HYDRACULTURE

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Final Landscape Architecture Project 2022

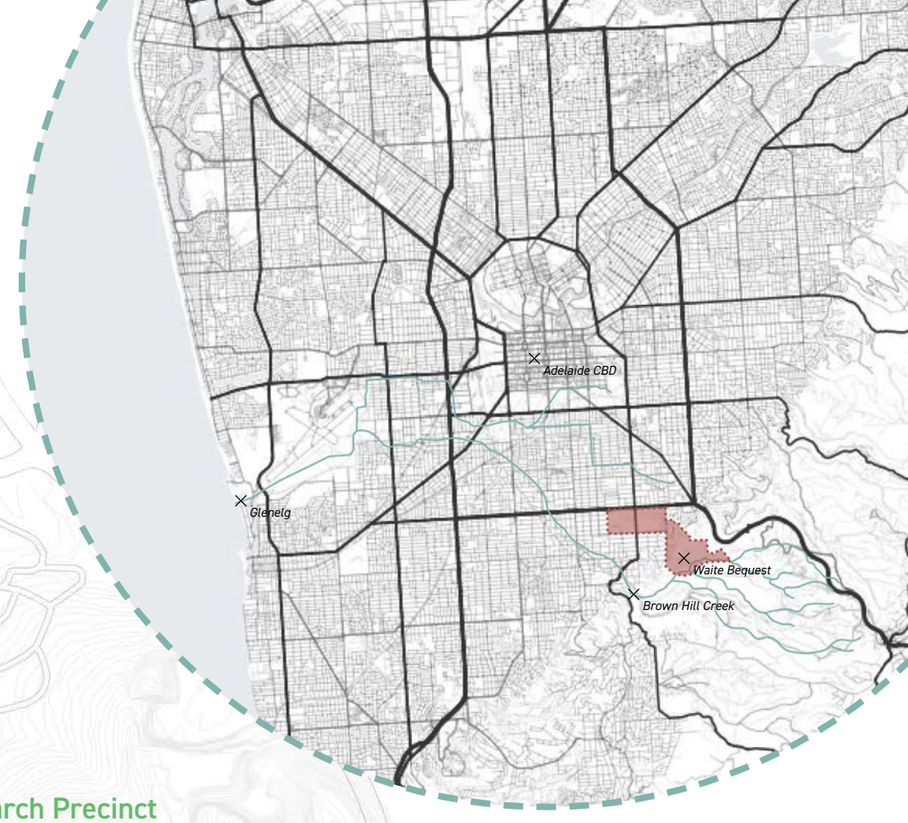
Overview | Food and the City.

TAFE + High School Grounds
45 Hectares

Heritage + Agricultural Precinct
54 Hectares

Research Precinct
31 Hectares

Conservation Reserve
127 Hectares



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Waite Bequest Zoning

Scale | 1:10000 @ A3

0 200 400 600 1000m

Site Considerations: Zoning and Land Use Regulations.

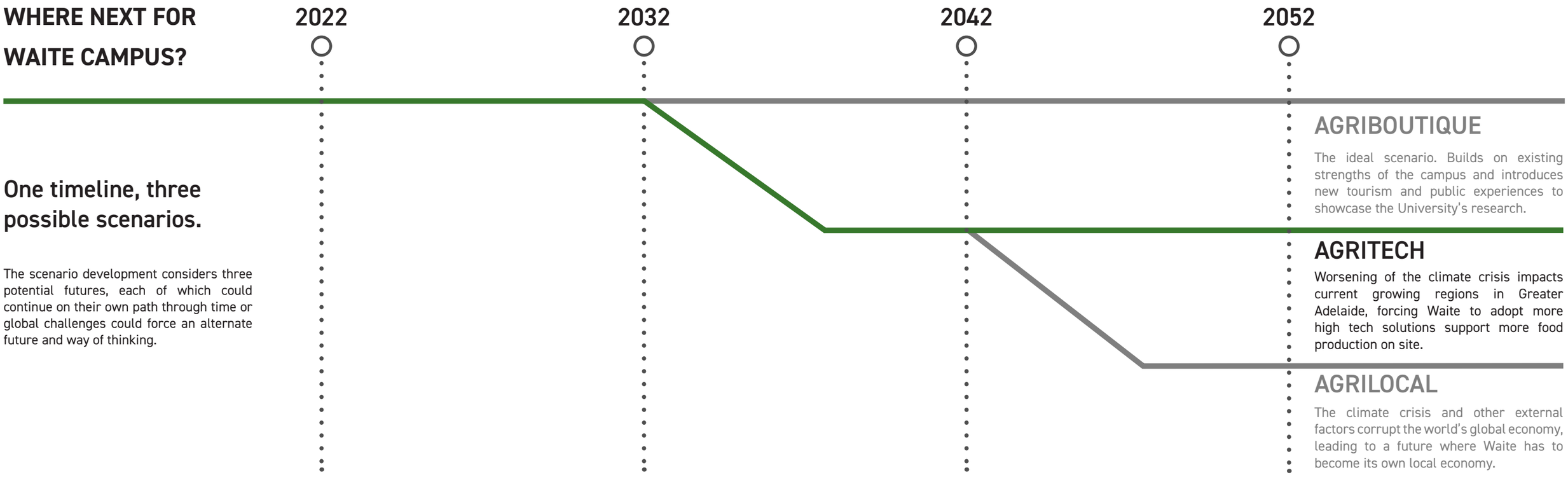
TAFE + High School Grounds: Agricultural high school.

Heritage + Agriculture Precinct: Scientific studies of agriculture, botany, entomology, horticulture and forestry, public park + recreation space.

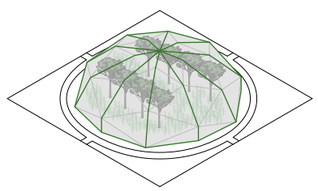
Research Precinct: Later addition in the bequest, purchased to allow university to expand in the future.

Conservation Reserve: The largest and best surviving examples of Grey Box Grassy Woodland in South Australia. Site dedicated for conservation work and the furtherance of scientific knowledge.

Project Origins

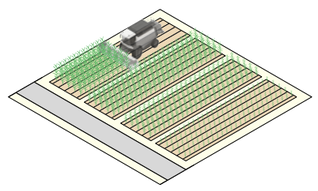


Agritech Projects:



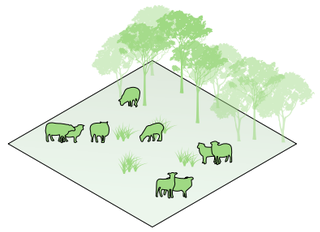
1. Geo Domes

- Artificial environment protects crops from dust storms, extreme temperatures and harsh rain + wind events and provide different growing conditions for a wide variety of crops..



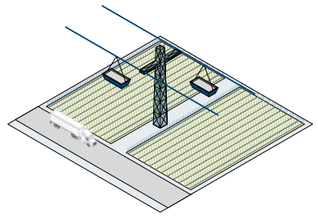
2. Rapid Crop Plantation

- Variations of fast growing, short cycled crops with a quick turn around.
- Genetically modified species developed specifically for changing environment by the university.



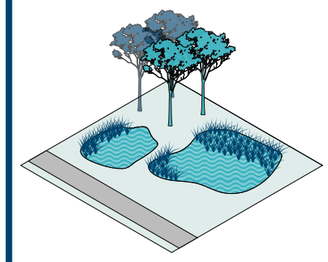
3. Grazing Land

- The outdoor environment has deteriorated significantly, but is still suitable to host livestock as currently practiced in the northern regions.



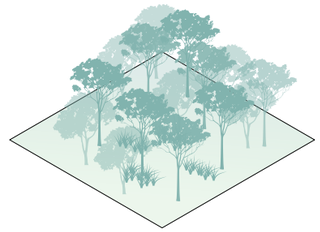
4. Transport Links

- Cable-car and autonomous systems support an increase in food export from the campus site by providing a more efficient method of moving produce.



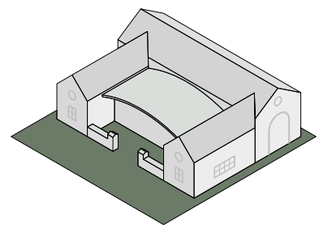
5. Stormwater Harvesting

- Capturing stormwater to support increased food production.
- Limited rainfall events, taking every opportunity to collect as much water as possible.



6. Sheltered Reserves

- Dense vegetation patches provide shelter for livestock during extreme weather events.



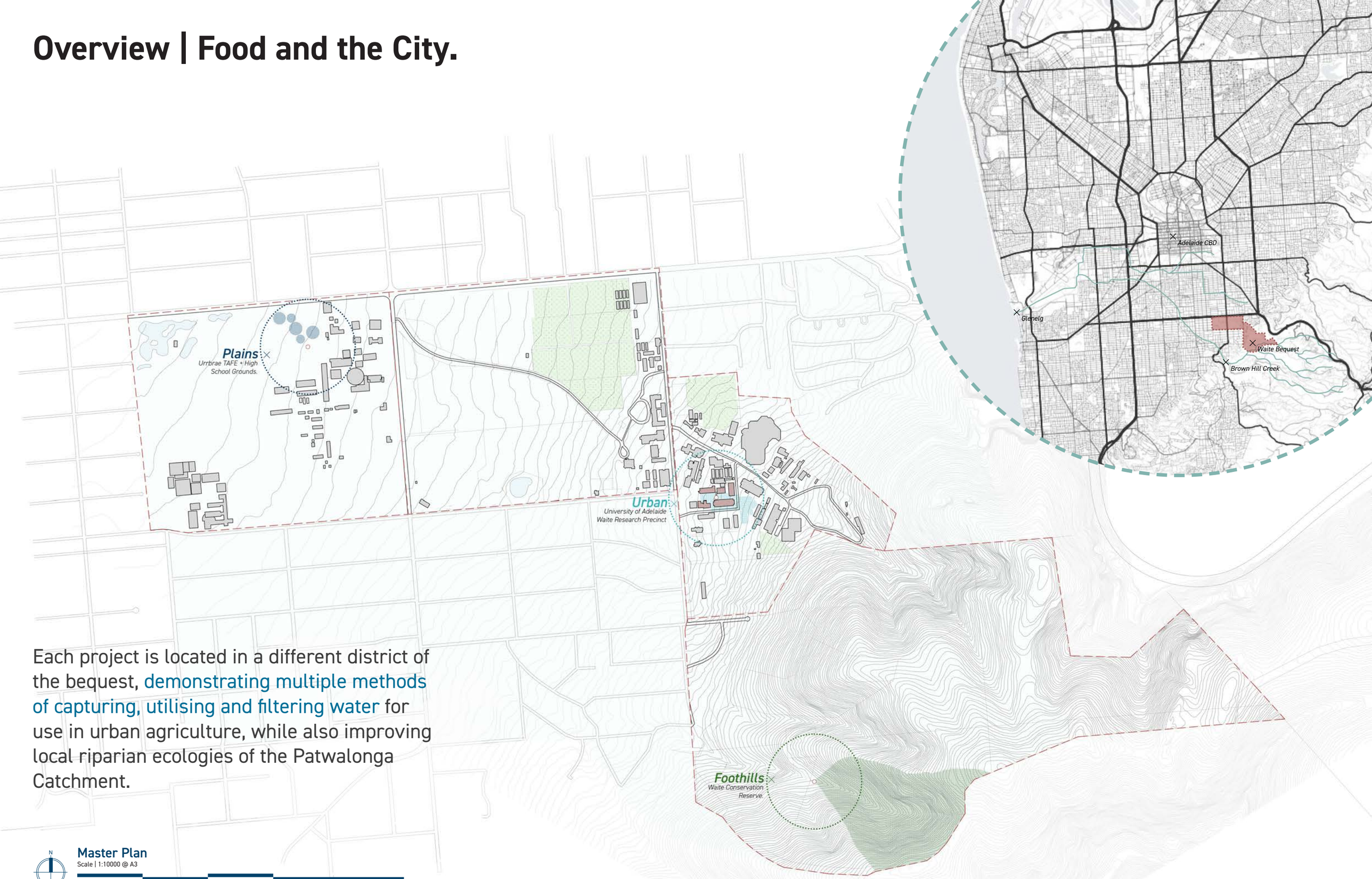
7. Heritage Adaption

- Heritage buildings on site are converted for use as protected growing environments as with artificial conditions.

Three Catchment Typologies, Three Explorations.

Hydraculture explores how we can integrate water systems into urban agriculture more sensibly, with a series of projects across the Waite campus.

Overview | Food and the City.



Each project is located in a different district of the bequest, demonstrating multiple methods of capturing, utilising and filtering water for use in urban agriculture, while also improving local riparian ecologies of the Patwalonga Catchment.

Master Plan
Scale | 1:10000 @ A3

0 200 400 600 1000m

01

PLAINS

Situated on the plains, the first, and largest of the three concepts is the wetland, or 'soak zone'. While constructed wetlands are typical examples of water sensitive urban design, this concept further explores the wetland's potential to be an urban agricultural site, beyond the typical use of irrigation. A series of ponds host various filtration processes before discharging water into the production zone, where aquatic livestock including freshwater fish and yabbies can be raised.

Below: Existing site condition, facing north towards Cross Road.

Catchment Detail

Beyond the Boundaries

The catchment for the wetland extends beyond the Waite bequest boundary into the Brownhill Creek catchment. The catchment includes surface runoff from the Waite Conservation Reserve foothills, the surrounding urban area of Urrbrae and Netherby, as well as runoff from stormwater inlets on Cross Road.

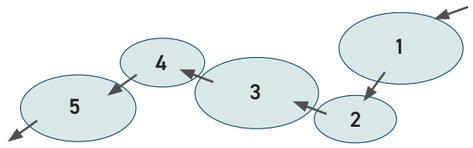
380 Ha
Total catchment area.

360,000,000L
Average annual catchment (Greenslade, 2020).

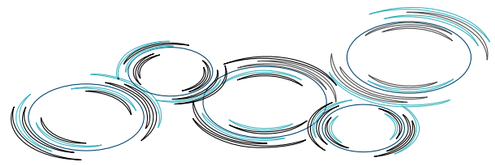
Concept Development

Capillary Waves

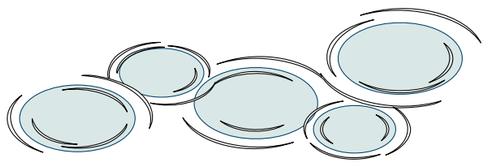
The form for the wetland concept was inspired by droplets hitting the surface of large bodies of water, creating circular ripples across the surface, known as capillary waves. These forms were abstracted to create a series of ponds, each with their own agricultural purpose. The rippling effect is further enhanced by the moon-like shapes which form the boardwalks connecting each of the ponds.



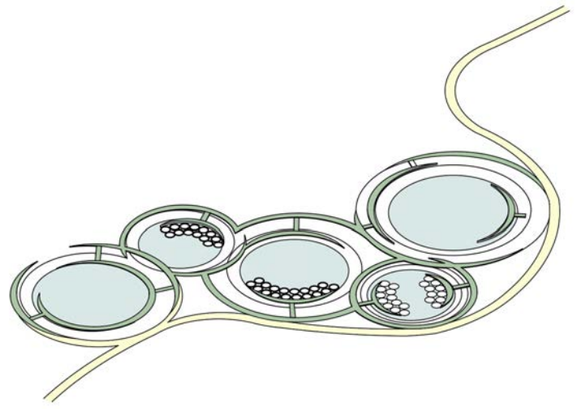
1. Staged Ponds.



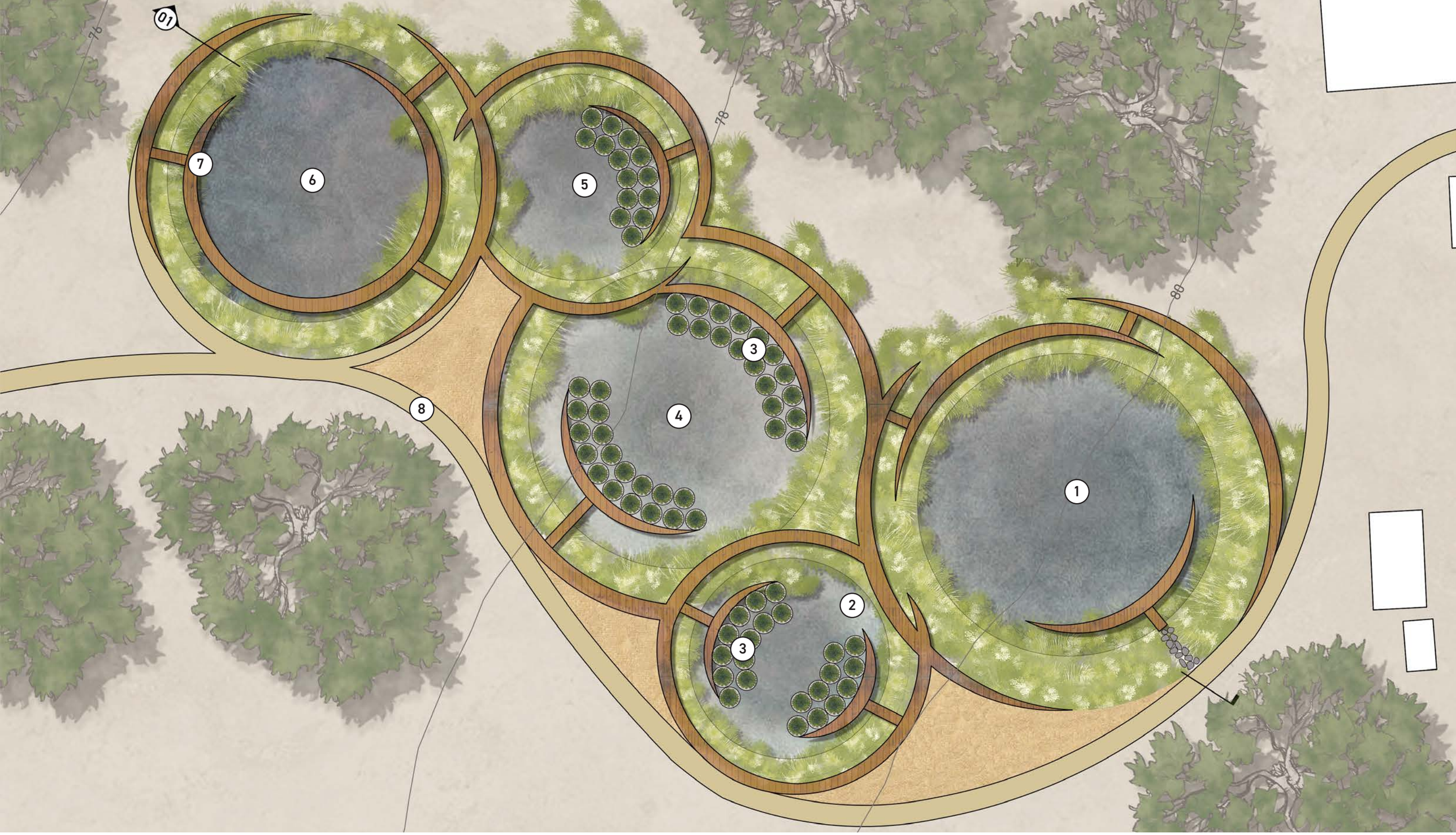
2. Capillary Waves.



3. Form Manipulation.



4. Connection.



Wetland Concept Plan

Scale | 1:500 @ A3

0 10 20 30 50m

1. Inlet + Sediment Basin
2. Macrophyte Zone - Shallow Marsh
3. Aquaponic Grow Pods
4. Macrophyte Zone - Deep Marsh
5. Settling Pond + Yabby Habitat
6. Outlet Basin + Fish Habitat
7. Fishing Deck
8. Water Walkway

Planting Detail

Plants in the wetland concept have been chosen for their filtration ability, as well as specific habitat for aquatic wildlife. Other plants such as *Schoenoplectus mucronatus* and *Triglochin procerum* also ave added benefit as an edible food source, and are grown in the aquaponic pods.

Bidyanus bidyanus
"Silver Perch"

Usage: Fish

Cherax destructor
"Common Yabby"

Usage: Shell Fish

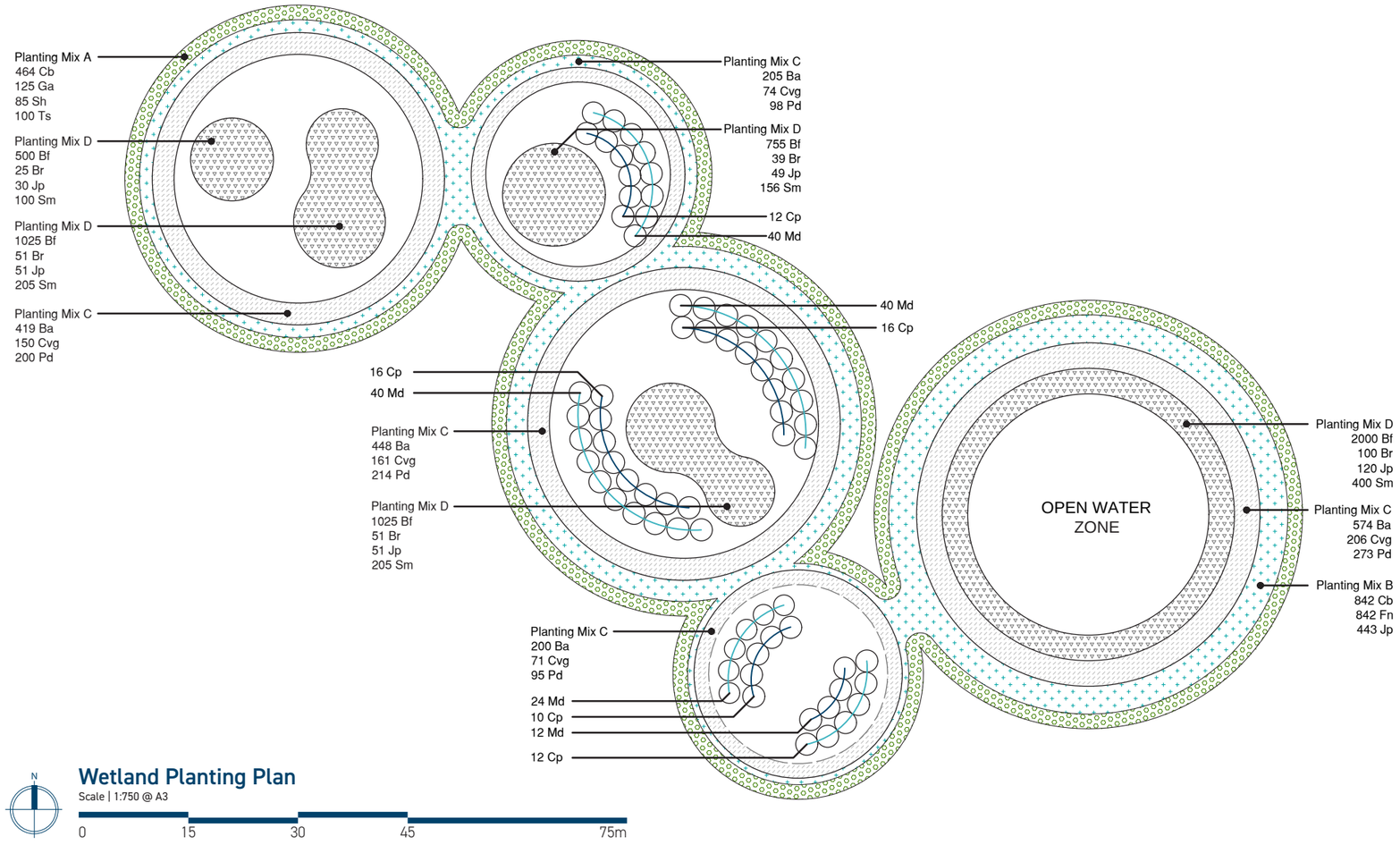
Schoenoplectus mucronatus
"Bog Balrush"

Usage: Starch + Creates Syrup

Triglochin procerum
"Water Ribbons"

Usage: Vegetables

Key	Botanical Name	Common Name	Spacing	Qty
Aquatic Crops				
Cp	Cycnogeton procerum	Giant Water Ribbons	1000	54
Md	Marsielea drummondii	Nardoo	500	116
Planting Mix A	**Groundcover**			
Cb (25%)	Carex bichenoviana	Plains Sedge	800	464
Gc (25%)	Goodenia amplexans	Clasping Goodenia	1500	125
Sh (30%)	Scaevole humilis	Purple Fusion	2000	85
Ts (20%)	Thryptomene saxicola	Thryptomene Supernova	1500	100
Planting Mix B	**Embankment**			
Cb (35%)	Carex bichenoviana	Plains Sedge	800	842
Fn (35%)	Ficinia nodosa	Knotted Club-Rush	800	842
Jp (30%)	Juncus pallidus	Pale Rush	1000	443
Planting Mix C	**Shallow Marsh Zone**			
Ba (30%)	Baumea articulata	Jointed Club-Rush	500	1846
Cvg (35%)	Cyperus vaginatus, gymnocaulos	Flat Sedges	900	662
Pd (35%)	Persicaria decipiens	Slender Knotweed	800	880
Planting Mix D	**Deep Marsh Zone**			
Bf (20%)	Bolboschoenus fluviatillis	River Balrush	500	5305
Br (25%)	Beaumea rubiginosa	Soft Twig-Rush	900	296
Jp (30%)	Juncus pallidus	Pale Rush	1000	301
Sm (25%)	Schoenoplectus mucronatus	Bog Balrush	500	1066



Wetland Planting Plan

Scale | 1:750 @ A3

0 15 30 45 75m

Section 01

Scale | 1:500 @ A3

0 10 20 30 50m

02

URBAN

Situated in the heart of the University of Adelaide's Waite Campus, the urban prototype explores the potential to cultivate market greens, herbs and other leafy salad crops in a series of terraced rain gardens and biofiltration beds. This new green infrastructure transforms the existing carpark and courtyard space into a urban agricultural zone which utilises captured runoff from the streets and rainwater from the roofs of surrounding buildings, while also creating an engaging social space.

Below: Existing site condition, facing east towards the Wine Research Centre.

Catchment Detail

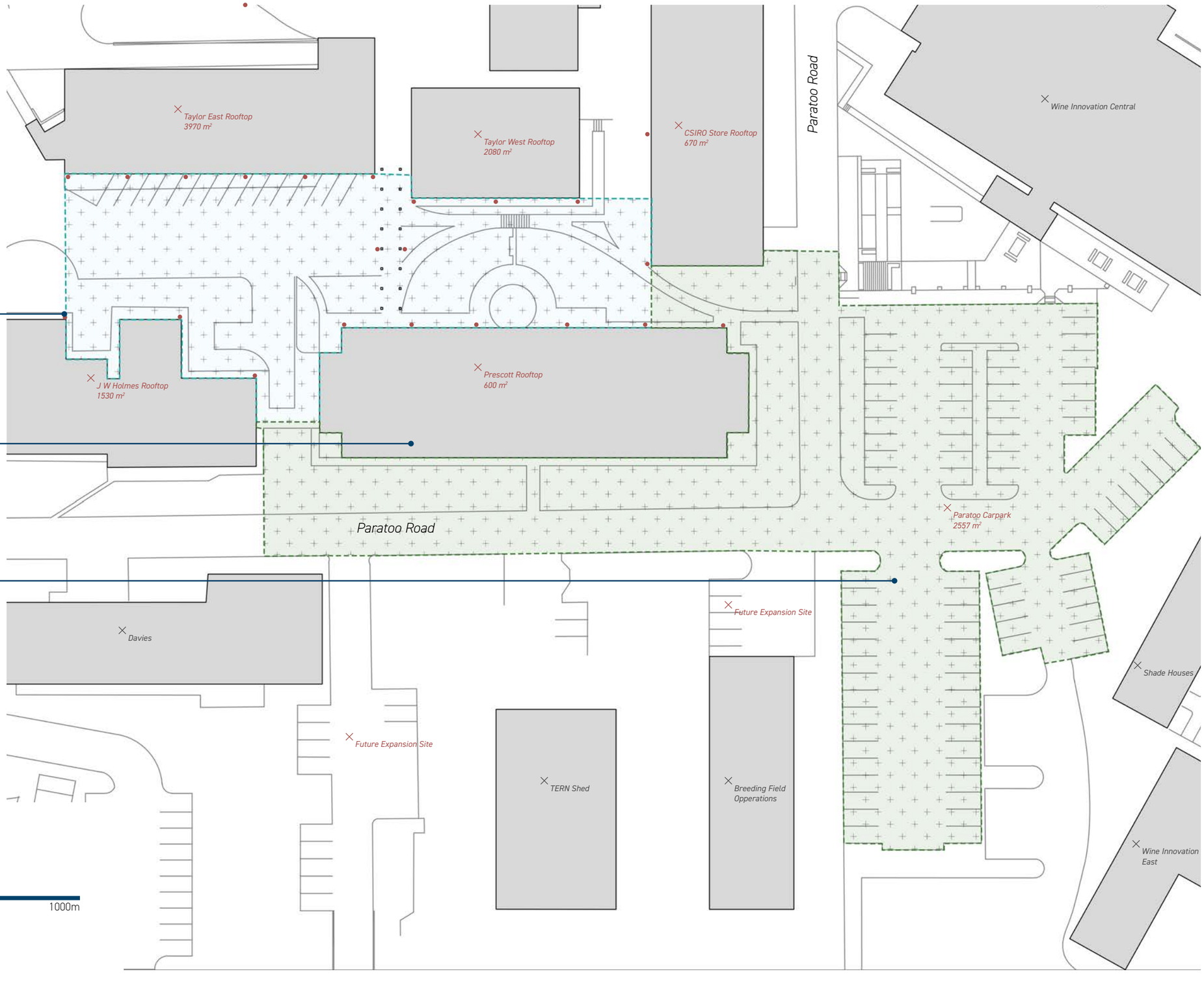
Room to Grow

This proposal transforms and existing carpark into a productive green zone, removing a significant pollution source and also has the potential to be expanded into other carparks across the site during future stages.

21
Downpipe interception points.

6864 m²
Total rooftop collection area.

2557 m²
Carpark collection area.



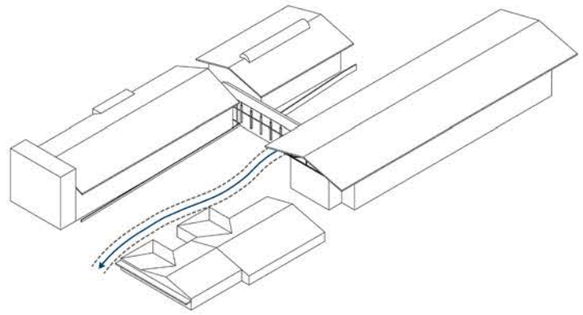
Urban Catchment
Scale | 1:10000 @ A3

0 200 400 600 1000m

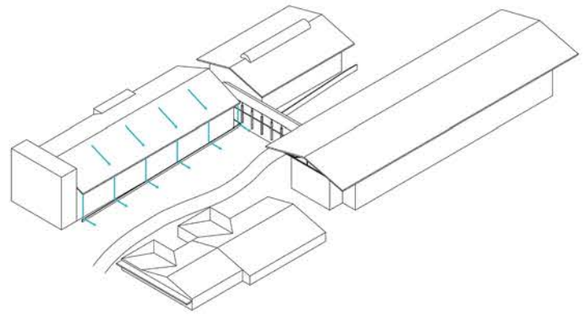
Concept Development

Urban Stream Syndrome

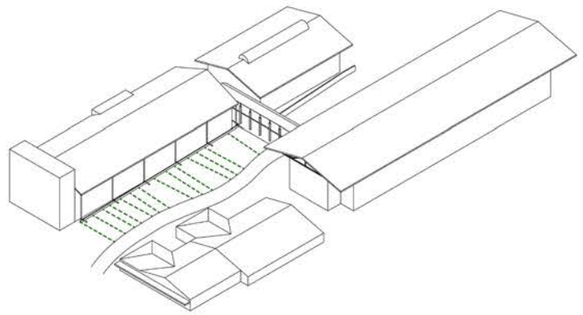
As a response to the strong flows of water across the site due to the lack of on-site stormwater infrastructure and largely impervious ground plane, the urban concept intercepts runoff from the adjacent streets and rooftops and utilises it for urban agricultural use. A series of rain gardens and biofiltration beds improve the quality of water by removing pollutants, and reduces the amount of water entering the stormwater sewer system, thereby reducing the impact of the urban stream syndrome, an issue which can destroy local waterway ecologies due to the high flows, pollution and nutrient overload caused by urban runoff.



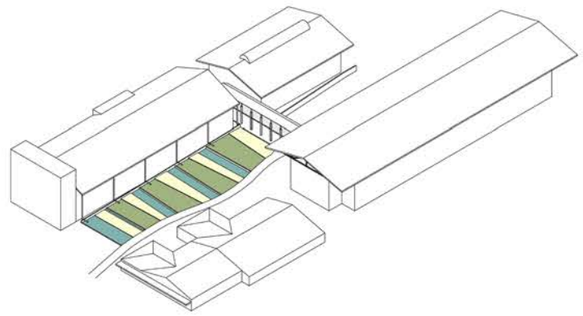
1. Urban Stream.



2. Redirect Rainwater.



3. Divide the Zones.



4. Program Functions.

Urban Concept Plan

Scale | 1:200 @ A3

0 4 8 12 20m

1. Treatment Zone A - Street Runoff
2. Ornamental Water Feature
3. Zone A Underground Storage Tank
4. Water Walk
5. Treatment Zone B - Rain Water
6. Terraced Decks
7. Aquaponic Grow Pods within Water Features
8. Zone B Storage Water Feature + Underground Tank

Planting Detail

Plants in the urban concept have selected and allocated into different zones depending on their tolerance to water. Crops are grown utilising rainwater in the reflection pools supply nearby cafe's with a mix of salad greens which can be used in stir-fries, salads and even to produce sauces.

Nasturtium officinale
"Watercress"

Usage: Vegetables

Mentha diemenica
"Native Peppermint"

Usage: Salads, Tea + Sauces

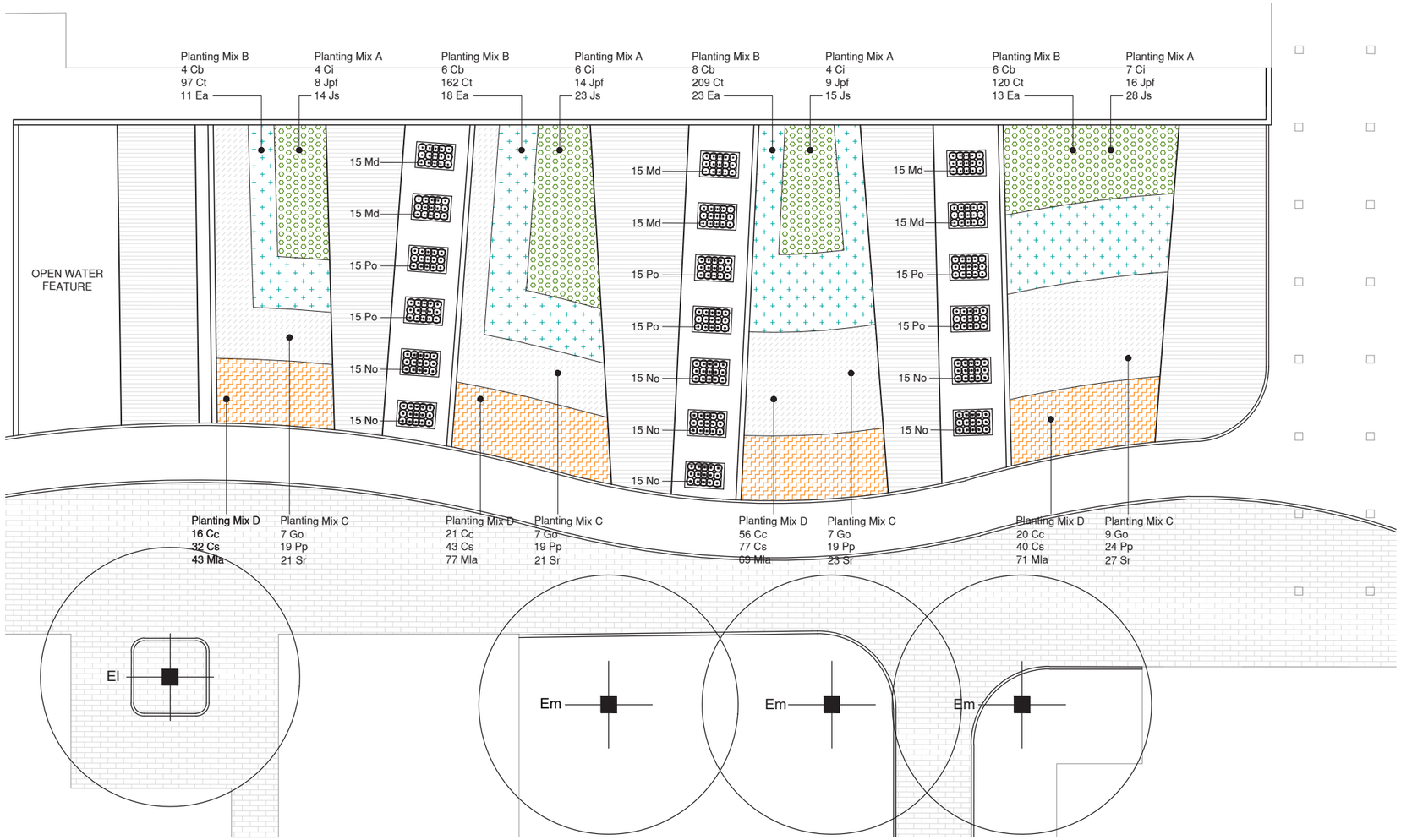
Mentha X piperita f. citrata
"Chocolate Mint"

Usage: Salads + Garnish

Persicaria odorata
"Vietnamese Mint"

Usage: Stir-fries, Salad + Soup

Key	Botanical Name	Common Name	Spacing	Qty
Aquatic Crops				
Md	Mentha diemenica	Native Peppermint	300	90
No	Nasturtium officinale	Watercress	300	105
Po	Persicaria odorata	Vietnamese Mint	300	90
Planting Mix A	**Inlet**			
Ci (35%)	Carex inversa	Knob Sedge	1000	47
Jpf (30%)	Juncus pauciflorus	Loose Flower Rush	600	36
Js (30%)	Juncus subsecundus	Finger Rush	500	65
Planting Mix B	**Treatment Zone A**			
Cb (20%)	Crassula helmsii	Swamp Crassula	800	24
Ct (35%)	Carex tereticaulis	Rush Sedge	200	588
Ea (35%)	Eleocharis acuta	Common Spike Rush	600	65
Planting Mix C	**Treatment Zone B**			
Go (35%)	Goodenia ovata	Hop Goodenia	1000	30
Pp (25%)	Poa poiformis	Blue Tussock Grass	500	82
Sr (40%)	Samolus repens	Creeping Brookweed	600	92
Planting Mix D	**Buffer Zone**			
Cc (50%)	Calocephalus citreus	Lemon Beauty Heads	600	76
Cs (25%)	Chrysocephalum semipapposum	Clustered Everlasting	400	40
Mla (25%)	Microseris lanceolata	Yam Daisy	100	71
Shrubs				
Cr	Callistemon rugulosus	Scarlett Bottlebrush	As Shown	4



Urban Planting Plan

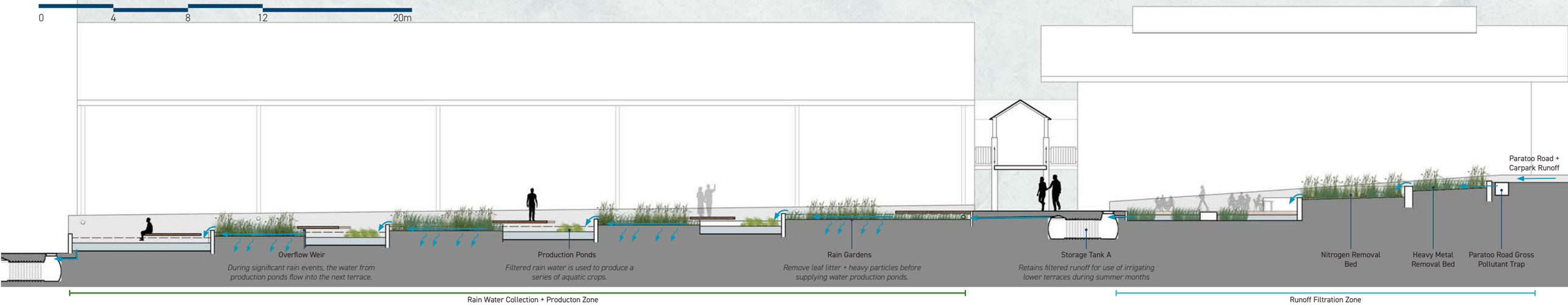
Scale | 1:200 @ A3

0 4 8 12 20m

Section 02

Scale | 1:200 @ A3

0 4 8 12 20m



03

FOOTHILLS

The third project site is situated within the foothills of the Waite Conservation Reserve and explores a sensitive approach to water harvesting and management systems within a rural setting. Inspired by the work of P A Yeomans, the foothills concept adopts the 'keyline' method, a system which utilises the existing site conditions to distribute water more evenly across the site, and also optimise water catchment and storage. Situated in a conservation reserve, the crops produced here are also carefully considered, with a selection of native species which can be used to produce herbs for cooking, as well as fruits which can be used in salads and to create sweet baked goods.

Below: Existing site condition, facing south east up the valley.

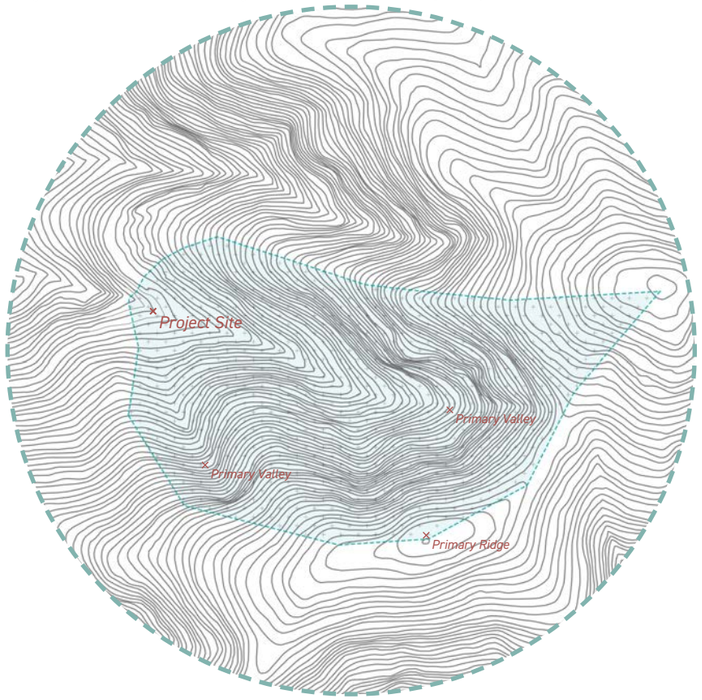
Catchment Detail

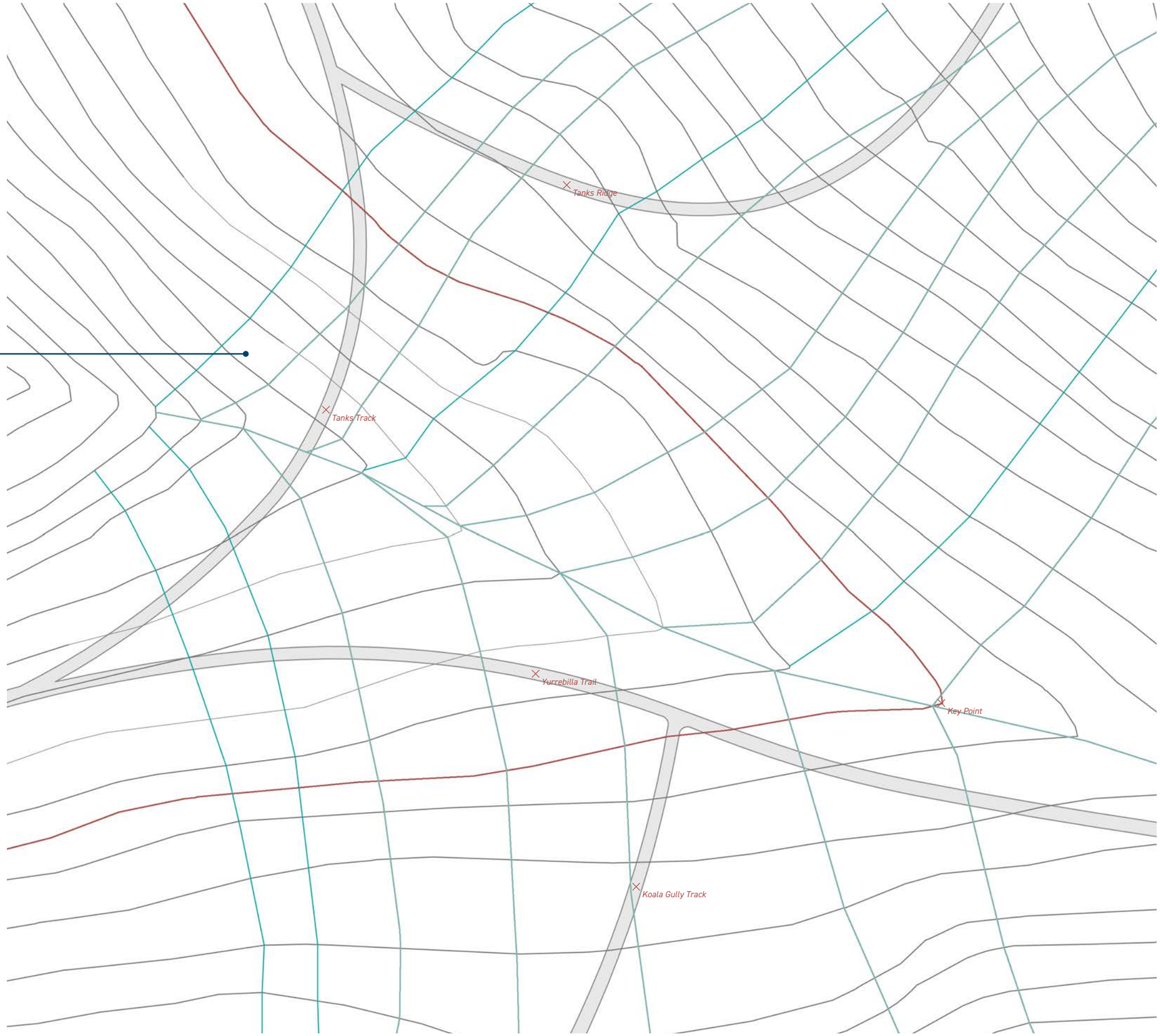
The Lay of the Land

Adopting a more sensitive approach, the foothills concept utilises the existing contours of the Waite Conservation Reserve to mindfully harvest and disperse water across the site for irrigation. Analysis of the site was conducted in Rhino + Grasshopper to analyse the flow of water runoff through the valley.

15.63 Ha
Total Catchment Area

Below: Foothills catchment diagram, identifying primary valleys and ridges, an integral element to understanding and locating Yeoman's keyline system.





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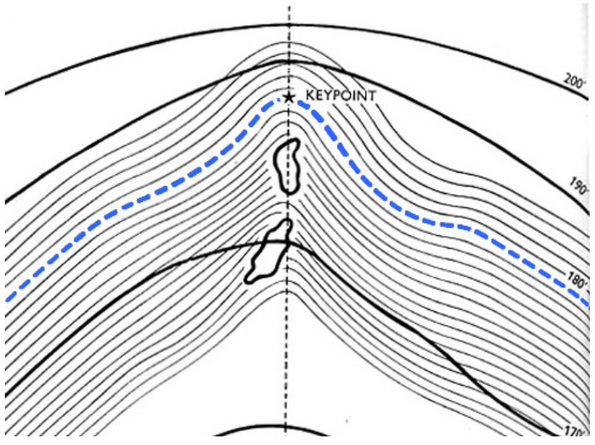
Foothills Catchment
Scale 1:500 @ A3

0 10 20 30 50m

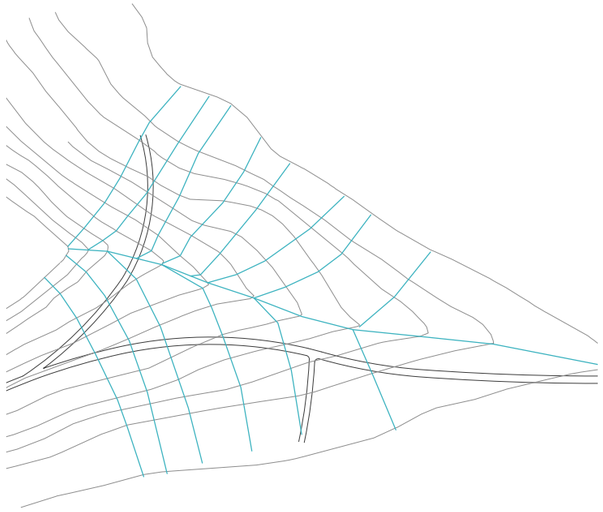
Concept Development

The Keyline System

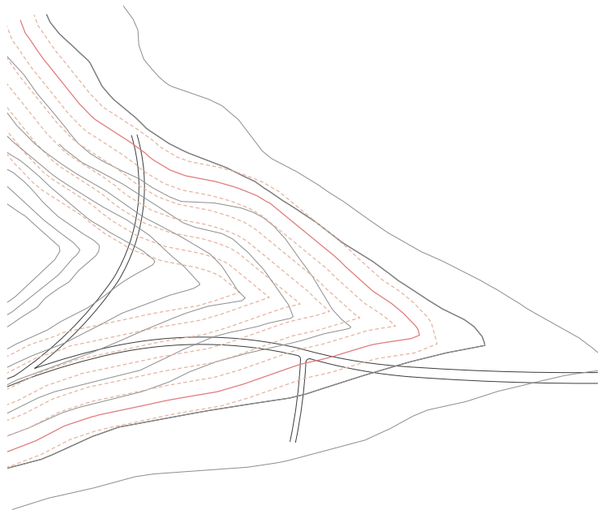
The form of the foothills concept has been inspired by the work of P A Yeomans, who developed the keyline system during the 1950's. Located off contour, furrows running parallel from the keyline effectively disperse the flow of runoff more evenly across the site, drawing water away from the wetter valleys and towards the drier ridges, enhancing rural production (Yeomans, 1965).



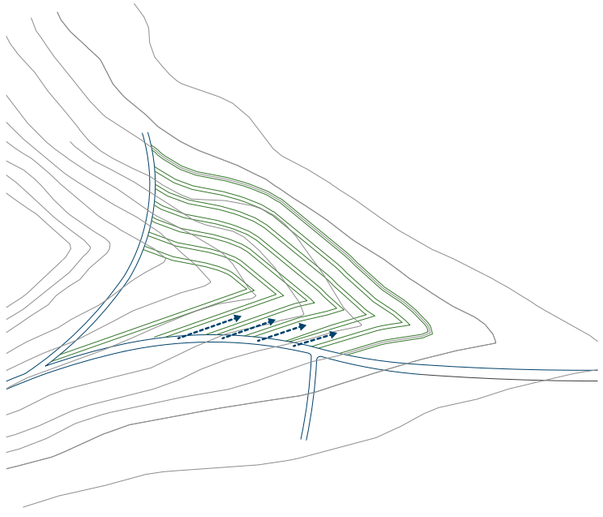
Above: Diagram from Yeoman's book, Water For Every Farm, demonstrating how the keyline is located and forms off-contour furrows.



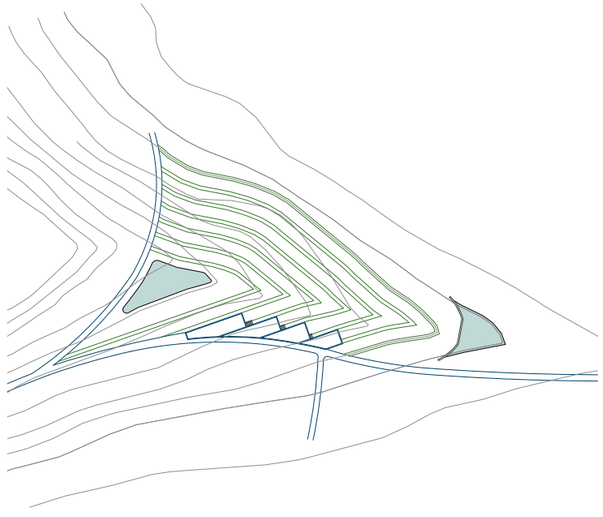
1. Analyse Site Flows.



2. Offset Keyline.



3. Extend Pathway.



4. Locate Dams.

Foothills Concept Plan

Scale | 1:200 @ A3

0 4 8 12 20m

1. Upper Catchment Dam
2. Furrows Offset From Keyline
3. Cultivation Beds, Alternating
4. Viewing Deck
5. Water Walk/Yurebilla Trail
6. Lower Storage Dam

Planting Detail

Situated in a conservation reserve, the plants here are carefully considered, with a selection of native species being chosen which can be used to produce herbs for cooking, as well as fruits which can be used in salads and to create sweet baked goods.

Olearia axillaris
"Wild Rosemary"

Produce: Herbs for Cooking

Santalum acuminatum
"(Quandong) Native Peach"

Produce: Jam + Confectionary

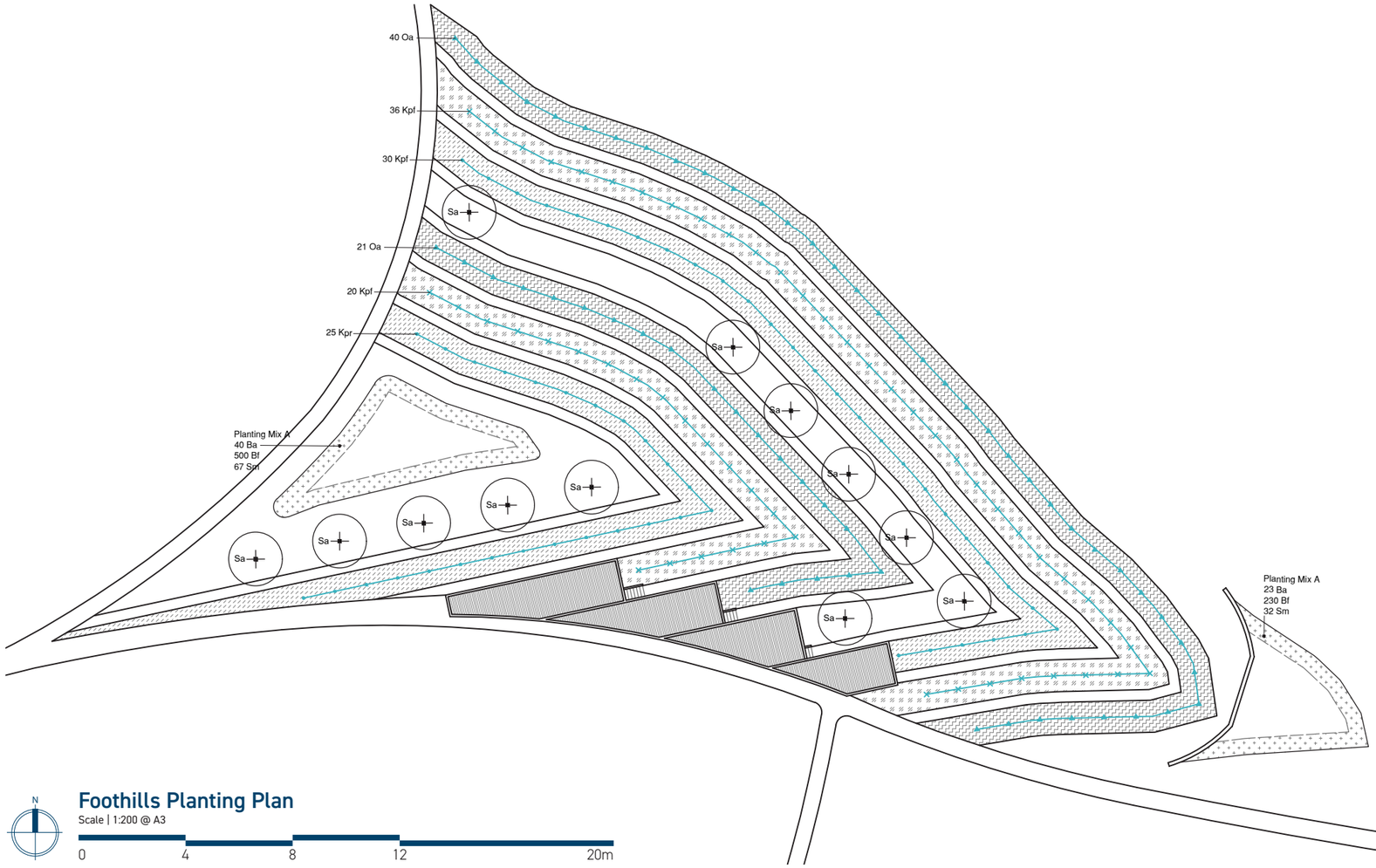
Kunzea pomifera
"(Muntries) Native Cranberry"

Produce: Sweets + Baked Goods

Kennedia prostrata
"Running Postman"

Produce: Salad Garnish + Tea

Key	Botanical Name	Common Name	Spacing	Qty
Groundcover				
Kpf	Kunzea pomifera	Muntries Native Cranberry	3000	46
Kpr	Kennedia prostrata	Running Postman	3000	55
Oa	Olearia axillaris	Wild Rosemary	2500	61
Planting Mix A	**Shallow Riparian Mix**			
Ba (50%)	Baumea articulata	Jointed Club Rush	1000	43
Bf (20%)	Bolboschoenus fluviatilis	River Balrush	200	730
Sm (30%)	Schoenoplectus mucronatus	Bog Balrush	600	104
Trees				
Sa	Santalum acuminatum	Quandong Native Peach	As Shown	12



N

Foothills Planting Plan

Scale | 1:200 @ A3

0 4 8 12 20m

Section 03

Scale | 1:200 @ A3

0 4 8 12 20m

Storage Zone

A second dam at the base of the valley increases the catchment capability of the site and provides more water supply for drier months.

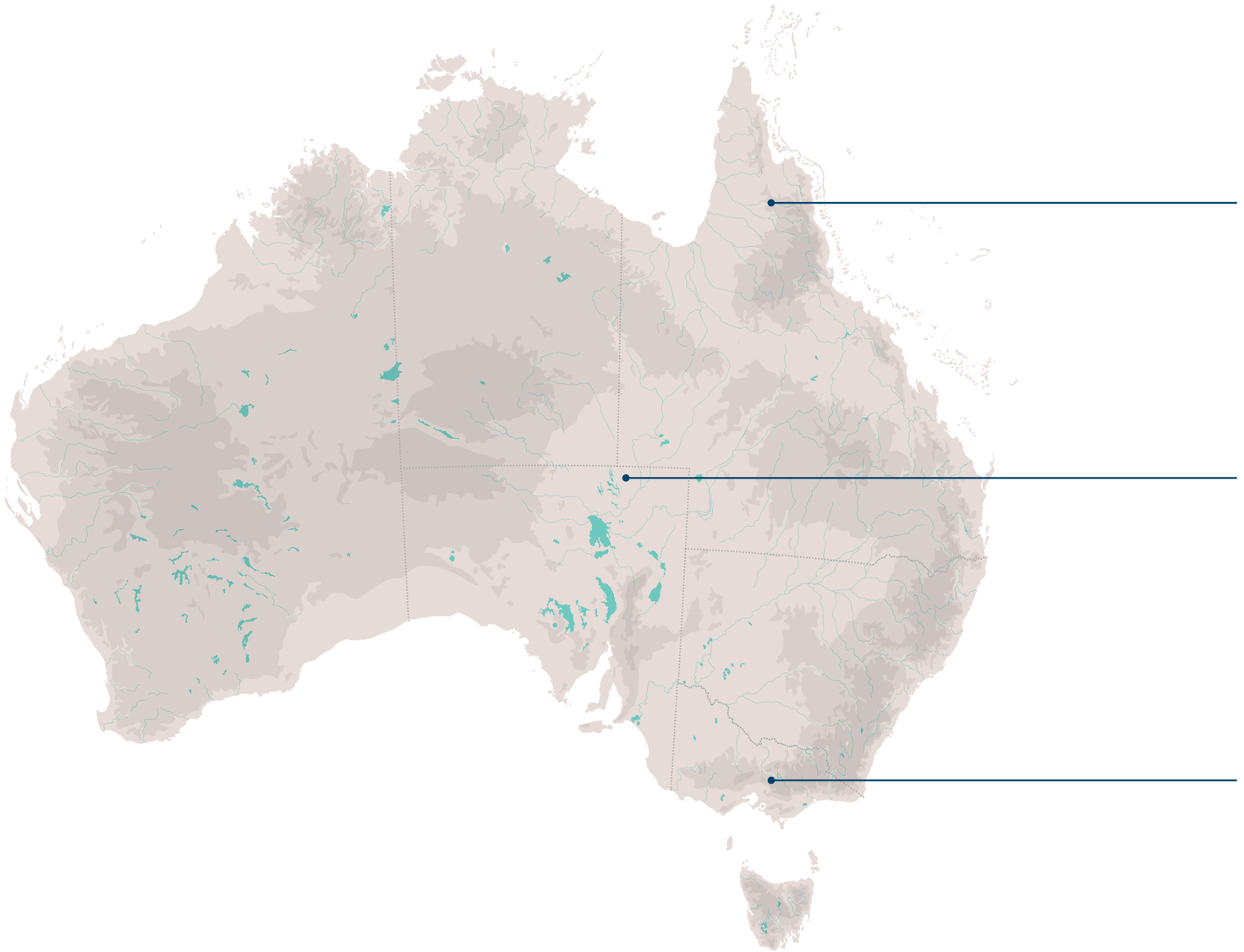
Irrigation Zone

Furrows following the keyline intercept water runoff and distribute it more evenly across the site and allows ground infiltration.

Retention Zone

Upper dam captures water from the valley for irrigation.

Why Investigate?



A Shifting Climate

Australia's climate is shifting due to impacts of the climate crisis, and it is expected that rainfall will most likely be less frequent, but intense events (CSIRO, 2020).

A Holistic Approach

The agricultural industry already consumes 60% of freshwater resources in Australia, but alternative sources such as recycled runoff is rarely utilised (ABS, 2021).

More with Less

World food demand is expected to increase by 140% from now by 2050 (Linehan et.al, 2012), but with less rainfall, we need to be smarted about how we treat our most precious resource.

By treating runoff as a resource rather than as a problem, we can not only create healthier water sources for urban agriculture, we can also improve local riparian ecologies leading towards more sustainable future.

HYDRACULTURE

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Final Review | Final Landscape Architecture Project 2022