



Report

Date : 25 May 2023
To : Mayor and Councillors
Tararua District Council
From : Roger Earp
Acting 3-Waters Manager
Subject : **Dannevirke Impounded Supply Update**
Item No : **11.5**

1. Recommendation

- 1.1 *That the report from the Acting 3-Waters Manager dated 25 May 2023 concerning the Dannevirke Impounded Supply Update be received.*

2. Reason for the Report

- 2.1 The purpose of this report is to provide Council with an update regarding the Dannevirke impounded supply and subsequent actions recommended to mitigate the risk of failure and to enable the safe and reliable supply of water to Dannevirke.
- 2.2 This report will also outline options in terms of progressing the repair of the dam including some cost estimates.

3. Background

- 3.1 In September 2022 a report was presented to Council titled Dannevirke Impounded Supply Financials and Planning (attached).
- 3.2 At the September 2022 Council meeting, Council approved funding of \$1,085,000 to progress the planning of permanent repairs and functional improvements, as well as planning for pre-treatment and supplementary water source solutions.
- 3.3 At the 15 March 2023 Council meeting, a report was presented to Council titled Dannevirke Impounded Water Supply Update (attached). The report provided an

update on the Dannevirke Impounded Supply and an outline of the next steps in this programme of work.

3.4 A review of the impounded supply's Potential Impact Classification (PIC) has been completed to pre-emptively comply with the requirements of the new Building (Dam Safety) Regulations 2022.

3.4.1 During resource consenting for original construction, the PIC was determined by Council at the time as being 'Low'.

3.4.2 Tonkin + Taylor (T+T) were engaged to review this and, in summary, identified a preliminary PIC as Medium or High. This has significant implications on Council's obligations under the Building (Dam Safety) Regulations 2022.

3.4.3 Further work is underway to confirm if the PIC is Medium or High and to better define the potential impacts, including:

- Obtaining more accurate topographic information for the downstream dam break area,
- Obtaining traffic volume data for Laws Road,
- Advancing to a more detailed Comprehensive level of PIC assessment,
- Comprehensive geotechnical investigations,
- Embankment / terrace stability reviews, and
- Hydraulic performance reviews.

The additional work recommended will help define standards for the upcoming remedial works, fulfil requirements under the regulations, and support ongoing dam safety management in line with recommended best practice.

4. Current Situation

4.1 Staff have been working with specialists from Tonkin and Taylor, GHD, and Damwatch to monitor and manage the current issues with the impounded supply, to progress planning of the required remedial works, and to plan the necessary mitigation measures required to reduce the risk of significant disruption to Dannevirke's water supply when remedial works are being undertaken.

4.2 This work has included an additional inspection of the impounded supply's liner via a Remotely Operated underwater Vehicle (ROV). Two tears in the liner were identified during inspections carried out in early May. Temporary repairs are scheduled for early June, via specialist divers, to reduce the leakage and risk of further deterioration to the impounded supply's liner and subsoil drainage system.

4.3 Right now, we are in a 'monitor and mitigate' mode due to the impounded supply operating with a heightened level of safety risk. The situation could deteriorate at

any time, and an uncontrolled release of the impounded supply's contents could occur.

- 4.4 If required due to further deterioration presenting an excessive risk of failure, the impounded supply would need to be emptied. This would create significant disruption to Dannevirke's water supply.
- 4.5 An increased monitoring regime has been put in place to assess for signs of deterioration, so that preventative measures can be implemented (e.g. further reducing the volume of stored water, but not completely emptying the impounded supply), to reduce the risk of water supply disruption.
- 4.6 The intent of the monitoring, mitigation and patching where needed, is to provide time to develop options with urgency but without compromising the robustness of the long-term solution and the asset. The measures improve (but don't guarantee) the chance of detecting issues and intervening, to prevent or mitigate an uncontrolled release from the reservoir. Undertaking interim repairs and patches is intended to slow the rate of deterioration. It is not possible to know with certainty whether and for how long the measures will remain effective in controlling the rate of deterioration.
- 4.7 A workshop was held with Council's iwi partners, Horizons Regional Council and Waikato Regional Council (as consent regulator for dams in New Zealand) on the 18th of May 2023. The purpose of this workshop was to present the considered options and seek feedback from a cultural, environmental and regulatory perspective. This information will be used to inform Council's decision making.

5. Options for Permanent Solution

- 5.1 Four overarching options have been considered for the impounded supply, being:
- Option 1 – Remedy impounded supply
- Option 2 – Monitor and mitigate
- Option 3 – Decommission the impounded supply and construct alternative storage
- Option 4 - Decommission the impounded supply and construct an alternate source, storage, and treatment facility
- 5.2 This work was commissioned prior to the liner tears being found in recent weeks. The work considered to date has been contemplated using a 'conventional' delivery approach. The project team will need to contemplate the viability of these potential solutions in the revised context, and an initial assessment is provided in this paper to Council.
- 5.3 Option 1 – Remedy impounded supply - is detailed further in section 6 of this report.

- 5.4 Option 2 – Monitor and mitigate - involves the continued management of the reservoir in its current condition, i.e. no intention for remediation works.
- 5.4.1 To manage the situation the reservoir would be operated at lower levels, enhanced surveillance and monitoring would be implemented and the interim emergency action plan enhanced, all to mitigate the risk of dam failure.
- 5.4.2 This option is not considered viable because:
- The situation is no longer manageable given the two tears have been identified in the liner that must be repaired as soon as possible
 - The present state of the reservoir could deteriorate rapidly at any time
 - The likelihood of that deterioration is unavoidably uncertain
 - This is not an acceptable approach from a long-term dam-safety and water supply perspective
- 5.5 Options 3 and 4 would require the existing impounded supply to be decommissioned and the land restored to an acceptable long-term state. Decommissioning would require a Building Consent, and reconfiguration of the reservoir to no longer meet the definition of a “dam”. Both options 3 and 4 would require the impounded supply to continue to be utilised whilst construction of an alternative solution was completed.
- 5.6 Option 3 – Alternative storage - comprises the construction of replacement storage of the same or similar volume (120 megalitres) as the existing impounded supply.
- 5.6.1 This option is not considered viable at this stage due to the potential time required to implement such a storage facility, which would include land acquisition, consenting, design, construction and commissioning.
- 5.7 Option 4 – Alternate source, storage and treatment - involves the construction of an entirely new water supply system including a new source, new storage, a new water treatment plant and a new pipeline to Dannevirke. It would eliminate the current reliance on the existing reservoir, water treatment plant and Tamaki River source.
- 5.7.1 Initial estimates are that this would take four years to complete. An alternative source with enough capacity to supply Dannevirke would have to be identified and proven, water storage and water treatment facilities constructed and commissioned. Initial estimates have not been developed. A larger and longer scheme to connecting the Waikato River to Te Awamutu completed in 2021 was in the order of \$36.
- 5.7.2 This option is not considered viable, at this stage due to the length of time for water source investigation, proving, construction and commissioning and cost.

6. Options for Impounded Supply Remediation

Options that have been considered include:

6.1 Partial fix of the reservoir

6.1.1 This option comprises a dewatering of the reservoir for a short period of time (to be defined), a top up of any subgrade depressions and an inspection and patching of any defects in the HDPE liner.

This option is not considered viable because:

- The cost of the partial fix would still be substantial
- Disruption and threat to the security of supply is less due to a shorter construction duration, however, may still be substantial
- The subgrade depressions and HDPE defects are likely to develop again within the next one to ten years since major deficiencies / vulnerabilities would remain
- Once the reservoir is dewatered it could become apparent that the damage to both the liner and subgrade is more significant than anticipated and more work is required to restore the reservoir to an acceptable and safe condition to refill.

6.2 Full fix of the reservoir

6.2.1 This involves undertaking the physical works necessary to provide an acceptable long-term solution in terms of dam safety. There are sub-options within this, with differing approaches to the following components:

- The impounded supply liner and subsoil drains
- The eastern embankment (i.e. the dam wall)
- The improvements to dam safety and functionality

6.2.2 For the impounded supply liner and subsoil drains, all sub-options require the impounded supply to be completely dewatered and the floating cover removed. The differences are:

- Partial Replacement. The partial replacement option comprises replacing all the subsoil drains; topping up depressions and replacing approximately 60% of the HDPE and clay liner. See Appendix 3.
- Full Replacement. The full replacement option comprises replacing all the subsoil drains; topping up depressions and replacing 100% of the HDPE and clay liner. See Appendix 3.

- **Build Over.** The build over option comprises building a new drainage system over the existing system, except for relatively quick, localised repairs local repairs, (topping up subgrade depressions, patching HDPE defects, but leaving the existing subsoil drains in place). See Appendix 3.

All options are viable at this stage, and present different cost versus risk scenarios. Based on the analysis completed to date the recommended option is Full Replacement.

It should be noted that the current floating cover is at the end of its useful life and will be disposed following removal. A decision has not yet been made as to whether the floating cover should be replaced.

6.2.3 The eastern embankment (i.e. the dam wall) sub-option relates to the modification of the eastern embankment. The options are:

- **Do nothing, i.e. no major works are completed on the eastern embankment.**
- **Downstream berm.** The downstream berm option comprises the building of a new berm on the lower part of the eastern slope of the dam embankment. For this to be constructed the reservoir does not need to be dewatered and hence this works could be completed at any time and would have minimal to no disruption to water supply.
- **Full Rebuild.** The full rebuild option comprises the removal of much of the present embankment (i.e., removal of 100% of the original fill material that was placed on the natural terrace slope and used to backfill the large, excavated trench for the subsoil drain outlet pipe), the rebuilding of the embankment and the replacement of the downstream section of the subsoil outlet pipe.

Both the downstream berm and the full rebuild options would involve a significant increase in cost, major earthworks, impacts on erosion and sediment control, and material coming from offsite.

Further investigation and assessment is required to enable an informed decision to be made as to which eastern embankment sub-option is technically required. The geotechnical investigations completed thus far have been limited to selected, fast-tracked aspects, prioritising the aspects most critical for dam safety. However, a full assessment against relevant seismic, stability, internal erosion, and hydraulic performance criteria for the updated PIC is needed to obtain Building Consent for the remedial works and to support ongoing dam safety management and compliance with the Building (Dam Safety) Regulations 2022 following the remedial works. The full assessment will check for deficiencies not previously identified so they can be addressed as part of the remedial works if appropriate. Deficiencies not identified now would likely be found post-remediation during activities to comply with the new regulations, and could then lead to further rounds of disruption to water supply. The sub-options described above, from “do nothing” through to “full rebuild” represent the range of possible works that could

be identified as needed by a full assessment against performance criteria for the updated PIC.

6.2.4 The dam safety improvements include various recommended upgrades to the impounded supply whilst the reservoir is empty and there is an opportunity to complete works with no added disruption to water supply. The recommended improvements include:

- an upgrade to the water supply outlet pipes,
- reinforcing the liner at the inlet structure, and
- the installation of dam safety instrumentation to bring the reservoir in line with modern standards and to ensure it will conform with the new dam legislation coming into effect in May 2024.

It is recommended that all three elements of the dam safety upgrade are included in the final solution, they are not alternative sub-options. These works are relatively minor when compared to replacing the liner, subsoil drains and any eastern dam embankment works.

7. Options for Minimising Water Supply Risk During Impounded Supply Remediation

7.1 As detailed in the previous reports to Council, there are significant risks of water supply disruption while the impounded supply is temporarily decommissioned, and remedial works are being completed. Various options have been assessed to mitigate these risks, including:

- Upgrading the existing water treatment plant
- Construction of supplementary water storage
- Securing a supplementary water source
- Reducing non-urban water usage

7.2 Upgrading the water treatment plant would enable poorer quality water to be taken directly from the Tamaki River and treated in accordance with the NZ Drinking Water Standards. This would reduce the risk of boil water notices and the reliance on such a large volume of stored 'good' water.

7.2.1 The initial estimates sought from water treatment providers in the New Zealand market are that enhancements to the current Water Treatment Plant would take between 18 – 24 months to complete and equipment supply and installation cost alone would be between \$3.5M and \$5.7M. This does not include costs for land acquisition, design and project management, supporting infrastructure or ongoing operation and sludge disposal costs.

- 7.3 Constructing additional water storage would reduce the risk of water supply disruption during poor river quality (typically related to severe weather events and/or unforeseen circumstances). This could be achieved through storage of untreated or treated water.
- 7.3.1 Council’s existing treated water reservoir stores approximately 5 megalitres (which equates to around 18 hours supply)
- 7.3.2 Three days of treated water storage is typically used as good practice. Achieving this would equate to constructing additional storage of around 15 megalitres. This would also provide additional long term resilience if there were unforeseen issues in the water supply system upstream of the reservoir, e.g. at the water treatment plant or main pipelines which are estimated to be nearing the end of their expected useful life.
- 7.3.3 Further work is necessary to determine a suitable location, land purchase requirements, cost and construction timeframes.
- 7.4 Securing a supplementary water source would add resilience during dry periods when the Tamaki River is in “low flow” and Council’s permitted take (under the existing resource consent for water abstraction) is less than Dannevirke’s typical usage.
- 7.4.1 Whilst various ground and surface water options have been explored, more work is required to determine if any sources are feasible. This is due to their location and/or estimated volume of sustainably available water.
- 7.4.2 Guidance from suppliers suggest that a new untreated water source could take approximately two years to prove before it could be treated and connected to Dannevirke’s water supply network.
- 7.4.3 We are exploring opportunities with Alliance Group, to partner and secure a supplementary or alternate water source for their use. This would reduce the demand on Dannevirke’s water supply by approximately 25-35%, whilst also providing Alliance Group with improved water security. Alliance Group require a lower level of water quality than the town requires under the NZ Drinking Water Standards, and already have onsite treatment and storage. A potential win for Council, community, and the Alliance Group.
- 7.4.4 In the next AP \$3.75M has been allocated to Dannevirke alternative water source infrastructure, although we would be seeking co-investment from the Alliance Group as a supplementary or alternate water source would be of significant benefit to the Company.
- 7.5 Various rural properties (including large farms) source water directly from the trunk line between the source intake and the water treatment plant, and between the water treatment plant and the treated water reservoir. To ensure security of water supply to the Dannevirke Community whilst the reservoir is repaired each of these farms would have a water meter installed and the volume of water

consumed closely monitored. During times of high turbidity or low water levels that take to each of these farms would be reduced to essential water only. Installation of the meters would also allow backflow prevention devices to be installed, reducing the risk of contamination.

8. Risk Management

8.1 The following key risks have been identified, with mitigation measures identified and implemented where possible:

8.1.1 Condition of the impounded supply deteriorates resulting in an uncontrolled release of water.

- This safety risk is being managed by monitoring and mitigation measures, i.e. operating the reservoir at lower levels, enhanced monitoring, and emergency preparedness activities. The safety risk remains heightened and could deteriorate to an emergency situation at any time.
- Council will also endeavour to make further improvements on monitoring following recommendations from the Failure Modes and Effects Analysis and Comprehensive Dam Safety Review.

8.1.2 Ability to source funding to complete remediation works.

- Funding options will need to be explored when costs are confirmed, to assess the impact on Council's debt levels.
- We would like to explore potential funding options from Central Government, and expect that political advocacy would be required to support this

8.1.3 Consenting requirements and possible Resource Management Act approval requirements.

- Staff have already commenced engagement with Horizons Regional Council and will continue to keep them informed. WSP has been engaged to support any consent application that may be required.

8.1.4 Sequencing of the works to allow the impounded supply to be repaired and still provide water to Dannevirke.

- Adjusting the programme to implement enabling works to reduce the risk of supply interruption to Dannevirke when the impounded supply is out of service.

8.1.5 Capacity of staff to manage and progress this project. This has been exacerbated by Cyclone Gabrielle and recent resignations.

- This is a significant risk due to challenges in recruiting suitable 3-Waters and project management staff. Recruitment of additional staff to provide the capacity required continues.
- 8.1.6 Availability of qualified suppliers and materials to complete design and construction works. This has been exacerbated by Cyclone Gabrielle.
- Staff are reaching out to possible suppliers and contractors for early engagement and to better understand availability and timeframes.
- 8.1.7 Landowner consent to purchase additional land (if required).
- Staff are engaging with the most affected landowners, and assessing additional land needs. Formal discussions will progress following Council resolution of the permanent solution.

9. Next Steps

- 9.1 The planned next steps are as follows:
- 9.1.1 Attempt to carry out temporary repairs to the two tears identified in early June.
- 9.1.2 Assess the stability of the reservoir once the temporary repairs have been completed against a pre-determined criteria.
- 9.1.3 If the temporary repairs are successful finalise permanent repair options for Council decision with the intention of these repairs being completed in the 2024/25 construction season (i.e. September 2024 to April 2025)
- 9.1.4 If the temporary repairs are not successful immediately prepare to commence repairs under 'emergency works' provisions during the 2023/24 construction season (i.e. September 2023 to April 2024).

Attachments

1. [Appendix 1 Dannevirke Impounded Supply and Financials and Planning Report September 2022](#)
2. [Appendix 2 Dannevirke Impounded Water Supply Update to Council March 2023](#)
3. [Appendix 3 Summary of Optioneering Workshop Slides](#)



Report

Date : 21 September 2022
To : Mayor and Councillors
Tararua District Council
From : Bryan Nicholson
Chief Executive
Subject : **Dannevirke Impounded Supply Financials and Planning**
Item No : **11.3**

1. Recommendation

- 1.1 *That the report from the Chief Executive dated 20 September 2022 concerning the Dannevirke Impounded Supply Financials and Planning (as circulated) be received, and*
- 1.2 *That Council approves option 3 - progress planning of permanent repairs and functional improvements, as well as planning for water pre-treatment and supplementary water source solutions, and*
- 1.3 *That Council approves funding of \$1,085,000 to progress the planning of permanent repairs and functional improvements, as well as planning for water pre-treatment and supplementary water source solutions, and*
- 1.4 *That Council through the Chief Executive will be provided with regular updates as to progress on the above, and*
- 1.5 *That any further decisions relating to the construction of the pre-treatment option and repairs to Dannevirke's Impounded Supply will be brought back to Council for a decision to proceed.*

2. Reason for the Report

- 2.1 The purpose of this report is to provide Council with an up-to-date financial report and subsequent actions taken to mitigate the risk of failure and to ensure a safe and reliable water source is continued.

- 2.2 This report will also outline options in terms of progressing the repair of the dam and the associated cost estimates.

3. Background

- 3.1 In 2010 Council approved the development of a large, impounded supply to help meet the then new abstraction restrictions for stream water take and to reduce the risks outlined in Council's Water Asset Management Plan. Following acceptance of the detailed plans construction started in February 2011.
- 3.2 Construction was completed in May 2013. In 2011 it was identified that the existing reservoir had a substantial leak that was causing issues with the construction of the new dam and was subsequently drained and taken offline to control the seepage from the south.
- 3.3 In July 2021, staff discovered possible leakage from the impounded supply, where flows from the subsoil drain network under the impounded supply were abnormally high.
- 3.4 As part of the response, specialists were engaged to carry out inspections of the impounded supply using remotely operated underwater vehicles (submersible drones). Several inspections were completed, due to weather disruption. These focused on the bottom of the reservoir and assessing the "plug hole", the point at the bottom which the water outlet is taken and fed to the treatment plant. There was no visible leak from this point. The floor liner and area immediately below the inlet structure were also assessed. While a leak wasn't specifically confirmed, several areas of interest were identified.
- 3.5 Viking Containment Solutions, who supplied and installed the original liner, were then engaged to carry out intrusive investigations (opening the liner) and repairs (where necessary) at accessible areas of interest previously identified. Again, this was disrupted several times due to weather.
- 3.6.1 A significantly damaged section of liner was confirmed immediately below the inlet structure, and repairs included (in summary):
1. Cutting open the cover liner
 2. Removing the damaged section of liner
 3. Replacing the area of protective clay layer with compacted lime. The clay protects the liner from stones in the underlying subgrade material, and had been scoured by leakage from the inlet structure
 4. Replacing the removed section of liner
 5. Welding the cover liner
- 3.6.2 Several issues were identified during the repair works:
1. Apparent stress cracking of the membrane in multiple locations beneath the inlet structure.

2. Significant scouring of the protective clay layer and subgrade beneath the inlet structure resulting in unsupported liner the full length of the batter slope
 3. Rocks the size of tennis balls in the subgrade beneath the inlet structure
 4. Abrasion of the underside of the membrane to the point where holes were made in the membrane
 5. Settling of the subgrade beneath the inlet structure
 6. A minor crack in the exterior wall of the inlet structure
 7. No cushioning or protective textile between the membrane and the subgrade
- 3.4 Viking Containment staff noted that the repairs to the liner that have been undertaken are permanent and final but there is still further batter slope that requires remediation. The repairs to the cover are temporary as 2 panels need to be replaced. They also noted that it was becoming increasingly difficult to repair the floating cover due to the aging of the cover membrane. To complete the repairs fully and permanently, the reservoir would need to be empty.
- 3.6 As a result of the repairs the loss of water from the reservoir reduced. However, the reservoir continued to lose water albeit at a lesser rate, therefore it was decided further investigations were required. An assessment of various inspection techniques was assessed by external engineers, which recommend pursuing further inspections via remotely operated underwater vehicles.
- 3.6 Additional inspections were completed to assess the liner in the reservoir however no leak sources were confirmed. Availability of the equipment and operators caused further delays in conducting the investigations. Once available a considerable amount of time was used inspecting the entire reservoir, unfortunately the inspections did not identify any further tears in the liner or any other issues.
- 3.11 Following this a possible risk was identified associated with the dam wall. Council engaged the services of Tonkin + Taylor (T+T) to complete an onsite assessment and prepare a report. T+T are recognised experts for dams and were engaged by Waikato Regional Council as part of the original resource consent application for construction of the impounded supply and associated dam wall. Their report focusses on dam safety, which in the dam engineering industry refers specifically to safety from a dam failure. The dam safety focus considers the “worst that could happen” in a hypothetical situation for the purposes of being suitably cautious; the focus on dam failure does not mean that a failure is at all likely to occur.
- 3.12 In their report (**attachment no.1**), T+T have provided several key recommendations which, in summary, include:
1. Operate the reservoir at the minimum level acceptable for water supply
 2. Undertake enhanced dam safety surveillance / monitoring
 3. Develop a contingency plan in case the situation deteriorates
 4. Prepare for repairs, including:
 - Undertake work to remove operational constraints to enable dewatering for investigation and remedial works.

- Review PIC based on latest industry practice, upcoming legislative changes, and criticality for water supply.
 - Geotechnical investigation and detailed design of remedial works.
 - Resource consent for remedial works.
 - Building consent for remedial works.
 - Contractor selection and engagement.
5. Update Health and Safety systems for risks related to the dam safety issue
 6. Undertake a reservoir water balance to identify unexpected losses that may correlate to leakage.
 7. Locate HDPE liner damage above reservoir water level, especially near the inlet structure where liner damage occurred in the 2021 incident.
 8. Inspection below reservoir level by remotely operated vehicle (ROV) and leakage tracing
 9. Geotechnical investigation and piezometer installation, including:
 - Two drillholes in the downstream shoulder of the eastern fill embankment.
 - Installation of multi-level piezometers in the drillholes to monitor pore water pressures.
 - Sampling and laboratory testing.
- 3.13 As a result of these recommendations Council setup an Incident Management Team to work through the various immediate actions. In conjunction with our consultants Council's will continue to work on the repair recommendations and those that require detailed designs and investigations. The outline of next steps will be explained later in the report.
- 3.14 An important factor that we would like to reiterate is that the dam maximum working level has been reduced to 9.5 metres from 12.5 metres. It will remain at this level and staff will continue to monitor the impacts. If the risk of having it at this level remains low, as identified by monitoring, then we may take a cautious approach to increase it incrementally. By way of comparison, the reservoir level is currently full to the self-imposed 9.5 metre maximum level, which is about a 1/3 more water in the dam when compared to this time last year. Further to this we are confident that the previous issues of sourcing water from the dam when it drops below 6m will be rectified by installing improved pumping methods. This provides further resilience to our water supply.

4. Financials

- 4.1 To date, responding to the impounded supply leak has cost just over \$286,000. This excludes staff time and is made up of the following key items:

1. \$36,392 for initial investigations, including remotely operated underwater vehicle (submersible drone) inspections, geotechnical assessment and professional services
2. \$71,187 for the initial repairs, including liner repairs, civil works and materials
3. \$2,304 for water supplies during the March 2022 boil water notice
4. \$12,201 for various materials required as part of the investigation and ongoing risk mitigation
5. \$13,741 for power supply improvements at the impounded supply and water treatment plant site
6. \$21,894 for legal and professional services required as part of the 2021/22 summer emergency water take justification and monitoring
7. \$6,294 for submersible pump repairs
8. \$22,105 for materials and laboratory testing associated with the subsoil drain discharge water recapture
9. \$42,888 for engineering (labour and materials) associated with the subsoil drain discharge water recapture, temporary pumping solution, power supply improvements, and general risk mitigation
10. \$3,630 for replacement of the impounded supply transducer (measuring the height of the impounded supply)
11. \$54,000 for a dam safety assessment, including on site investigation, background information collation and reporting

4.2 Committed expenditure currently includes:

1. Completion of power supply improvements and LiDAR survey of the surrounding area.

4.3 If the recommended option is approved, then addition funding of estimated \$1,085,000 will be required. See below for the various activities required to make up this funding, with reference to the applicable T+T recommendation number.

4.4 Please note that \$250,000 of the funding total listed above is committed expenditure as this forms part of the work required to monitor the dam. This work is outlined in the 'Next Steps' section 1-3.

T+T	Item	Cost	Funding Type
N/A	Dam failure modelling	\$10,000	OPEX
1	Install improved flow and turbidity meter monitoring systems	\$100,000	CAPEX (Dev)
2	Install piezometers and monitoring system in the dam wall	\$50,000	CAPEX (Dev)

1	Design and implement a temporary solution enabling abstraction of required water volumes from the impounded supply	\$150,000	CAPEX (Dev)
4	Design of pre-treatment solution	\$75,000	CAPEX (Dev)
4	Design of a supplementary water source	\$75,000	CAPEX (Dev)
4	Design of functional improvements to the impounded supply	\$75,000	CAPEX (Dev)
4	Planning and management of permanent repairs to the impounded supply	\$250,000	CAPEX (Renewal)
N/A	Engagement of external Programme Manager	\$200,000	CAPEX (Dev)
N/A	Contingencies	\$100,000	CAPEX (Dev)
	Total	\$1,085,000	

- 4.5 Capital development expenditure detailed above will be funded via external loans. Council has sufficient headroom in the current year to fund this additional loan. As part of the 2023-24 Annual Plan, Council will review the headroom in light of the proposed capital programme and recover the unbudgeted interest cost for the additional loan noted.

5. Options

- 5.1 Council's options are, unfortunately, very limited.

5.2 Option 1.

Leave impounded supply as-is, acknowledging ongoing leaks and associated risks, with enhanced monitoring and increased surveillance of the dam wall.

This is the least expensive option. The view could be that the dam will be managed and funded by the new entity under the government's 3-Waters reform in two years. The risk with this is if reform doesn't proceed then we will need to plan for repairs and at that point it is likely the costs would have increased. Another risk is that there is likely to be an increase in the probability of dam failure and/or increased damage to the subgrade, therefore more severe and ongoing issues.

5.3 Option 2.

Progress the planning of permanent repairs to the impounded supply, but exclude planning for functional improvements, water pre-treatment and supplementary water source acknowledging the current functional limitations and risks to water supply and quality.

This would require reasonable investment but does not provide any resilience. A major risk with this option is that if there are weather events that cause high turbidity levels to the river then boil water notices will be required to be issued. Recent weather patterns have indicated that this is highly likely and ongoing.

5.4 Option 3.

Progress planning of permanent repairs and functional improvements, as well as planning for water pre-treatment and supplementary water source solutions.

This is the most expensive option but will provide additional resilience while the dam is being repaired as well as into the future. Further Council decisions will be required once all the relevant information and investigations into the final design risk mitigations and solutions are completed. Additional funding at this stage is only sought for the contractor and consultant costs to identify and investigate the best process and solution to repair and add resilience into Dannevirke's water supply.

Option 3 is the recommended option.

6. Next Steps

6.1 The next three steps are required regardless of the option decided by Council and are currently in progress.

1. Installation of automated and continuous monitoring systems (ref. Recommendation No.2). External experts have recommended enhanced monitoring of the subsoil drain discharge and dam wall. Visual inspections have increased, including using drone LiDAR surveys, however increased monitoring of the subsoil drain discharge flows (which is currently downloaded onsite weekly) and turbidity not currently monitored is strongly recommended. Estimated cost to implement this solution is **\$100,000**.
2. The installation of an improved flow meter and new turbidity meter, connected to Council's telemetry system is recommended. Data will be continuously updated, with automatic alarms sent to staff if there are any significant changes. This system will continue to be utilised after impounded supply repairs are completed, to mitigate the risk of potential future leakages. Estimated cost to implement this solution is **\$100,000**.
3. Dam piezometer. (ref. Recommendation 2) Estimated cost to implement this solution is **\$50,000**.

6.2 Should Council approve the recommendation (option 3) then the following steps will proceed.

4. Design and implement a temporary solution enabling abstraction of required water volumes from the impounded supply regardless of the height of water (ref. Recommendation No.1). This will temporarily resolve the issue of the current filter feed pumps not being able to supply water from the impounded supply when water is below 7-8 metres. Designs are being completed by staff and will be peer reviewed by external consultants. The solution is expected to include the installation of at least one pump on the impounded supply cover, capable of supplying at least 75 litres per second from the impounded supply to the water treatment plant. The rough estimated cost to implement this solution is **\$150,000**
5. Design of pre-treatment solution (ref. Recommendation No.4). We currently expect that permanent repairs to the impounded supply will require it to be drainage and taken offline for up to 12 months. With the current water treatment plant only capable of treating raw water (to NZ Drinking Water Standards requirements) of a maximum 10 NTU, boil water notices are expected to regularly be required when the Tamaki River goes above this. A pre-treatment solution would seek to treat highly turbid water to a level the current water treatment can manage. Estimated cost for external experts to investigate and design the solution is **\$75,000**.
6. Construction of the solution is currently expected to cost \$1 – 2M, and result in consequential additional operating costs (i.e. power and chemicals) however a future report to Council will be submitted once investigations and designs are completed.
7. Design of a supplementary water source (ref. Recommendation No.4). With the impounded supply expected to be offline for up to 12 months while permanent repairs are completed, we expect to go through at least one summer. There is an almost certain likelihood that during this time the Tamaki River will enter “low flows”, below 240 litre per second, where Council’s current water abstraction resource consent limits abstraction to a maximum of 54 litres per second. Dannevirke typically uses 65 litres per second of treated water, so significant water restrictions would be required. An additional water source would be sought, to abstract approximately 20 litres per second from a yet confirmed surface or groundwater source, supplementing the existing water sourced from the Tamaki River, to sustain Dannevirke’s typical usage. Estimated cost for external experts to investigate and design the solution is **\$75,000**.
8. Design of functional improvements to the impounded supply. Various risks and opportunities for improvement associated with the impounded supply have been identified throughout Council’s response to the current issues. Staff recommend these are investigated further and optimal solutions designed to be implemented as part of the permanent repairs. This includes reviewing the future of the existing cover and developing a permanent solution to the existing pumping restrictions. The rough estimated cost for external experts to investigate and design the solution is **\$75,000**.

9. Planning and management of permanent repairs to the impounded supply (ref. Recommendation No.4). The exact cause of the remaining abnormal leakage from the impounded supply is not yet confirmed, however it is currently expected that for permanent repairs to be completed, we will need to drain it, remove all liner material, complete civil earthworks to remedy any scoured areas and structural deficiencies, and reline. This work is complex and requires the use and coordination of various suppliers. It is also expected to necessitate both resource and building consents. Staff do not have the capability and/or capacity required to plan and manage delivery all aspect of these permanent repairs. The use of external experts will be required. The estimated cost for planning and management of permanent repairs is **\$250,000**, however excludes costs associated with the application of any necessary resource and building consents.

10. Engagement of external Programme Manager. There are many moving parts to Council's ongoing response to the current issues with the impounded supply, while current staff's capacity is already stretched delivering business-as-usual services, improvements to compliance management, asset management and infrastructure planning, significant capital works programmes, and responding to various central government led legislative changes and reform programmes. The use of external Programme Management is recommended, to effectively deliver the planning and construction (and associated external suppliers) required to deliver the most successful outcomes for Dannevirke. Industry guidance suggests project management costs are in the order of 10% of a total project cost, therefore we expect programme management costs to be a minimum of **\$200,000**.

Attachments

1. Tonkin & Taylor Report



Report

Date : 10 March 2023
To : Mayor and Councillors
Tararua District Council
From : Roger Earp
Senior Programme Manager - Impound Supply
Subject : **Dannevirke Impounded Water Supply Update**
Item No : **11.2**

1. Recommendation

- 1.1 *That the report from the Senior Programme Manager - Impound Supply dated 06 March 2023 concerning the Dannevirke Impounded Water Supply Update be received.*

2. Reason for the Report

- 2.1 The purpose of this report is to provide Council with an update on the Dannevirke Impounded Supply Reservoir (the 'Dam') and an outline of the next steps in this programme of work.

3. Background

- 3.1 On the 21 September 2021 a report was presented to Council on Dam Financials and Planning. In summary it outlined that a possible leak was identified in the Dam in July 2021; this was investigated and resulted in repairs being made to an area immediately below the inlet structure. Note - there is still further remediation work required below the inlet, but this cannot be completed until the reservoir is empty. The repairs reduced the loss of water but did not stop it completely.
- 3.2 Tonkin & Taylor undertook additional investigation in 2022, primarily from a dam integrity and safety perspective, and identified further areas of concern and provided recommendations as to how the Dam should be monitored to ensure its continued safe operation until remediation work can be completed. One of these

recommendations was to reduce the maximum water level 12.5 metres to 9.5 metres, which has occurred.

3.3 In addition to the leak, there are several other factors impacting the Dannevirke water supply that need to be considered in Council’s response:

1. It has a single water source – the Tamaki River.
2. Water cannot be extracted during periods of high turbidity.
3. When the river level is low, typically in summer when demand is at its greatest, consent conditions limit the volume of water that can be extracted.
4. Only half of the stored water (under interim reduced maximum level) can be extracted due to an abstraction hydraulic design oversight.
5. The floating roof requires permanent repairs.
6. The Dam will be subject to significant additional management and monitoring requirements when new legislation is introduced in 2024.

3.4 In September 2022 the Council approved funding of \$1,085,000 to progress the planning of permanent repairs and functional improvements, as well as planning for pre-treatment and supplementary water source solutions (report to September Council meeting attached). This included:

Item	Cost
1 Dam failure modelling	\$10,000
2 Install improved flow and turbidity meter monitoring systems	\$100,000
3 Install piezometers and monitoring system in the dam wall	\$50,000
4 Design and implement a temporary solution enabling abstraction of required water volumes from the impounded supply	\$150,000
5 Design of pre-treatment solution	\$75,000
6 Design of a supplementary water source	\$75,000
7 Design of functional improvements to the impounded supply	\$75,000
8 Planning and management of permanent repairs to the impounded supply	\$250,000
9 Engagement of external Programme Manager	\$200,000
10 Contingencies	\$100,000
Total	\$1,085,000

4. Progress Update

4.1 Item 1 - Dam failure modelling

4.1.1 A LiDAR (Light Detection and Ranging) survey of the impounded supply and surrounding area has been completed via Horizons Regional Council and survey information has been received. This will enable modelling of a major dam failure (very low probability) and analysis of associated impacts, informing the development of an Emergency Management Plan (required under new dam safety legislation).

4.2 Item 2: Install improved flow and turbidity meter monitoring system

4.2.1 A scope of work has been developed and pricing has been requested from suppliers. This has been more complex than initially expected due to the nature of the subsoil drain infrastructure and availability of power and telecommunications, however, is still expected to be completed within budget.

4.3 Item 3: Install piezometers and monitoring system in the dam wall

4.3.1 This item has been put on hold until after the geotechnical investigations have been completed. There are concerns the installation of piezometers may undermine the integrity of the Dam wall. Note – the higher the Potential Impact Classification the more piezometers will be required. The cost of this item is expected to increase significantly.

4.4 Item 4: Design and implement a temporary solution enabling abstraction of required water volumes from the impounded supply

4.4.1 This item is 40% complete. The physical works are scheduled to commence before the end of March and are expected to be completed and tested by the end of May 2023. There has been delay due to a hydraulic issue discovery and ongoing input from various suppliers.

4.5 Item 5: Design a pre-treatment solution

4.5.1 GHD has been commissioned to deliver a concept design only. It is 85% complete and an interim report is expected this month.

4.6 Item 6: Design a supplementary water source

4.6.1 GHD has been commissioned to complete a desktop study only, utilising information from the previously completed aquifer investigation. It is 60% complete, however, at this stage it appears very unlikely that a single water source will be identified that can provide the 20 L/s required. Note – this budget will not be sufficient to also cover discovery and design costs.

4.7 Item 7: Design of functional improvements to the impounded supply

- 4.7.1 GHD is delivering this item. It is currently on hold until the full extent of Dam remediation has been quantified.
- 4.8 Item 8. Planning and management of permanent repairs to the impounded supply
- 4.8.1 The first stage of the Failure Mode and Effects Analysis has been completed by Tonkin and Taylor. Stage 2 will occur once the Comprehensive Dam Safety Review has been completed by Damwatch in April and a geotechnical investigation conducted. Additional budget is expected to be required for this item.
- 4.9 Item 9. Engagement of external Programme Manager
- 4.9.1 After discussions with various external suppliers and assessing costs and benefits, Council employed a Senior Programme Manager on a fixed term contract for 12 months. This allows remaining budget to be reallocated to another item, or extension of the existing fixed term.
- 4.10 Item 10. Contingencies
- 4.10.1 Not required to date, however, will be needed to cover shortfalls.
- 4.11 In addition, Tonkin & Taylor have completed an Initial Potential Impact Classification assessment for the Dam of Medium to High. The final classification will have ramifications, potentially significant, on the monitoring and management of the Dam once the new Building (Dam Safety) Regulations 2022 come into effect on the 13 May 2024. The current Potential Impact Classification for the Dam is 'Low'.
- 4.12 Consent Application. WSP has been engaged to amend and renew the resource consent (the present consent expires on the 1 July 2026) to take surface water from the Tamaki River to ensure a continuous water supply to Dannevirke whilst any remediation works are completed on the Dam.

5. Next Steps

- 5.1 The next key activity in this programme is an Optioneering Workshop scheduled for mid-April 2023. The purpose of this workshop is to enable Tonkin & Taylor, GHD and other Dam specialists to report back on the possible options, assess their associated implications (e.g. cost, impact to water service delivery, timeframes, cultural impacts, etc.) and determine a recommended course of action. Iwi have been invited to attend this workshop. A further report will be submitted to Council following this workshop.
- 5.2 In summary two broad options will be considered:
1. Empty and repair the Dam
 2. Replace the Dam with an alternative storage facility i.e. a tank farm
- 5.3 However, before the Dam can be emptied a pre-treatment facility and additional water storage capacity will be required regardless of which remediation option is approved to ensure continuity of supply. Initial feedback from suppliers indicates

that to design and install a pre-treatment facility would take from 12 to 18 months. Consequently, the earliest the Dam could be emptied for repairs would be August/September 2024. A detailed timeline will be included with the future report to Council.

6. Risk Management

6.1 A comprehensive Risk Register is being maintained. The following key risks have been identified and mitigation measures have and continue to be implemented:

1. Condition of the dam deteriorates resulting in an uncontrolled release of water. This risk is being treated with improved monitoring measurements. Tararua District Council will also endeavour to make further improvements on monitoring following recommendations from the Failure Modes and Effects Analysis and Comprehensive Dam Safety Review.
2. Ability to source funding to complete remediation works. Staff will be preparing a paper to the Department of Internal Affairs outlaying our proposed remedial works and costing options.
3. Consenting requirements and possible Resource Management Act approval requirements. Staff are engaging early with the Horizons Regional Council and identifying our possible avenues.
4. Sequencing of the works to allow the Dam to be repaired and still provide water to Dannevirke. Adjusting the programme to implement enabling works to reduce the risk of supply interruption to Dannevirke when the Dam is out of service.
5. Availability of qualified suppliers and materials to complete design and construction works. This has been exasperated by Cyclone Gabrielle. Staff are reaching out to possible suppliers and contractors for early engagement and to better understand suitable timeframes.
6. Landowner consent to purchase additional land (if required). Staff are engaging with the most affected landowners, and also assessing additional land needs. Formal discussions will progress following Council resolution of the permanent solution.

6.2 It is recommended that this programme of work is included in the Annual Plan and not implemented in isolation to avoid an additional consultation process and other overheads.

7. Conclusion

7.1 The planning of permanent repairs and functional improvements, as well as planning for pre-treatment and supplementary water source solutions, is progressing, albeit at a slower pace than expected due to resource constraints, supplier availability, and the recent cyclone.