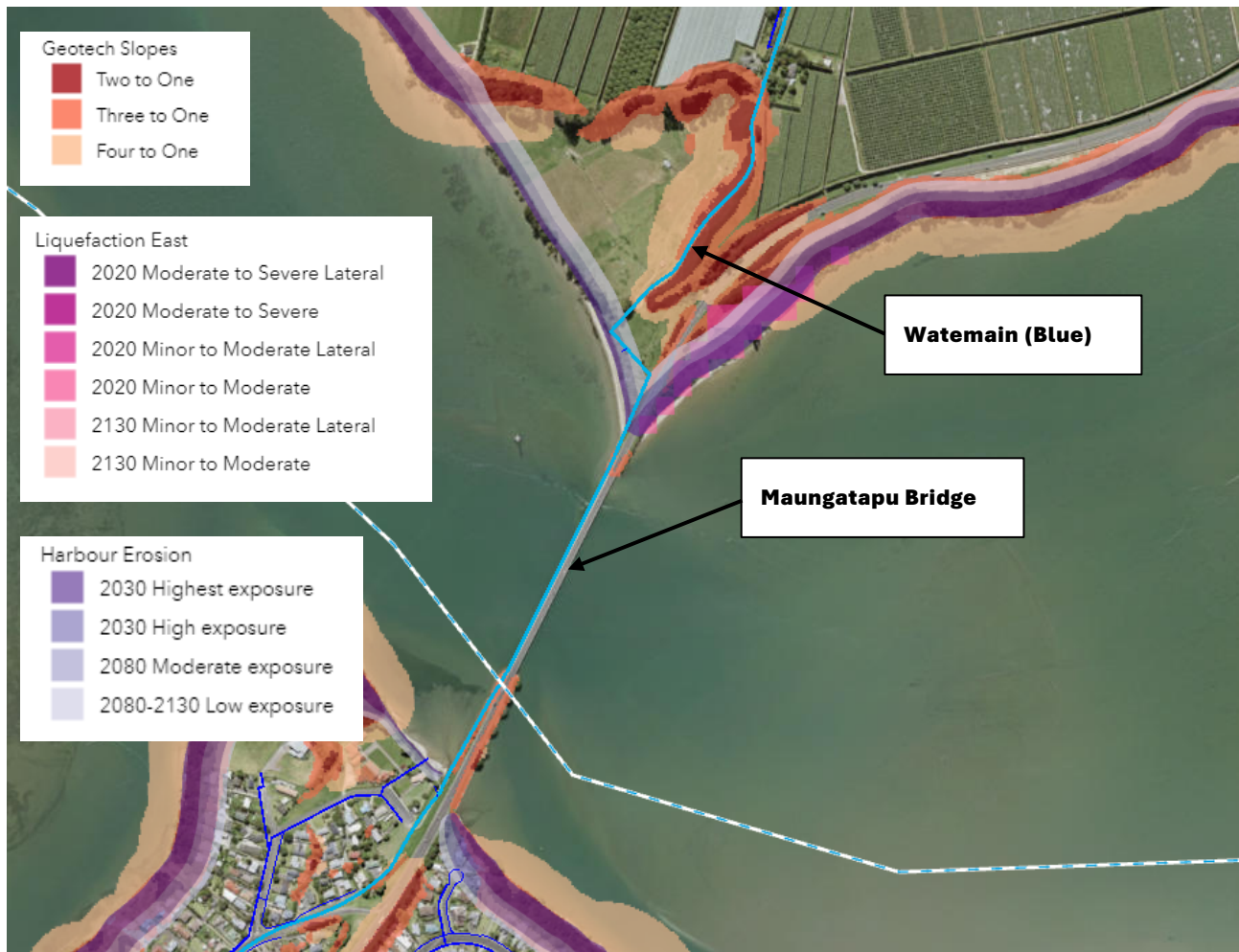


Figure 11: Pipeline over Maungatapu Bridge

It is noted that Project ID 508 and 511, located at the Tauranga Harbour Bridge, involve similar works to a main water supply pipeline. However, the pipeline associated with Project ID 508 and 511 is less critical to water supply in the area as other sources are able to meet normal demand if the pipeline is out of service. It is however critical for fire flow and resilience measures should still be considered.

Project ID 577, located at the Tauranga Harbour Bridge, faces similar risks as Project IDs 506, 508 and 511, but its design already includes bellows (flexible connections) at critical points. The pipelines associated with Project IDs 506, 508 and 577 were furthermore installed during the upgrade of Tauranga Harbour Bridge and it is assumed that the large scale of the bridge construction would result in robust measures being put in place.

5.2 Project Priority Two – Project ID 567

Harbour erosion is shown to affect the beach along The Mall Road in Mount Maunganui. This poses a risk to a number of assets along The Mall Road over the next 50 years, but is expected to affect wastewater pump station PS054 and the stormwater outfalls in the short-term. In addition to the harbour erosion, the pump station is also exposed to sea level rise, tsunami, inundation, and liquefaction. However, addressing the harbour erosion risk is considered the most urgent. Harbour erosion exposure of PS054 is shown in Figure 12.

It is proposed to address the harbour erosion through restoration or stabilisation of the beach, such as a rock revetment along the beach front. The rock revetment can be extended to protect a larger section of the beach if desired, or could also be done at a later stage as the beach becomes further exposed to erosion.

It is also proposed to inspect the pump station wet well to determine if infiltration of groundwater is an issue. The groundwater level is expected to be high in this area and will increase as sea levels rise. Furthermore, it should be determined whether or not there are other infiltration pathways that need to be eliminated such as the odour filter vent. Infiltration from the odour filter vent can be eliminated by raising the vent to prevent inflow during inundation events. It should also be considered whether the electrical components of the pump station have the appropriate waterproofing and whether they need to be replaced with appropriately rated equipment to mitigate damage during inundation events.

The area that this pump station services is expected to see an increase in flow as the wastewater system is exposed to higher groundwater levels accompanied by a rise in sea levels. This puts the pump station under pressure as it needs to deal with higher flows. Mitigating this increase in flows will be important part of servicing the area in the long term. Projects that address this issue are proposed in other Project IDs (see project ID 568).



Figure 12: PS054 and proposed rock revetment location

5.3 Project Priority Three – Stormwater outfalls

Several stormwater outfalls discharging to the harbour are affected by rising sea levels and harbour erosion. The hydraulic performance of these outfalls will become progressively more affected as sea levels rise, and in the meantime, they are exposed to a harsh environment and require ongoing maintenance. It is good practice to prevent the sea water from entering the system back up through these outfalls and limit the exposure it has to the sea. Backflow into the stormwater system can also impact on low lying developments where it can spill above ground. Anecdotal evidence suggests that backflow is already occurring and getting close to surface level.

Even though it is good practice to have backflow prevention valves on the outfalls and they may already be installed on these outfalls, it may also be that they are not functioning correctly. It is therefore recommended to install non-return valves on outfall pipelines to prevent ingress of seawater at high tide. The outfall

performance should also be monitored to inform ongoing maintenance. It is proposed to inspect and install new valves on multiple outfalls at the same time. These outfalls are listed in Project IDs 531, 532, 533, 535, 538, 539 and 541.

In the long term, the impact of sea level rise on development in the area needs to be considered. The stormwater system's performance will continue to deteriorate as sea levels rise as the outfall and the associated stormwater network serves a relatively low-lying area. Ultimately, the long-term solution is likely to involve stormwater pumping if occupation of the area remains.

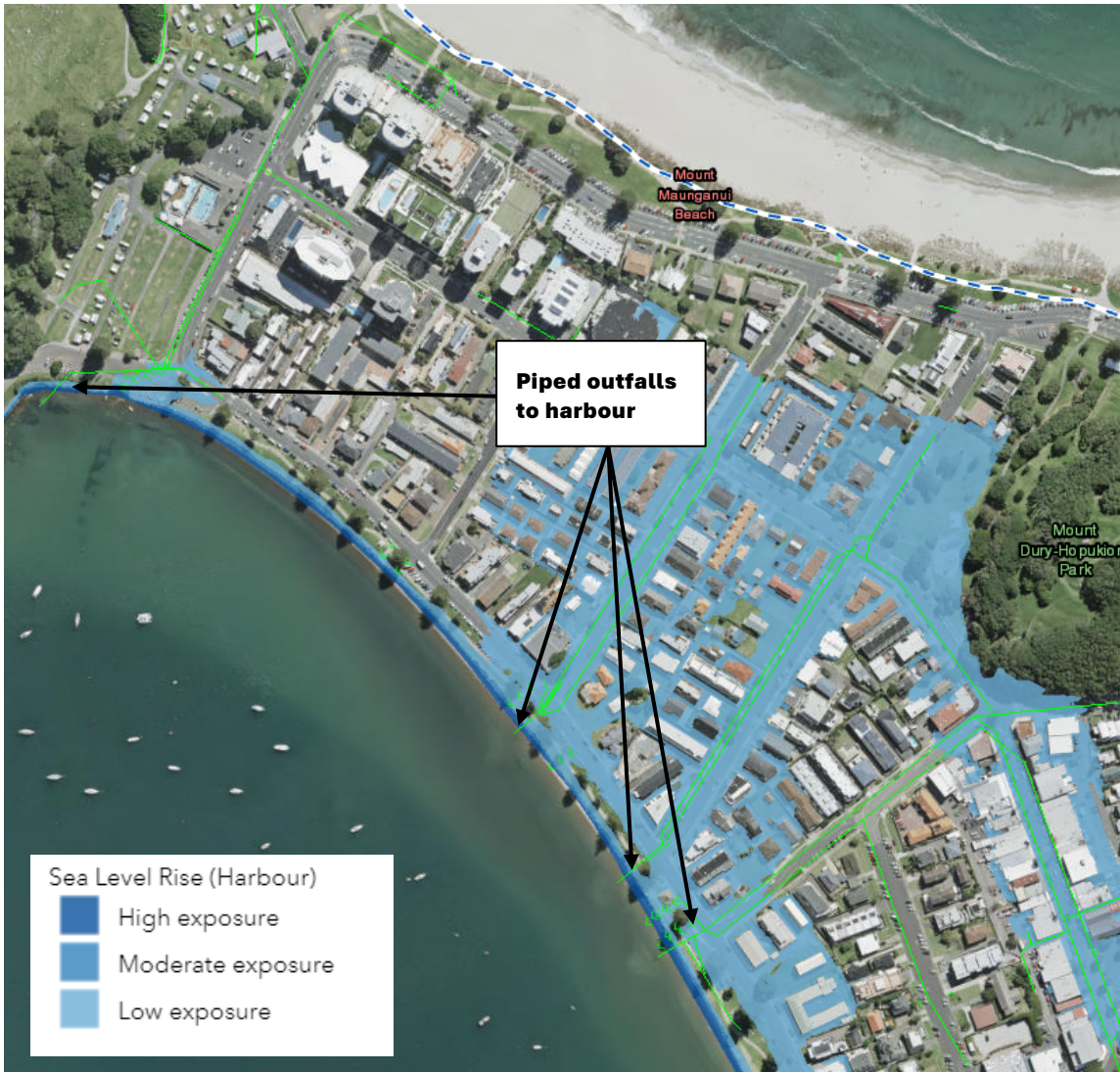


Figure 13: Stormwater outfalls in Mount Maunganui area

Auckland
Level 3 Stantec House, 111 Carlton Gore Road
Newmarket, Auckland 1023
PO Box 13-052, Armagh
Christchurch 8141
Tel +64 9 580 4500

**Please visit www.stantec.com to learn more about how
Stantec design with community in mind.**