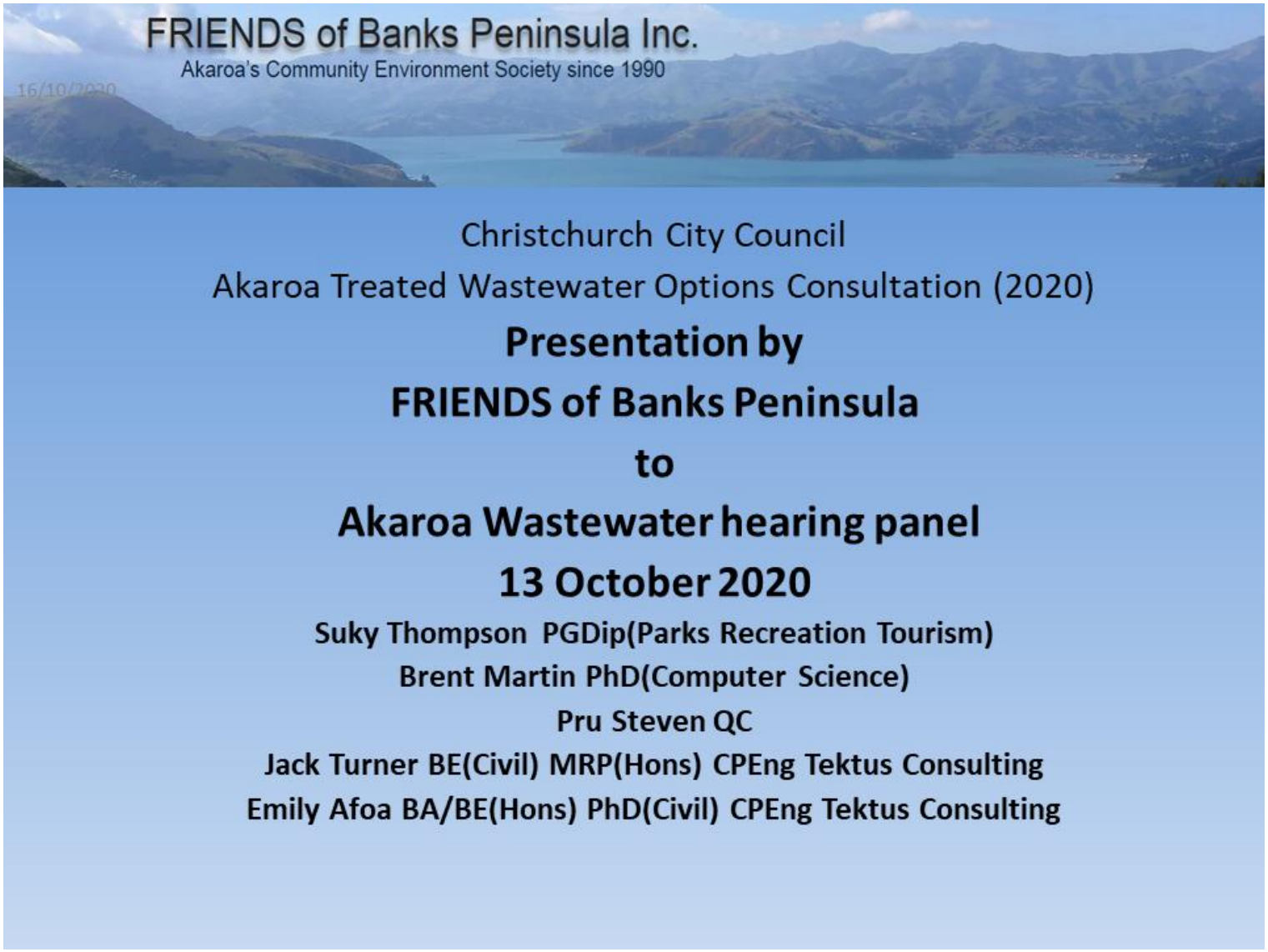
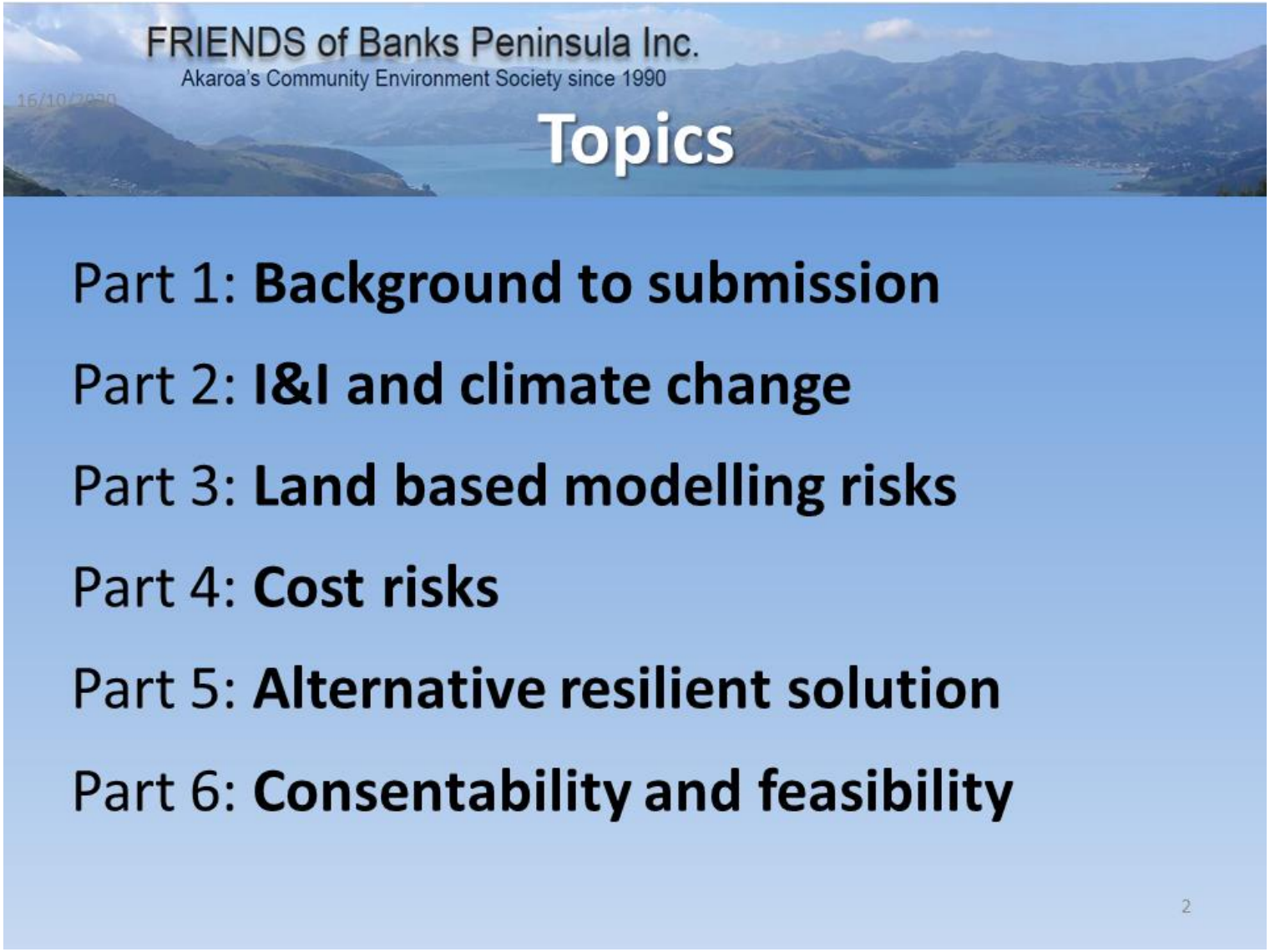


- Acknowledge the hearing panel has a difficult job ahead
- Thanks to those many community members who have contributed to this submission through their donations the Friends Wastewater steering committee and to the 10 submitters who have given up their time slot to enable a more comprehensive presentation

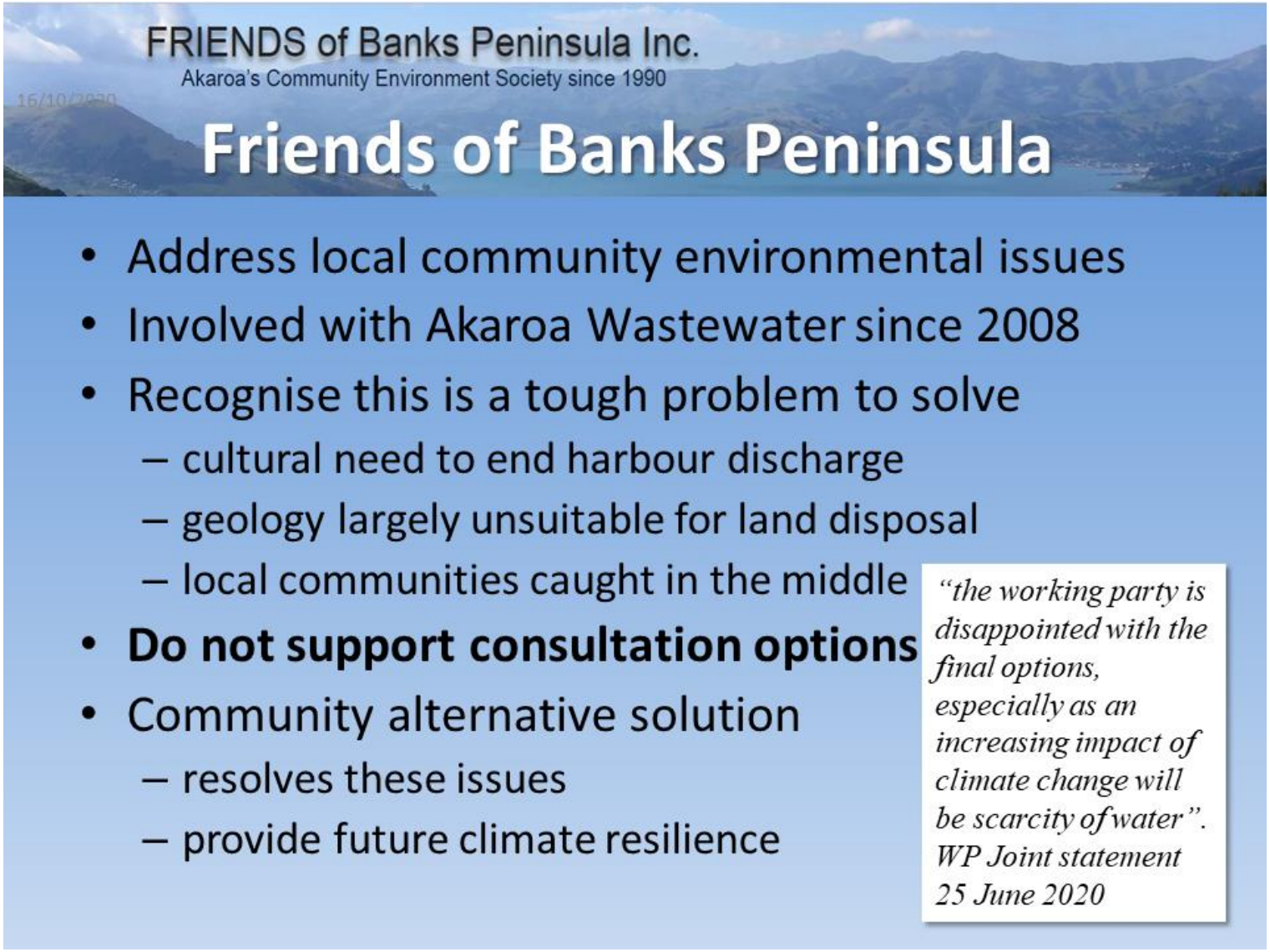


- We do not have sufficient time to address all the matters in our submission, we have selected these topics as key to present today.
- We will have a variety of speakers and take questions at the end, including our experts available for question

Part 1:

Background to submission

Presenter: Suky Thompson



- Environmental society working on behalf of community for 30 years
- Long running issue that is extremely difficult to solve. Conclusion in 2010 that year round land irrigation was not possible because of topography
- Steep, slip prone loess soils
- Working Party disappointed in the options
- FOBP does not support any of the consultation options
- There is not community support for land irrigation, with Inner Bays option favoured by Council only selected by 1/5 of submitters as first choice
- Attempt to provide an alternative that will provide more resilience and deals with climate change issues

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Informing our Submissions

- In depth understanding of proposals
  - 4 year Working Party process
  - Reviewed all technical reports
  - Taken expert advice
    - legal, engineering,
    - quantity survey, ecologist
- Clear community message
  - **Treat to potable standard**
  - **Reuse in Akaroa to solve chronic water shortages**

- Resultant **submission endorsed by 340 people**

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- Second submission we have made on the wastewater disposal issue
- Much of the devil is in the detail – and we will be trying to cover some of this today, and it is also covered in our rebuttal evidence that we will provide to you in a written format at the end of our submission.
- We have held 12 community meetings since 2016 – and the community has given us the same clear message at each. Treat the water to a potable standard and reuse it to solve Akaroa's chronic water shortages. Akaroa has had complete outdoor watering bans every summer for years.

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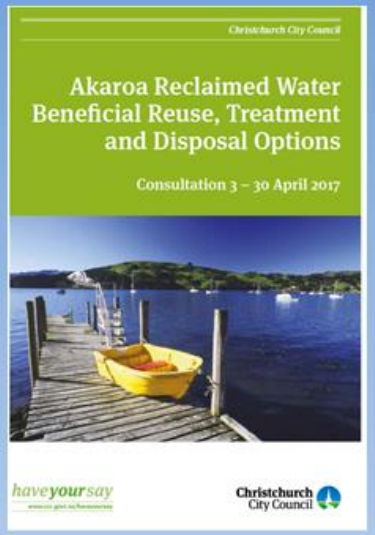
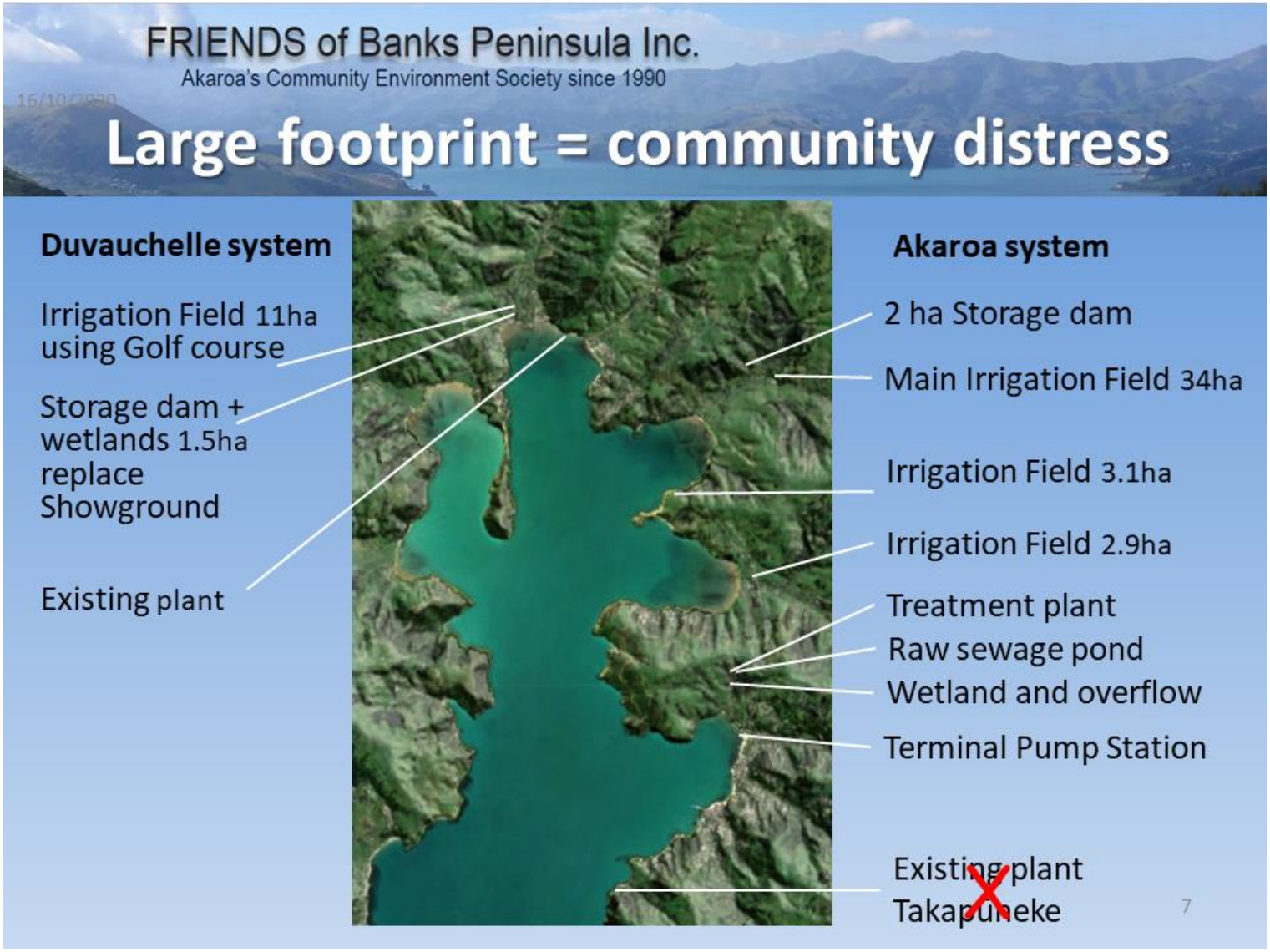
2017 Submission

- Advocated purple pipe re-use in Akaroa terminating with harbour outfall
  - New concept in 2017
  - Adopted as Option 4 in 2020
- Our calculations showed 100% re-use possible over time
  - Based on Council's data
- Council review of FOBP calculations
  - Led to discovery of faulty flow meter
  - Actual wastewater volume is double with 60% I&I



- FOBP 2017 submission led to discovery of faulty flow meter
- Once correct flows were known the wastewater volume doubled with 60% on an average year storm and ground water infiltration.
- This discovery precluded an undersized system being constructed



- Community concerned because the footprint of land disposal is so large and so prominent.
- Currently the treatment plant is beyond the far end of Akaroa,
- The Terminal Pump station will introduce a large concrete building at the entrance to Akaroa –near community facilities. It will be opened regularly to remove solids. It is to be constructed on a coastal capped landfill
- The new Treatment Plant, now includes a raw sewage pond and constructed wetland at the entrance to Akaroa.
- Irrigation fields will impact three locations in the inner harbour
- Then there is the storage dam
- At Duvuachelle the golf is to replaced with a smaller course, the 100 year old Duvauchelle Show relocated

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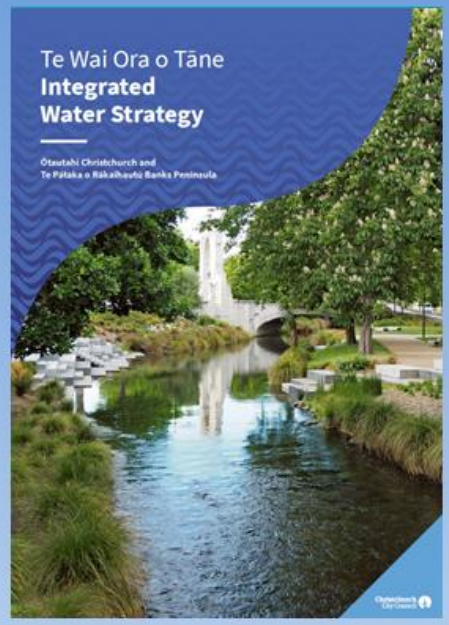
2020 Submission aims

- Critique of consultation options
  - Identify risks
- Help Council find a better solution
  - Meet cultural needs
  - Reduce impact on communities
  - Reduce environmental risk
  - Provide future climate resilience
- Integrated approach:
  - REDUCE stormwater infiltration
  - REUSE wastewater beneficially
  - RECYCLE to alleviate town supply shortage



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- Our written submission presents a detailed analysis of the modelling underpinning the land based options and identified the risks. These risks have not been addressed in the Officers report
- Our aim as an environmental society is to help the Council find a better solution – one that addresses the cultural needs without putting the burden back onto communities, but instead provides climate resilience
- Thinking has moved on since 2017. Much greater appreciation that climate change is real, happening and the threats it poses.
- Hence submission takes integrated three waters approach. We aim to reduce the stormwater infiltration, and to reuse and recycle the water where it is most needed – to alleviate Akaroa's current water shortages because they are only likely to get much worse in future.

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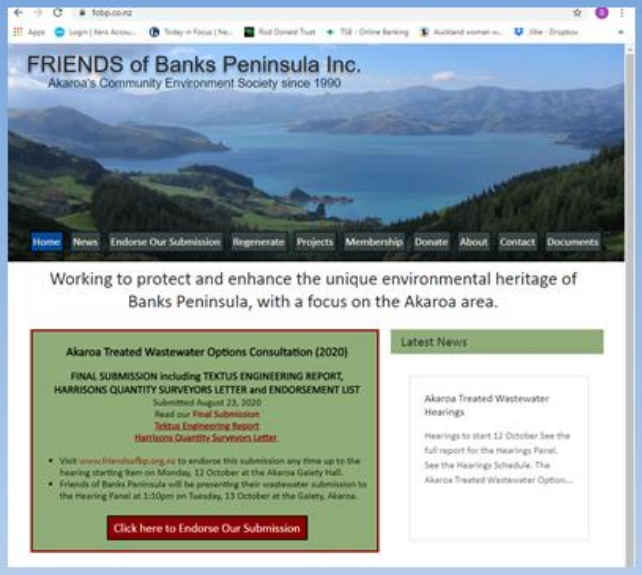
Public development

- Developed transparently in public domain
- Community fundraised for expert advice
  - Local residents personal donations
  - Takamatua Ratepayers Association
- Endorsed by
  - 340 individuals
  - Akaroa Civic Trust , Akaroa Ratepayers
  - Robinsons Bay Ratepayers
  - Other submitters
- Includes social and heritage impacts
  - Support other submitters concerns
  - Akaroa Civic Trust, Pavitt Cottage Trust
- Focus of presentation today
  - Environmental and cost risks
  - Future solution



- We have been transparent in the development of this submission, publishing it on our website as it has progressed
- It has now been endorsed by 340 people and is supported by the main local community organisations submitting.
- Reading through submissions we see that there are many other submitters who also favour a reuse system along similar lines to what we are advocating
- We support the Akaroa Civic Trust and Pavitt Cottage Trust who have focused on the heritage impacts and the many personal submissions explaining the social impacts.
- We will focus our presentation today on the environmental aspects of our submission due to the limited time.

Part 2:

I&I

and

Climate Change

Presenter: Suky Thompson

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Volume a critical factor

- Harbour disposal is not volume limited
- Land based disposal **is** volume limited
  - More wastewater means bigger storage ponds
  - More wastewater needs more land for disposal
  - Correct sizing is critical
- Storage ponds are greatest community concern
- I&I – broken pipe network
  - Affects storage requirement drastically

- By moving to a land based disposal system the Council is moving to a system that is inherently volume limited
- Water needs to be stored up at times when it is too wet too irrigate
- The levels I&I have a drastic impact on the sizing of this storage
- The size of these storage ponds and the volume of water are the principal community concern

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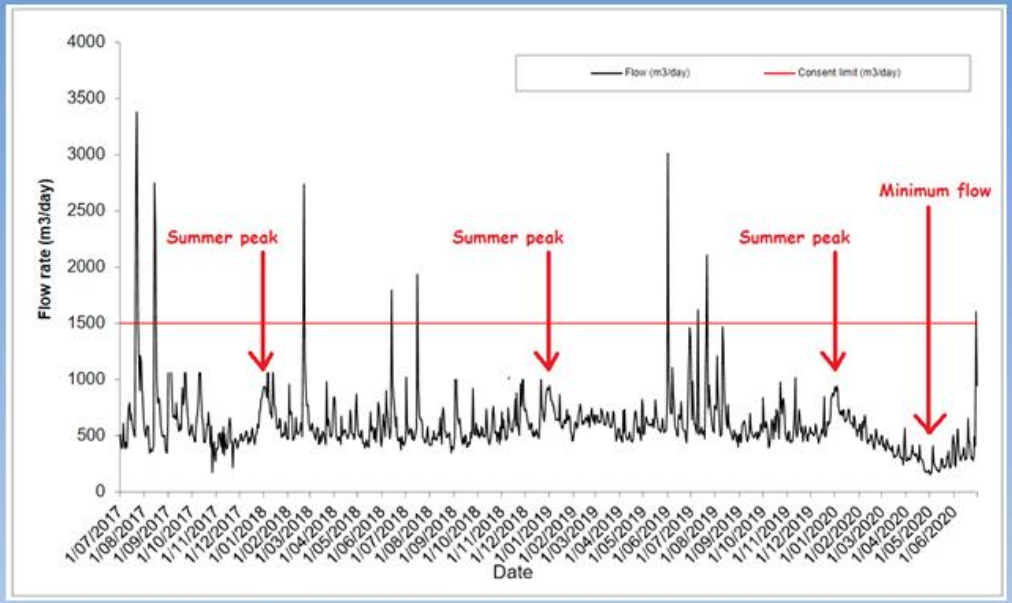
Significant I&I reduction critical

- I&I peaks during wettest conditions when irrigation is least feasible



- Winter I&I drives the need for oversized storage ponds
- I&I also results in raw network overflows

- Important graph to appreciate. Shows 3 years of data from 2017-2020 since flow meter fixed
- Large peaks are stormwater coming through because of I&I. This water must be stored, because its too wet too irrigate
- Note how flows drop in 2020. This shows the base level of groundwater infiltration. 2020 has been an exceptionally dry year

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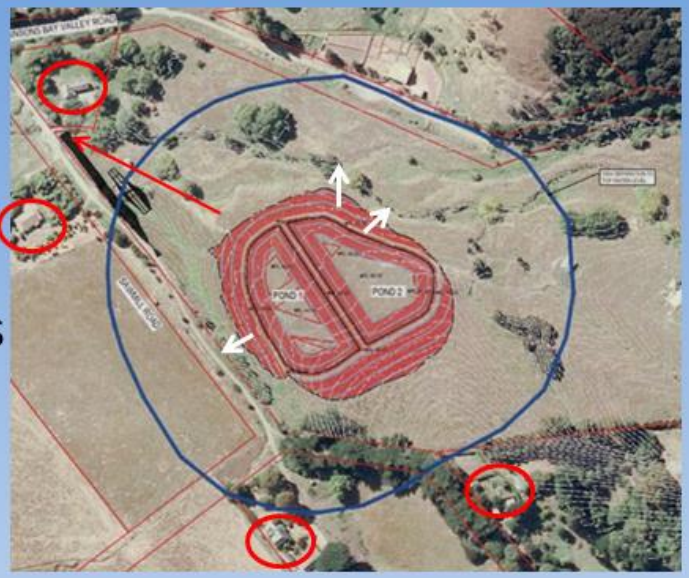
I&I means huge storage requirement

- Main storage dam to hold 19,000m^3
  - 2.7ha excavated 4m deep
  - 4m high dam face
- Sawmill Road only Inner Bays site with capacity
- Setbacks at minimum limits
  - Close to homes
  - Access over heritage site
  - Earthworks encroach on stream and gully
  - Downstream valley infrastructure at risk



- Most offensive part of entire proposal is this dam
- Only 1 site can be found where it will fit
- Close to houses, above the heritage site
- Most concerning –earthworks encroach into stream gullies

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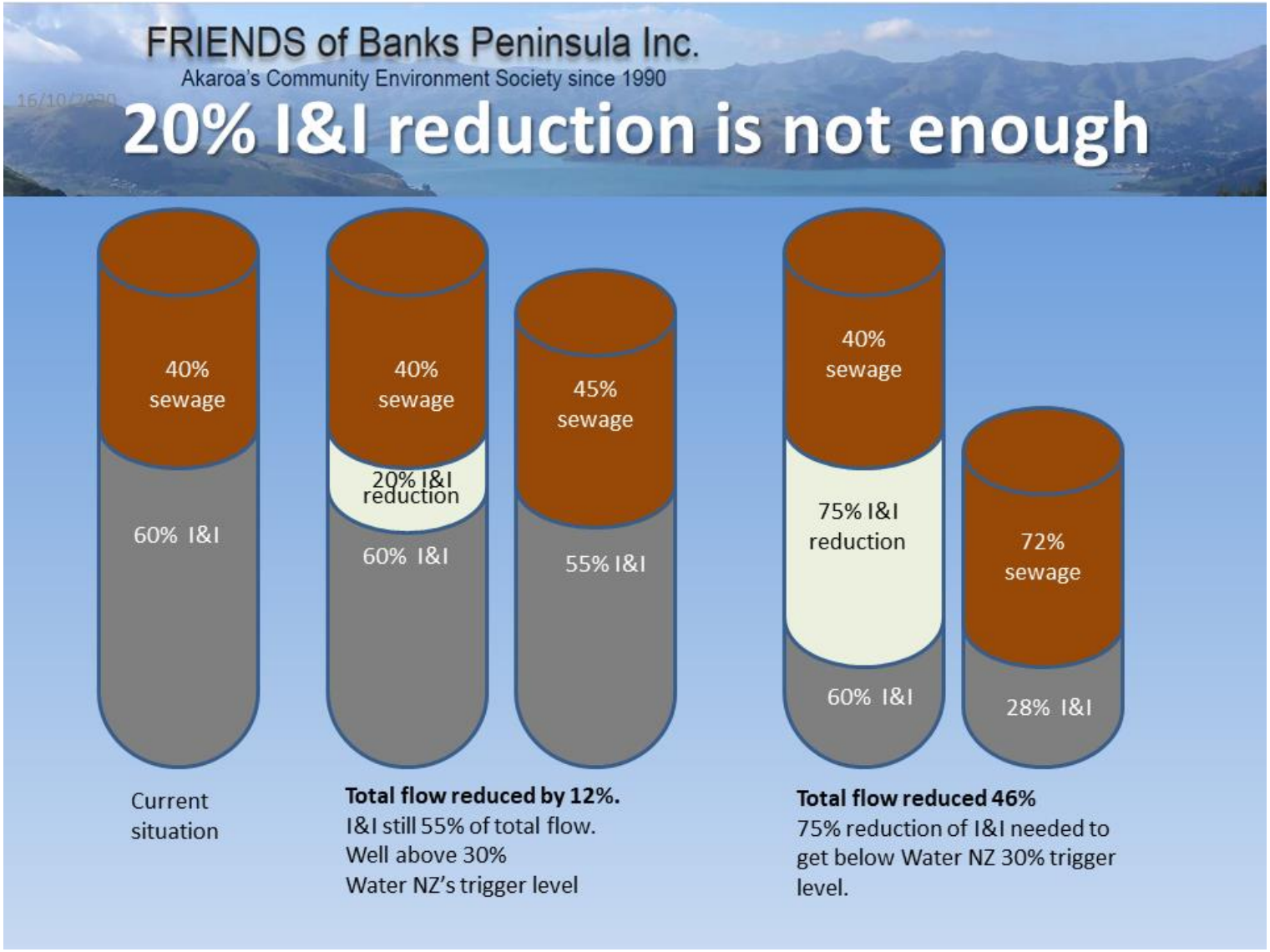
Pond Site 10 – I&I workarounds

- Raw sewage pond
  - Buffers inflow during heavy rain
- Constructed wetland enables Inner Bays option
  - Releases water to harbour if Robinsons Bay full
  - Reduces size of Robinsons Bay storage pond so it can fit
  - Similar wetlands needed for Duvauchelle scheme to fit

- I&I and the spikes and volume it creates also drive the need for what is proposed at Pond Site 10
- The raw sewage pond is needed because the treatment plant cannot process the volume of water in heavy rain
- Without the wetland the Robinsons Bay site was too small for the storage pond. Engineering it required a deeper and much more costly dam. The wetland reduces the storage size in Robinsons Bay by releasing water to the harbour during those peak storms shown on the previous slide on an as needed basis.



- 20% reduction sounds a lot, but because it is 20% of the 60% is only brings down the total volume by 12%
- Professional body Water NZ recommends action should be taken if I&I gets above 30%.
- Reducing it by 75% is needed to get the flow down to half - the level understood in 2015 when the WWTP was consented

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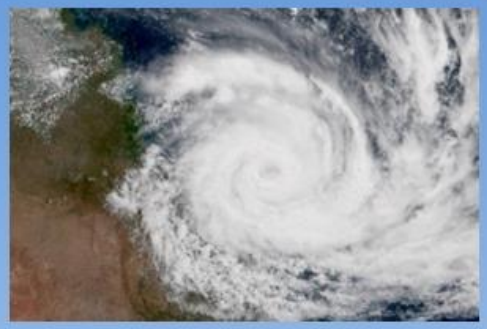
Climate Change exacerbates I&I risk

- Climate change exacerbates
  - peak storms
  - coastal groundwater level
- Partial fix to I&I proposed
  - Leaves network vulnerable to further incursion
  - Risks undersized system in future
  - Increases risk of raw overflows
- Fully fixing I&I provides future resilience
  - Requires a sealed system in lower part of Akaroa



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- Increased storms and rising coastal ground water levels will lead to increased I&I
- Partially fixing the network leaves it vulnerable. When holes are fixed then groundwater rises to find the next hole. Leaving this vulnerability means we could have more extreme storms in future where more raw overflows occur if the system is undersized in extreme storms
- A sealed system, certainly in the lower part of Akaroa is required

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Reducing I&I top priority

- Reducing I&I significantly would
  - greatly reduce size of system
  - provide a much more resilient system
  - reduce raw sewage network overflows
- Strong public support in submissions
- **Add Government funding to Council funds**
  - **replace broken pipes with modern sealed system in lower town**
  - **$3.1m + $3.1m = $6.2m for I&I new pipes**

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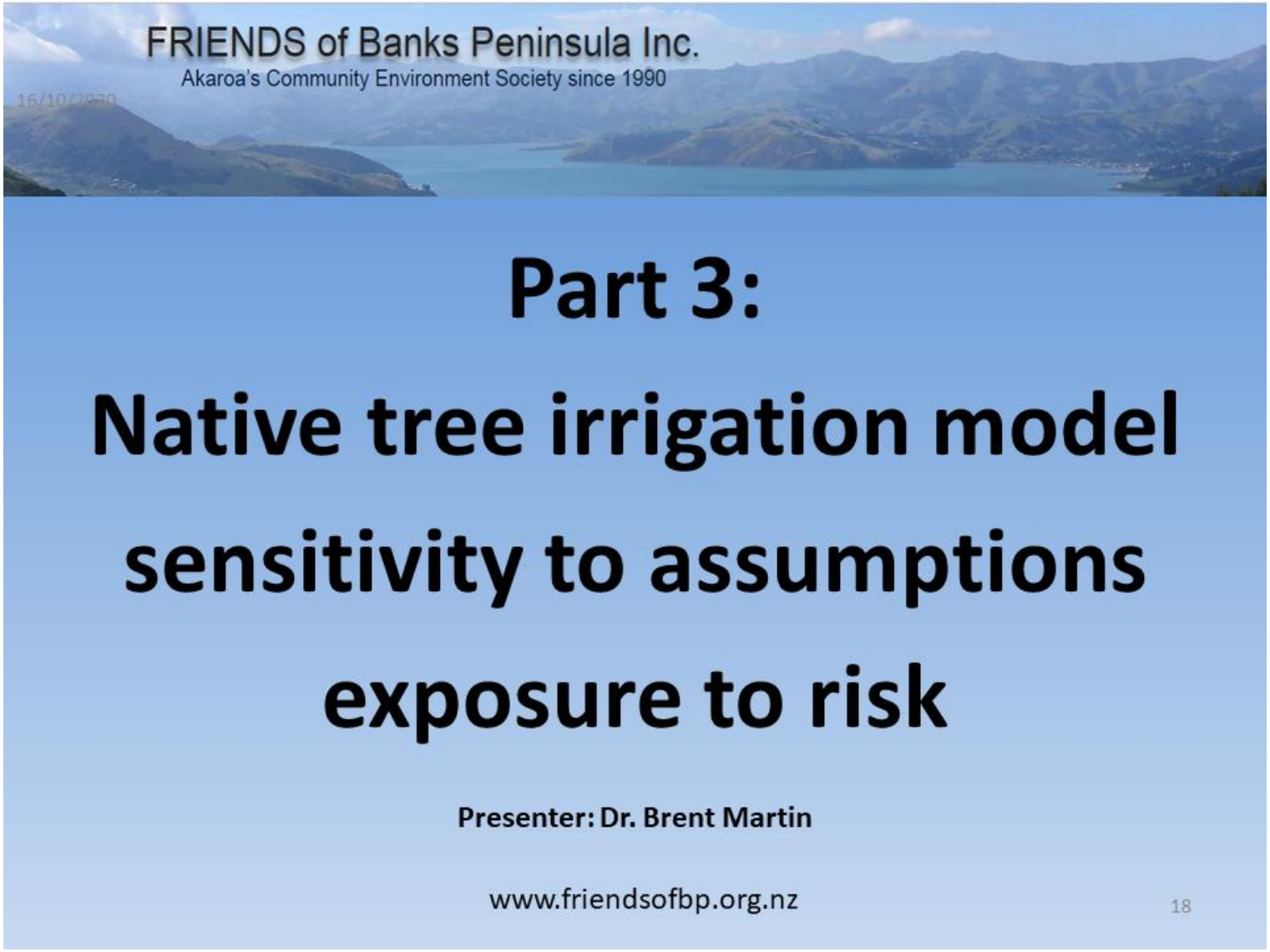
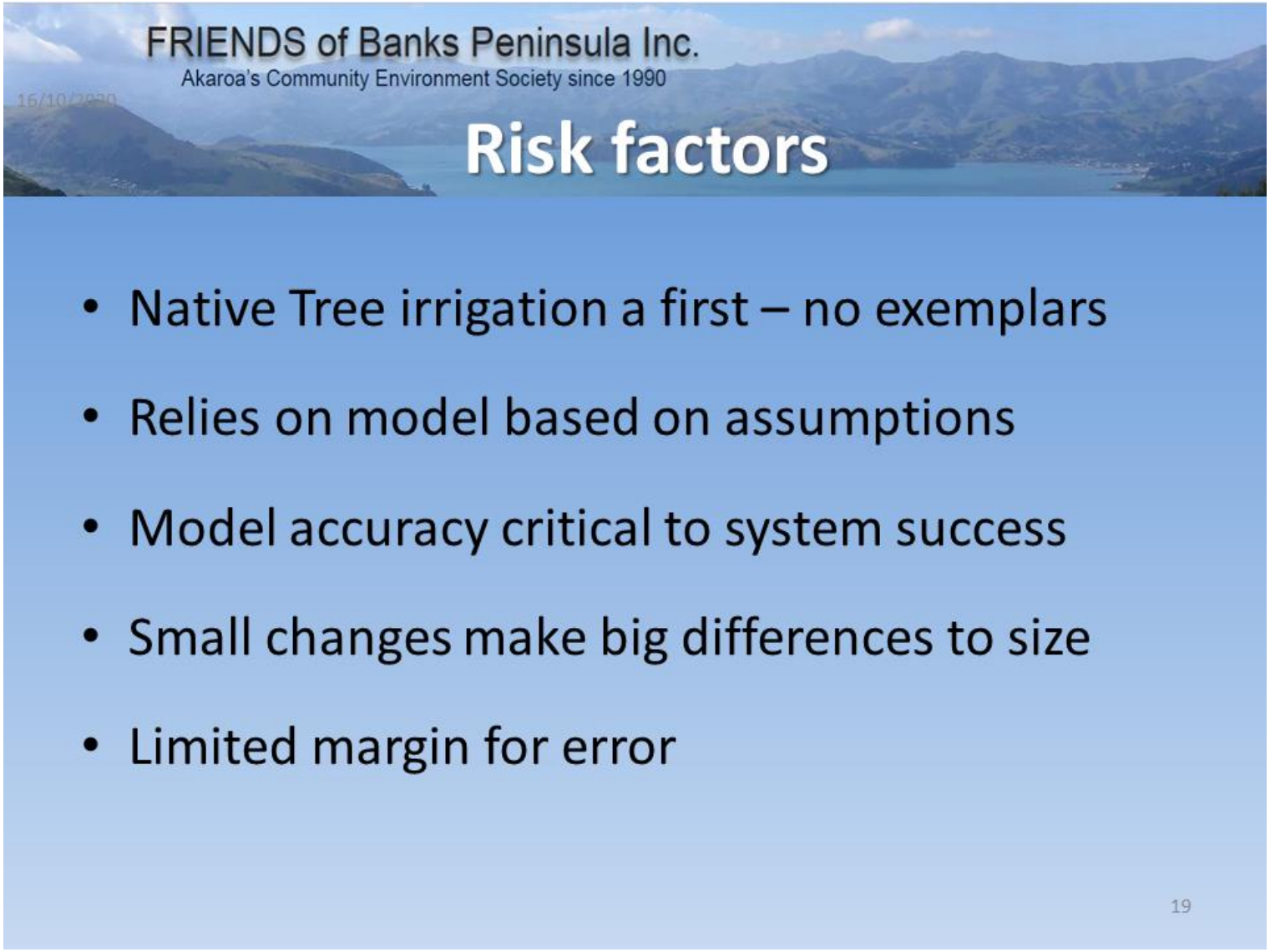
- Hence we identify reducing I&K significantly is the top priority
- It has a ripple effect through the entire system reducing the size of all elements
- We ask that the shovel ready funding be added to Council funding so this can be achieved.



- Land-based disposal has unique challenges that add risk



- The proposed land-based options are unique – no equivalent examples exist
- Design is based on modeling. Like all modeling, this is underpinned by parameters and assumptions. Key ones are:
  - Ability of the tree canopy to intercept rainfall
  - Ability of the native trees to take up nitrogen and remain healthy
- These assumptions (and others) are critical because the models that rely on them determine
  - The irrigation rate, and therefore size of the area to be irrigated, and
  - The volume of storage required to handle the incoming flows

Risk is compounded because the local geography means available land is scarce and the solutions are expensive, so the schemes are designed to the minimum land area and storage, with little room for expansion without much greater local impact

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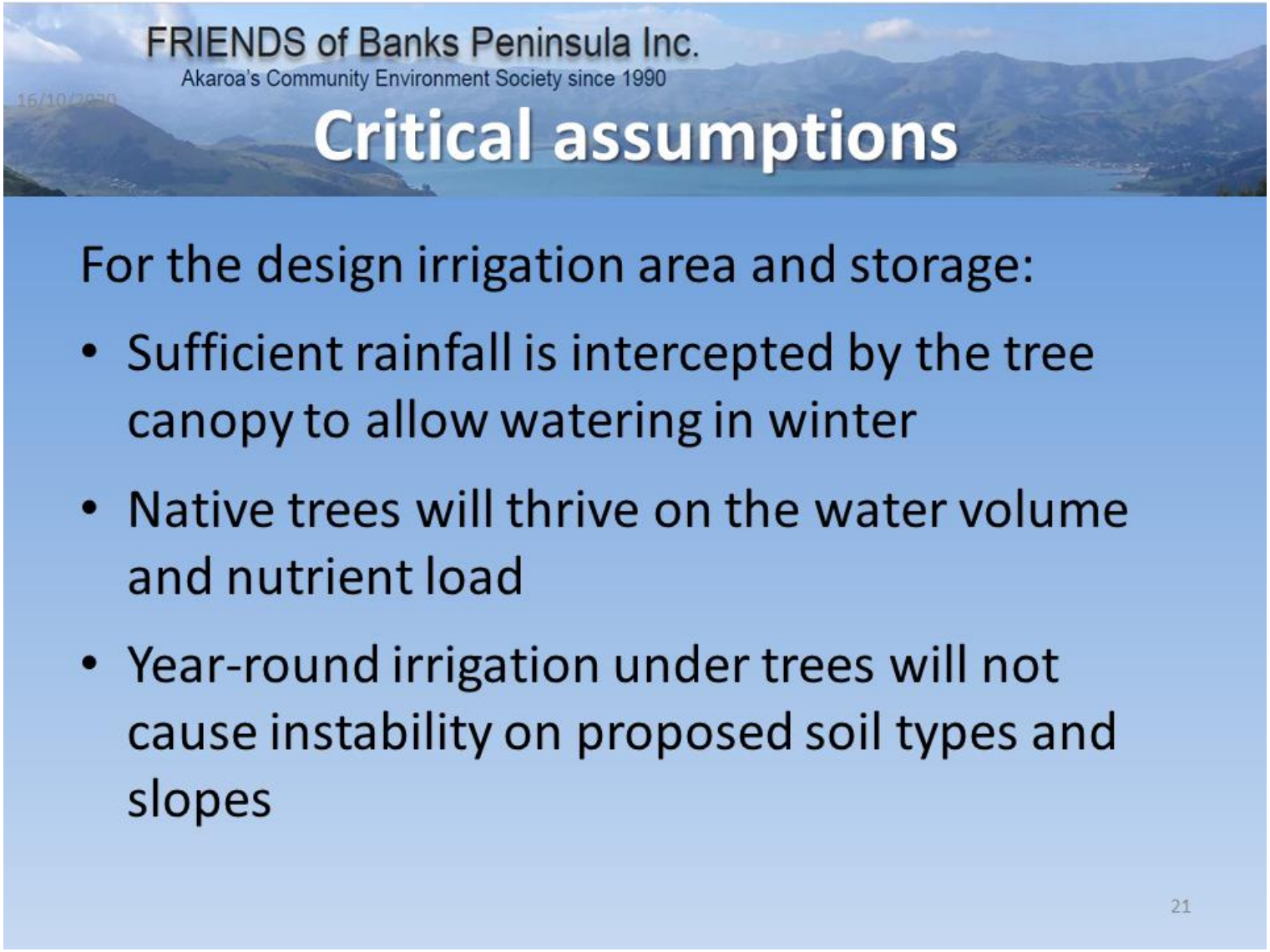
Native Tree irrigation a first

- Council exemplars of limited relevance
- Levin ("The Pot")
  - 50ha pines on sand plain
  - 10ha kanuka/manuka
  - recently planted
  - *"world first", "experiment"*
- Waikouaiti, Warrington
  - small systems discharging to sand near the coast
- None limited by soil uptake

- Most irrigation to trees differs in three important ways:
  - Irrigation is to pines
  - Soil is freely draining, such as gravel or sand
  - Sites are relatively flat
- Examples given by Council are all either very small, in sand near the open sea, very recent, or all three. Levin for example has only just started trialling irrigation to manuka/kanuka, and the existing scheme is acknowledged to be polluting the adjacent stream with nitrates
- Therefore need to be rigorous about assumptions made



- Banks Peninsula's challenging soils and geography means difficulty and high cost securing sufficient suitable land
- Leads to maximal load on minimal areas
- Lowered ability to irrigate in winter and necessity to irrigate all flows means storage critical to success
- Lack of exemplars means relying on critical assumptions
- If any of these assumptions are incorrect the system will be undersized or may fail altogether

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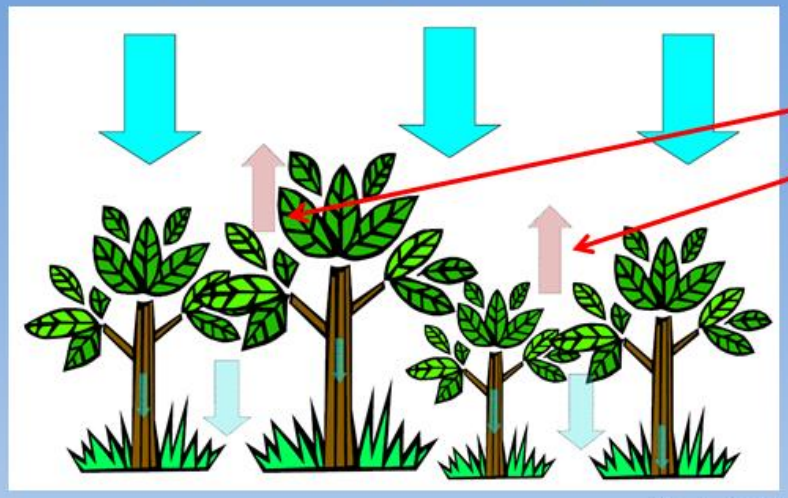
Reliance on canopy intercept

- Canopy intercept underpins concept of winter irrigation



Intercepted rainfall doesn't wet ground

(Davie 2007)

- Key component of solution
  - Assumes intercepted rainfall can be "replaced" with wastewater
  - Essential because proposed irrigation fields have poor draining soils

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- Rain falling on tree canopy is held and evaporates, so ground is less wet
- The additional soil moisture deficit can then be filled by irrigating
- Allows watering in winter when wetter and evapotranspiration is lower
- Key question is how much rainfall will be intercepted

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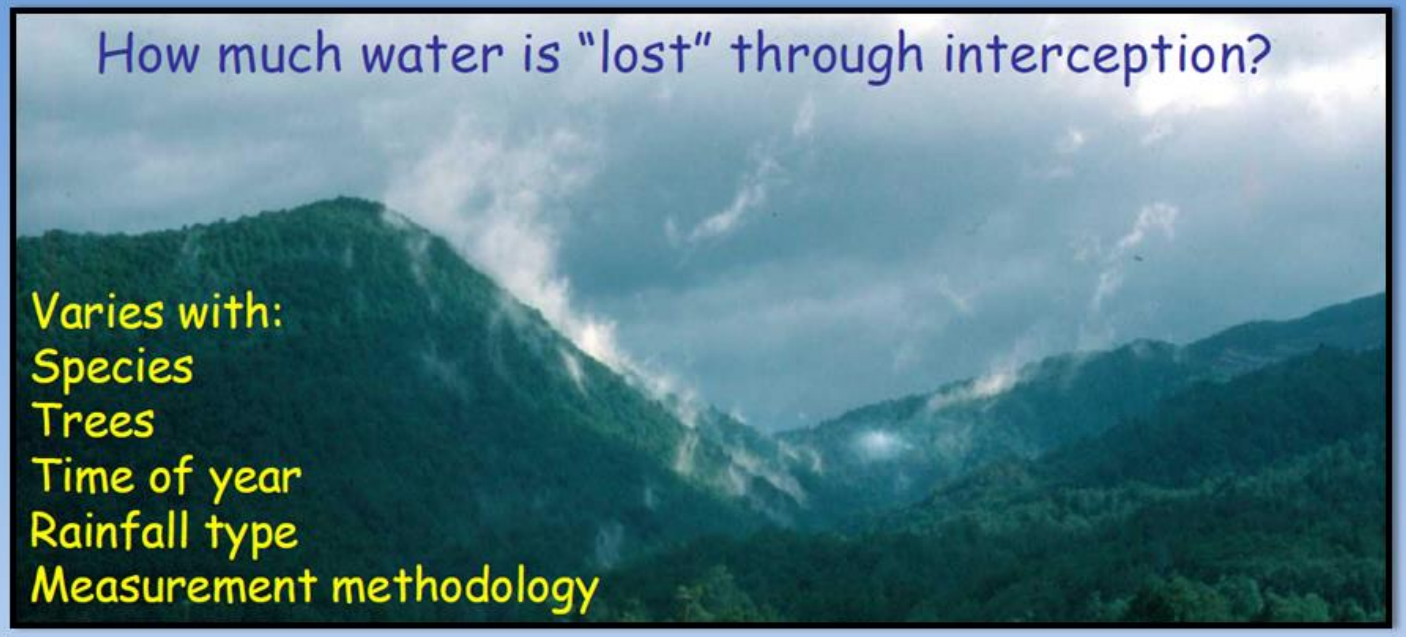
Intercept rates highly variable



Slide from Landcare Research workshop presentation by Tim Davie

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- Large variation depending on tree species, age, the time of year, climate, even the methodology used to measure it.
- Not possible to know how the proposed native trees will perform

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Canopy intercept rate assumption

Summary NZ figures - annual

Canopy cover	*Interception loss*
Pinus radiata	22%
Douglas Fir	29%
Native forest	33%
Scrub (manuka/kanuka)	37%
Tussock grassland	21%

Caution with annual percentages
Climate an important factor

Average used in model

(Tim Davie, Landcare research)

No guarantee 37% canopy intercept will be achieved

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- Published annual averages used, based on a small number of field studies
- Rate used is 37% (manuka/kanuka)
- This is the *highest* rate for NZ forest types
- Proposal is for a mixture of species. Other species will have lower rate:
  - Native forest average is 33%
  - Broadleaf forests tend to be lower again at around 30%
  - Flaxes, Cabbage trees likely to be lower again (not canopy-forming)
- Very small number of data points used to calculate (with high statistical variance): experts caution that the averages are a very crude instrument that should be used conservatively
- 37% at risk of not being achieved, so winter watering reduced and storage requirements increased

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Duvauchelle wastewater tree trial

- Trees planted in 2015, half irrigated with Duvauchelle wastewater
- Intended to verify that irrigation will perform as modelled
- Results released in Officers report 2 October 2020
  - Based on soil samples taken in 2018
  - After 3 years irrigation only and during initial rapid growth stage
- Results raise questions around
  - Nitrogen removal
  - Tree ability to thrive

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- In the absence of comparable (and long-running) examples, the proposals rely on a study into irrigating native trees with wastewater being carried out in Duvauchelle by Canterbury University
- Trial has been running about five years. Various reports have been produced on its performance. The most recent includes soils samples taken in 2018, after irrigation had been proceeding for three years, and released with the Officers report
- The report, along with a site visit and independent assessment, suggests there are some problems, notably nitrogen buildup and leaching, and tree health

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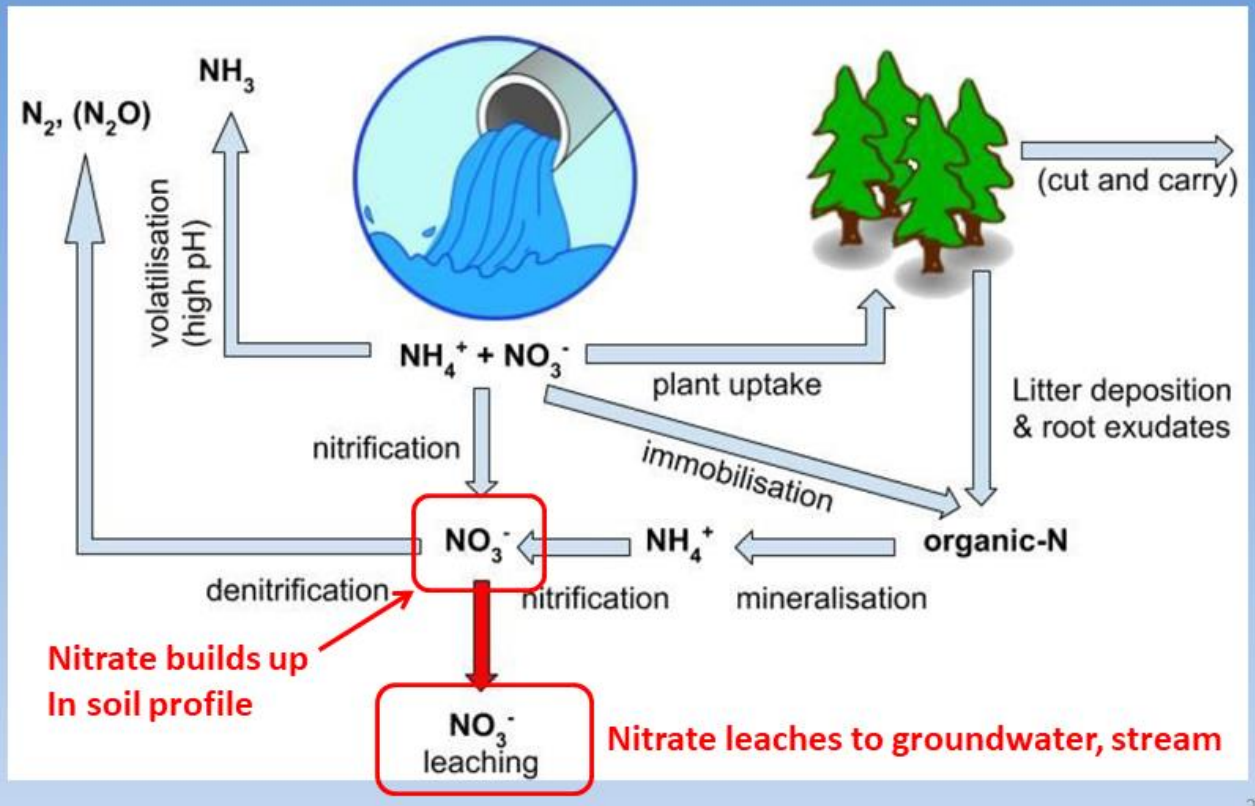
What is Nitrate leaching



- Nitrate leaching is important because nitrogen that doesn't get taken up by plants or otherwise consumed ultimately ends up in groundwater, and then in streams.
- Nitrates that aren't consumed will travel down the soil profile until they meet groundwater and leach
- Some may accumulate in the soil, depending on conditions, including vegetation species and size
- Eventually, the soil's ability to store the nitrate becomes exhausted, and then all nitrate not consumed by other processes leaches out

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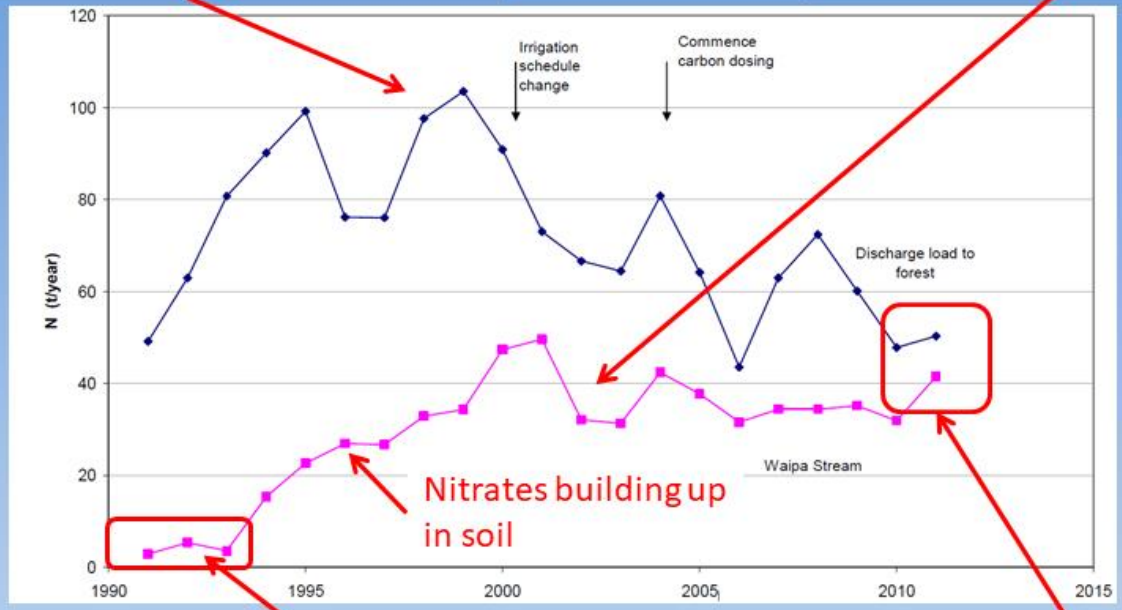
Long-term experience Whakarewarewa

Amount of nitrogen irrigated to forest

Nitrogen leached into stream



First three years OK (length of Duvauchelle tree trial)

Long term: almost All nitrogen is leaching

- Rotorua has been irrigating pine trees at Whakarewarewa forest for decades now.
- At first, the system worked well and it looked like the nitrogen in the wastewater was all being consumed. Over the first three years (so the same as the period leading up to the soil analysis at Duvauchelle), almost no leaching occurred
- Over time though, the leaching increased until almost all of the nitrogen (chiefly as nitrates) was leaching out and polluting the nearby stream. This is attributed to the soils saturating with nitrates.

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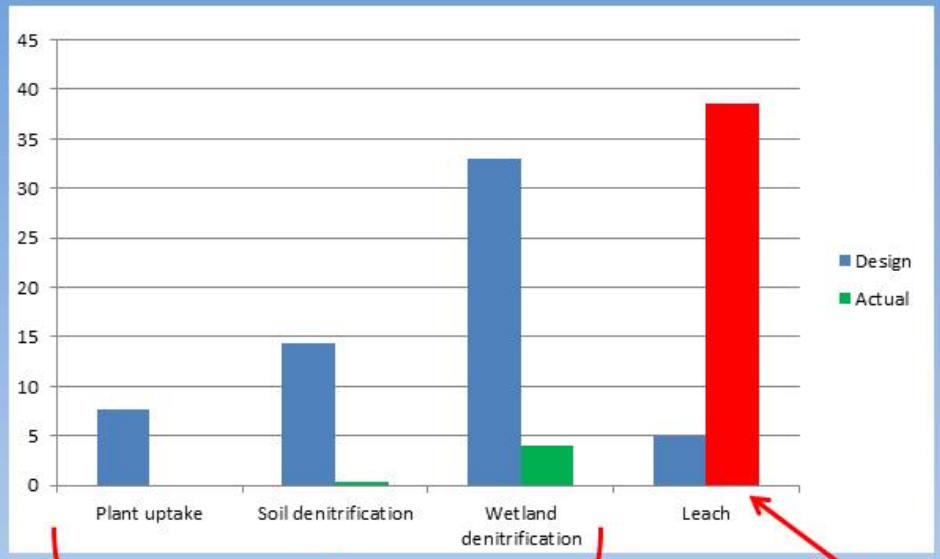
Design versus actuals - Whakarewarewa

Nitrate performance expectations versus 20 year actual results*



* Rotorua Te Arawa Lakes Strategy Group 2013: Progress on the Change in Consent Condition Application for the Rotorua Wastewater Treatment Plant and Land Treatment System, June 2013

- Over the long term none of the various nitrogen-removing components have worked as expected:
  - Trees remove negligible nitrogen
  - Soil denitrification minimal
  - Wetlands (not trees) were supposed to remove most of the nitrogen but response was very limited
  - End result: almost all of the nitrogen is leaching out

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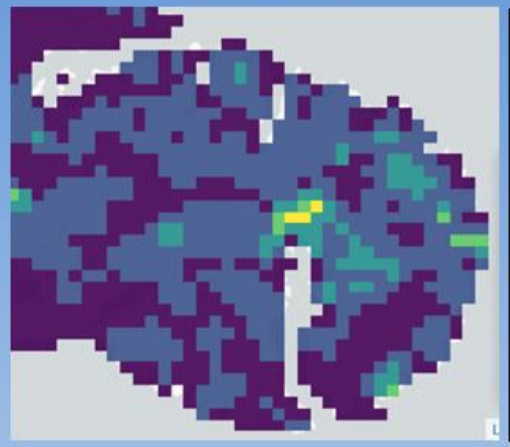
Leaching results Duvauchelle tree trial



Nitrate-nitrogen leached
Median concentration
kgN/ha
Modelled
2017

- <5
- 5–15
- 15–30
- 30–45
- >45

Results after three years

Trial - average

Trial - worst

- Leaching significantly increased *after first three years*:
  - Equal to worst 1% of Banks Peninsula
  - Flax, cabbage trees worst: same as highest on BP (dairy farm)
- Likely to continue to increase – accumulating in topsoil
  - Nitrate concentrations doubled in first three years

Map source: https://www.stats.govt.nz/indicators/nitrate-leaching-from-livestock

- The Duvauchelle trial report includes calculated estimates for nitrate leaching that show it increases, but is considered "similar to grazed pasture"
- In fact, leaching is calculated to have doubled in the three years, and is at the top end of what is observed on Banks Peninsula (light green and yellow)
- If the worst performers (which are also the best growers in the conditions) are used, leaching is comparable to a dairy farm, and would make the site one of the top nitrate polluters.
- These results are after the first three years only; Whakarewarewa experience suggests performance could be significantly worse longer term, and the nitrate soil buildup could also have implications for plant health

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Tree mortality

- 36.5% mortality reported after three years
  - Manuka and kanuka heavy losses

- Coprosmas deformed growth
- Flaxes, cabbage trees doing best but
  - Poorest nitrogen performance
  - Non canopy-forming species

30

- The trial reports 36.5% mortality after three years
- Although the report states most losses occurred when the trees were first planted, a site visit reveals plants continuing to die (left two pictures). Almost all manuka is now dead, and significant amounts of the kanuka, as well as losses across the other species. The report notes that several species fared poorly from the outset
- Of the plants still alive, many do not appear healthy. Many Coprosma robusta in particular (which had the highest nitrogen uptake) are defoliating.
- To determine the significance, we asked an independent ecologist to assess the trial

- As you will see from these excerpts, the ecologist concluded that the trees are not at all healthy, and the trial appears to have failed, with the long-term survival of the trees in doubt
- He comments on the appearance of toxicity, pointing out that, in addition to potential nutrient issues, there are many household chemicals going into the wastewater that could be toxic to native vegetation.
- He also points out that specific results (i.e. comparing irrigation to non-irrigation) are limited in value because of the way the trial is being conducted, with the experimental and control plots too close together, meaning the watering is affecting the entire site

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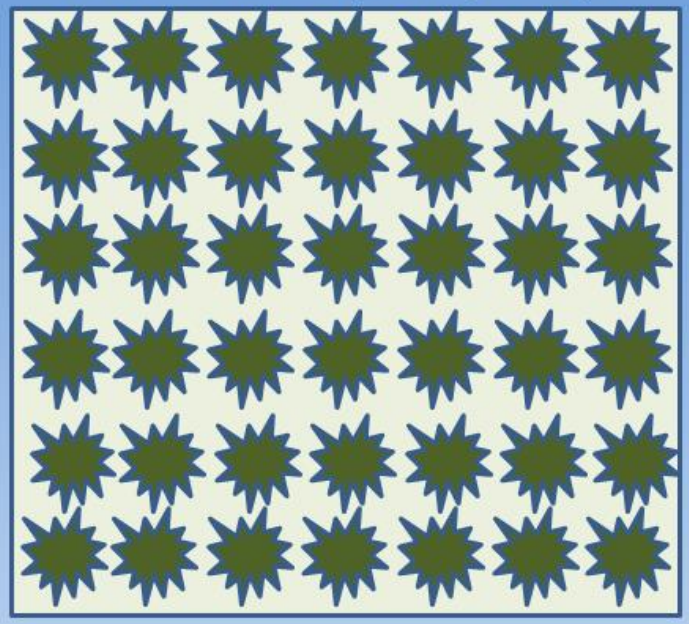
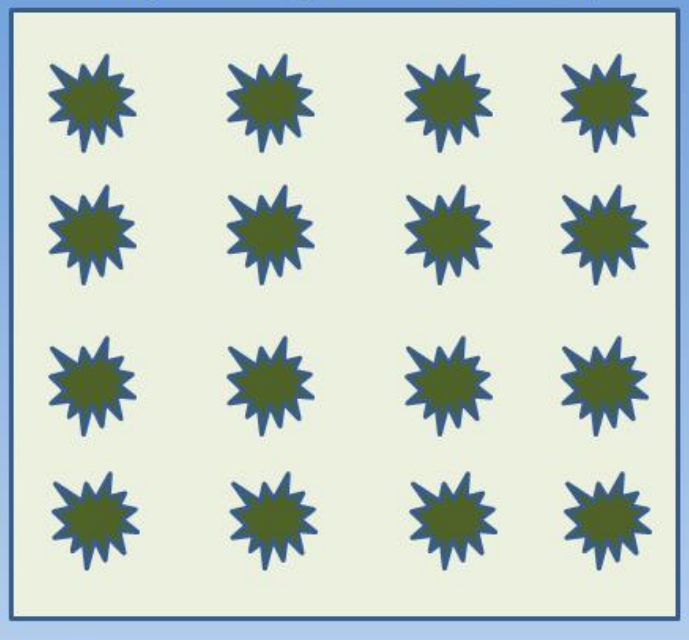
Applicability of trial to proposal

Duvauchelle Trial planting density



Proposed irrigation fields density



- Lower density of planting costed into proposals
- Fewer plants to take up nutrients per ha

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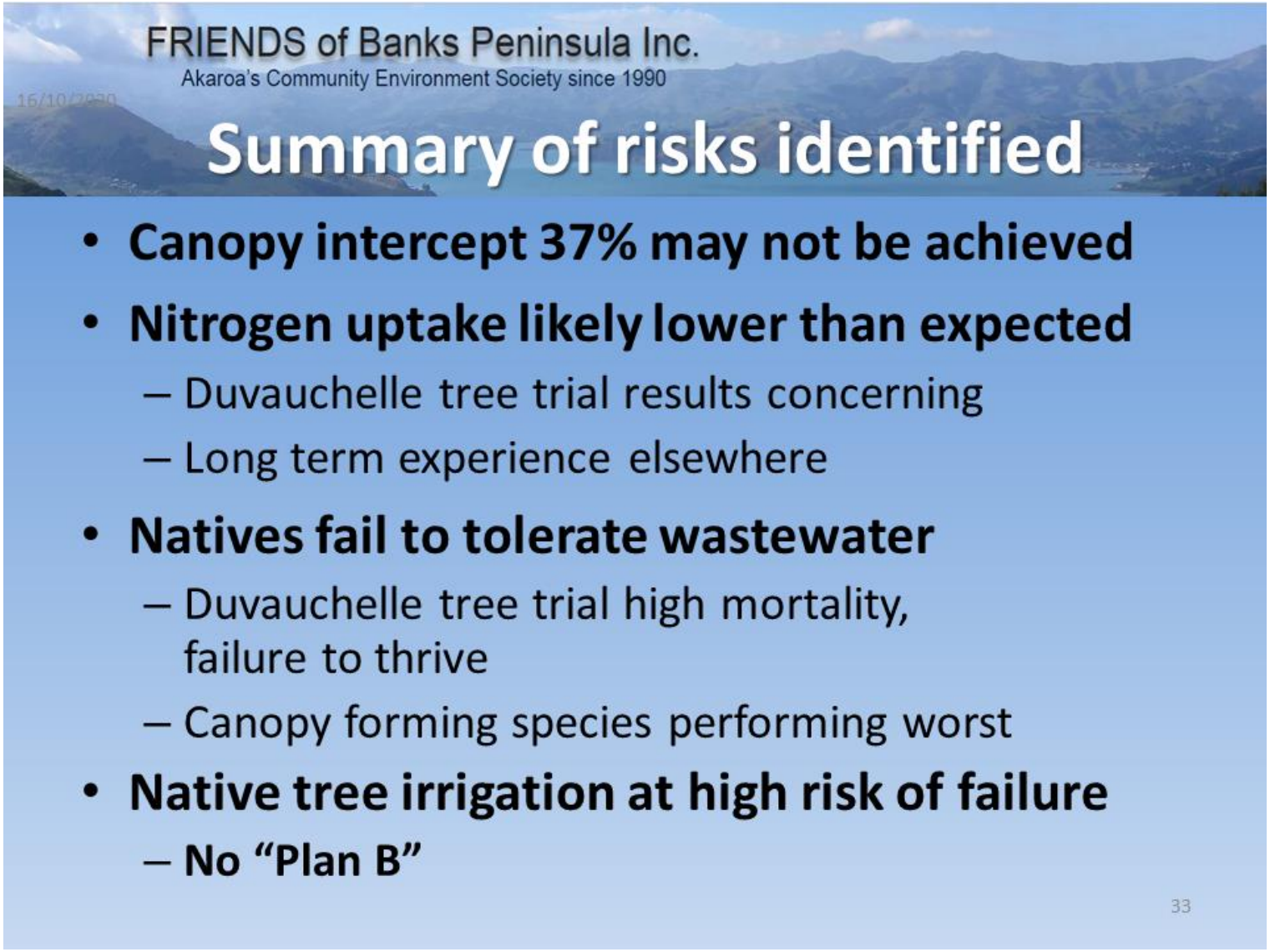
- The trial the trees have been planted at very high density – 20,000 trees per hectare
- We understand the proposed density to be 7,500 trees per hectare or less, based on costing details.
- We question whether the lower tree number means less nutrient will be taken up by the trees leading to greater leaching, or more will be taken up per tree, with more severe impacts on their health



- Canopy intercept of 37% may be too optimistic for the plant types and location, meaning less winter watering is possible
- Nitrate uptake by the plants may be insufficient to avoid excessive soil buildup and leaching into groundwater and streams
  - Plants most resistant to ill health effects from wastewater (cabbage trees, flaxes) have the poorest nitrate leaching outcome
- The trees may not thrive on wastewater and at worst, may die. Significant and ongoing losses would seriously compromise both canopy interception and nutrient uptake
  - No plan B if trees die after closure of Takapuneke – it would be years before new trees could take up all of the wastewater again

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Sensitivity to model assumptions

Modelled storage requirement

Reduction in I&I	30 ha	40 ha	60 ha
0%	**463,000m³**	36,000m³	21,000m³
20%	40,000m³	24,000m³	16,000m³
40%	21,000m³	14,000m³	12,000m³
60%	10,000m³	9,000m³	9,000m³

- Inner Bays irrigation field size and storage based on
  - 20% I&I reduction achieved and maintained
  - Canopy interception of 37%
  - Tree and soil ability to take the water & nutrients
- Larger system required if assumptions not achieved

- Figures most recent available detailing model. *Akaroa Wastewater Summary of Disposal and Reuse options, CH2M Beca Ltd 8 May 2020. Table 4-4.* Storage requirement now provided by both Robinsons Bay Pond and wetland.

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- For the preferred option of Inner Bays, the storage requirements are dependent on:
  - Achieving 20% I&I reduction – to reduce overall volume, and
  - 40ha of *usable* land, *at the irrigation loading rates modelled*
- If either of these assumptions fails, the storage requirement rapidly rises
- An increase in water volume equivalent to not achieving 20% I&I (approx. 12% increase in total volume) and a loss of 10ha of available land (or 25% reduction in long-term sustainable irrigation rates) would make the system unviable without adding significantly more land

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Inner Bays Highest Risk Exposure

- No room for expansion
- Proximity to streams
  - Higher risk of nitrogen pollution
- Streams drain to vulnerable shallow mudflats
- High impacts on people if system does not perform
  - Odour from mudflats

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- The Inner Bays option proposed is the most exposed to risk:
  - Location in inhabited valleys and highly visible places
  - Streams running through or beside the main irrigation sites are at risk of being polluted with nutrients, impacting whitebait and other aquatic fauna
  - Streams will carry any pollutants out into the shallow bays where they will accumulate in the silt bottom
  - Accumulating nutrients may cause environmental harm and other impacts such as odour from a buildup of decomposing vegetation

Part 4:

Cost risks

Presenter: Suky Thompson

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Extremely expensive and growing

- Latest Inner Bays budget estimate **$68.8** million
  - **$6 million** increase on consultation top end cost
  - $30 million more than current budget of $38.8 million
- **830 connections = $82,800 per connection**
- **Costings in consultation document include WWTP**

The four options at a glance

	Comparisons			
	Inner Bays Irrigation Scheme	Goughs Bay Irrigation Scheme	Pompeys Pillar Irrigation Scheme	Harbour Outfall Scheme
Capital cost range ($ millions)	$54m to $63m	$61m to $71m	$66m to $76m	$45m to $52m
Operating cost (per year)	$510,000	$580,000	$580,000	$470,000
Carbon impact (over 35 years)	8,900 tonnes stored	4,500 tonnes stored	8,300 tonnes stored	1,300 tonnes emitted
Distance from treatment plant (approximate kilometres)	5.6km	11km	13km	4km

All figures include approx $35m for WWTP component

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- The total number of connections in Akaroa is approximately 830
- The current amount the Finance and Performance committee has budgeted this works out at over $82,000 per connection – more than enough for each house to have two or three modern septic tank systems!
- The costs given in the consultation document include the wastewater treatment plant and pipe networks that are not part of this consultation process. We think this masks the differences between the options

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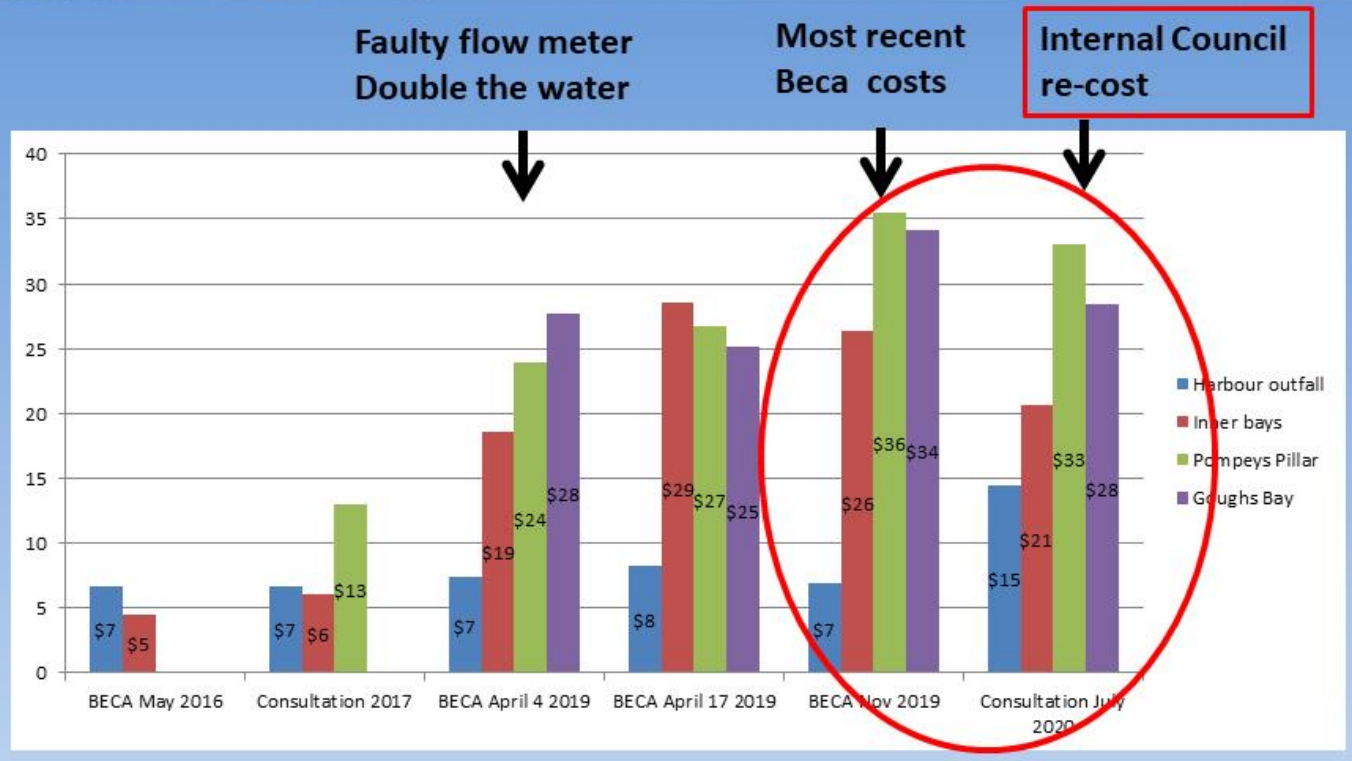
Cost history excluding WWTP



- Costs shown here are for the disposal options only, with the cost of the WWTP removed
- Tracking cost escalation since first consultation in 2016
- We also have some questions over the internal re costing done by Council in March this year

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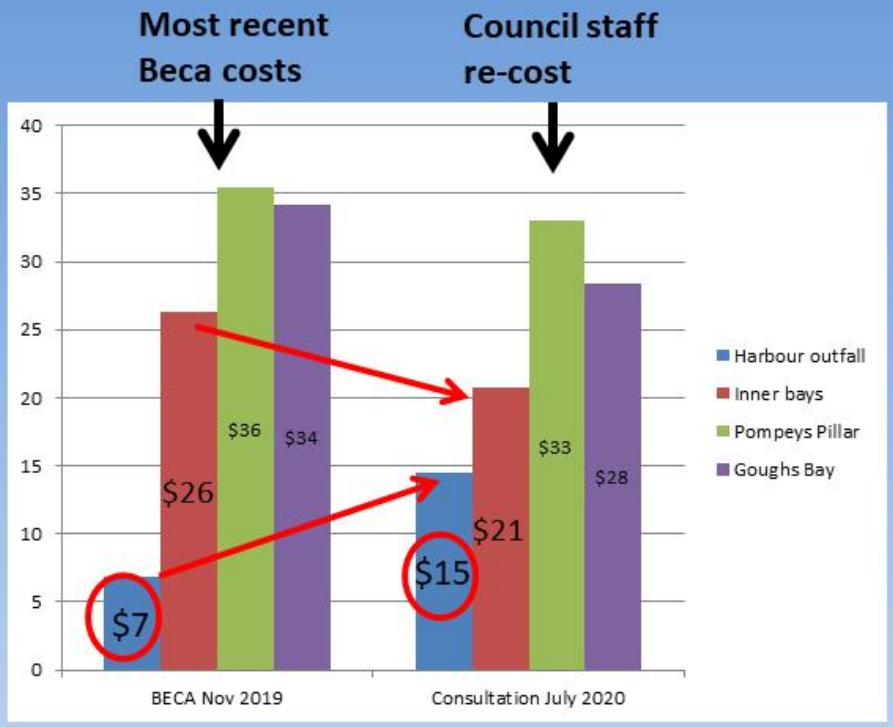
Examining internal re-costing

- Harbour outfall more than doubles
  - Highest contingency applied to lowest risk option



- Inner Bays cost reduced despite complexity

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- During that final recosting exercise the cost of the harbour outfall more than doubled
- The working party was given copies of those costings, and from examining this we can see the principal factor was a big increase in the contingency – when this option carries the lowest risk. That contingency is not about appeal costs
- At the same time the Inner Bays option was reduced, despite it being the most complex and depending on so many different factors working as you have heard

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Cost blowout risk

- Alarm bell raised by our Quantity Surveyor
  - Cost volatility = budget risk
- **We therefore request:**
  - **Independent review of costs**
  - **By impartial external agency**

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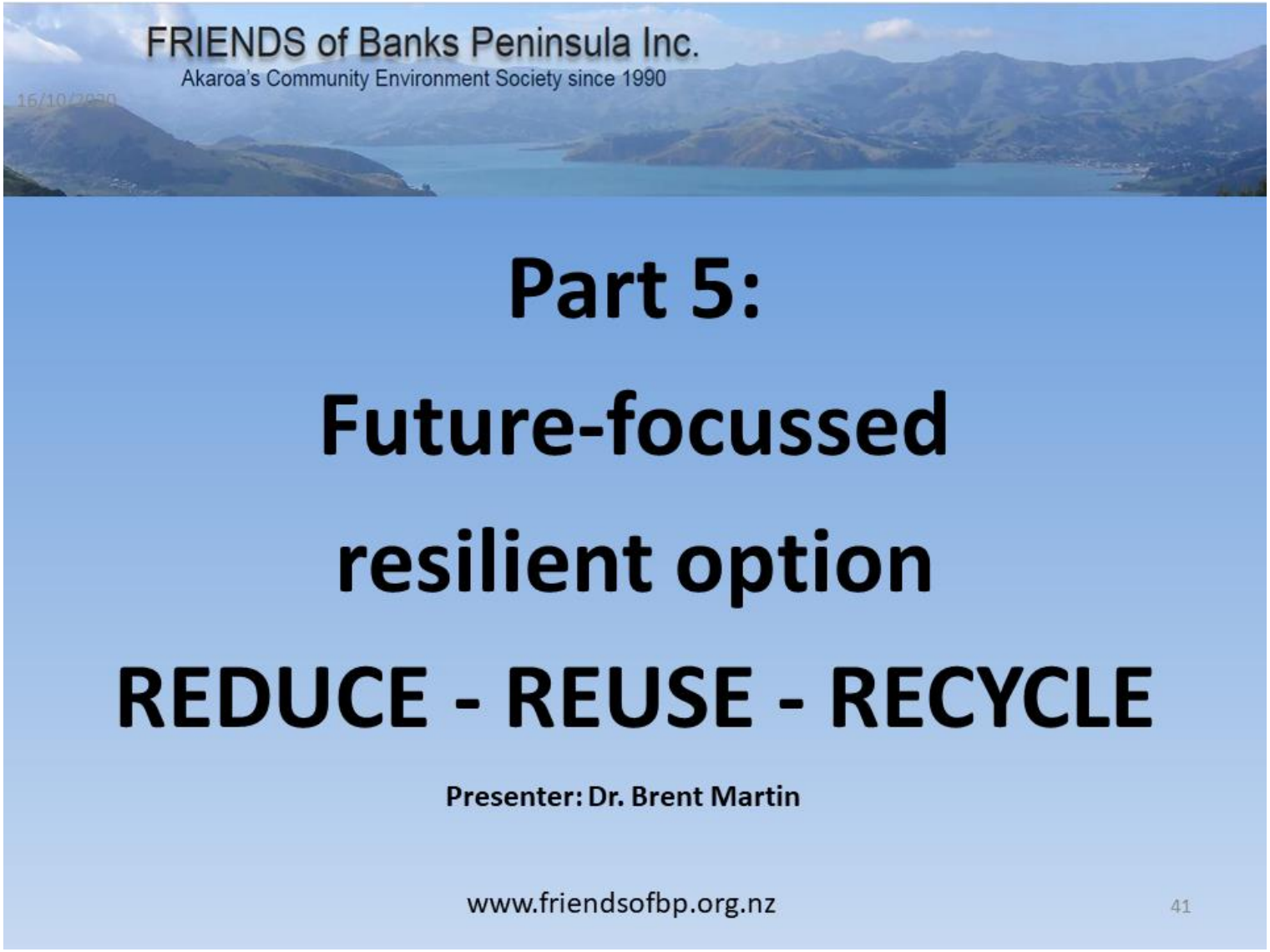
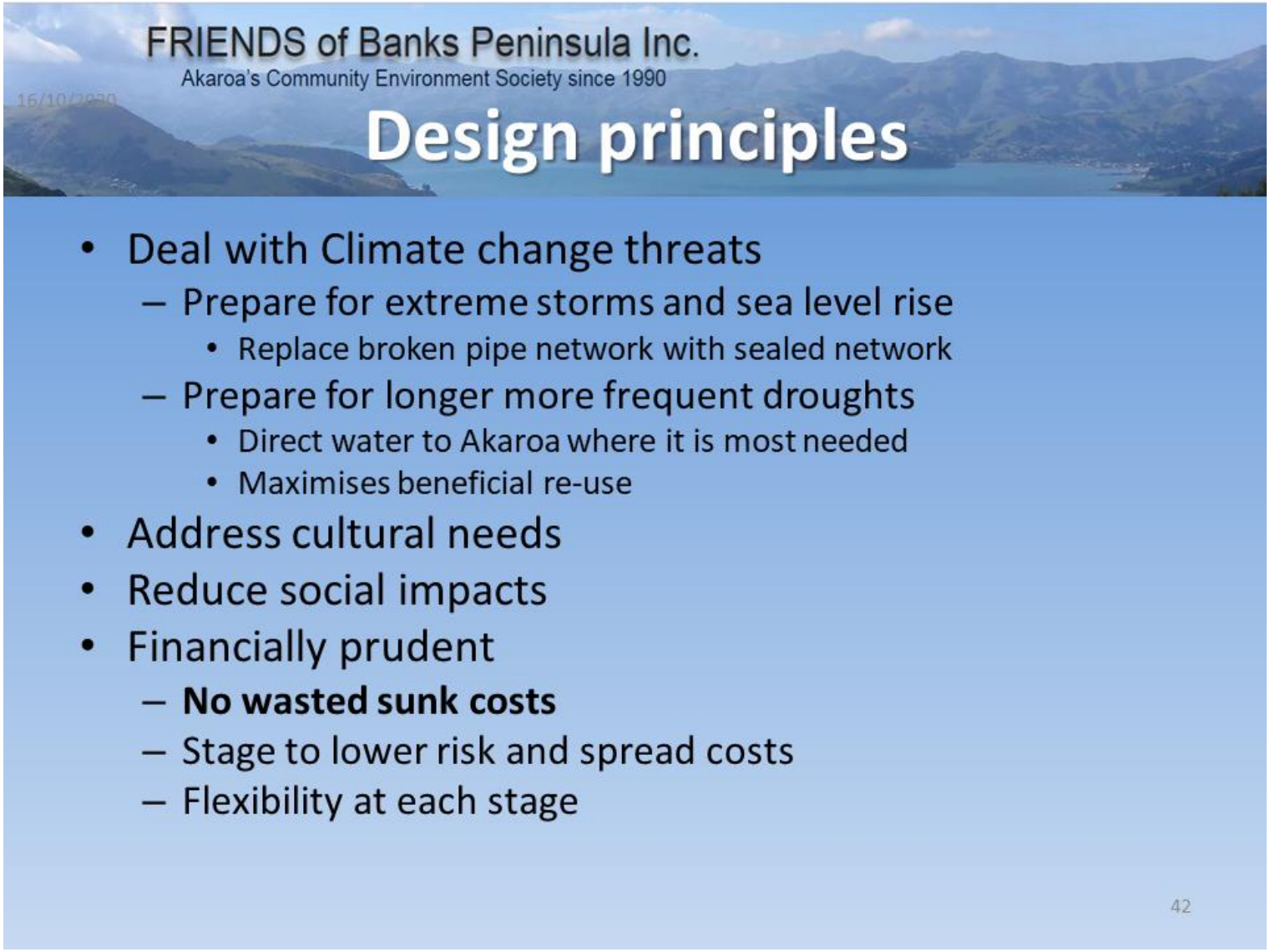
- QS letter is in our submission
- We ask the Council gets an independent review done –and by an organization that is not in the position of compromising its future contracts with Council



- We now present an alternative solution approach, based around achieving a future-focussed resilient option through the philosophy of "Reduce Recycle Reuse"
- Focus is on the whole solution, and misconceptions or contested statements in the Officers report



- The design principles aim to address all of the issues this system is subject to:
  - Building future resilience through a robust network and water recycling
  - Recognising and addressing cultural and community needs so that the system minimizes impacts on peoples' lives and maximizes acceptance
  - Affordable over the long term, with maximum return on investment and flexibility to adjust the programme as required – always a "plan B"

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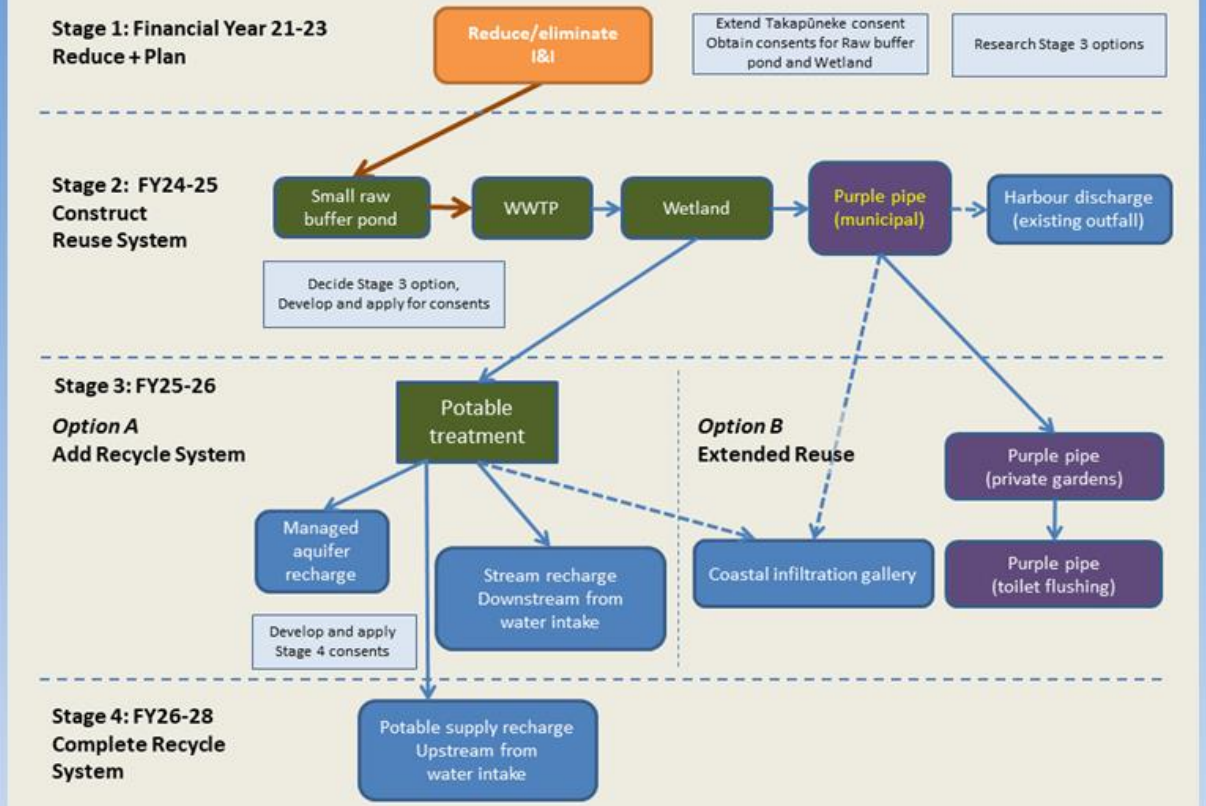
Staging in Reduce Reuse Recycle



- The system will be built in stages, spreading cost over multiple LTP cycles
- As the stages progress, Akaroa will move from the current situation to a new treatment plant and the closing of the Takapuneke plant, and then in two stages to full recycling of the treated wastewater, a first for New Zealand

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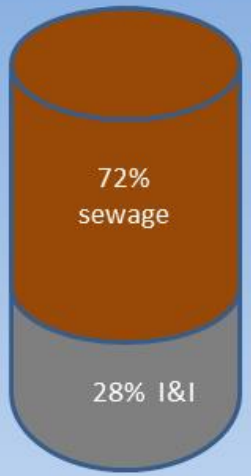
Stage 1 - Reduce I&I to below 30%

- High priority in Mahaanui Iwi Management Plan
  - All parties agree I&I reduction makes sense
- Current approach not guaranteed to deliver results
  - 20% insufficient to make a real difference
  - Network left vulnerable to climate change
- Tektus engineers advise
  - Partial low-pressure system in lower town to eliminate most inflow
  - CIPP if and where needed
- Saves money down the track
  - Smaller WWTP
  - Smaller everything
- Reduces raw sewage overflows



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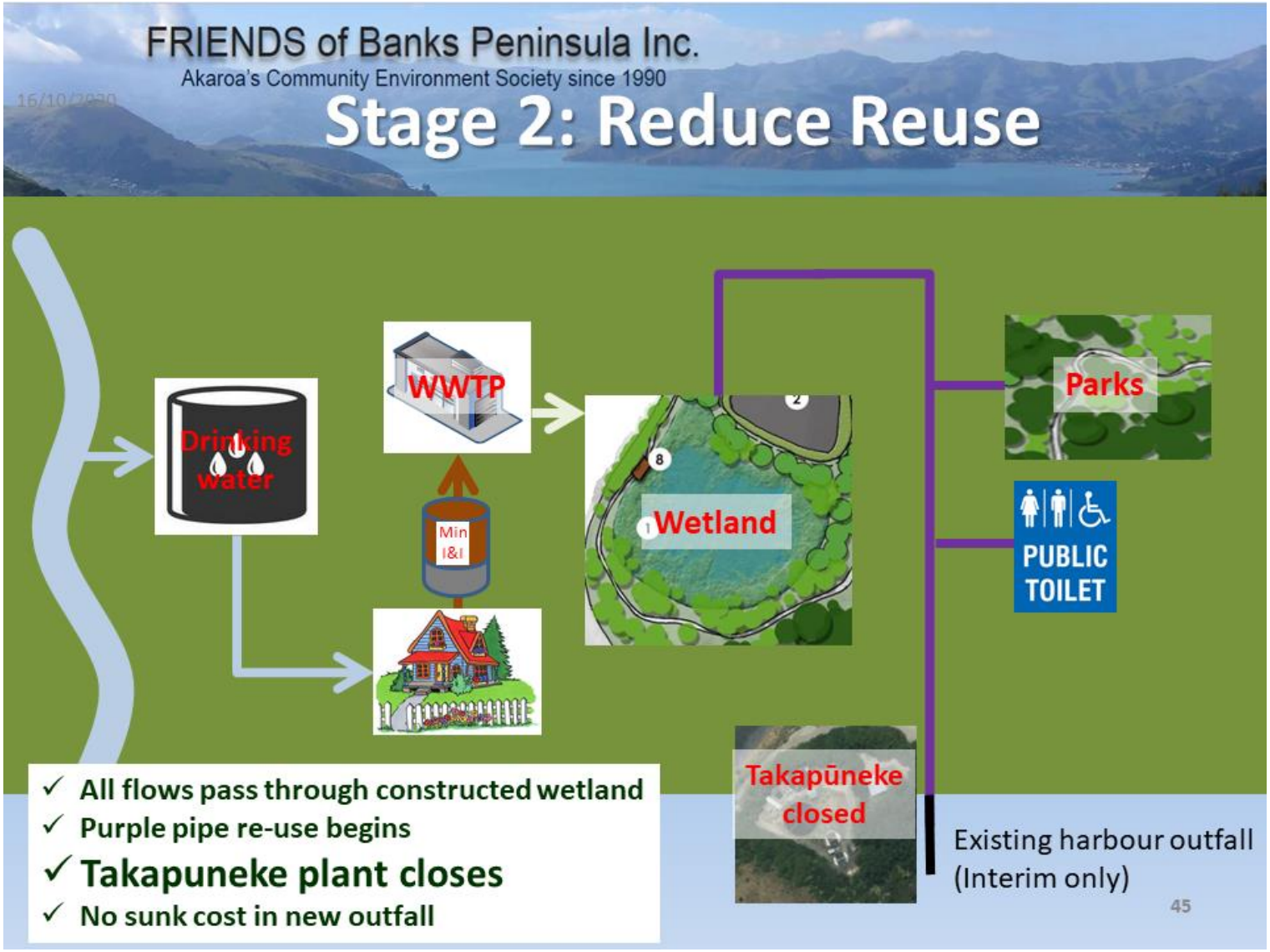
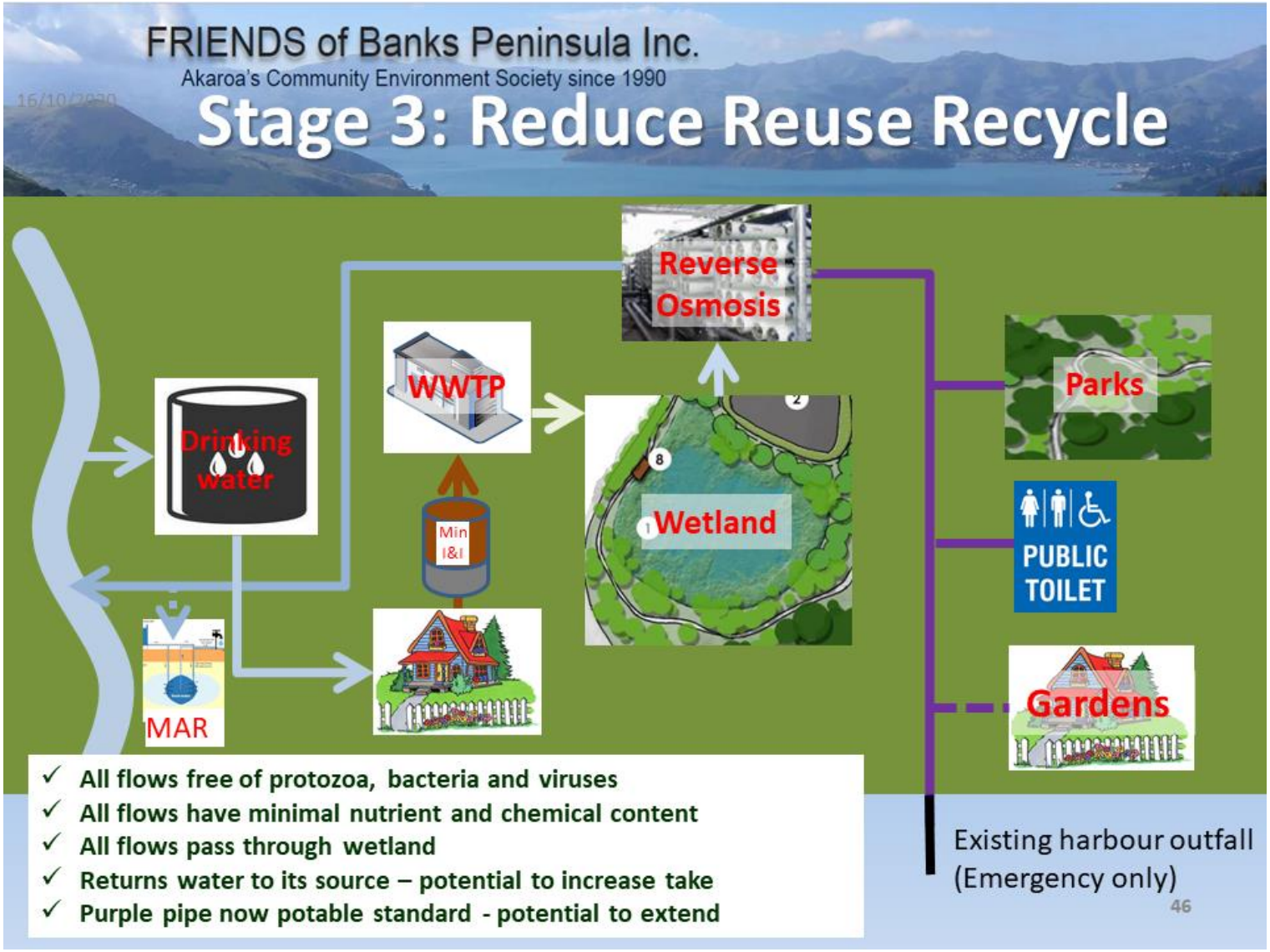
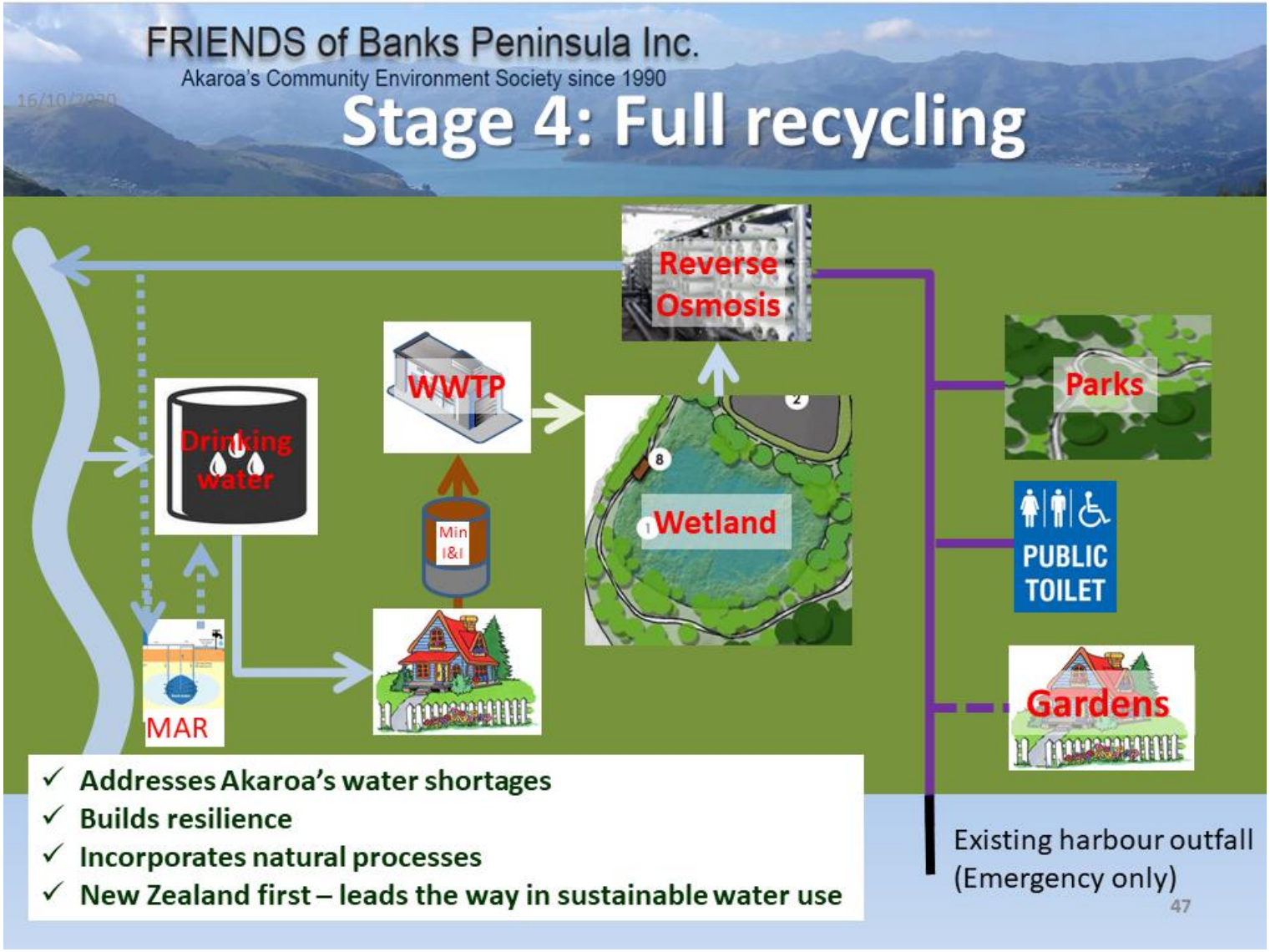
- Both the councils engieers (Beca) and those we engaged (Tektus) agree that the Council's proposed I&I reduction approach of "find and fix" is unlikely to achieve a major reduction because fixing one set of leaks often produces another
- Tektus advocate a more comprehensive approach, such as lining significant areas of the network internally or, preferably, replacing the lower part with a sealed low-pressure system.
- This low pressure system would also replace the gravity sewer main that needs to be rebuilt to reverse the direction of flow; this might potentially reduce costs.
- The lower the I&I, the smaller and more robust the entire system is, reducing costs and increasing resilience



- Once the I&I reduction is known, the new system can be sized and built
- The proposal here is much the same as the Councils', except:
- The raw sewage buffer pond could be smaller, or even replaced with tanks at the plant, because it doesn't have the same peaks to contend with, and
- A larger constructed wetland (or similar) is built to provide land treatment to all of the treated wastewater. This is a fundamental difference from what is proposed by Council's Option 4
- The first stage of a purple pipe reuse system is built, since this can be done cost-effectively by routing the treated wastewater through town as proposed by Council in Option 4
- The existing harbour outfall is retained in the interim, until the rest of the wastewater can be reused. This avoids sinking substantial cost into an almost redundant component. The water leaving this outfall will be substantially cleaner than the current plant produces, and would have made contact with land



- The next step is to enable all of the treated wastewater to be reused, by returning it to the water catchment
- This is made achievable by treating the water to potable standard, so it can be safely returned to the environment, by returning it to one or more streams, or in combination with other techniques such as MAR, noting that the water is now potable and does not contain contaminants.
- Potable water more likely to be consentable and acceptable by the public for reuse in private households
- At this stage the water will not be taken up and consumed again, but rather replenishes the stream flow, improving stream health and potentially allowing more water to be taken than would otherwise be possible



- The final stage of the project involves returning the potable treated water *above* the water take, completing the cycle.
- This replies on further legislative change, and community awareness and acceptance of the idea
- Auckland city is already talking about "when, not if" for wastewater recycling, so Akaroa won't be working alone, but could be the first such system in New Zealand

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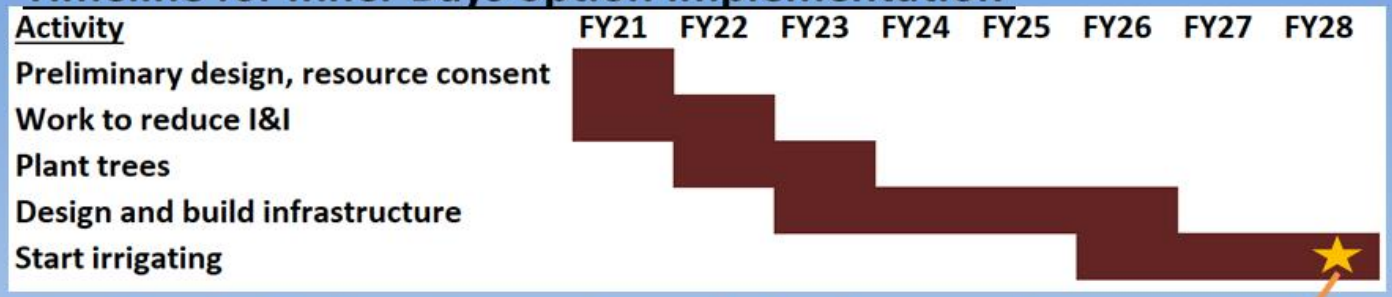
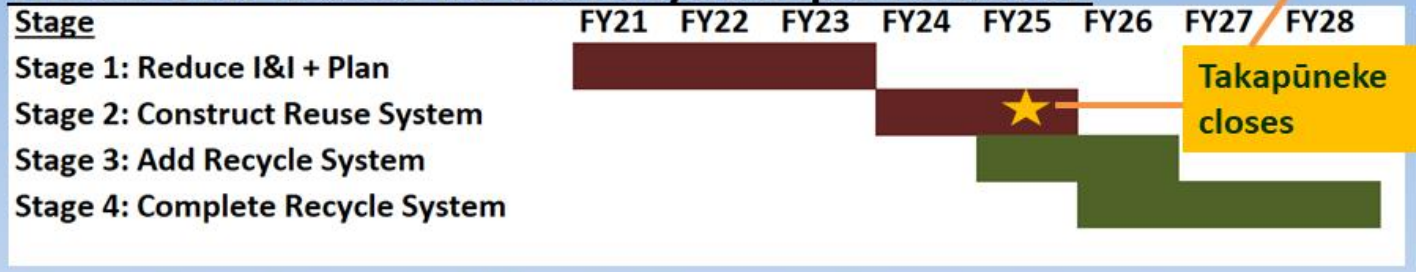
Timeline compared to Inner Bays

- Council extending Takapūneke consent to 2028

Timeline for Inner Bays option implementation[1]



Timeline for Reduce Re-use Recycle implementation



[1]*Source: Working Party meeting 8 March 2019. Start date adjusted to match current progress*

- The overall timeline could be the same as for the Inner Bays option, although this is dependent on legislation progressing to enable water reuse in New Zealand
- The Takapuneke plant would close earlier because it is not reliant on the growth of a forest but can happen as soon as the new plant is built
  - Given the uncertainties in the native trees thriving on the proposed irrigation regime, this could be delayed for the Inner Bays option

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Constructed Wetland

- All wastewater passes through constructed wetland
- Constructed wetlands supported in IMP
- Based on criteria Council have been using
- Duvauchelle proposed scheme includes this method:
  - *"A minimum of 2-3 days residence time in the wetland is provided to effect meaningful treatment and "passage through land" to address cultural concerns of Ngāi Tahu"**

*Combined Akaroa Duvauchelle Wastewater Scheme - Review of Costs and Benefits Revision 2

- We are proposing to use constructed wetlands for land contact
- The land contact time is anticipated to be 2-3 days. This is the design criteria applied for both the wetland proposed for the Inner Bays option, and under consideration for the Duvauchelle golf course, the latter for substantial use every winter
  - Not for us to decide what is acceptable to Ngai Tahu, but basing our design on Council's approach

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Land requirement for wetlands

- Approx 1.4 ha if I&I reduced to 30%
- Based on Beca 2016 calculations of area needed
- Potential wetland sites identified in 2016 consultation

- If I&I can be reduced to around 30%, flows will be equal to those originally designed for
- This required 1.4ha of wetland, although this can be reduced further by increasing the depth of the wetlands
- Pond site 10 is already intended to be used for this; reducing or removing the raw buffer pond would free up more space
- Other potential sites were identified in the original design in 2016, suggesting it is feasible

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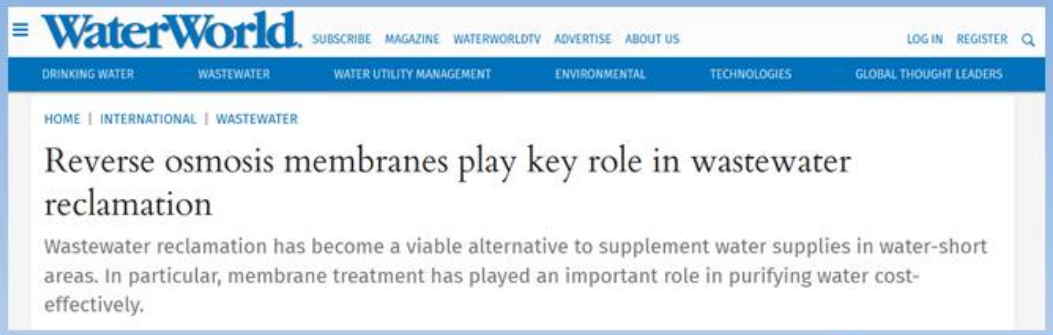
Reverse osmosis delivers

- Improved wastewater quality and safety

Contaminant	Ultra Filtration	Reverse Osmosis
Viruses	Moderately effective	Highly effective removal
Nitrates	Low	83-92% removed
Salts, Dissolved chemicals	No removal	Removes many

- Output to supplement water supplies



- Cost-effective water purification

Reverse osmosis (RO) membranes provide a cost-effective water purification solution for wastewater reclamation facilities. The Public Utilities Board (PUB) in Singapore,

Singapore operating cost similar to proposed plant

- RO is highly effective in removing the remaining contaminants that still exist in the water after it has undergone ultrafiltration:
  - smaller viruses
  - Unlike ultrafiltration, removes dissolved nutrients, and other salts and chemicals, including emerging contaminants and so-called "forever chemicals". The water is now almost completely pure.
- RO is increasingly being used for wastewater reclamation, having become much more efficient and cost-effective in recent years (see Waterworld magazine's website)
- A review of Singapore's Bedok plant suggests energy use and cost is on par with the proposed treatment plant
- Substantially lower than those in the Officers report: it is important to remember that the water being filtered by the RO will already be very clean, and the amount of contaminant to be removed is orders of magnitude lower than for, say, a desalination plant, so the energy cost is also much lower.

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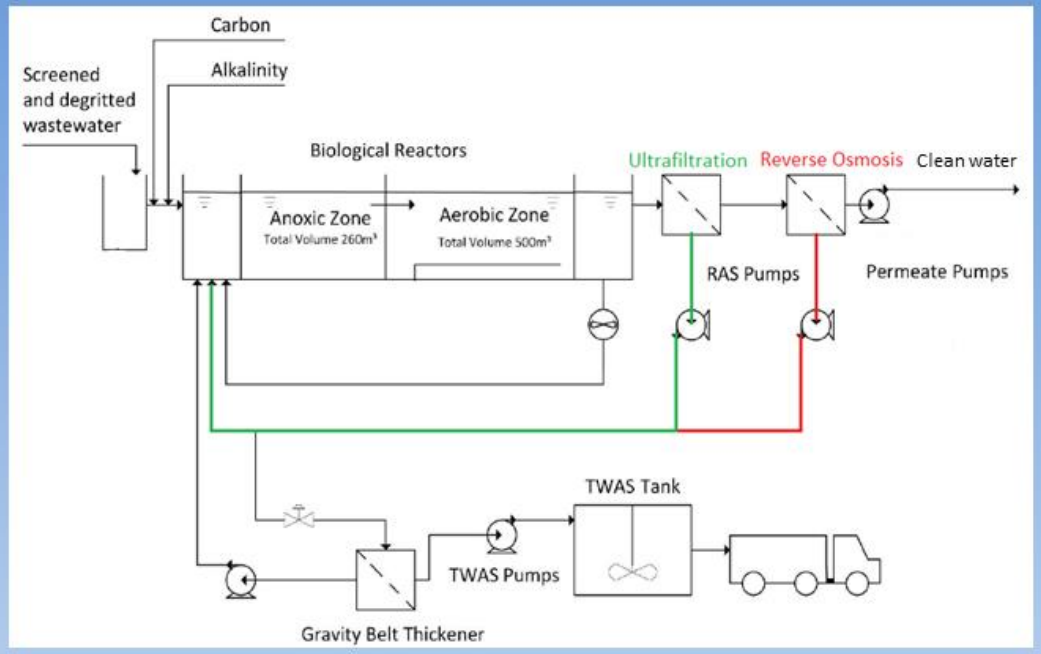
Recycle retentate through WWTP

- Highly treated wastewater input minimises retentate
- Recycle retentate through the plant
- Same as ultrafiltration in current proposal



- The officers report quotes a rejection rate of up to 40% (i.e. 40% of the water fails to go through the filter and remains as polluted concentrate), but modern facilities such as in Singapore have RO filters that bring that down to 15%
- The WWTP design proposed by Council includes recycling the ultrafiltration retentate back through the biological rector for further nutrient removal, and to provide nutrients for the nitrification step
- We are proposing to do the same thing with the reverse osmosis retentate:
  - Dissolved nitrates are returned to the biological rector for further removal
- Remaining nitrates and other dissolved contaminants (chemicals) can be precipitated out by adding other reactants, and they are then removed with the sludge

Result

- **Three Waters climate resilient system**
  - Akaroa broken sewer network fixed
  - Water returned to town to alleviate water shortage
- **Modern plant installed**
- **Takapūneke turned off sooner than planned**
  - All water passes over land through wetland
- **Costs spread over 3 LTP cycles**
- **Akaroa system a real exemplar for rest of NZ**

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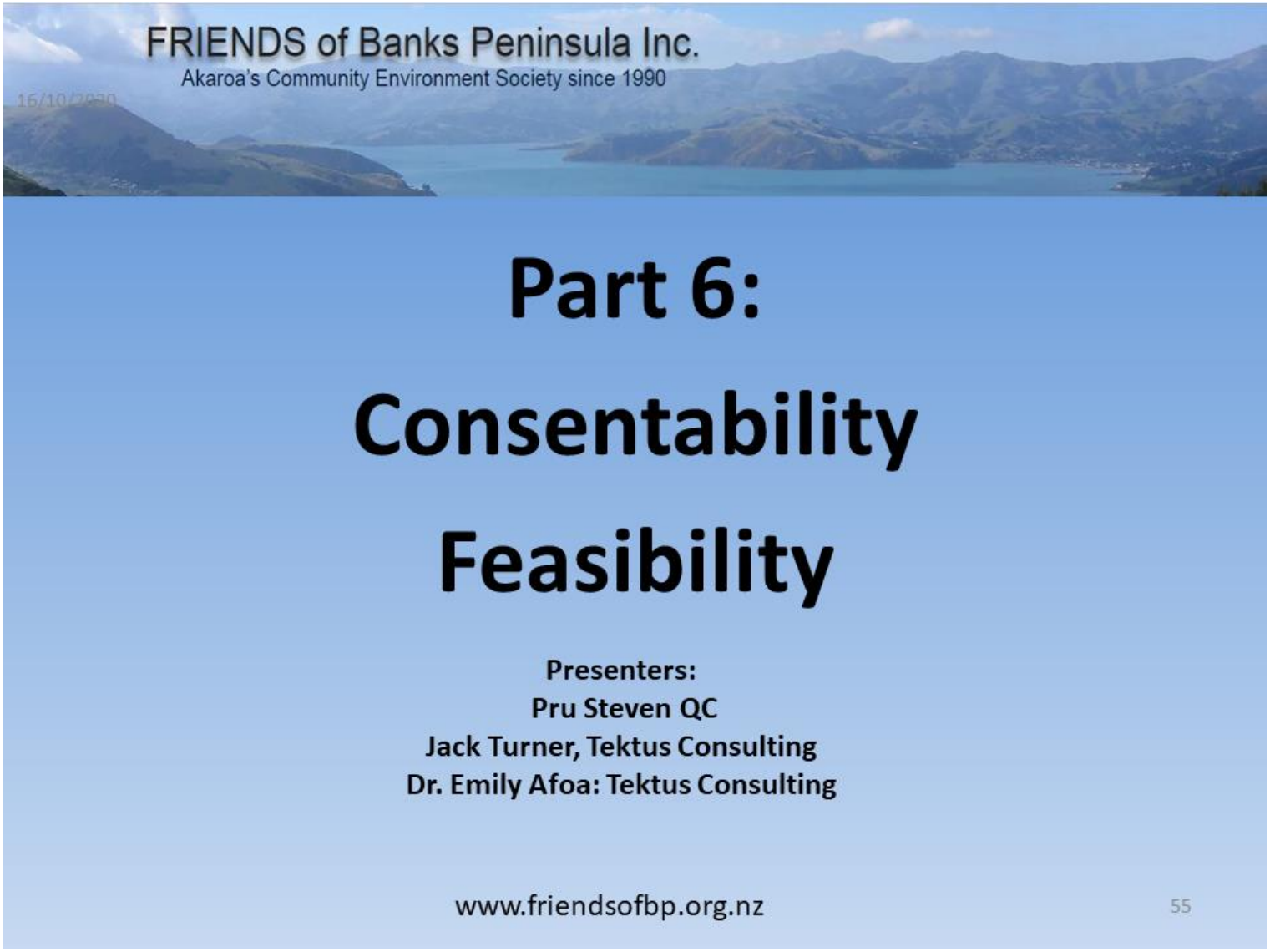
Summary of decision sought

1. **Stop and rethink path forward**
   - set aside the current options
2. **Reduce I&I to below 30%**
3. **Set up a new multi-disciplinary team**
   - focus on Integrated Three Waters solution with government
4. **Adopt a new integrated solution**
   - focused on climate resilience
   - reusing water in Akaroa where it is most needed
5. **Work with government to change legislative framework to enable full recycling**



- See expert memos in compendium of material supplied to the hearing panel

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