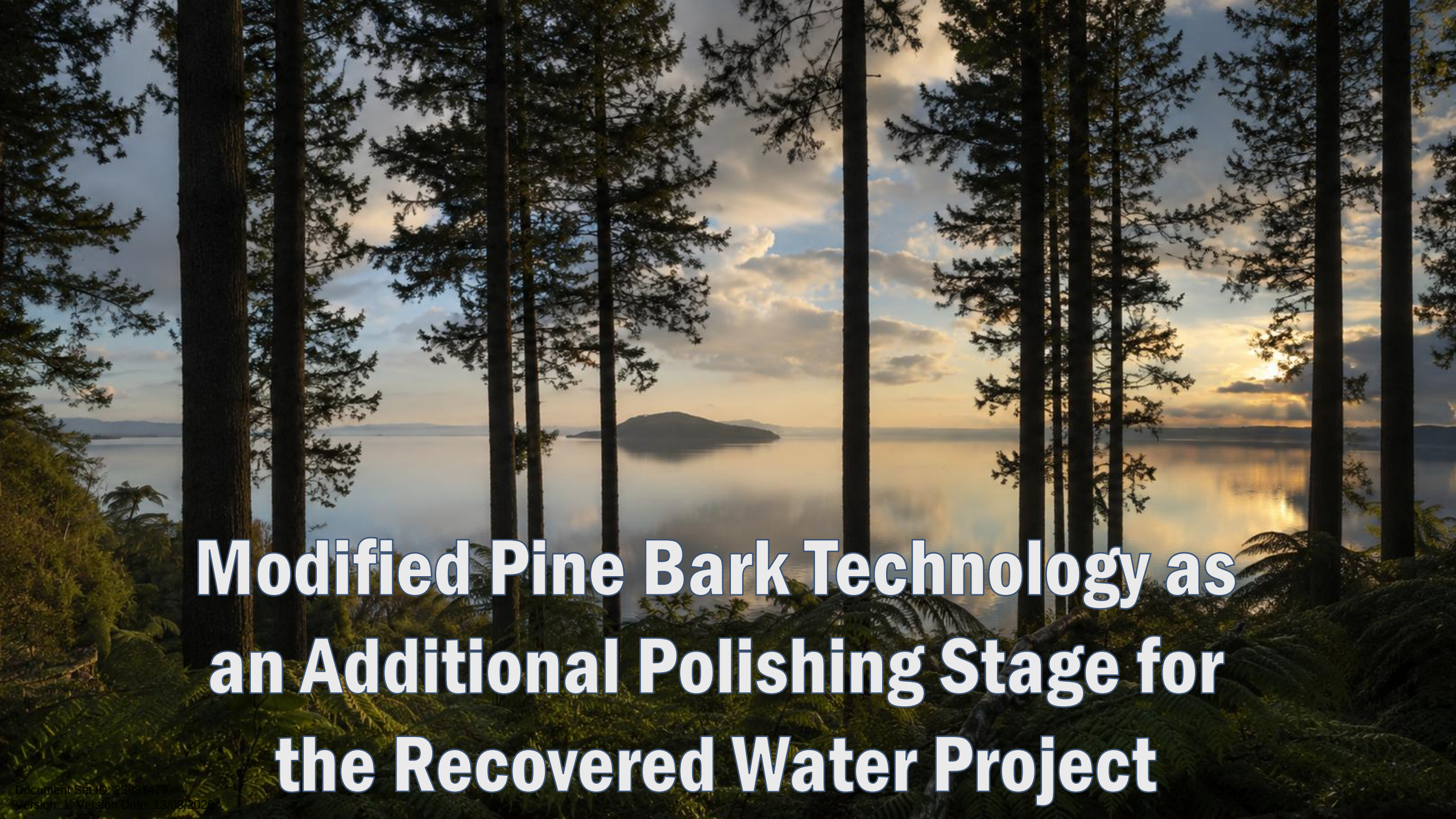
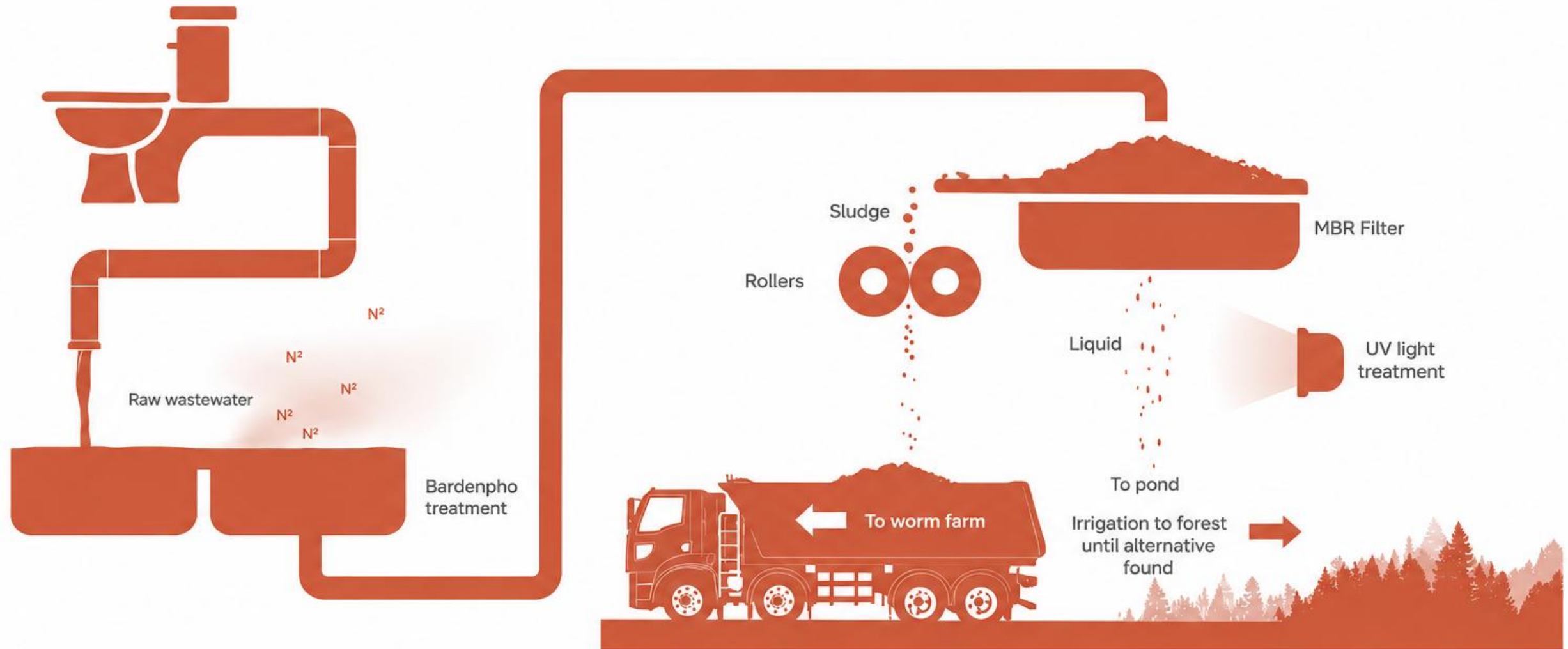




Modified Pine Bark Technology as an Additional Polishing Stage for the Recovered Water Project

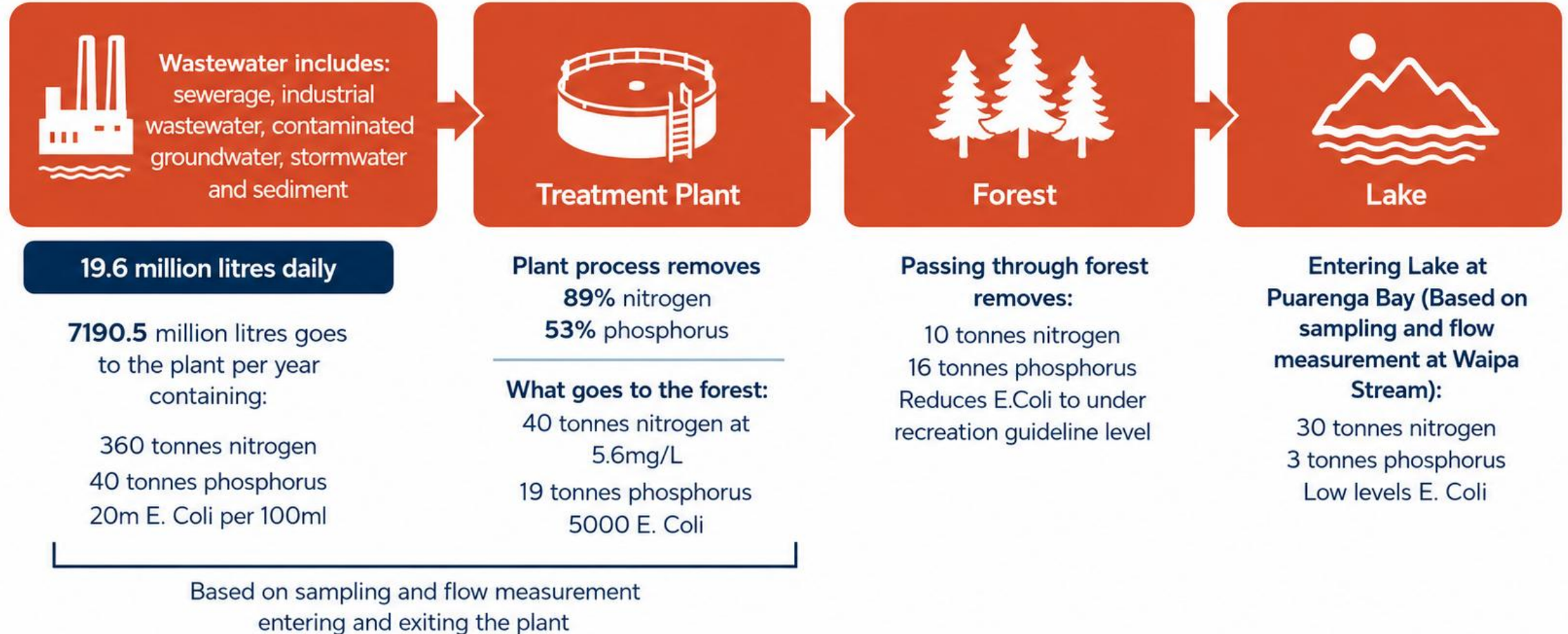
WHERE ARE WE NOW?



WHERE ARE WE NOW?

HOW DOES THE PLANT WORK?

Current Wastewater Treatment Plant - NOW



Note: with the forest process becoming more unreliable, nutrient removal is becoming less effective.

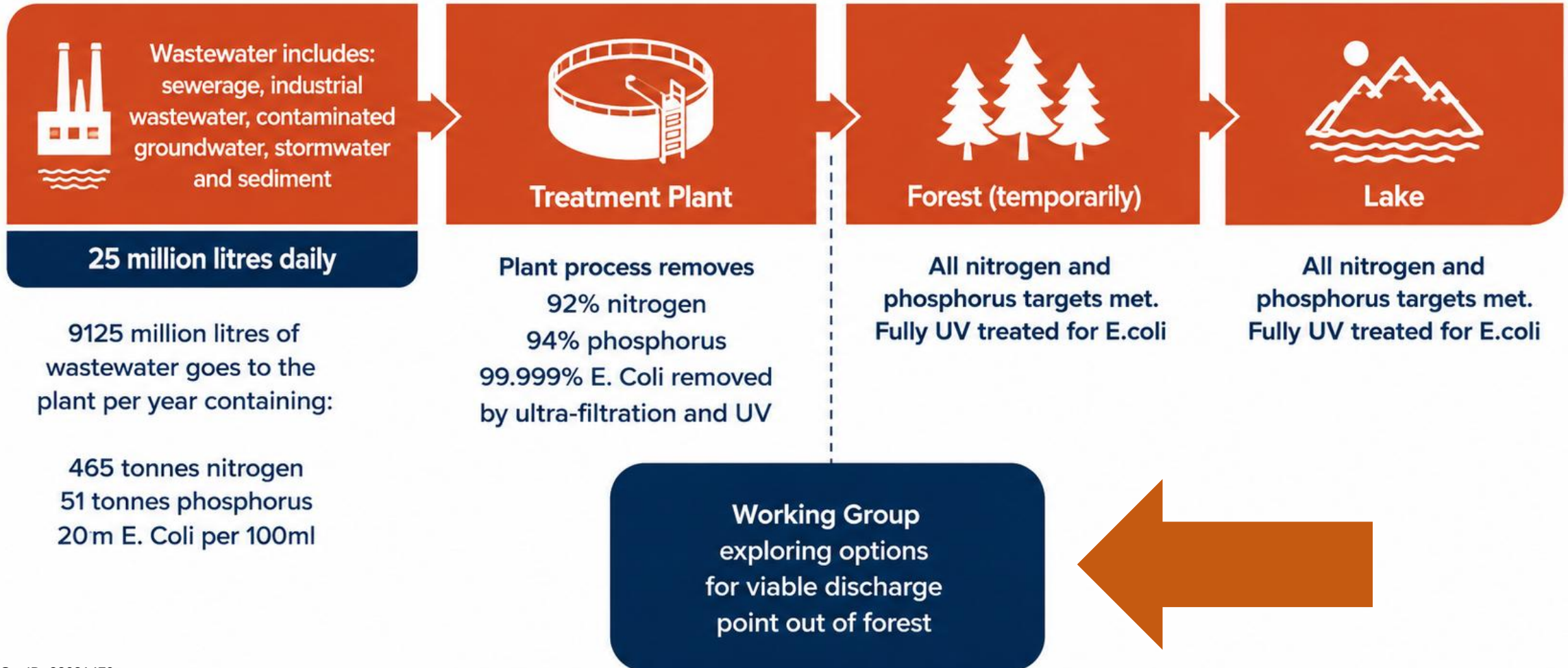
WHERE ARE WE NOW?

HOW WILL THE UPGRADED PLANT WORK?

Proposed Wastewater Treatment Plant Upgrade

(Factoring in population growth)

Entire treatment process removes a total of: **426 tonnes nitrogen/48 tonnes phosphorus**



OBJECTIVE

To identify the best long-term solution for managing Rotorua's highly treated wastewater, while protecting Lake Rotorua and the wider environment.

THE CHALLENGE

Conventional treatment processes are not specifically designed to remove all pharmaceutical residues and other emerging contaminants.

THE CHALLENGE

Throughout consultation on the Recovered Water Project, our Community has consistently sought assurance that Council will pursue the HIGHEST practical level of environmental protection.

THE OPPORTUNITY

Investigating a scientifically supported polishing technology, demonstrates Council's COMMITMENT to continuous improvement and innovation.

THE OPPORTUNITY

OULU 2026
C 1054



UNIVERSITATIS OULUENSIS

Mahdiyeh Mohammadzadeh

ADSORPTION AND
DEGRADATION OF
RESIDUAL
PHARMACEUTICALS
IN WATER

UNIVERSITY OF OULU GRADUATE SCHOOL;
UNIVERSITY OF OULU,
FACULTY OF TECHNOLOGY



Researchers at the University of Oulu, Finland have developed a “Magnetite-modified pine bark adsorption medium” specifically for the removal of pharmaceutical residues from treated municipal wastewater.

HOW DOES IT WORK?



Pine bark columns efficiently remove pharmaceutical residues from wastewater. Image: Mahdiyeh Mohammadzadeh / University of Oulu

HOW DOES IT WORK?

1 SOURCE

Highly treated MBR effluent contains trace pharmaceuticals and other organic contaminants



2 ADSORPTION MEDIA

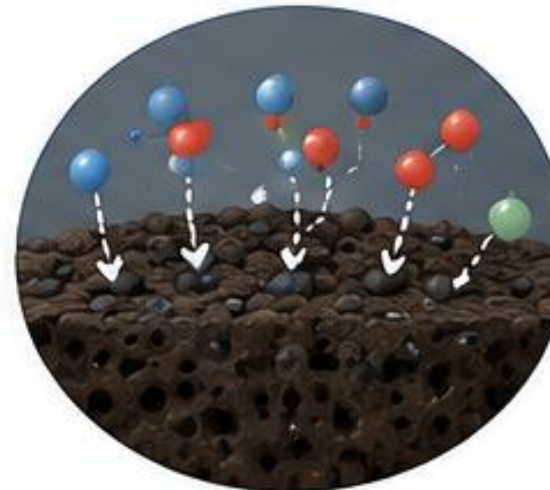
Pine bark is modified with magnetite (iron oxides) to create a high surface area adsorbent



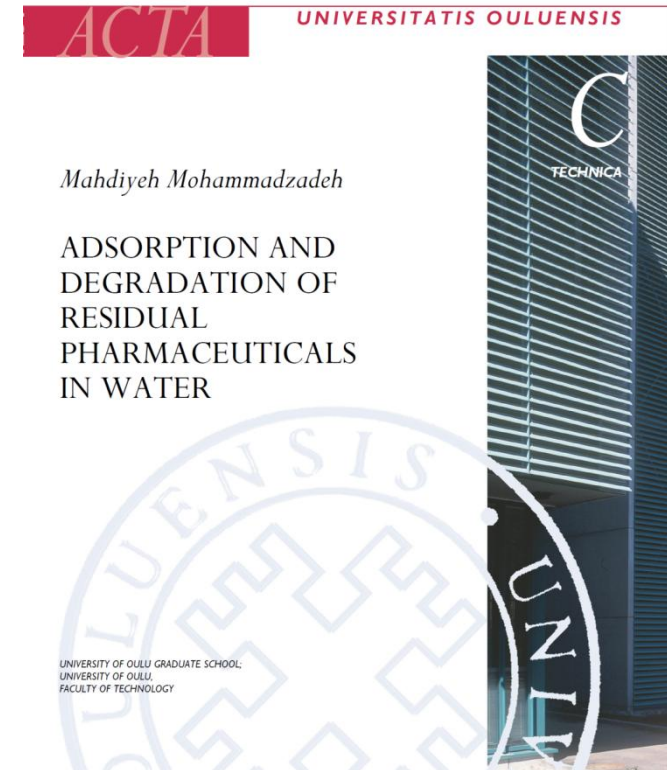
Magnetite-modified pine bark (MPB)

3 ADSORPTION PROCESS

Contaminant molecules are attracted to and bind to the surface of the modified bark



- Pharmaceuticals
- Antibiotics
- Other organic contaminants



Source: Mahdiyeh
Mohammadzadeh
/ University of Oulu

HOW DOES IT WORK?

4 FILTRATION COLUMN

Effluent flows through a packed bed of MPB where adsorption continuously occurs



5 TREATED WATER

Contaminants removed. Cleaner water leaves the column. Media ready for regeneration



6 REGENERATION & REUSE

Adsorbed contaminants are released using a mild regeneration process and the media is reused



Source: Mahdiyeh
Mohammadzadeh
/ University of Oulu

WHY MODIFIED PINE WORKS



NATURAL & RENEWABLE

Uses abundant pine bark – a forestry by-product



MAGNETITE ENHANCEMENT

Iron oxides increase surface chemistry and binding capacity



STRONG ADSORPTION

Binds a wide range of pharmaceuticals, antibiotics and other organics



REGENERABLE & REUSABLE

Media can be regenerated and reused multiple times, reducing costs and waste

Source: Mahdiyeh Mohammadzadeh / University of Oulu

RESULT



Removes >90% of key pharmaceuticals in pilot-scale testing



Performs as well as activated carbon at much lower cost



Supports a more sustainable, locally sourced solution



Delivers cleaner, safer water for Rotorua and our environment

Source: Mahdiyeh Mohammadzadeh / University of Oulu

OTHER BENEFITS-EFFECTIVELY REMOVES METALS

	Iron (ppm)	Copper (ppm)	Zinc (ppm)		Iron (ppm)	Copper (ppm)	Zinc (ppm)
Paint only 1	245	1.4	6.04	Cu laced 1	218	5.08	6.88
Paint only 2	245	1.28	5.48	Cu laced 2	211	5.62	5.17
Paint only 3	217	1.26	5.06	Cu laced 3	215	5.06	5.31
average	235.6667	1.313333	5.526667	average	214.6667	5.253333	5.786667
PO filtered 1	0.48	0.016	5.89	Cu filtered 1	0.06	0.0366	0.061
PO filtered 2	0.2	0.016	0.164	Cu filtered 2	0.16	0.0422	0.056
PO filtered 3	1.02	0.0149	5.82	Cu filtered 3	0.19	0.0522	0.109
average	0.566667	0.015633	3.958	average	0.136667	0.043667	0.075333
Efficiency (%)	99.75955	99.9881	99.28384		99.99936	99.99169	99.98698

Similar forestry-derived adsorption technology tested by Scion, has also demonstrated removal of Metals.

Source: NZ Institute for Bioeconomy/Science (Scion)

INTERNATIONAL RESEARCH IS EXPANDING

Iron Modified Pine Bark has been shown to be effective at removing contaminants.

Research Organisation

- ✓ University of Oulu
- ✓ US Forest Service
- ✓ Scion

Contaminant Removed

- ✓ Pharmaceuticals
- ✓ Pesticides
- ✓ Iron, Copper & Zinc

THE SCION CONNECTION

Following review of the Finnish research, scientists from Scion advised that:

- NZ Radiata pine has been shown to have greater contaminant binding, than that used by the University of Oulu.
- The quantity of bark needed for use 'at scale' is readily available, AND cost-effective.

Quote: *"Short story – we CAN do what they did in their thesis, with our pine resource."*

WHAT COULD THE PLANT LOOK LIKE?



WHAT COULD THE PLANT LOOK LIKE?



Mock-up generated with the assistance of AI

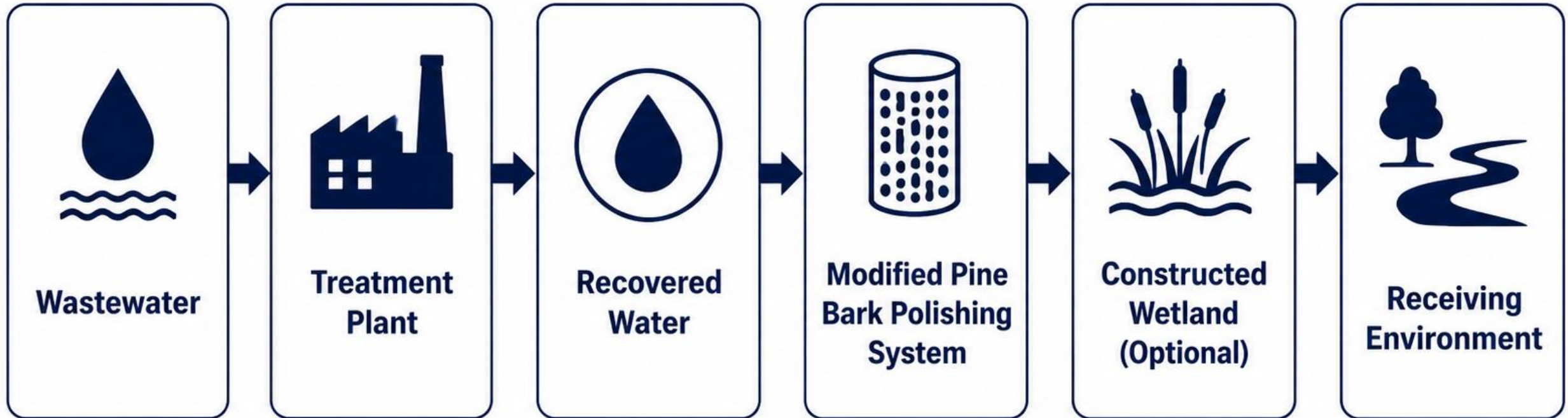
WHAT COULD THE PLANT LOOK LIKE?



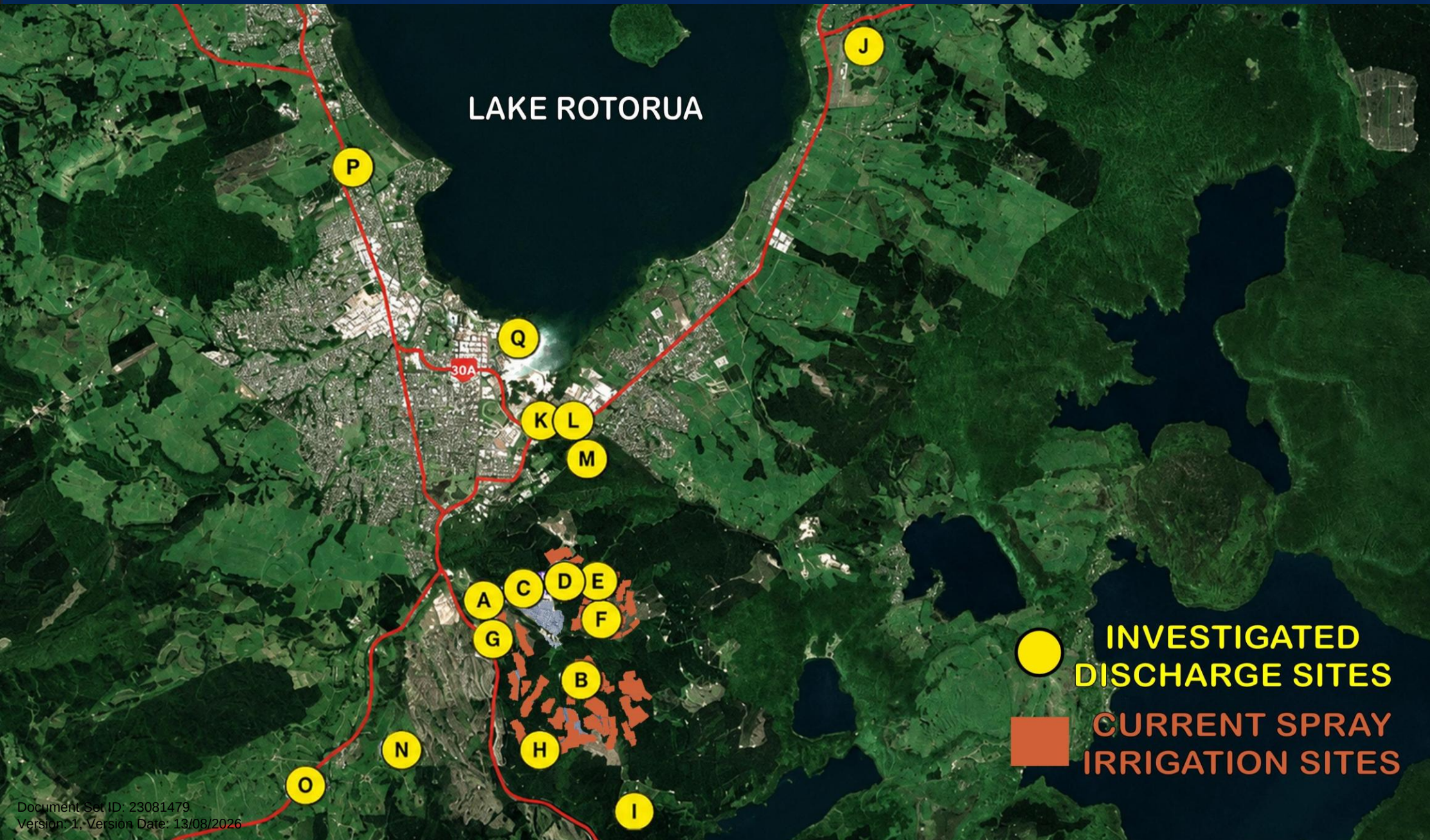
Mock-up generated with the assistance of AI

HOW WOULD IT FUNCTION?

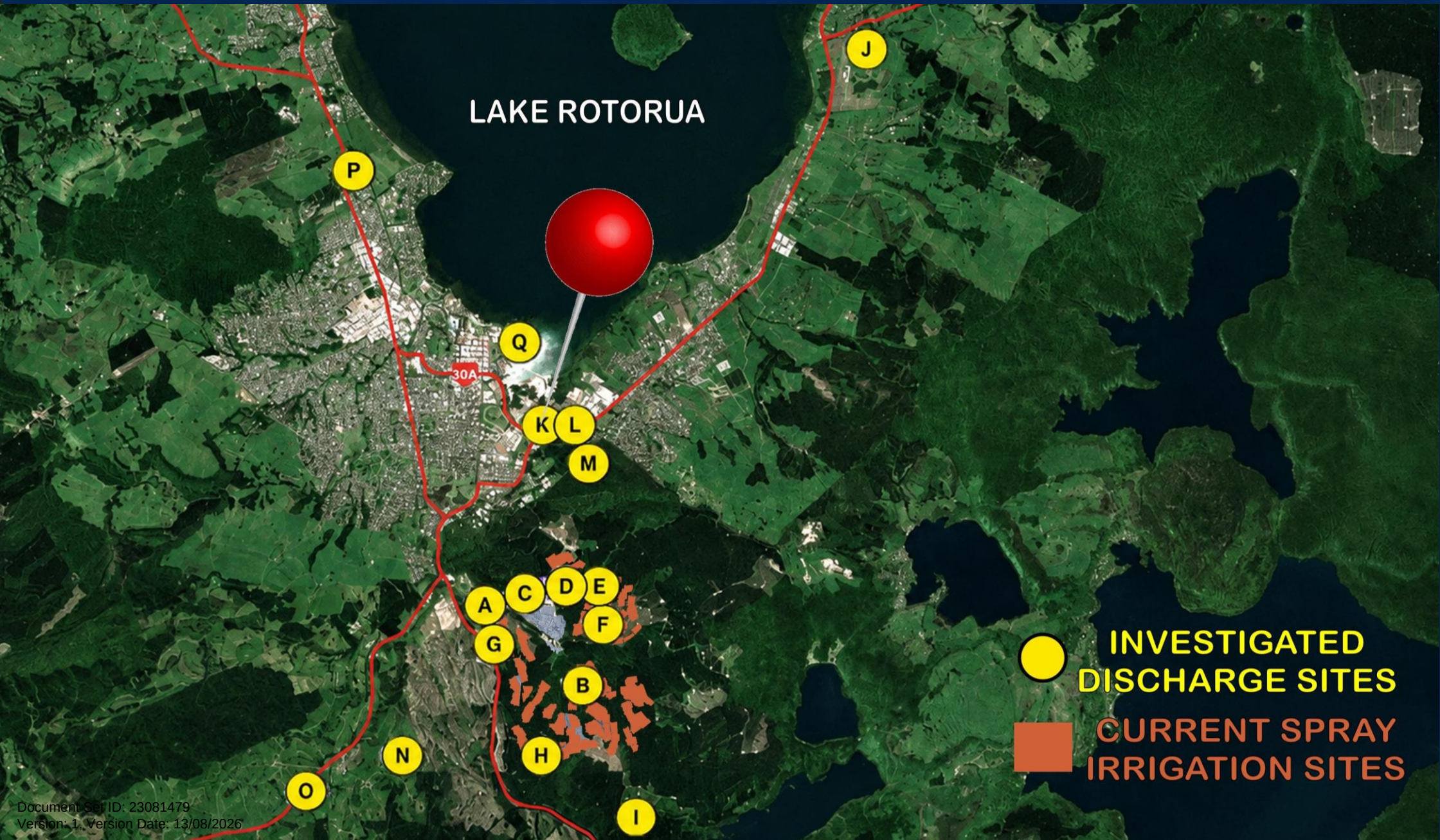
POTENTIAL FUTURE PROCESS



CHALLENGE-THE DISCHARGE POINT



SOLUTION-THE DISCHARGE POINT-SITE K

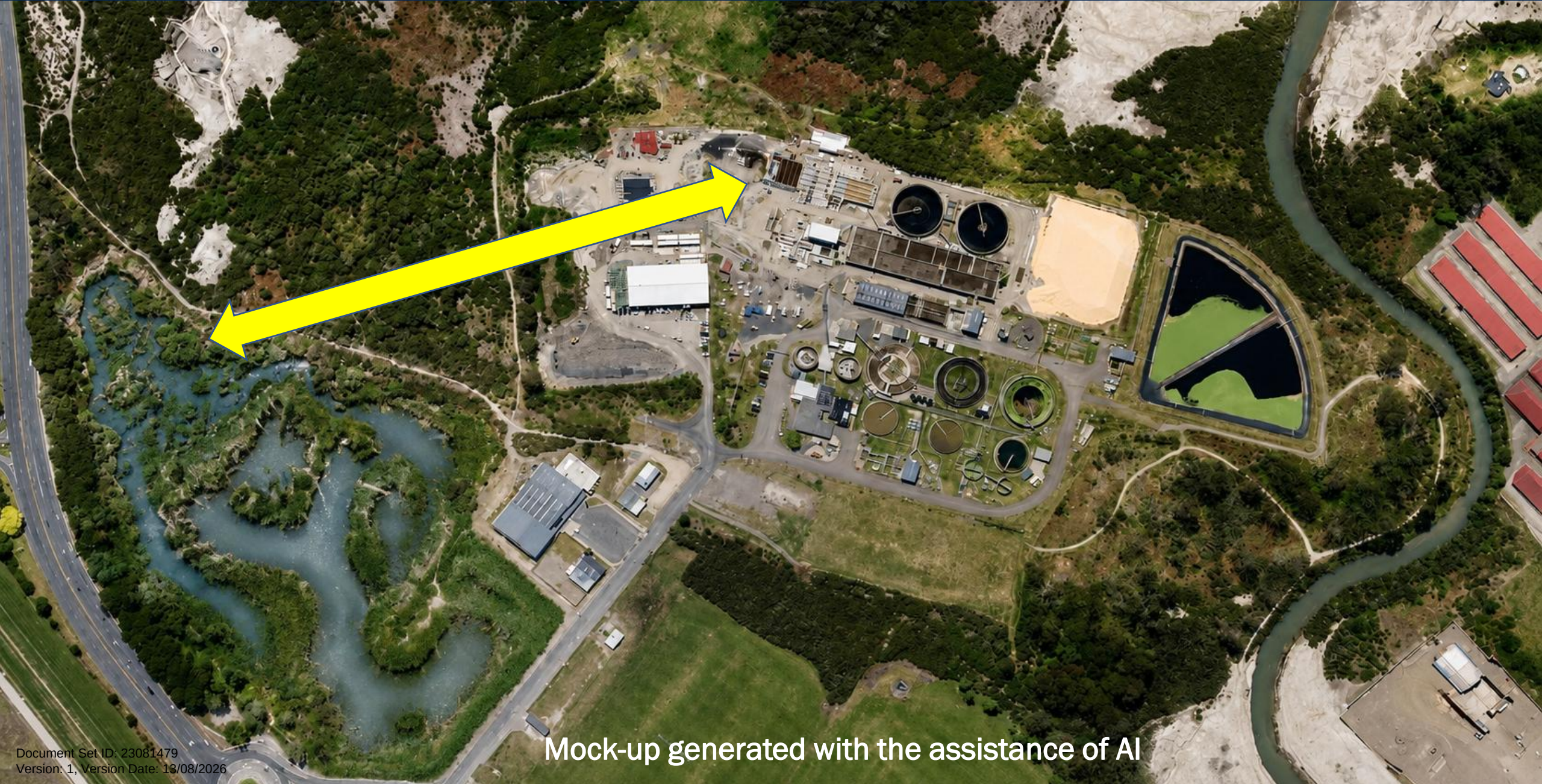


SOLUTION-THE DISCHARGE POINT-SITE K



Mock-up generated with the assistance of AI

SITE K IS THE CLOSEST PRACTICAL POINT



Mock-up generated with the assistance of AI

SITE K-CONSTRUCTED WETLAND



Mock-up generated with the assistance of AI

ADDITIONAL POLISHING OF RECOVERED WATER



- ▶ Artificial wetlands modelled on natural systems but engineered to varying degrees to improve specific functions, predominantly water quality improvements.
- ▶ Treatment CW mimic processes occurring in natural systems (chemical, physical, biological) to remove a variety of pollutants.

Mock-up generated with the assistance of AI

QUESTION



Does incorporating Modified Pine Bark Technology, with a Constructed Wetland, achieve the objectives of the Recovered Water Project?



Find a suitable discharge site.
Identify a location that meets technical, regulatory and environmental requirements.



Protect the environment.
Enhance water quality and support ecological health.



Deliver value for money.
Reduce long-term operational costs and maximise resource efficiency.



Maintain public confidence.
Demonstrate responsible environmental stewardship and community benefit.

Modified Pine Bark Technology, integrated with a Constructed Wetland, offers a scientifically proven, locally sourced solution that can deliver **cleaner water, stronger environmental outcomes, enhanced biodiversity, recreational benefits and long-term value** for ratepayers. Before committing to an irreversible long-term solution, the Recovered Water Working Group has an opportunity to recommend an **innovative approach** that not only meets the objectives of the Recovered Water Project, but creates a **lasting legacy for Rotorua**.



THANK YOU FOR YOUR TIME