Stephen Molineux & Timbi Poon

Asset Management of Brownfield Reservoirs – Opportunities/lessons from a comprehensive condition assessment and remediation programme

WSP & Beca-HunterH20

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Overview of Presentation

- Quick recap of the Wellington Water's 'Very High Criticality' asset assessment program
- 2021 Reservoir external condition assessment using a 'Digital Workflow'
- 2022-2023 Design of required work and roof leakage testing
- 2023-2027 Delivery of a three-year program of works
- Data capture to inform re-inspection and 'Whole of life' asset management

Proactive Asset Management Preventing Asset Failure

Dixon Street, Wellington CBD, wastewater trunk main failure – 20 December 2019

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Case Study: Proactive Asset Management Preventing Asset Failure

Very High Criticality Asset:

"An asset whose failure has an unacceptable and extensive impact on the livelihoods of people and our environment and where time to restore service would be greater than 1 day".

Very High Critical Assets were determined by assessing an assets Failure Mode against the resulting customer service impacts:

-H&S

-Public health

-Environmental impact

-Cost

-Service outage & duration

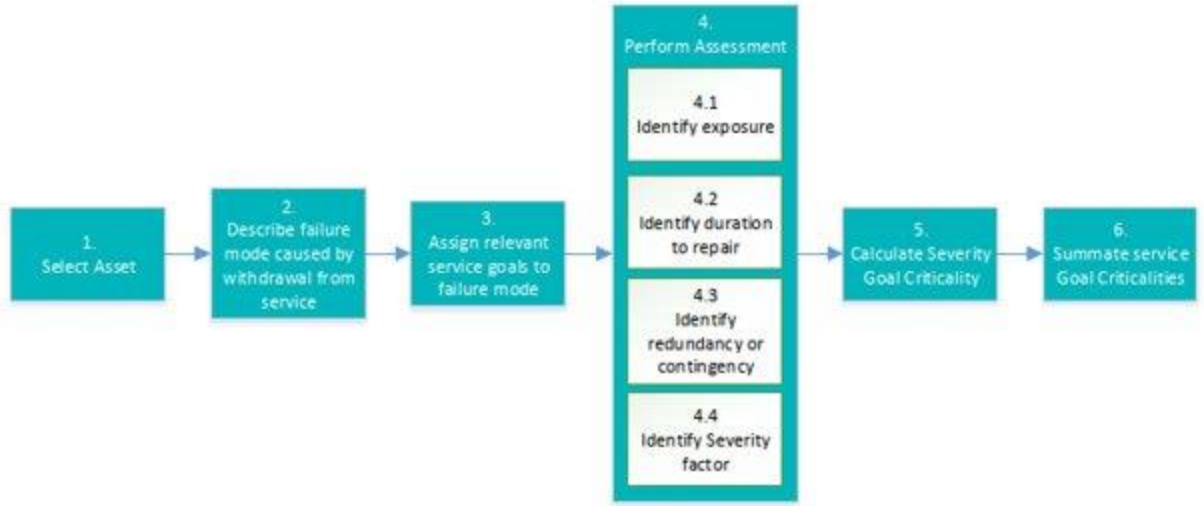
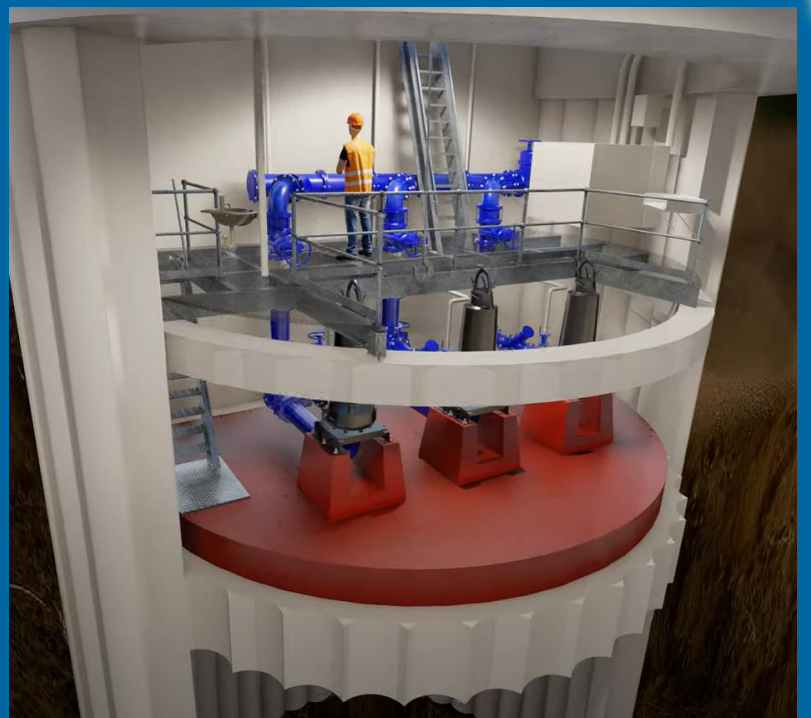


Figure 1: WWL flow chart for assessment of assign asset criticality.

Very High Criticality Assets Identified across the Wellington region:

77km of drinking water pipes
230km of wastewater pipes
164 km of stormwater pipes
140 reservoirs
84 pump stations
560 water treatment plant assets



140 Drinking Water Reservoirs External Visual Condition Assessment

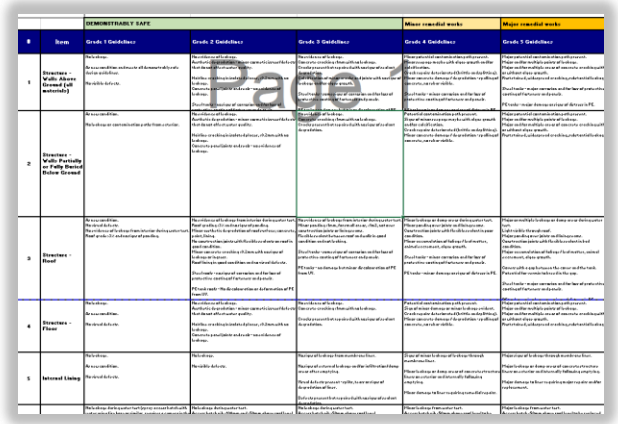
Failure Modes assessed:

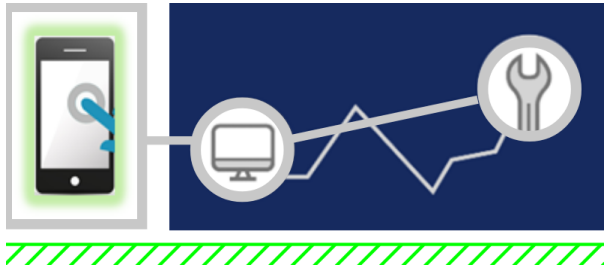
1. Health and Safety – Preventing falls from height

2. Structural Durability Failure – Identification of immediate risks and longer-term vulnerabilities. Excludes Seismic.

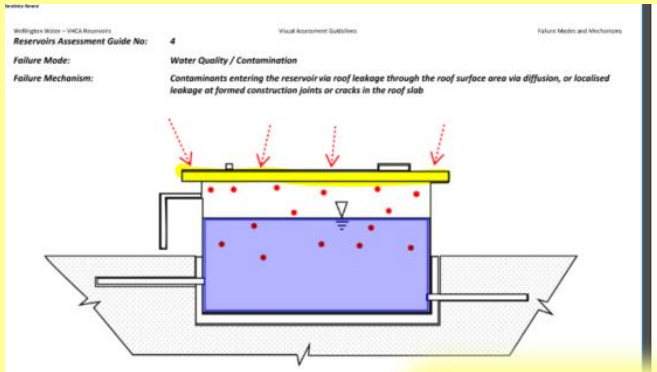
3. Water Quality – Assessment of contamination resilience.

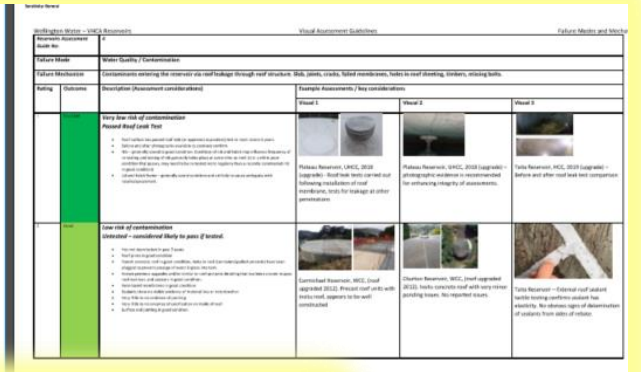
Condition Assessment – Visual Assessment Guidelines

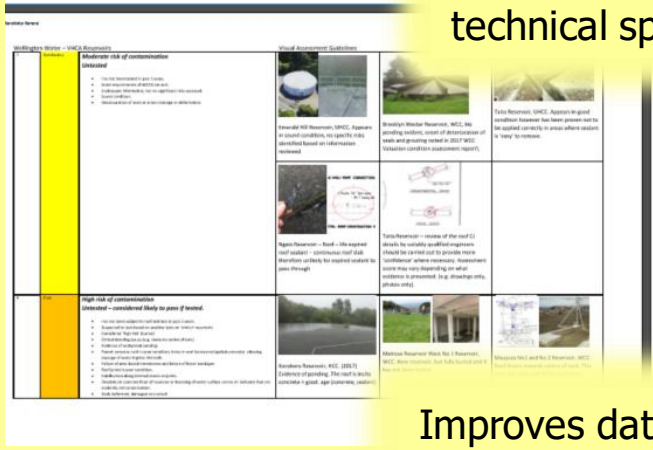


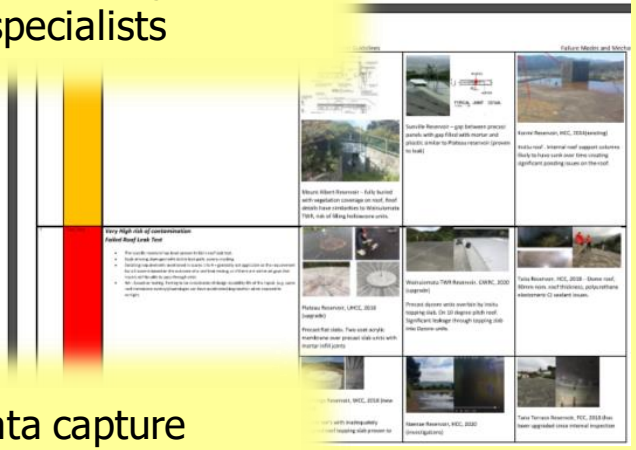


Foundation of the project









Preserves knowledge from technical specialists

Improves data capture consistency

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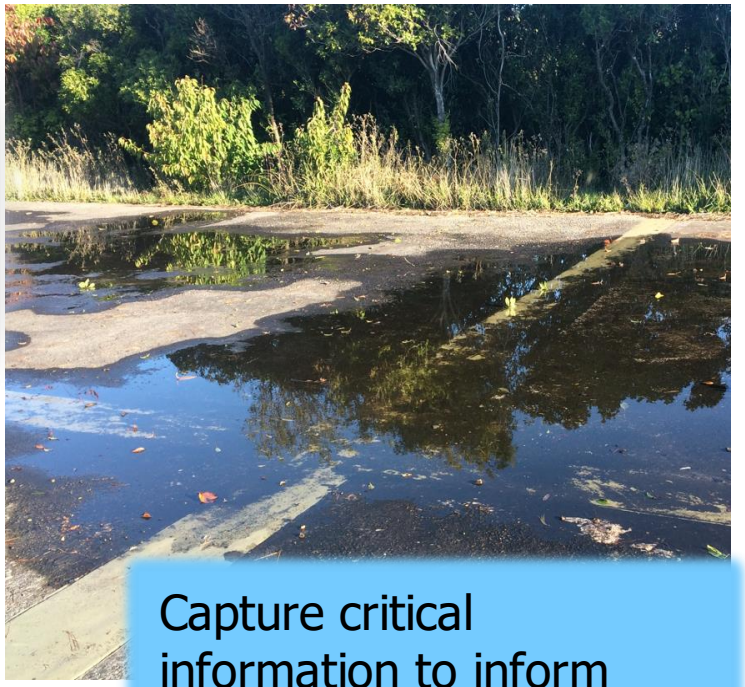
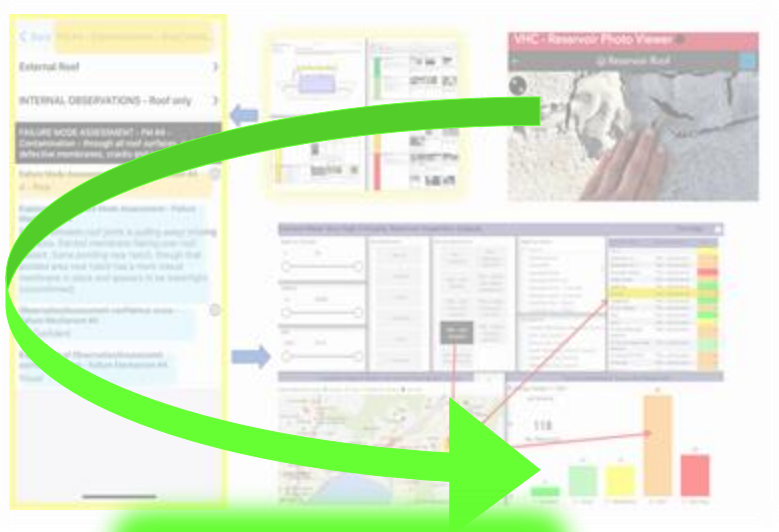
Condition Assessment - Mobile App

Focus on the end user experience



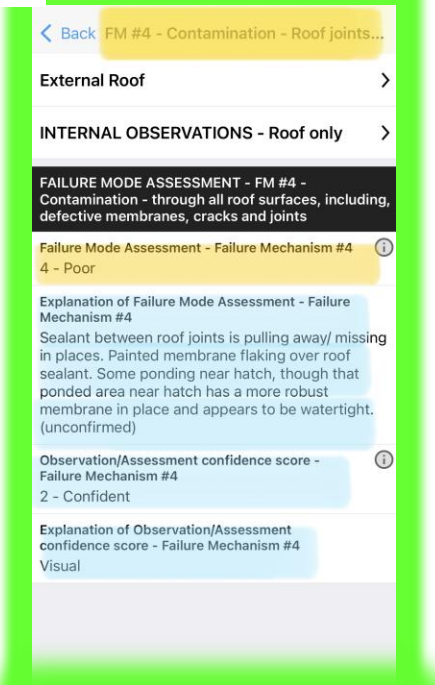
Capture critical information to inform technical assessment



Know the full Information workflow

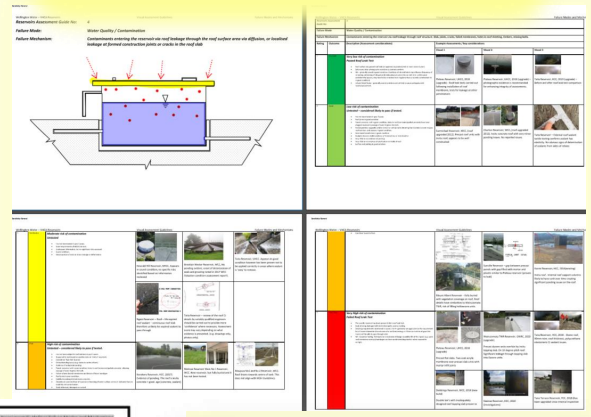
Log outputs from other inspection activities

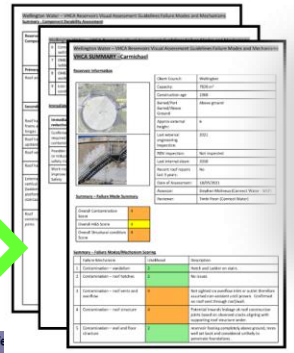
The Digital Workflow



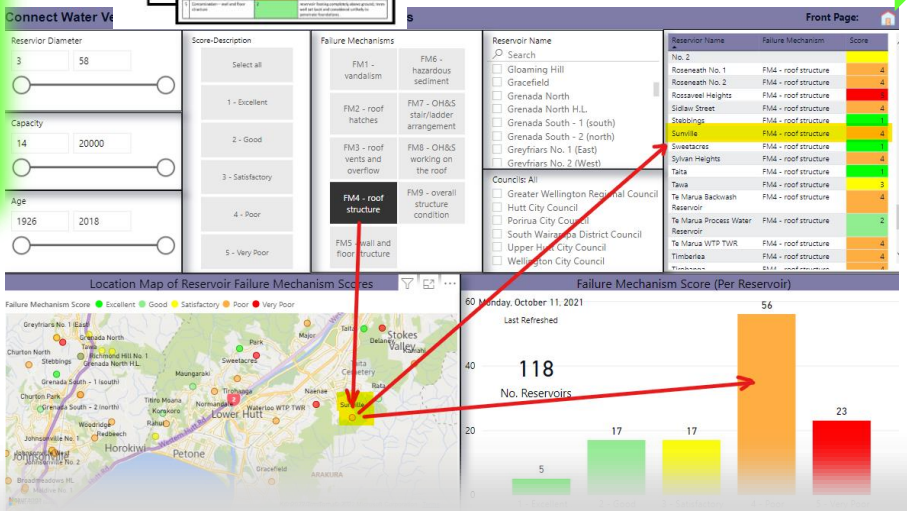
Phone App: Digitally record assessment score and supporting evidence

Assessment scoring

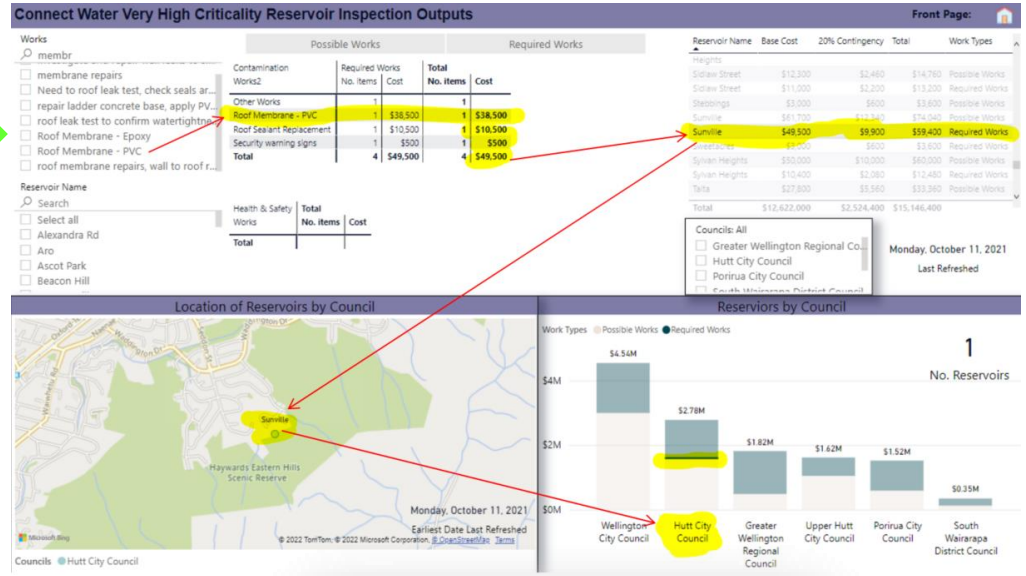




Auto-generated summary reports



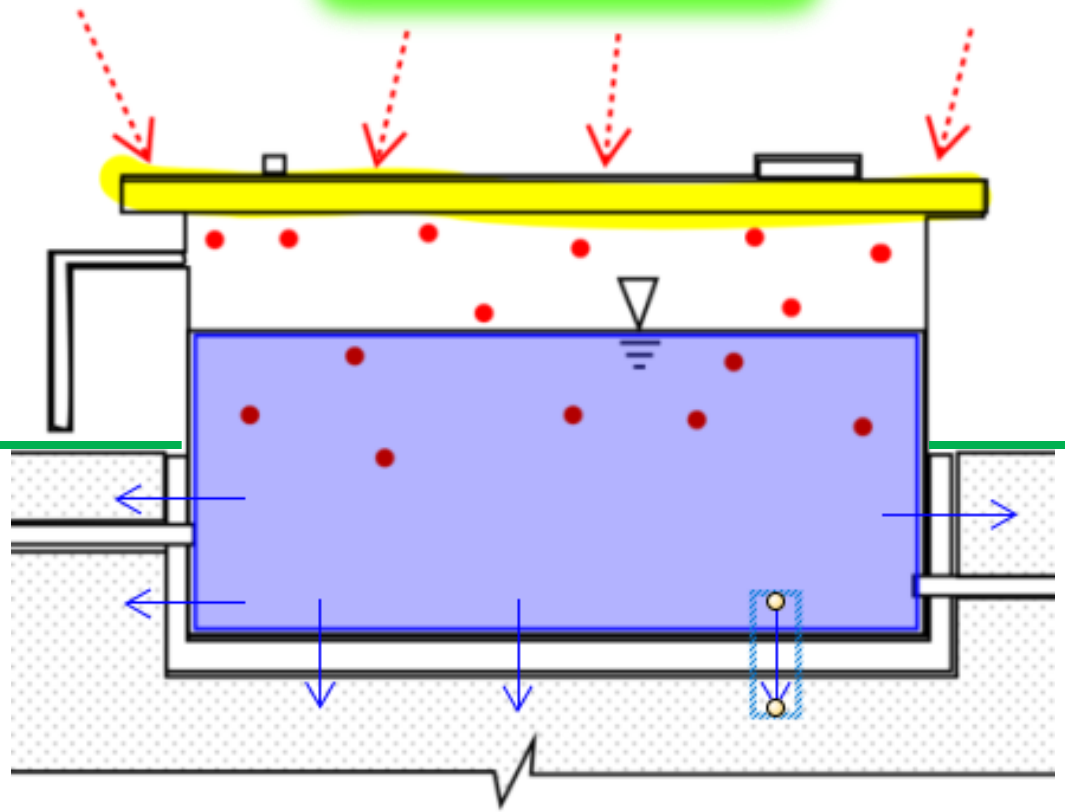
Auto-updated Interactive Dashboards



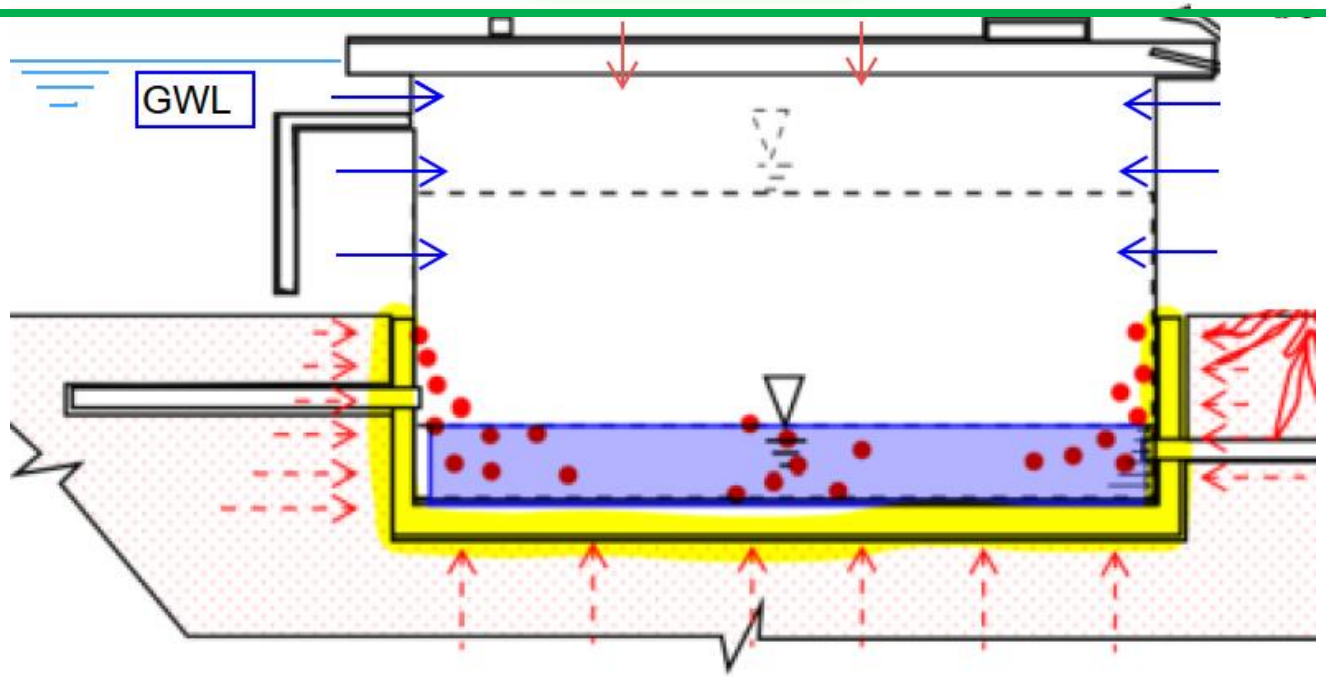
Costings based on recent installations

Contamination Resilience – Above ground vs Buried

Above ground Reservoir

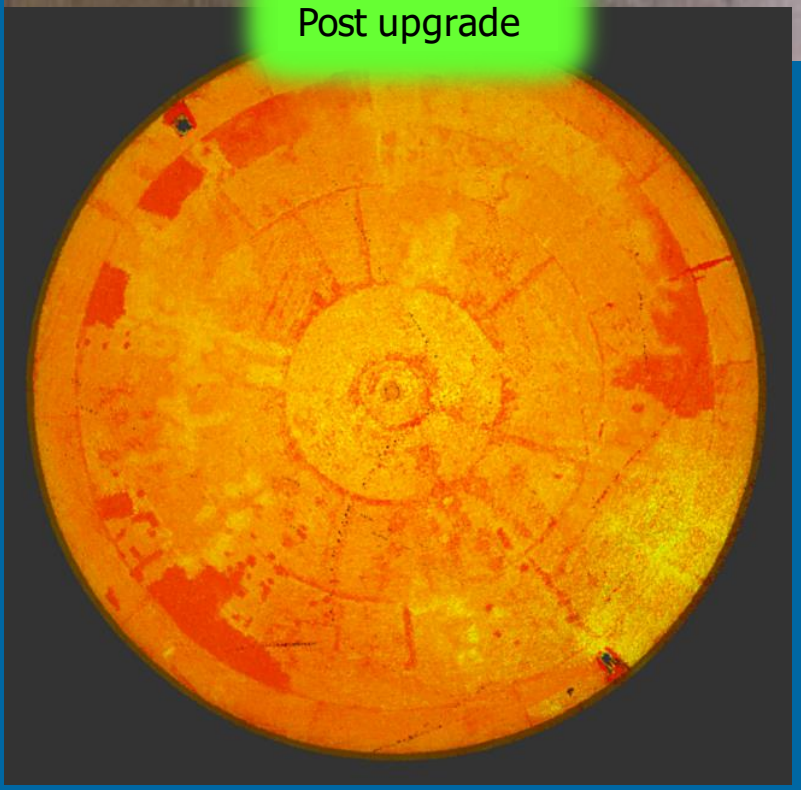


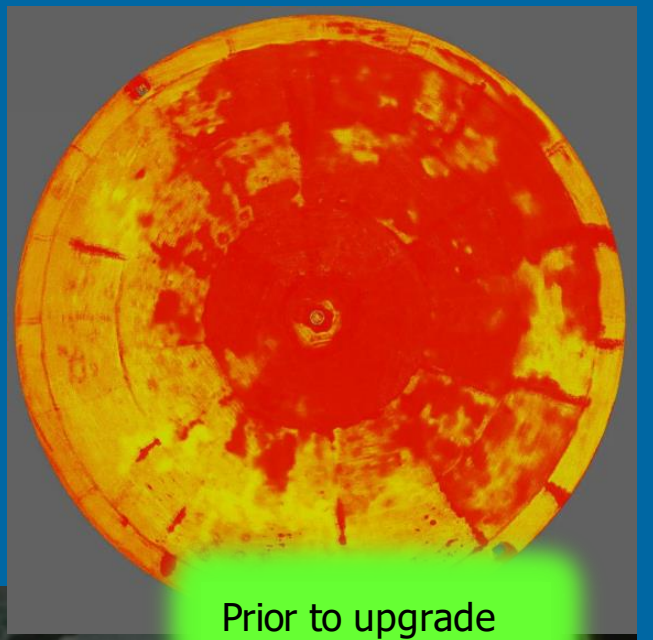
Buried Reservoir



Offline Roof Leakage Testing

- Industry best practice to demonstrate water tightness
- Can be difficult and expensive to take reservoirs offline

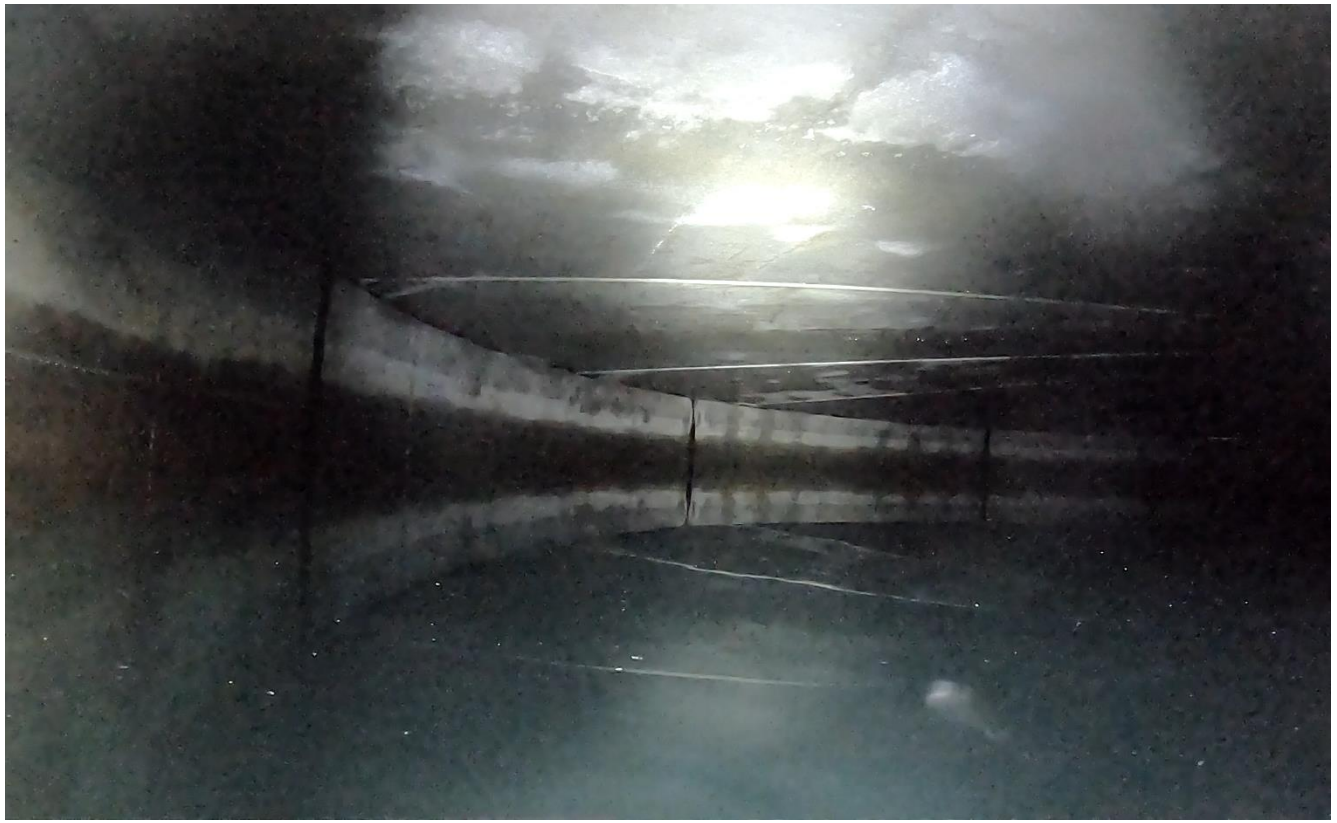




- Consider utilising rainfall events
- Hatch mounted fans assist drying reservoir interior

Online Leakage Testing

- Use of drones, boats & selfie sticks
- Experience required to differentiation between condensation and leakage
- Observations inform the 'Visual Assessment Guidelines'

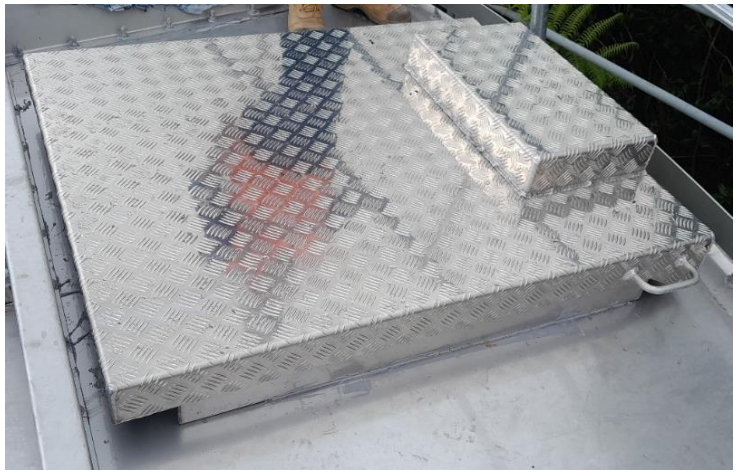


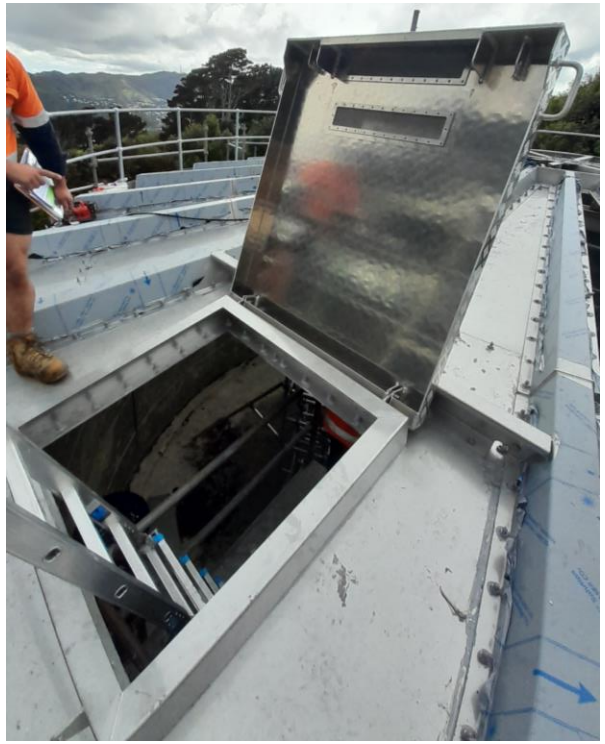
Remedial Program of Works

- Four-year $14 million program of works covering 6 different client councils.
- Juno Civil Ltd allocated as the contractor under Wellington Water's contractor.
- All work on above ground reservoirs designed to be completed without taking the tank offline
- Economies of scale providing design optimisation and delivery efficiencies.

Hatch & Hatch nib Replacement

- Hatch Design
- Protected Hinges and locks
- Rubber seal to prevent vermin entry
- Robust construction to prevent vandalism
- Lightweight lid for ease of lifting
- Integrated air venting
- Methodology to undertake replacement while reservoir is online





Online Hatch nib replacement

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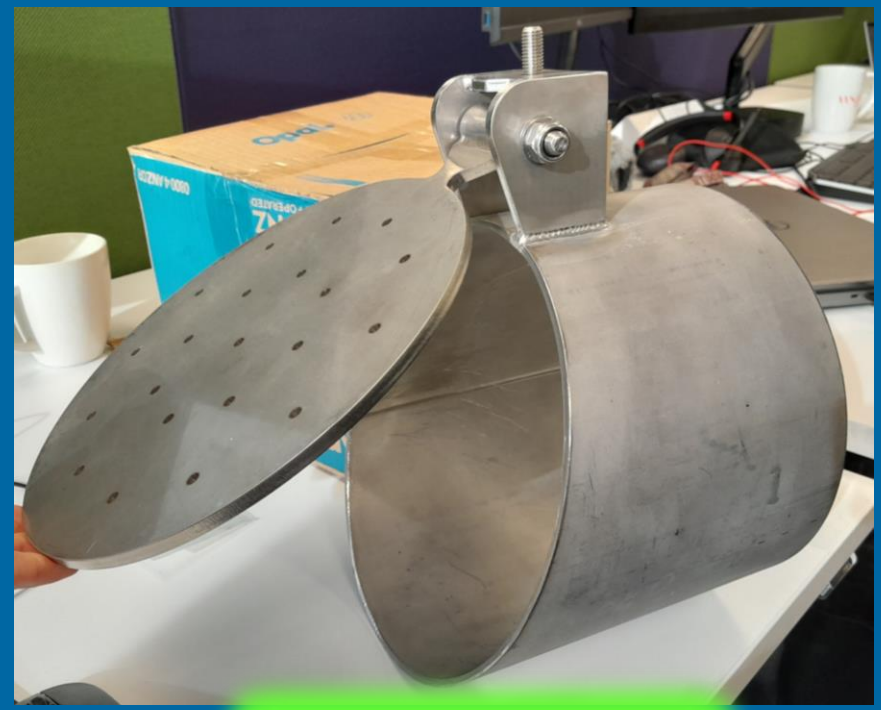
Air vents & Overflow pipes– Rodent protection

- Warm blooded animals – Very High risk
- Insects – lower risk
- Venting capacity requirements need to be considered when using flap gate valves on overflow pipes

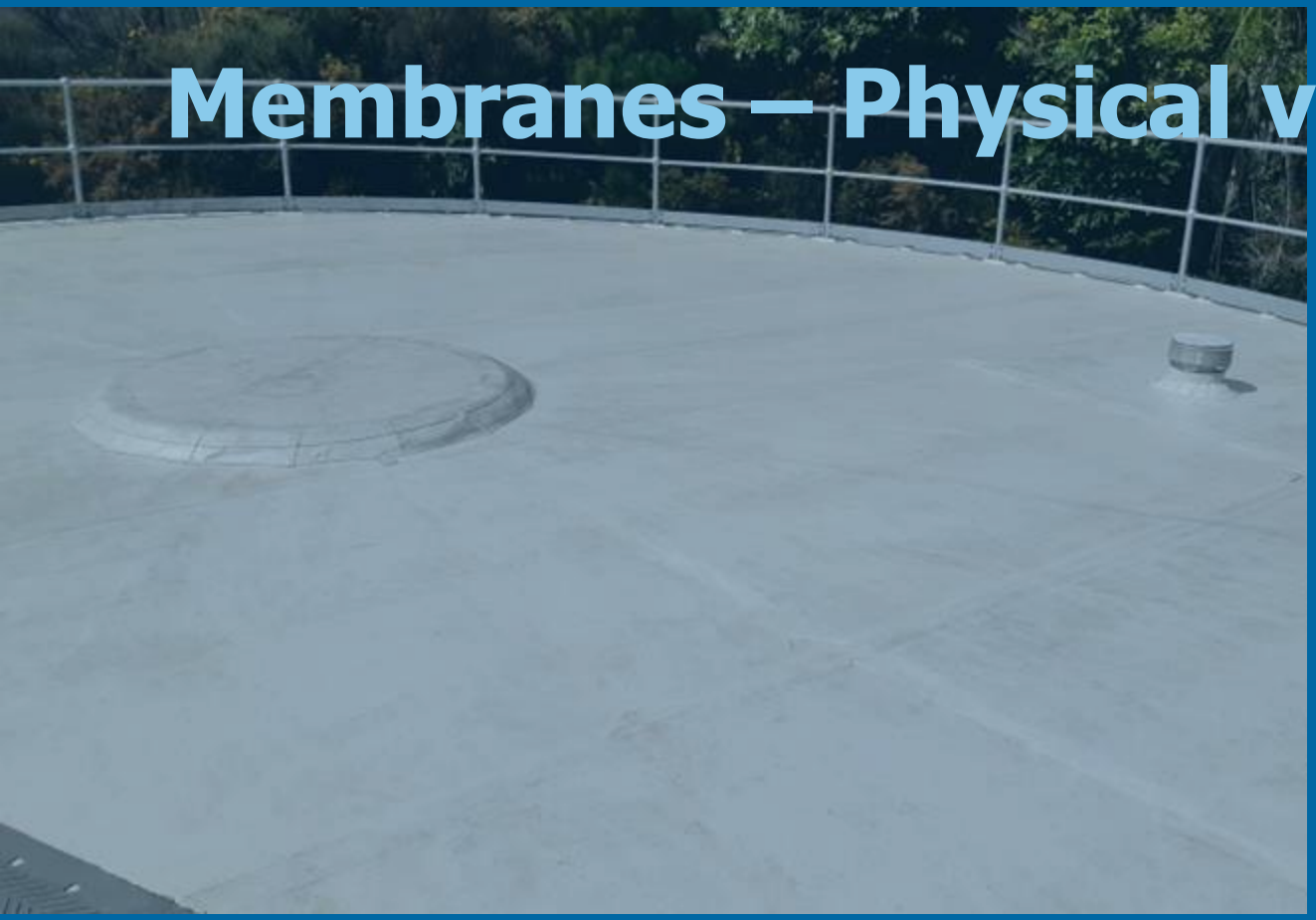
Air Vent Mesh installation

Internal Overflow pipe



External overflow pipe
flap gate valve

Membranes – Physical vs Epoxy



<u>Physical membranes</u>

More expensive.

Longer design life, more durable with less maintenance

<u>Epoxy Membranes:</u>

Effective solution for roof surfaces with minimal thermal movement and few construction joints.

Decay quickly with roof ponding

Sealant Replacements

- Replace all sealants – future asset management
- Pay extra attention to sealants covering critical post tensioning elements.
- Consider the security of sealants with direct access to the water supply beneath

Structural Durability Repairs

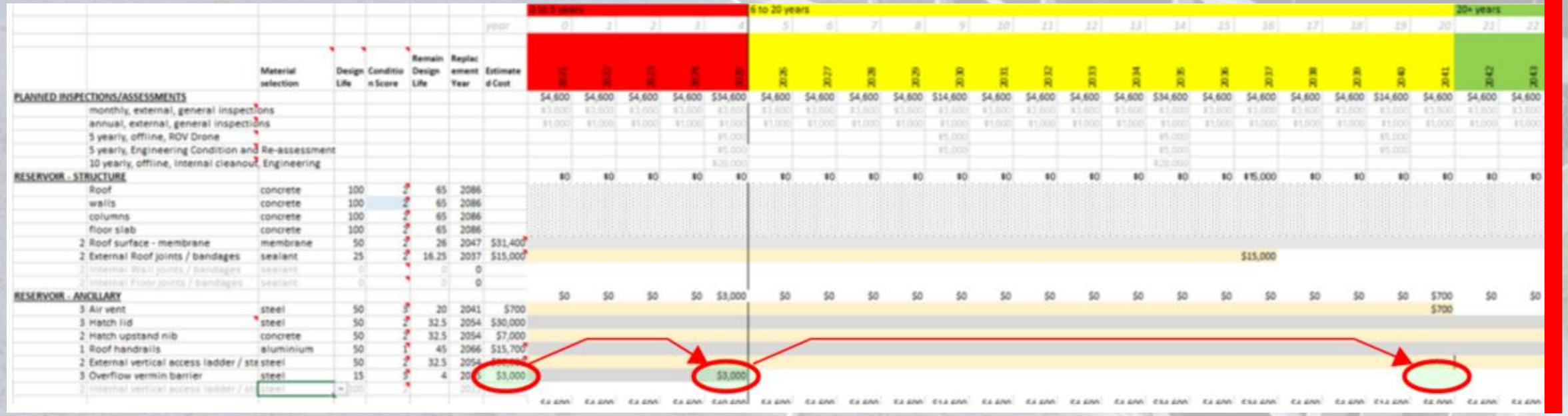
- Undertake preventative structural durability repairs before they compromise the structural integrity.

- Specification of staircases and security upgrades that are robust, vandal proof and earthquake resilient.

Staircase and Handrail installation

Predictive Maintenance & Whole of Life Asset Management

End Of Asset Life



		Material selection	Design Life	Condition Score	Remain Design Life	Replacement Year	Estimated Cost
PLANNED INSPECTIONS/ASSESSMENTS							
	monthly, external, general inspections						
	annual, external, general inspections						
	5 yearly, offline, ROV Drone						
	5 yearly, Engineering Condition and	Re-assessment					
	10 yearly, offline, internal cleanout	Engineering					
RESERVOIR - STRUCTURE							
	Roof	concrete	100		65	2086	
	walls	concrete	100		65	2086	
	columns	concrete	100		65	2086	
	floor slab	concrete	100		65	2086	
2	Roof surface - membrane	membrane	50		26	2047	$31,400
2	External Roof joints / bandages	sealant	25		16.25	2037	$15,000
2	Internal Wall joints / bandages	sealant	0		0	0	
2	Internal Floor joints / bandages	sealant	0		0	0	
RESERVOIR - ANCILLARY							
3	Air vent	steel	50		20	2041	$700
3	Hatch lid	steel	50		32.5	2054	$30,000
2	Hatch upstand nib	concrete	50		32.5	2054	$7,000
1	Roof handrails	aluminium	50		45	2066	$15,700
2	External vertical access ladder / sta	steel	50		32.5	2054	
3	Overflow vermin barrier	steel	15		4	20	$3,000
2	Internal vertical access ladder / sta	steel	100				

Conclusion & Key points

- Condition assessment provides visibility of asset condition to ensure intervention can be undertaken prior to failure.
- Consider investing in a digital workflow for sizable condition assessments or data capture exercises.
- Site inspection specifications with photographic examples are a great tool to inform visual assessments.
- Assessment and remediation at scale provides better outcomes and consistency.
- Water tightness testing underpins the contamination resilience of reservoirs. The cost of testing should be balanced against the cost of a remediation. Prioritise testing on larger tanks and those you are unfamiliar with.
- Many contamination improvements can be implemented cheaply and will mitigate some of the most significant risks (mesh installation, sealant replacement, flap gate valves, epoxy membranes)
- Do not underestimate the operational effort and cost to take tanks offline.
- Consider 'whole of life' maintenance and upgrade requirements when specifying upgrades. Consider when the next drain down is likely to occur.
- Consultant collaboration draws on the strengths of both organisations.

Acknowledgements & References & Questions:

- Wellington Water – John Scott, Rob Blakemore, Paul Winstanley
- WSP & Beca design teams

- EPA presentation; ‘Understanding the significance of breaches to and sediment buildup in finished drinking water storage tanks’ – Bob Clement, 2019