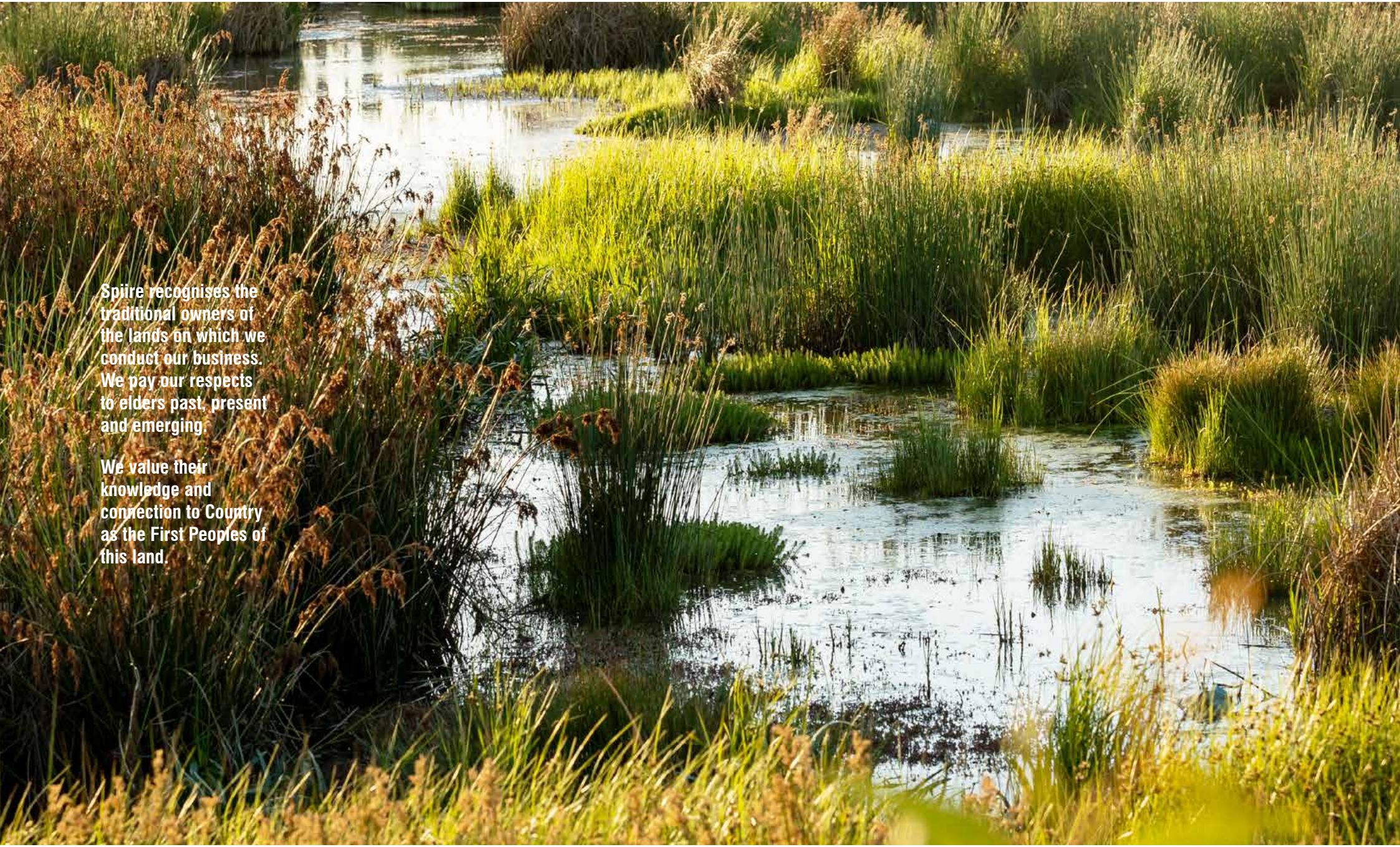
spiire

Tatura Integrated Water Management Strategy

Prepared for Greater Shepparton City Council

Reference number: 307990
1 April 2021



Spiire recognises the traditional owners of the lands on which we conduct our business. We pay our respects to elders past, present and emerging.

We value their knowledge and connection to Country as the First Peoples of this land.

Contents

Image Caption

Issue Date	Rev No	Authors	Checked	Approved
02/12/2020	Draft	J.Carroll	J. Espagne	M.Yule
30/03/2021	Final for Council Approval	J.Carroll	J.Espagne	M.Yule

Introduction

Spiire Australia has been engaged by Greater Shepparton City Council to develop an Integrated Water Management Strategy (IWMS) and investigate opportunities to implement integrated water management (IWM) within proposed Tatura growth areas to the north and east of the township.

Tatura was listed as high priority township within the Greater Shepparton Townships Framework Plan Review 2019 and Council seeks to encourage the growth of the town by developing a structure plan for the area. This IWMS has been developed with the vision to inform the future Council Structure Plan, as well as identify innovative opportunities for the conservation and utilisation of water within the township.

A range of IWM measures have been investigated including:

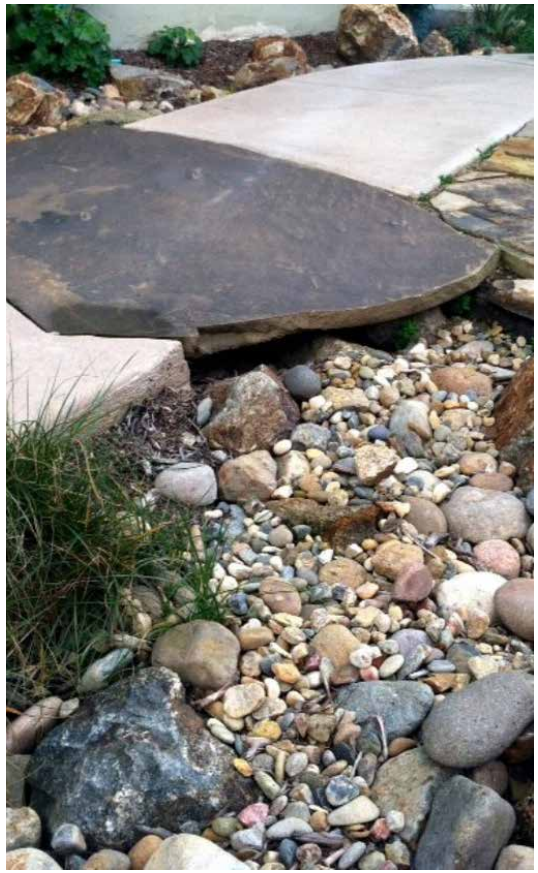
- Drainage infrastructure
- Stormwater harvesting
- Rainwater tanks
- Demand management
- Water Sensitive Urban Design (WSUD)
- Onsite water management
- Increased vegetation and biodiversity connections
- Education and policy programs.

The IWM options presented in this report provide realistic and feasible options for integration in the community, considering existing topography, infrastructure, and landscape.

This report has been developed with the intention to provide a high-level framework for drainage and IWM options that could be incorporated into the Structure Plan. Detailed assessments of the sub-catchments will be required as a part of further studies to produce a sustainable integrated water management plan for the proposed development in Tatura. This Strategy includes:

- Identification of opportunities to assist with management (and/or treatment) of stormwater runoff prior to entry into watercourses, with the intention of mitigating peak flow and reducing/ mitigating pollution associated with this runoff
- Identification of feasible opportunities for water retention, treatment and irrigation of green spaces within the township of Tatura
- Identification of feasible opportunities to use alternative water for non-drinking purposes within Tatura
- Incorporation of WSUD principles into future works, design and implementation programs

The intent of this report is to not to provide one solution but rather a number of alternatives to allow Council and the community to decide what best suits their needs.



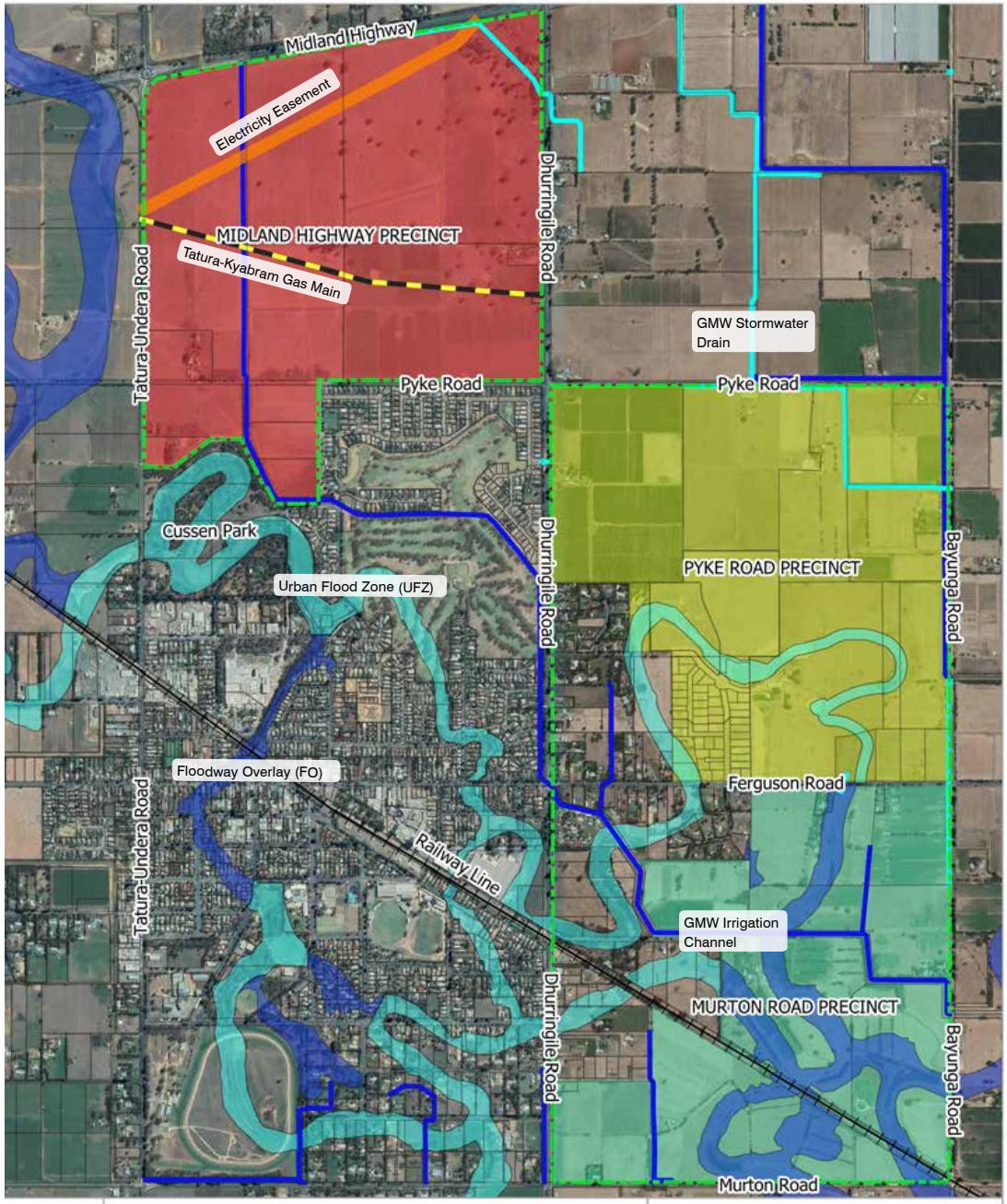
Study Area

Tatura is a township located approximately 17km southwest of Shepparton in the Greater Shepparton City Council. Due to growth in the region, the City of Greater Shepparton is investigating two areas for rezoning outside the current township.

The first investigation area is located to the north of the township and is bounded by the Midland Highway to the north, Dhurringile Rd to the east, Pyke Rd and Cussen Park to the south and Tatura-Undera Rd to the West. Due to its proximity to the Midland Highway it has been referred to as the Midland Highway Precinct. The Midland Highway Precinct is characterised by two main catchments which have been created due to a GMW irrigation channel. The irrigation channel runs from south to north and splits catchment in two with approximately 75% area being allocated to the east and 25% to the west. The eastern catchment is a homogeneous catchment that generally slopes to the northeast corner of the investigation area. The western catchment consists of two sub-catchments which are divided by the Tatura-Kyabram gas main that traverses the site. The northern sub-catchment drains towards the north whist the southern sub-catchment drains to a culvert under Tatura-Undera Rd which connects to a formalised drain to the west.

The second investigation area is located to the east of the township and is bounded by Pyke Rd to the north, Bayunga Rd to the east, Murton Rd to the south and Dhurringile Rd to the west. The eastern investigation area is much more complex in regards to catchment delineation than the northern investigation area. This is due to the large depressions that meander across the area, a GMW irrigation channel that runs from east to west which divides the southern third of the site from the northern portion, and a railway line which traverses the southern third of the site diagonally from the southeast corner of the investigation area. As a result the eastern investigation area is divided into two main precincts the Pyke Rd Precinct in the north and the Murton Rd Precinct in the South. It is also heavily fragmented with a number of sub-catchments that drain to the large depressions which traverse the site.

The total area of the investigation is 767ha, with the Midland Highway Precinct comprising of approximately 245ha, Pyke Rd Precinct 223ha and the Murton Rd Precinct 189ha. The Midland Highway Precinct is currently zoned entirely Farm Zone whilst the Pyke Rd Precinct and Murton Rd Precinct are a mixture of zones which include Rural Living, Low Density Residential, Industrial, Farm Zone and Urban Flood Zone. These areas have been broken down further later in the report, into local catchments which have been created based on the topography of the land and natural drainage areas.



NOTATIONS

File Ref: 307990
Plan: W GIS 307990
Rev: B
Date: 26.03.2021

Designed: J.Carroll
Checked: M.Yule
Authorised: J.Espagne

LEGEND

- INVESTIGATION AREA
- GMW IRRIGATION CHANNELS
- GMW STORMWATER DRAINS
- ELECTRICITY EASEMENT
- GAS MAIN
- RAILWAY LINE
- URBAN FLOOD ZONE
- FLOODWAY OVERLAY
- MIDLAND HIGHWAY PRECINCT
- MURTON ROAD PRECINCT
- PYKE ROAD PRECINCT

205 0 205 410 615 m

1:20,000

Coordinate System: GDA 1994 MGA Zone 55
Paper size A3 Landscape

spiire
414 La Trobe Street
PO Box 16084
Melbourne Vic 8007
T 61 3 9993 7888
spiire.com.au
ABN 55 050 029 635

Topography & Existing Water Cycle

The topography of the study area is illustrated by the adjacent map. The map is based on LIDAR of the study area and demonstrates the 'lay of the land', with the higher areas being shaded in a red/brown colour whilst the lower areas are characterised by a shade of green. As described on the previous page, the Midland Highway Precinct generally slopes towards the north and west, whilst the eastern precincts, Pyke Rd Precinct and Murton Rd Precinct, are more complex and the vast majority of the area drains towards the existing depressions that traverse the area. The proposed retarding basins which are discussed later in the report have been included to demonstrate that they are generally located in the lower lying areas of the catchment. This is to ensure that the terrain does not have to be modified excessively to capture additional runoff due to development.

As the investigation area is predominantly zoned as either farm zone or low density residential, it means that the runoff from the land will generally follow the natural topography and flow to the north in the northern investigation area and flow towards the natural depressions in the eastern study area. Further confirmation of the natural flow paths is evident by the Urban Flood Zone and Floodway Overlay illustrated on the previous page.

Another characteristic of the current conditions is that presently there is less runoff than what will occur after development of the region. This is due to more water being infiltrated and evaporated into natural surrounds. A water balance has been undertaken to understand the current conditions and how stormwater is distributed across the investigation area. This can be seen in Figure 1 and Table 1.

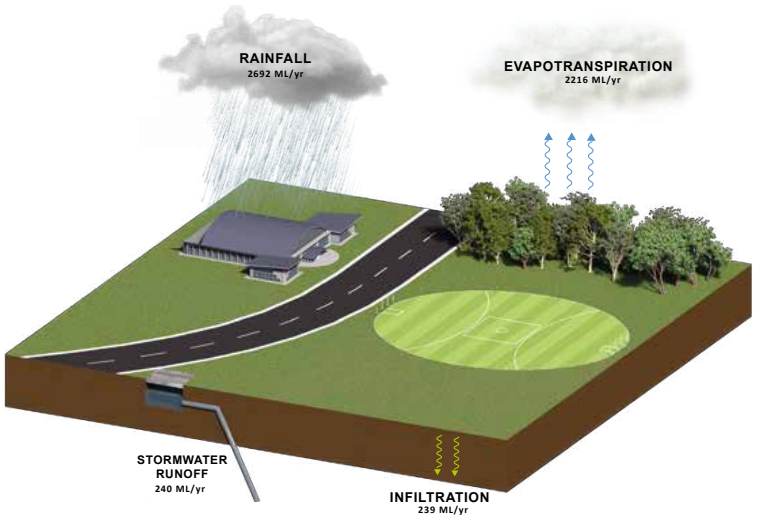
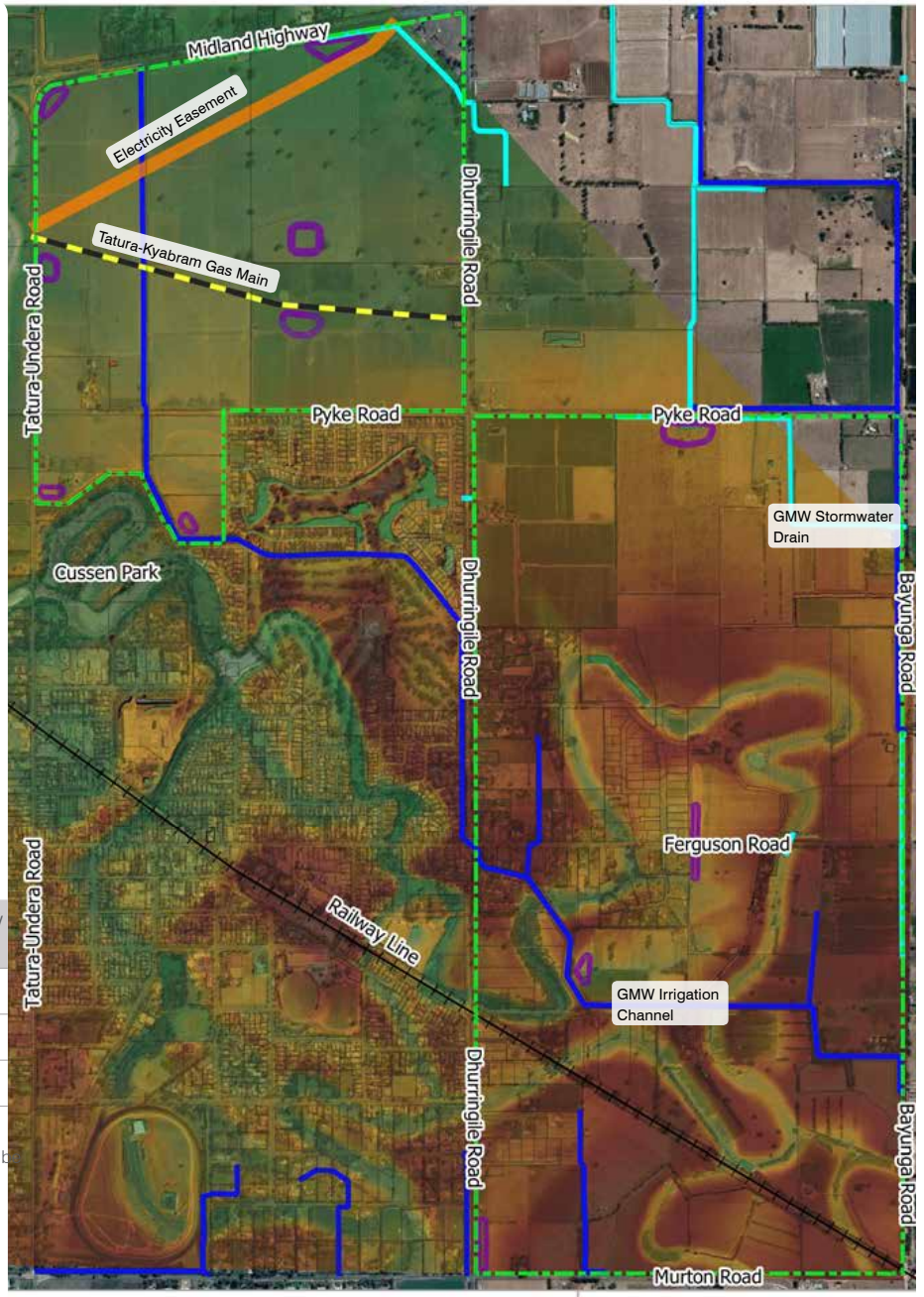


Figure 1: Visual Water Balance - Existing Conditions

Table 1: Catchment Water Balance - Existing Conditions

Catchment	Catchment Area (ha)	Rain (ML/yr)	Evapotransipiration (ML/yr)	Infiltration (ML/yr)	Runoff (ML/yr)
Northern	234	1049	870	94	86
Eastern	363	1643	1346	145	154
Total	**597**	**2692**	**2215**	**239**	**240**

Note: Totals do not equal rainfall due to soil storage factors and the catchment areas refer to the areas currently proposed to be rezoned, not the total investigation area. Refer to page for areas to b rezoned.



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LEGEND

- INVESTIGATION AREA
- GMW IRRIGATION CHANNELS
- GMW STORMWATER DRAINS
- ELECTRICITY EASEMENT
- GAS MAIN
- RAILWAY LINE
- RETARDING BASIN

TERRAIN ELEVATION m (AHD)

109.5	112	114.5
110	112.5	115
110.5	113	115.5
111	113.5	116
111.5	114	116.5

205 0 205 410 615 m

1:20,000

Coordinate System: GDA 1994 MGA Zone 55
Paper size A3 Landscape

spiire
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Integrated Water Management in Tatura

What is IWM?

Integrated water management (IWM) is a holistic approach to managing water and addresses all components of the water cycle in order provide benefits to the community and environment. The adjacent diagram illustrates how IWM can be broken-down into its key components starting from the inside of the diagram and moving outward.

Why IWM in Tatura?

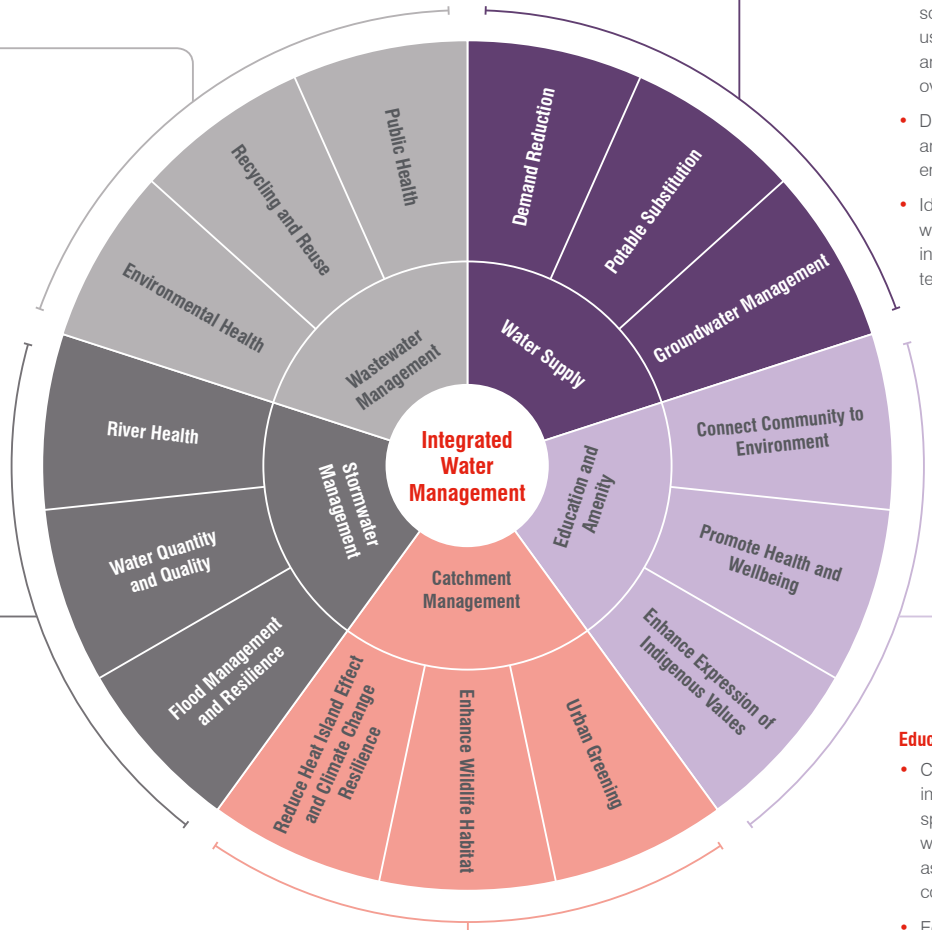
Due to increased uncertainty around water supply caused by climate change, IWM seeks to diversify and decentralise water systems so that more resilient systems can be created. Climate change is significant threat to water resources due to its impact on rainfall, which in general is either causing a lack of rainfall, or conversely too much of it at once. Both of these scenarios are risk to water resources since a lack of rain reduces and threatens water supply whilst too much rainfall can devastative property, crops, as well as contaminate water supplies.

IWM can mitigate these risks by reducing reliance on a single water source and utilising water more effectively through the implementation of innovative technologies, such as rainwater tanks, stormwater harvesting, and tree pits.

As the township of Tatura is expanding, it is an ideal time to implement IWM infrastructure in order to future-proof its water supply and provide preventive measures to protect the environment from significant variations in water supply. Finally, installing IWM in greenfield areas is the most economical option for the community.

How can IWM be applied Tatura?

There are multiple ways that IWM can be applied to Tatura. The text around the diagram provides examples of how the key components of IWM can be approached when developing the growth areas of Tatura.



Wastewater Management Examples

- Standard sewerage systems will be provided to new premises, which is preferred over septic systems.
- The Tatura Wastewater Treatment Plant currently provides treatment of wastewater which is reused by irrigators such as woodlots and crop growers.

Water Supply Examples

- Identifying and developing alternative water solutions to reduce the potable water usage, i.e. rainwater harvesting for houses and stormwater harvesting for schools and ovals.
- Demand management including 5 star water and energy appliances to reduce water and energy use in households.
- Identifying and developing alternative water solutions featuring all forms of water, including rainwater harvesting and smart technology.

Stormwater Management Examples

- Implementation of retarding basins with pumps to prevent the new urban areas causing flood impacts to neighbouring properties.
- Large and small scale Water Sensitive Urban Design within existing streetscapes to provide localised stormwater quality treatment.
- Integrating flood management and stormwater harvesting opportunities, to reduce downstream flooding whilst providing a source of water, e.g. stormwater harvesting for oval irrigation.

Catchment Management Examples

- Promoting Healthy Streetscapes through urban greening by prioritising pedestrians, trees and WSUD in streetscape upgrade. Provides opportunities to reduce urban heat island effect from the developing areas.
- Using linear retarding basins to create biolinks, wildlife corridors and urban greening for development.

Education and Amenity Examples

- Connecting communities and water through implementing water assets in community spaces, e.g. providing Cussen Park with more water and integrating WSUD assets such as wetlands to make them a community focal point.
- Education through multiple facets, such as partnering with schools to provide water education and providing interpretive signage on all assets
- Increased neighbourhood amenity through greener community spaces that encourage shade, active water play and connections for biodiversity.

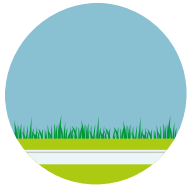
Integrated Water Management in Tatura

Objectives

The intent of this IWM strategy is to address the key components of IWM outlined on the previous page in order to achieve the following objectives.

Integrate and Promote Strategic Water Use

- A diverse range of water supplies and sources
- Manage water efficiency and demand
- Safe & secure water supply
- Educating the residents, businesses and organisations around Tatura about water use
- Implement policy promoting environmental controls prior to discharge to creeks



Effective and Affordable Wastewater Systems

- Meet public health and environmental standards
- Reduce wastewater generated
- Effective wastewater systems to meet current and future regulations
- Maximise waste-to-resource opportunities (fit for purpose alternate water) in balance with maintaining waterway flows

Effective Stormwater Management That Protects Our Waterways

- Flows to Cussen Park are improved to protect important riparian ecosystems
- Appropriate levels of flood protection in new development
- Community and property resilient to local flood risk
- Improve water quality in watercourses

Create Cool, Green and Water Sensitive Urban Landscapes

- Diverse urban landscapes that reflect local conditions and community values
- Waterways accessible as valuable open space
- Aboriginal cultural values associated with waterways are protected
- A united, empowered and engaged community co-operating to enact IWM opportunities
- Street tree selection that balances shade, water efficiency, fire risk and amenity values

Climate Change Resilient Systems

- Safe conveyance of flows
- Improve water quality
- Reduce the peak magnitude and volume of post-development stormwater flows
- Alternate water sources
- Protection from extended droughts, heat and intense rainfall events

IWM Aspect

In order to meet the objectives the following aspects will be incorporated into the Tatura IWM Strategy.

- Waterways and Flood Plains - Protecting existing watercourses and flood plains against increased runoff from development.
- Major Drainage - Providing adequate infrastructure to ensure that flooding does not occur in the new urban areas.
- Catchment Management and Land Use - Designing assets that provide multiple benefits such as drainage and community amenity
- WSUD - Ensuring that runoff from new development is having a minimal impact on the environment whilst providing assets for community enjoyment.
- Drinking Water - Reducing a reliance on potable water consumption and finding alternative water sources.
- Sewerage - Reduce wastewater in a safe and environmentally friendly manner.
- Alternative Water - Providing additional water sources to supplement potable water supply.

Stakeholder Engagement

Several levels of stakeholder engagement have occurred in order to help inform this IWMS. Prior to commencing this report Council consulted with DELWP, Goulburn Valley Water, Goulburn Murray Water, and landowners within the area to obtain their input. Some of the key comments/concerns raised were:

- Runoff from the rezoned area will drain to undeveloped areas and the increased runoff may impact existing property owners.
- Consideration should be given to any stormwater drainage which may be required to outfall to Goulburn Murray Water assets
- Open channels should be converted to pipes when appropriate.
- Parks and public areas should extend along waterways with native vegetation.
- Drainage lines should follow existing natural drain paths
- Drainage should be directed through Cussen Park to enhance the wetlands in that environment.
- The IWMS should take into consideration the impacts of climate change
- Any development should maintain natural flows through the mosquito depression.

In addition to the above, Spiire has been consulting with Council in order to ensure that the asset proposed are practical options for Council.

IWM Implementation Strategy in Tatura

It is envisioned that this report will provide a framework for the future drainage needs of the area and options of IWM initiatives that can be implemented within the future Tatura Structure Plan. Once preferable options have been identified these options will be refined further following the implementation of the Tatura Structure Plan, which identifies land uses. Below are the most suitable options proposed for the Tatura growth area.

IWM Aspect	Objectives	Base Case IWM Options		Aspirational IWM Options	Rationale
Waterways & Flood Plains	• Flows to Cussen Park are improved to protect important riparian ecosystems • Improve water quality in watercourses	Above ground detention for each catchment	Linear retarding basins to create biolinks	Smart rainwater tanks with storage provision for detention purposes	Above ground detention is to be utilised as its more cost effective and has the benefit of contributing to a 'green corridor'.
Major Drainage	• Appropriate levels of flood protection in new development • Community and property resilient to local flood risk	Conventional stormwater drainage, utilising pipes and roads	Linear streetscape swales and piped drainage system	Infiltration of stormwater for use by local vegetation	Piped drainage required for flood protection for new developments, however, swales to be used where practical to provide stormwater treatment and grade control.
Catchment Management & Land Use	• Diverse urban landscapes that reflect local conditions and community values • Street tree selection that balances shade, water efficiency, fire risk and amenity values	Conventional street trees and paths within reserves	Conventional street trees and paths within reserves interfacing assets	Diverse vegetation, pathways interfacing assets and wayfinding	The intent is to have the community interacting with water assets to allow for increased amenity, urban greening, and education opportunities.
WSUD	• Improve water quality in watercourses • Waterways accessible as valuable open space	End of the line WSUD assets or distributed treatment	Combination of distributed and end of the line assets	Treatment of stormwater through WSUD assets and supply to supplement water in GMW irrigation	A combination of both assets is favoured as higher levels of treatment is achieved at a reasonable cost.
Drinking Water	• A diverse range of water supplies and sources • Safe & secure water supply	Connect to conventional potable networks	Supply of water from alternative water sources, such as ground water.	Implementation of lot scale tanks and efficient appliances to offset drinking water demand	Required for health and regulatory purposes.
Sewerage	• Meet public health and environmental standards • Reduce wastewater generated	Connect to conventional sewerage network	Third pipe supply supply from Tatura WWTP	Onsite decentralised sewerage treatment for reuse.	Required for health and regulatory purposes.
Alternative Water	• Maximise waste-to-resource opportunities (fit for purpose alternate water) in balance with maintaining waterway flows	No alternative water considered	Passive street tree water, rainwater tanks, and stormwater harvesting	Recycled water	Reduces a reliance on potable water, reduced sewerage treatment, uses water which is fit for purpose.

Selected as an option for Tatura

Potential alternative options for Tatura

IWM Implementation Strategy and Objectives

The table below builds on the previous pages to demonstrate how the selected IWM measures relate to the objectives of IWM.

The measures selected aim to address the key components of IWM whilst also being appropriate for the site conditions and context. The selected measures were:

- Waterway and Flood plains - Above ground onsite detention or linear retarding basins to create biolinks.
- Major Drainage - Swales and piped drainage
- Catchment Management and Land use - Diverse vegetation, pathways interfacing assets and wayfinding
- WSUD Assets - Wetlands and tree pits
- Potable Water - Standard system, with rainwater tanks and demand management to offset drinking water demand
- Sewerage - Utilise existing recycling systems
- Alternative Water - Stormwater and rainwater harvesting
- Education and Policy Programs

It is acknowledged, that further IWM opportunities are available for Tatura, however, the opportunities analysed in this report were selected in consultation with Council, as best aligning with the IWM vision and stakeholder priorities.

Table 2: IWM options assessment for Tatura

	IWM Objectives	EFFECTIVE STORMWATER MANAGEMENT THAT PROTECTS OUR WATERWAYS	INTEGRATE AND PROMOTE STRATEGIC WATER USE	EFFECTIVE AND AFFORDABLE WASTEWATER SYSTEMS	COOL, GREEN AND WATER SENSITIVE URBAN LANDSCAPES	CLIMATE CHANGE RESILIENT SYSTEMS
	OPTIONS					
1	Waterways and Flood Plains - Above ground onsite detention	✓			✓	✓
2	Major Drainage - Swales and piped drainage system	✓				✓
3	Catchment Management and Land Use - Diverse vegetation, pathways interfacing assets and wayfinding	✓			✓	✓
4	WSUD - Wetlands and tree pits	✓	✓			✓
5	Potable Water and Demand Management		✓	✓		✓
6	Sewerage - Utilise existing water recycling			✓		
7	Alternative Water - Stormwater and rainwater harvesting	✓	✓	✓	✓	✓
8	Education and Policy Programs		✓		✓	✓

IWM Opportunities

Above Ground Retarding Basins

In order to prevent new properties and existing properties from flooding, above ground retarding basins are an effective option. Although generally considered standard drainage infrastructure, the have the following benefits:

- They control flood flows and provide a constant outflow rate
- Cost effective compared to the underground basins
- Their space can be utilised to add to community amenity

In terms of their implementation in Tatura, due the flat terrain, it means that the retarding basins will require pumped outlets and as a result flows to downstream areas and properties are controlled. Also, their open space can be combined with other stormwater assets such as wetlands, or community assets such as parks and ovals to provide increased amenity to the community.

Above ground retarding basins were selected over underground retarding basins, due to the high costs associated with underground basins. As the basin areas can be over a hectare, this would require significant costs to create a structurally integral asset which may not be financially viable for landowners in the area. Furthermore, on going maintenance costs could be much higher because if repairs are required on an underground asset the work would be much more complex and labour intensive.

An alternative option for Tatura is to implement linear retarding basins to create biolinks and open spaces corridors for pedestrians and cyclists, and to enhance to the community amenity of the new urban areas.

Swales and Piped Drainage

In order to convey stormwater to the retarding basins, assets such as swales and pipes will be required. Whilst both assets are considered standard drainage assets, they both provide benefits and contribute to IWM by managing stormwater. The main benefits that the assets provide are as follows:

- Pipes primary function is that they prevent flooding by conveying stormwater below the ground, which adds capacity to the drainage system.
- Swales on the other hand also provide some flood prevention benefits by channelising flows, however they also treat the water through their vegetation and capture sediment prior to discharging into waterways

It is envisioned that both these assets will be utilised in the Tatura growth area due to their respective benefits

Swales were also included to be utilised as opposed to just pipes because they can be more appropriate for low density areas, they can help in situations where there is limited grade and they also provide stormwater treatment, as mentioned above.

Catchment Management and Land Use

IWM is not just about water assets it is also about how communities interact with water. In this context, the planning of new growth areas provides opportunities to utilise the water assets in the area for other purposes such as amenity and urban greening.

Allowing community to interact with water assets, such as waterways and wetlands, provides more liveable communities, as they provide a place of gathering, recreation and relaxation. In addition to this they also allow for:

- Increased cooling and mitigation of the urban heat island effect;
- Improved air quality
- Create wildlife habitat
- Intercept stormwater runoff
- Assist and help to prevent soil erosion
- Enhance climate resiliency

In the Tatura growth areas, it is proposed that diverse vegetation and pathways that interface with water assets are implemented, as opposed to the conventional paths that don't interact with water infrastrucutre so that a greater public amenity is achieved and the community engage with, as well as appreciate, water assets.

IWM Opportunities

Water Sensitive Urban Design

WSUD assets contribute to reducing pollutant loads entering watercourses. There is potential to design WSUD assets, such as wetlands, raingardens and tree pits in the green spaces in the new growth areas Tatura. These assets would help to improve amenity and create an opportunity to educate residents about the water cycle.

WSUD has the following benefits:

- Reduce pollutant loads of stormwater entering waterways
- Bring water to the surface to enable the community's visual connection to the water cycle
- Slowing down of water and promoting infiltration
- Urban greening
- Improve amenity

A combination of distributed assets and end of the line WSUD assets was selected due to the benefits the combination brings, as opposed to only selecting distributed assets or end of the line assets. Only having distributed assets is more costly as economies of scale are not achieved and there are significant on going maintenance costs, whereas end of the line assets are not necessarily effective as distributed assets, however their value for money is higher and they are easier to maintain. By combining both options, cost savings can be achieved from the end of the line assets whilst the distributed assets enhance the overall treatment of the catchment.

Potable Water

Standard potable water systems will be in place to service the new growth areas of Tatura as this a requirement by the regional water authority and cannot be modified due to health and regulatory reasons. However, although standard potable water systems will be in place, its consumption and reliance on it can be reduced through the use of, alternative water systems.

Alternative water systems utilise other sources of water, besides potable water, in a manner that is fit for purpose. For example, whilst stormwater may not be fit for drinking purposes, it can be utilised to supply water for other activities where water quality requirements are not as strict, such as watering ovals or industrial wash-down purposes. As a result, by using alternative water, potable water demand is reduced which in-turn mitigates threats to water supply

In addition, potable water consumption is proposed to be reduced in Tatura through the implementation of rainwater tanks on new lots and demand management initiatives, such as water efficient appliances and water education.

Wastewater

The wastewater strategy for the new growth areas of Tatura will be to provide standard sewerage connections to premises and utilise the existing water recycling system at the Tatura Wastewater Facility. The Tatura Wastewater facility currently treats water so that it can be reused by irrigators in the area for industries such as crops, dairy and woodlots. As these irrigators utilise large amounts of water, the wastewater created from the new developable areas are certain to have an end user and the treated wastewater will be utilised effectively within the broader community.

It was investigated if wastewater could be treated to Class A recycled water so that the recycled water cold be reused within the new development area via a purple pipe system, however, there are currently no provisions for this level of treatment within the Tatura region and installing the required infrastructure would be prohibitively expensive unless funded at a state level, which is currently not proposed.

IWM Opportunities

Alternative Water Options

Two potential alternative water sources for Tatura are stormwater and rainwater harvesting. Stormwater and rainwater harvesting provides opportunity to reduce excess stormwater runoff entering watercourses around Tatura. Some examples of how harvested stormwater can be utilised are:

- Commercial sites using stormwater for non-potable reuse
- Irrigators complimenting their water demands with stormwater

For rainwater harvesting, rainwater tanks can be fitted in the new residential and commercial areas. Harvested rainwater can be used for non-potable water usage on site such as toilets and irrigation.

Stormwater and rainwater harvesting provides the following benefits:

- Reduce demand on potable water supply
- Help control and manage peak stormwater flows
- Rainwater tanks can be retrofitted on existing buildings and have a relatively low capital cost
- A highly visible technology, which can be used for education

In addition to water harvesting, technologies such as tree pits also allow for runoff to be utilised as an alternative water source which can subsequently contribute other aspects of IWM such as urban greening by creating vibrate green spaces and streetscapes.

Another alternative water source investigated was recycled water, however, as mentioned on the previous page, Tatura currently lacks the required infrastructure to provide Class A recycled water and installing such infrastructure would be prohibitively expensive.

Education and Policy

Education programs are a great way to involve the community in the integrated water space. These programs provide the community with information around the water cycle, its interaction with Tatura and how the communities actions directly influence it.

Several educational initiatives are proposed for the purpose of spreading awareness could be:

- The water cycle
- Water consumption in Tatura
- Cultural and heritage values of water and landscape
- Maintenance and operation
- Construction sediment management and control.

Benefits of education and policy include:

- Connect the community to the landscape, cultural values and biodiversity
- Bring water to the forefront of the community awareness
- Promote health and well-being connecting with the environment
- Support the broader community awareness and appreciation about where our water comes from and its impacts on the environment
- Reduce potable water consumption
- Make contractors and developers accountable for the impact they have on waterways and the surrounding environment
- Assist in providing guidelines or a framework for future development, construction and maintenance activities

Strategy Intent: Areas and Zonings

The Tatura Framework Plan proposes to rezone approximately 767ha of land of varying zone types. The predominant zoning is Farm Zone; however, within the framework area other zone types include Low Density Residential, Rural Living, Industrial, Urban Flood Zone and Public Park and Recreation Zone. It is currently understood that the investigation area will be rezoned into two main types of zoning; residential, which includes low density residential, and Rural Living. However, to account for potential changes in future zoning, any areas with minimum lot sizes of 2000m^2 or below have been assumed to be zoned residential.

Since the two zone types of produce significantly different amounts of runoff, due to the impervious area associated with each zone type, two different approaches are required. The approaches for each zone type will be as follows:

Rural Living Zoning

Rural Living Zone (20,000m^2 lots and above) results in the creation of a small impervious area compared to the broader property. As a result, the increase in runoff from the pre-developed conditions is minimal, and therefore the works required to cater for the additional runoff is minor in nature and can be undertaken by the property owner. Furthermore, due the large minimum lot size there is ample space on each property to capture stormwater and reuse it on the property.

Owing to the factors above its proposed that development within the Rural Living zone implement their own water sensitive urban design and/or IWM measures and not be included in the regional infrastructure. There are two main reasons for this:

- Property owners are able to implement measures which are fit for purpose. For example, they may decide to install rainwater tanks for reuse within the house, construct a dam for watering the vegetation, or any other suitable alternative.
- The contributions to regional infrastructure is generally more expensive than cost of onsite measures. As a result, it would likely be disadvantageous to the property owner to pay contributions to regional measures when they could provide adequate stormwater treatment or reuse on site.

It is recommended that Council set the minimum requirements for these properties with respect to stormwater management.

Finally the Victorian Planning Provisions state under Section 53.18 that low density subdivisions should be:

- Designed and managed in accordance with the requirements and to the satisfaction of the relevant drainage authority.
- Designed and managed in accordance with the requirements and to the satisfaction of the water authority where reuse of stormwater is proposed.
- Designed to meet the current best practice performance objectives for stormwater quality as contained in the Urban Stormwater - Best Practice Environmental Management Guidelines (Victorian Stormwater Committee, 1999).
- Designed to ensure that flows downstream of the subdivision site are restricted to pre-development levels unless increased flows are approved by the relevant drainage authority and there are no detrimental downstream impacts.
- Designed to contribute to cooling, improving local habitat and providing attractive and enjoyable spaces.

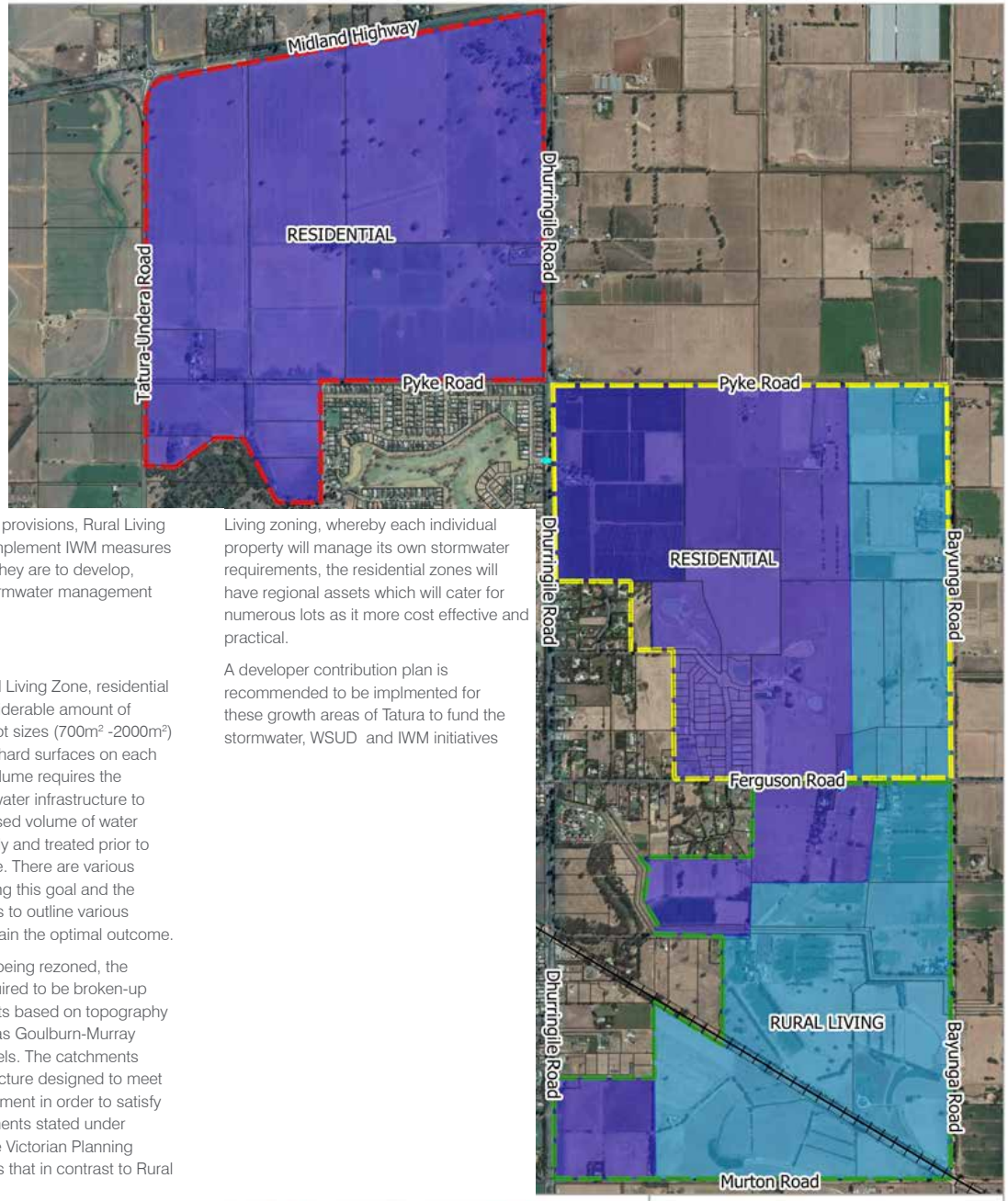
Therefore under these provisions, Rural Living sites are required to implement IWM measures on a lot sized scale if they are to develop, which compliment stormwater management requirements.

Residential Zoning

In contrast to the Rural Living Zone, residential zoning creates a considerable amount of runoff due to smaller lot sizes (700m^2 -2000m^2) and larger portions of hard surfaces on each lot. This increase in volume requires the construction of stormwater infrastructure to ensure that the increased volume of water can be conveyed safely and treated prior to entering a watercourse. There are various methods for a achieving this goal and the intent of this strategy is to outline various options in order to obtain the optimal outcome.

Due to the large area being rezoned, the residential area is required to be broken-up into smaller catchments based on topography and constraints such as Goulburn-Murray Water irrigation channels. The catchments will then have infrastructure designed to meet the needs of the catchment in order to satisfy development requirements stated under Clause 56.07-04 of the Victorian Planning Provisions. This means that in contrast to Rural Living zoning, whereby each individual property will manage its own stormwater requirements, the residential zones will have regional assets which will cater for numerous lots as it more cost effective and practical.

A developer contribution plan is recommended to be implmented for these growth areas of Tatura to fund the stormwater, WSUD and IWM initiatives



NOTATIONS

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Plan: W GIS 307990
Rev: B
Date: 26.03.2021

Designed: J.Carroll
Checked: M.Yule
Authorised: J.Espagne

LEGEND

- RESIDENTIAL
- RURAL LIVING
- MIDLAND HIGHWAY PRECINCT
- MURTON ROAD PRECINCT
- PYKE ROAD PRECINCT
- RAILWAY LINE

205 0 205 410 615 m

1:20,000

Coordinate System: GDA 1994 MGA Zone 55
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PO Box 16084
Melbourne Vic 8007
T 61 3 9993 7888
spiire.com.au
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Drainage Infrastructure

The intent of this report is to provide options on stormwater infrastructure which may best service the needs of each catchment. In order to do this, the infrastructure will be broken down into two main components drainage infrastructure and IWM infrastructure. Drainage infrastructure refers to the standard infrastructure required to manage runoff and includes assets such as underground pipes and retarding basins, whilst IWM infrastructure is in relation to the treatment, reduction and reuse of urban runoff and includes infrastructure such as stormwater harvesting, soakage pits, WSUD assets etc.

Drainage Infrastructure

In order to allow development to occur to the north and east of Tatura, drainage infrastructure is required to ensure that the new properties do not flood and neighbouring or downstream properties are not affected by the increased runoff created by the new development. Some typical types of drainage infrastructure options include retarding basins, underground pipelines, waterways, culverts.

Retarding basins for each catchment have been investigated and preliminary sized. These are a critical piece of infrastructure to prevent flooding of neighbouring properties, they provide an outfall for underground pipes, and they have large footprints which is important to understand for creating the future urban Structure Plan. A summary of the retarding basin key characteristics can be found in Table 3 below, with the location of each retarding basin shown on the following pages.

As mentioned in the Strategy Intent section, the retarding basins have been sized based on the assumption that higher densities may occur in future, i.e. lot sizes 2000m^2 and below will eventually be zoned residential.

This conservative approach allows for easier refinement of the assets once the zoning types are finalised. Furthermore, only the new retarding basins have been shown. There is proposed excavation of the urban flood zone to provide additional storage for sites draining to this area, however, as it is not expected to take any additional land, it has not been included in the retarding basin locations. Finally the retarding basin foot prints have been sized assuming 1 in 5 batters. This is for safety and maintenance purposes and also to allow for community use during dry weather periods.

It should be noted that, pipelines and other asset types were not investigated as they are subject to being designed in accordance with road layouts which are currently not available.

Table 3: Catchments and Retarding Basins

Catchment	Catchment Area (ha)	RB Name	Area (m^2)	Storage (m^3)
A	11.5	A	5,353	11,164
B	23.4	B	9,094	25,450
C	25.0	C	9,363	23,681
D	11.2	D	5,053	10,736
E	48.4	E	15,022	45,980
F	53.7	F1	17,017	53,645
F	56.8	F2	16,559	56,257
H	61.5	H	18,960	60,085
N	8.4	N	5,160	7,973
Q	6.5	Q	4,304	6,234
R	16.0	R	6,644	15,672
V	16.6	V	9,033	16,226

Drainage Infrastructure

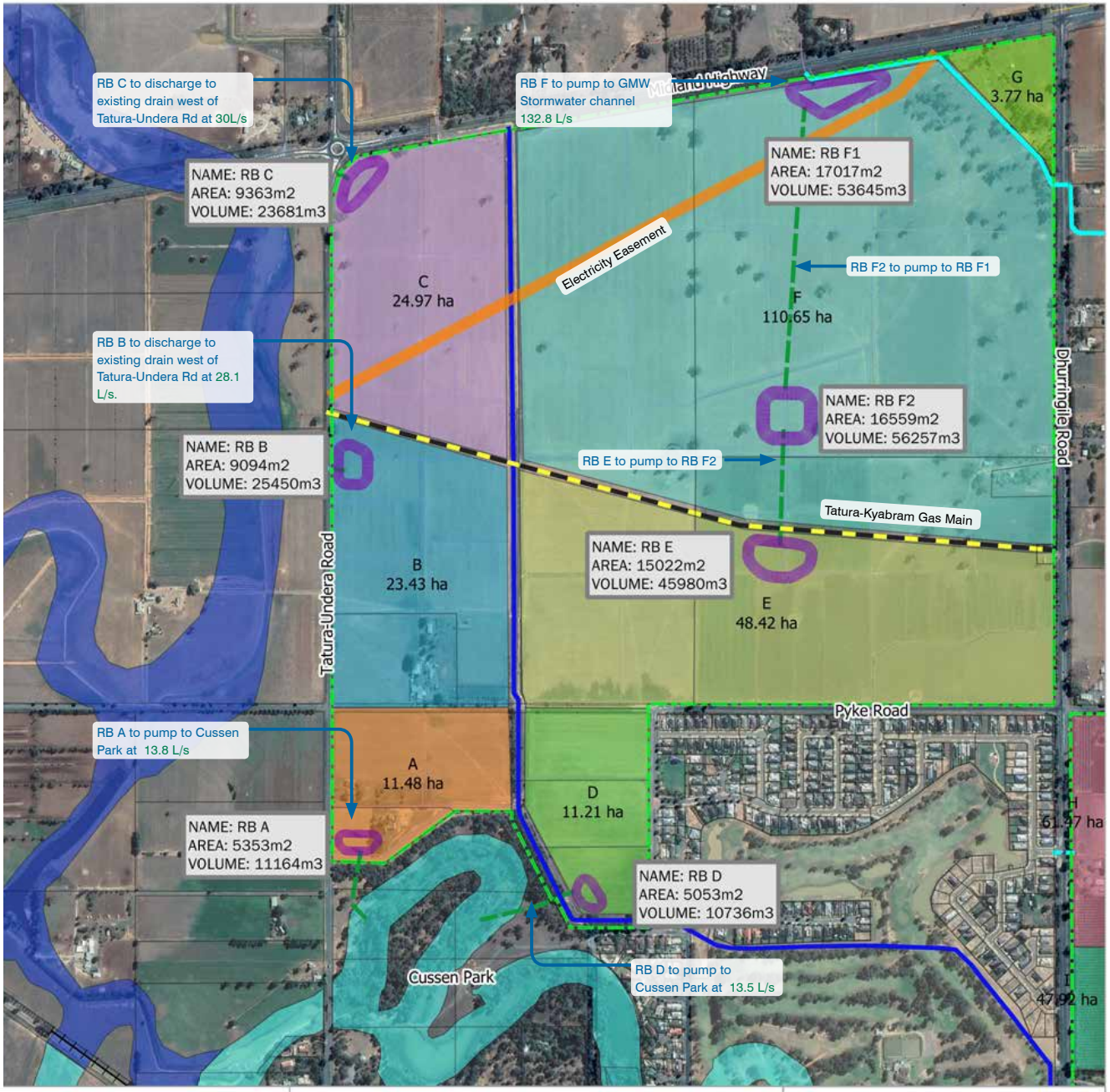
Midland Highway Precinct

The Midland Highway precinct comprises of the sub-catchments A-G which generally slope from the south to the north. There are several significant constraints within this area, including a GMW irrigation channel running south to north, the Tatura-Kyabram Gas main which runs from east to west and a major electrical easement which runs from the west of the site to the north-east.

The drainage infrastructure in this area has been designed generally in accordance with the natural contours with retarding basins being located in the natural low points and draining to existing drainage lines or watercourses. The exception being catchments A and D, which have been design to drain southwards towards Cussen Park in order provide the park with an alternative water source as requested in the in community and stakeholder consultation.

The retarding basins also address one of the other stakeholder concerns around the impact on flooding of downstream properties. The intent of the basins will be to capture runoff and discharge it at steady rate so that the increased runoff from development won't increase existing flood levels.

It should also be noted that a retarding hasn't been located on Catchment G, this is because it is a small catchment and can be determined at the development stage.



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LEGEND

- INVESTIGATION AREA
- CULVERTS
- GMW IRRIGATION CHANNEL
- GMW STORMWATER DRAIN
- ELECTRICITY EASEMENT
- GAS MAIN
- RETARDING BASIN
- URBAN FLOOD ZONE (UFZ)
- FLOODWAY OVERLAY (FO)

102 0 102 204 306 m

1:10,000

Coordinate System: GDA 1994 MGA Zone 55
Paper size A3 Landscape

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414 La Trobe Street
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Melbourne Vic 8007
T 61 3 9993 7888
spiire.com.au
ABN 55 050 029 635

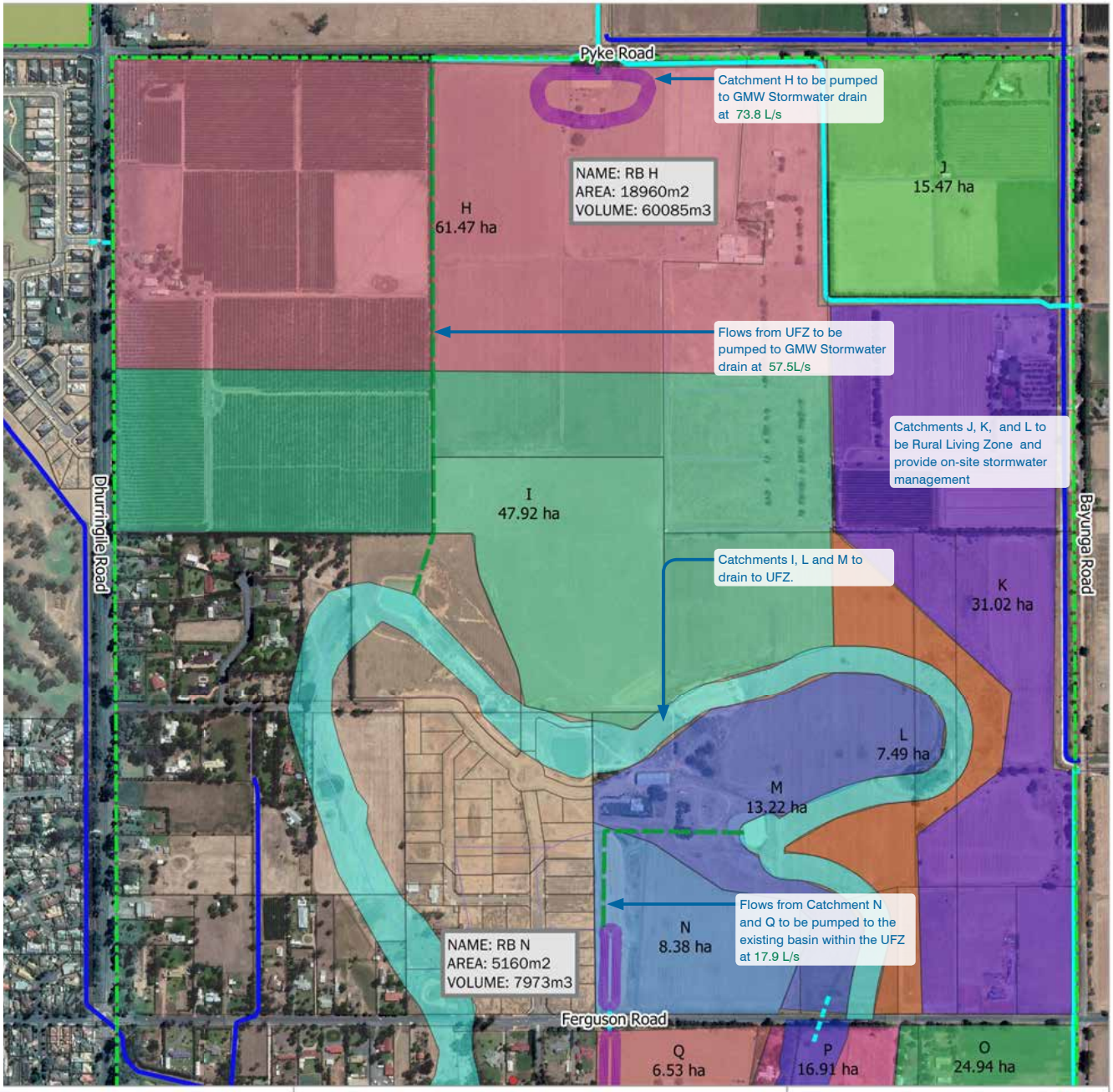
Drainage Infrastructure

Pyke Road Precinct

Pyke Road Precinct comprises of the sub-catchments H-N which, similar to the Midland Highway Precinct, generally slope from the south to the north. A significant feature of this area is a large depression which meanders through the southern portion of the region. This depression is flood prone and zoned as Urban Flood Zone (UFZ). Approximately half of the area to be rezoned will drain to this depression whilst the rest will drain to the north.

As this region is defined by a large depression zoned UFZ, the intent of this strategy was to utilise this area for drainage and amenity purposes. Catchments I-N will drain to this location, where it will be excavated and utilised as retarding basin and then pumped to the GMW drain located along the northern boundary.

The drainage strategy is similar to the endorsed development plan for Tatura Waters, with the exception of Catchment H which is proposed to drain to the north because of the natural topography. This results in an additional retarding basin on the development site, however, as the development plan has been endorsed, this retarding basin is for consideration purposes only, as it may be more cost effective and practical to provide an additional retarding basin in the north than modify the site so that it all drains to the depression. Furthermore, it should be noted that the Tatura Waters development plan is based on low development densities such as farm zone and low density residential, whilst this strategy has assumed that catchments, I, J, M, N will eventually be zoned residential.



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LEGEND

- INVESTIGATION AREA
- RETARDING BASIN
- CULVERTS
- GMW IRRIGATION CHANNELS
- GMW STORMWATER DRAINS
- SW RISING MAIN
- URBAN FLOOD ZONE (UFZ)
- FLOODWAY OVERLAY (FO)

76 0 76 152 228 m

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Drainage Infrastructure

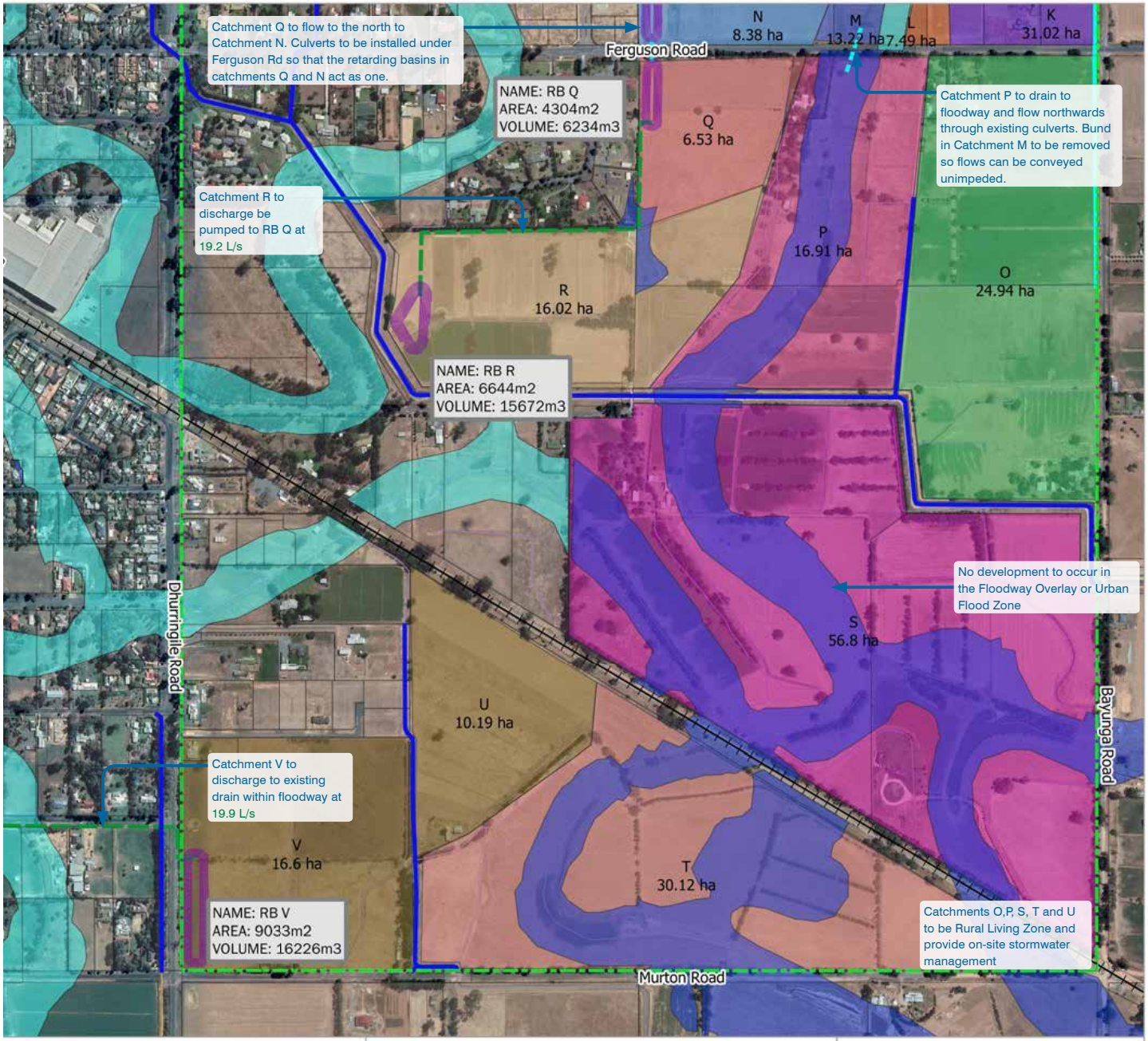
Murton Road Precinct

Murton Road Precinct is characterised by the by numerous depressions which meander across the precinct and as a result the land is to be zoned predominantly Rural Living since higher densities would not be feasible. The catchments P, Q, R and T are planned to be zoned residential and therefore only these catchments require regional drainage infrastructure installed as the Rural Living areas will provide their own stormwater infrastructure.

For Catchment P to drain effectively it is proposed that the bund on located on the north side of Ferguson Rd be removed as it is blocking the natural flow of drainage within the depression. Under normal circumstances Catchment P would flow to one of the retarding basins north of Ferguson Rd where it would be able to be pumped up to the GMW drain north of the development area. It was investigated if Catchment P could drain to west, either to Catchment Q or R, however, because of the topography of the natural terrain the water level in Catchment P would put properties in those catchments at risk if since the high water level in flood events may cause the drains in catchments Q or R to overflow.

In order to drain Catchment R, it is proposed to place a retarding basin at the western end of the catchment and then pump flows up to RB Q. This outlet was determined to be the most feasible option given the constraints of the GMW irrigation channel and access to existing drainage networks.

Catchment V is proposed to outlet to the existing Council drainage in Hampton Rd.



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Flood Results:
Data:

LEGEND

- INVESTIGATION AREA
- RETARDING BASIN
- CULVERTS
- GMW IRRIGATION CHANNELS
- GMW STORMWATER DRAINS
- SW RISING MAIN
- RAILWAY
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Water Balance and IWM Infrastructure

In order to understand the volumes of water likely to be produced by the rezoning of new areas around Tatura, a conceptual water cycle model was developed in MUSIC, using 10 years worth of rainfall data. The model estimated the volumes of runoff that would be generated in each catchment on an annual basis. Table 4 states the runoff generated from each catchment and were it goes, i.e. evaporates, infiltrates etc.

Whilst the increased runoff needs to be managed in order prevent flooding, it can also be seen as a resource. Table 5 indicates that up to 743ML/yr of additional runoff will be available to be utilised for non-potable purposes. Some of the options provided in this report, utilise runoff as a resource. The main example is the implementation of rainwater tanks, which if installed on each property, would reduce runoff by 170ML/yr whilst simultaneously reducing potable water demand by the same amount. Other examples are, tree pits, which utilise the increased runoff to help trees grow, which intern provides various benefits to the community such as urban cooling, increased amenity, and increased biodiversity. Stormwater reuse, can also be captured and reused to water green areas, such as ovals or gardens, this has the benefit of not only decreasing potable water usage for irrigation but also improving public amenity and community spaces. Options for the reuse of the additional stormwater are outlined in the following pages.

Note: The calculations for the mains water, sewer and rainwater tanks are based on households of 2.4 people per household (2016 Census), with each household using 481L/day. The rainwater tanks are assumed to provide water for toilets, laundry and the garden, and can use up to 250L/day. To confirm the supply of rainwater to the tanks, the stormwater program MUSIC was utilised. An assumption of 10 lots per hectare was made for residential areas, until such time that a structure plan is formalised.

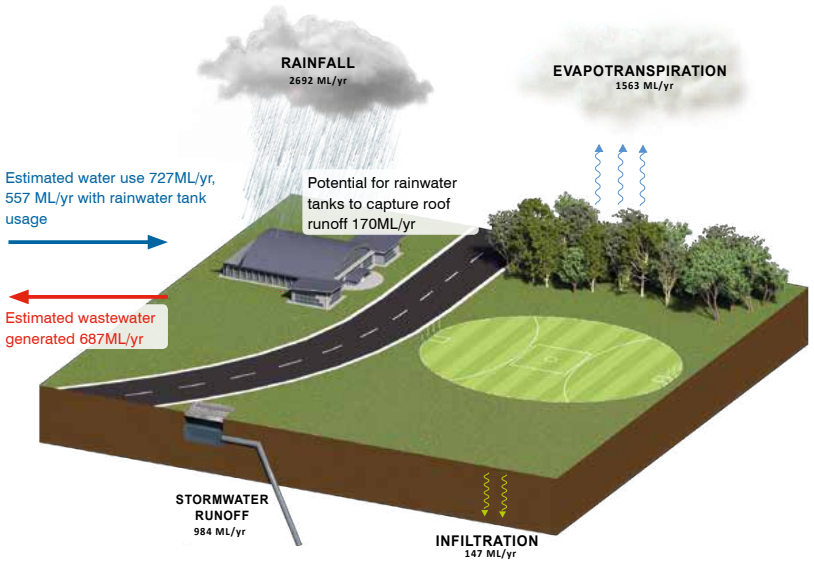


Figure 3: Visual Water Balance - Developed Conditions

Table 5: Differences in Water Balance Scenarios

	Catchment Area (ha)	Rain (ML/yr)	Evapotransipiration (ML/yr)	Infiltration (ML/yr)	Runoff (ML/yr)
Pre-developed	597	2692	2216	239	240
Developed	597	2692	1563	147	984
Difference	**0**	**0**	**-653**	**-92**	**+743**

Table 4: Catchment Water Balance

Catchment	Catchment Area (ha)	Rain (ML/yr)	Evapotransipiration (ML/yr)	Infiltration (ML/yr)	Runoff/ Potential reuse (ML/yr)
A	11	51	24	2	25
B	23	109	53	2	54
C	25	111	52	4	55
D	11	50	23	2	25
E	48	216	101	9	107
F	111	494	231	20	244
G	4	17	8	1	8
H	61	274	128	11	135
I	48	214	100	9	106
J	15	69	57	6	6
K	31	138	115	12	11
L	7	33	28	3	3
M	13	59	28	2	29
N	8	37	17	1	18
O	25	134	111	12	11
P	17	75	46	5	25
Q	7	29	14	1	14
R	16	72	33	3	35
S	57	254	210	23	21
T	30	134	112	12	11
U	10	45	38	4	4
V	17	74	35	3	37
Total	**597**	**2692**	**1563**	**147**	**984**

Note: Totals do not equal rainfall due to soil storage factors

IWM Infrastructure

Midland Highway Precinct

As catchments A and D are proposed to drain to Council land at Cussen Park, treatment measures such as swale or wetland could be implemented within this area. This would have the benefit of providing approximately 50ML treated water per year to Cussen Park, which was a recommendation by DELWP in the stakeholder consultation process.

An alternative IWM option explored for the A and D catchments was to treat the water via a WSUD asset such as wetland and then pump into the GMW irrigation channel, however, this option was deemed infeasible by GMW and therefore not explored further.

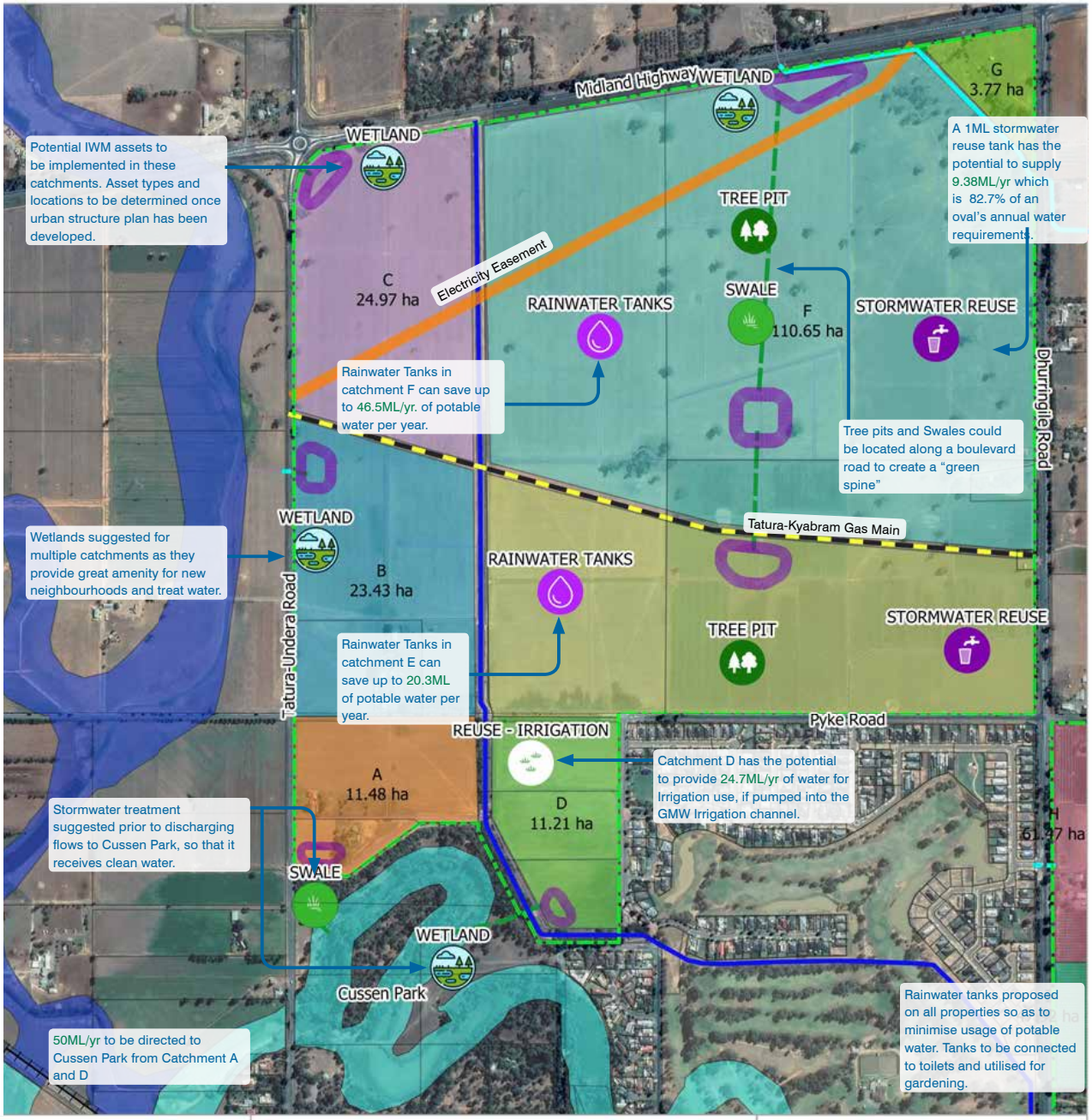
For the remaining catchments, due to the large area being rezoned and the structure plan still in progress there are numerous possibilities for the implementation of IWM infrastructure in this area. For example, if there were schools and ovals proposed within this area, stormwater reuse would be favourable option. To provide an example of the benefit that stormwater reuse can provide, an analysis was undertaken of installing a 1 megalitre (ML) tank in catchment F. If a reuse tank was installed for an AFL oval, it could provide approximately 83% of the water usage required for that oval (refer to Table 4 for calculations),

It has been assumed that combination of IWM measures will be implemented in each catchment. For instance, for Catchment F, it could be that tree pits, stormwater reuse, swales and wetlands are implemented in this catchment, with the space between the electricity easement and the highway being an ideal opportunity to co-located assets such as wetlands and retarding basin, whilst catchment E, may only implement tree pits and a wetland.

The adjacent plans shows some of the possibilities, however the feasibility and practicality of these options will have to be refined once a structure plan is finalised and land uses have been determined.

Table 4: Analysis of a 1ML Stormwater Harvesting System in Catchment F

	Value	Comment
Evapotranspiration - Grass	659.12mm	0.55 of all evapotranspiration for warm season (1198.4mm)
Effective Rainfall	127.85mm	50% of Warm season rainfall (Oct - April)
Water demand - Grass	531.27mm	Difference in evapotranspiration of grass and effective rainfall
Water demand considering sprinkler efficiency	708.36mm	Assumed 0.75 efficiency when watering grass
Oval Area	16,000m²	Average AFL oval
Annual water demand of oval	11.34ML	(708.36*16000/100000)
1ML Stormwater reuse tank supply per annum	9.38ML	Calculated for catchment F in MUSIC
Annual water demand of Oval demand met	82.7%	



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- INVESTIGATION AREA
- CULVERTS
- GMW IRRIGATION CHANNELS
- GMW STORMWATER DRAINS
- ELECTRICITY EASEMENT
- GAS MAIN
- URBAN FLOOD ZONE (UFZ)
- FLOODWAY OVERLAY (FO)

102 0 102 204 306 m

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Melbourne Vic 8007
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IWM Infrastructure

Pyke Road Precinct

Approximately half of the Pyke Road Precinct is zoned is low density and therefore IWM options will be provided on a lot scale and subject to the future owners preferences.

The situation for the residential catchments is similar to the Midland Highway Precinct, it has large catchments where multiple IWM possibilities are available and are dependent on the land use. Once a preliminary structure plan has been developed, the preferred IWM options can be defined. In general the intent would be to locate assets near or within the Urban Flood Zone and Council Reserve, such as tree infiltration trenches and wetlands in order to minimise the impact of developable land. It would also have the added benefit of creating a green corridor along the existing depression.

For areas where there is minimal land available for WSUD/IWM assets it is recommended smaller, more localised assets be constructed such as street tree pits and rainwater tanks to increase local vegetation cover and reduce potable water demand.

As mentioned in the drainage infrastructure section, this area already has an endorsed development plan and these IWM options could potentially be integrated into development.

Prior to development, it is recommended that a drinking water and sewerage strategy is undertaken which can further investigate ways to incorporate IWM into the precinct.

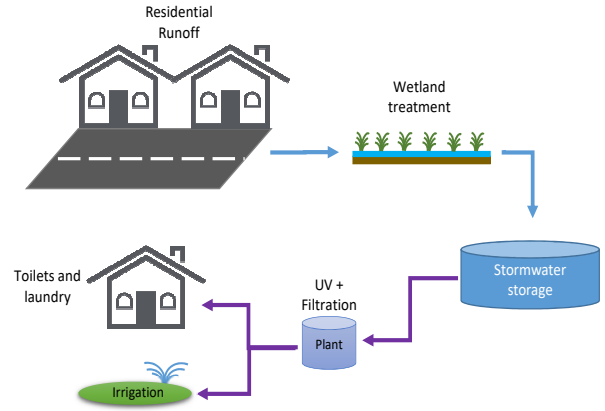
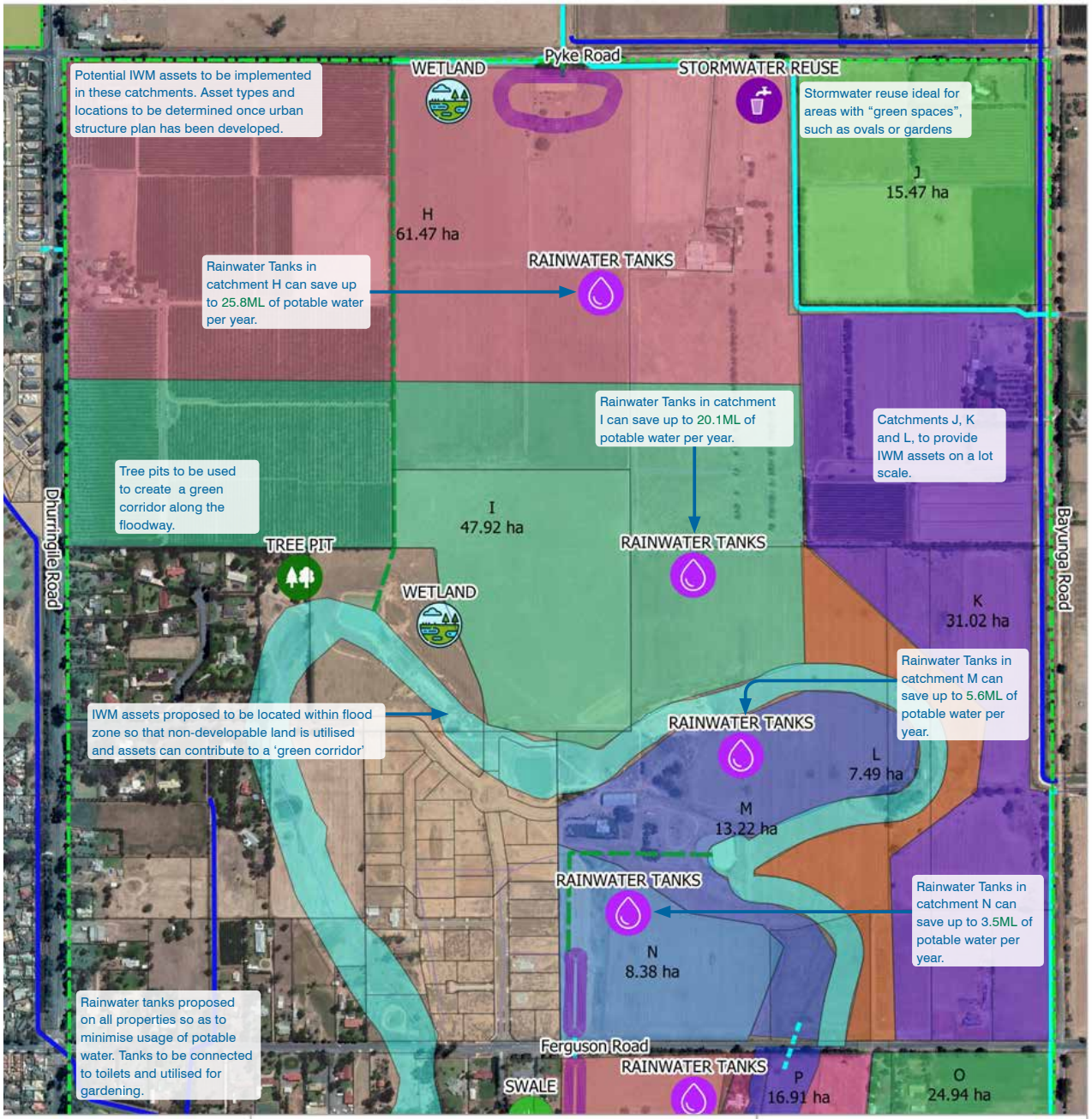


Figure 3: Stormwater Harvesting Process Example



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76 0 76 152 228 m

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IWM Infrastructure

Murton Road Precinct

A large portion of the Murton Road Precinct is zoned low density residential, as a result these areas will be providing onsite IWM solutions. For the areas which are zoned residential, the following options were explored:

- For Catchment Q, a swale drain as proposed to be constructed along the existing drainage line to the UFZ to the west, through the 56 Ferguson Rd property, however this would require an easement over private property which would be acquired by Council. After discussions with Council this was not a preferred option and Catchment Q will be directed to the north.
- Similar to Midland Highway Precinct, in Catchment R reuse for irrigation was explored by treating runoff through a WSUD asset and then pumping back into a GMW irrigation drain, however, after discussions with GMW, they advised that this option would not be acceptable to GMW.
- Rainwater tanks implemented at a lot level.

It is also recommended that prior to development occuring that a drinking water and sewerage strategy is undertaken which can further investigate ways to incorporate IWM into the precinct.

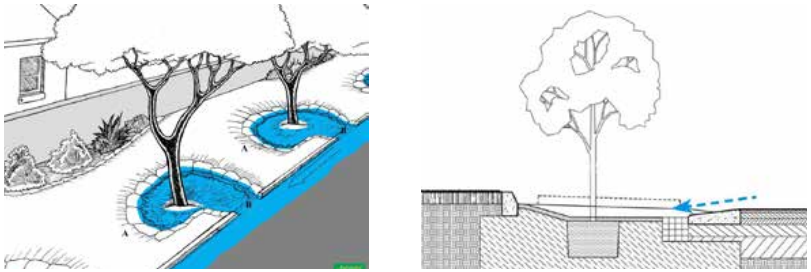
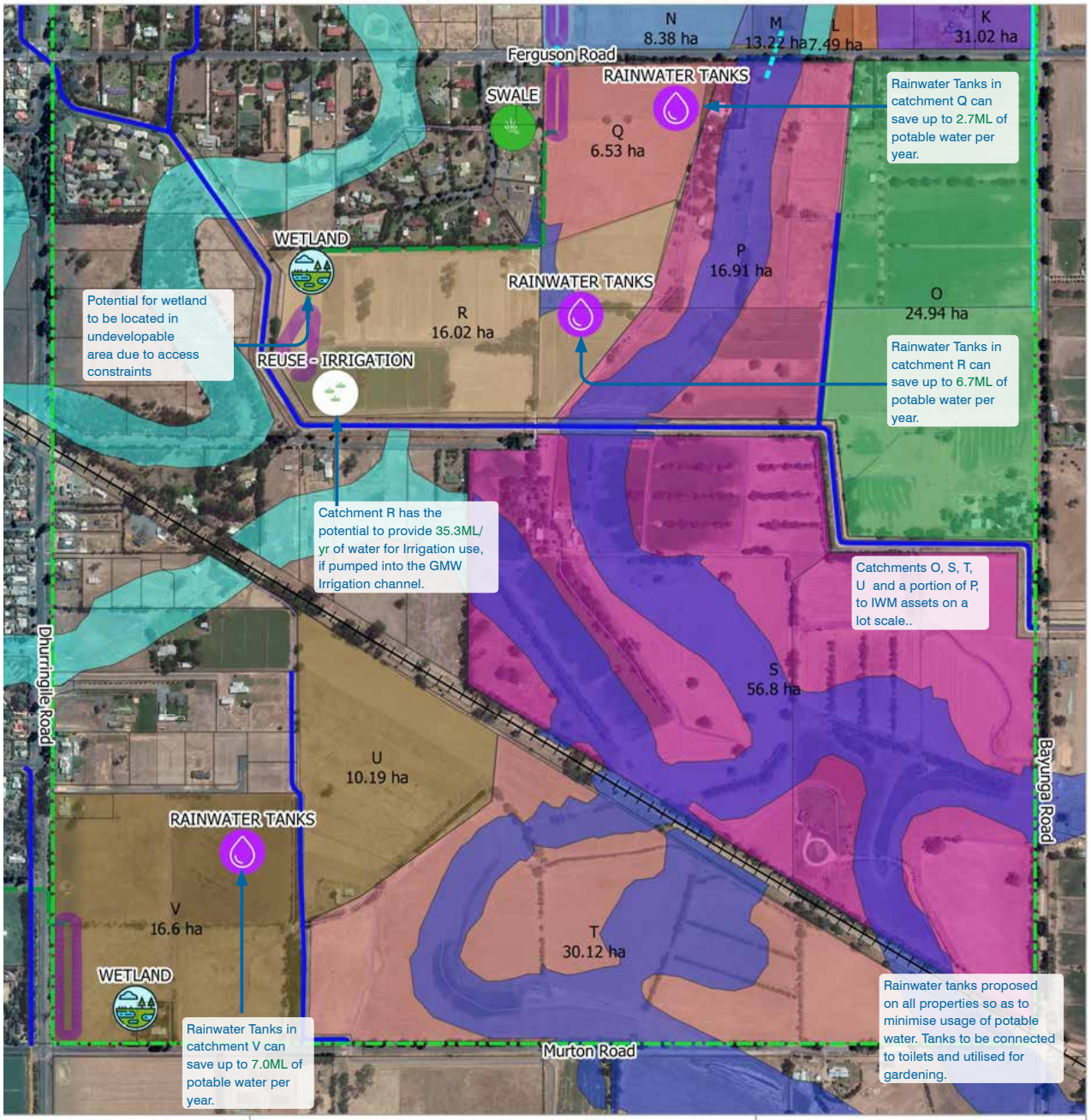


Figure 4: Examples Of How Street Trees function



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- GMW STORMWATER DRAINS
- URBAN FLOOD ZONE (UFZ)
- FLOODWAY OVERLAY (FO)
- RAILWAY

76 0 76 152 228 m

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Alternative Options

In addition to the scenarios presented in this report, alternative designs and options were investigated for consideration by Council. The main options investigated were:

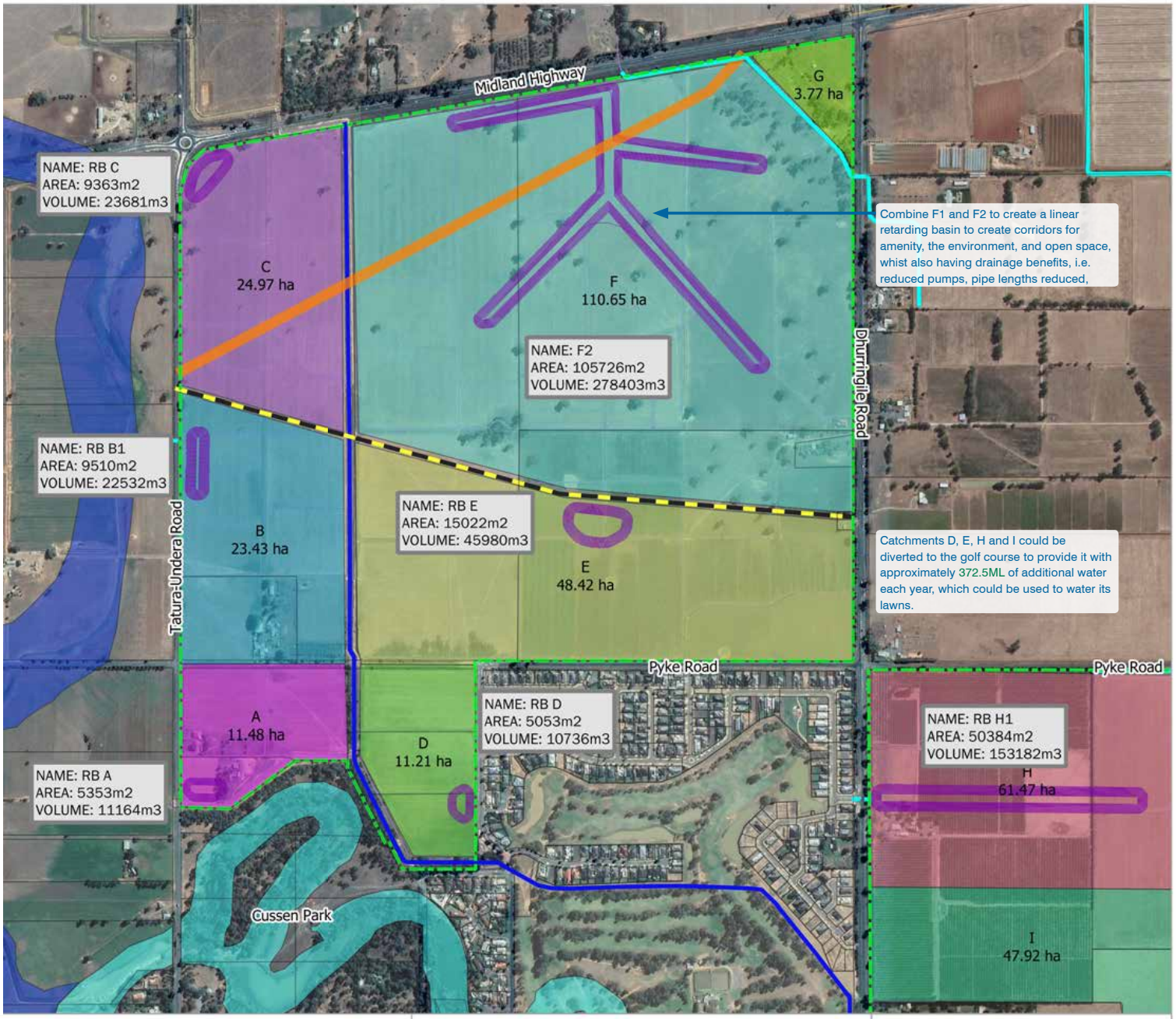
- Linear retarding basins
- Stormwater reuse within Tatura.

These concepts are outlined on the following pages.

Linear retarding basins

The intent of these retarding basins was to provide an alternative to the standard form of constructing retarding basins within the Shepparton area by creating linear drainage reserves which would mimic a constructed waterway. These retarding basins can provide various benefits for the new developments, the main benefit being providing amenity to the new development area. Waterbodies can be located in the bottom of basins and the elongated retarding basins would create long linear open spaces which could incorporate footpaths and parks making them features of the new development. They would also allow for the creation of a green corridor where trees could be planted to promote urban greening and biolinks in the new estates. These trees would have several advantages for the new the estates, they have the potential to reduce the temperature of the surrounding areas through increasing shade and minimising the use of impervious surfaces which store and radiate heat, as well as allow for the implementation of WSUD structures, such as tree infiltration pits, to be included within reserves, which reduce urban runoff loads.

These linear retarding basins would also allow for a reduction in the number of retarding basins and pumps, particularly in Catchment F, which is a large catchment where multiple RBs would be required. However, these linear retarding basins are larger in size than the traditional retarding basins and as result would require a larger reserve area than a standard retarding basin.



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- GAS MAIN
- RETARDING BASIN
- URBAN FLOOD ZONE (UFZ)
- FLOODWAY OVERLAY (FO)

102 0 102 204 306 m

1:10,000

Coordinate System: GDA 1994 MGA Zone 55
Paper size A3 Landscape

spiire
414 La Trobe Street
PO Box 16084
Melbourne Vic 8007
T 61 3 9993 7888
spiire.com.au
ABN 55 050 029 635

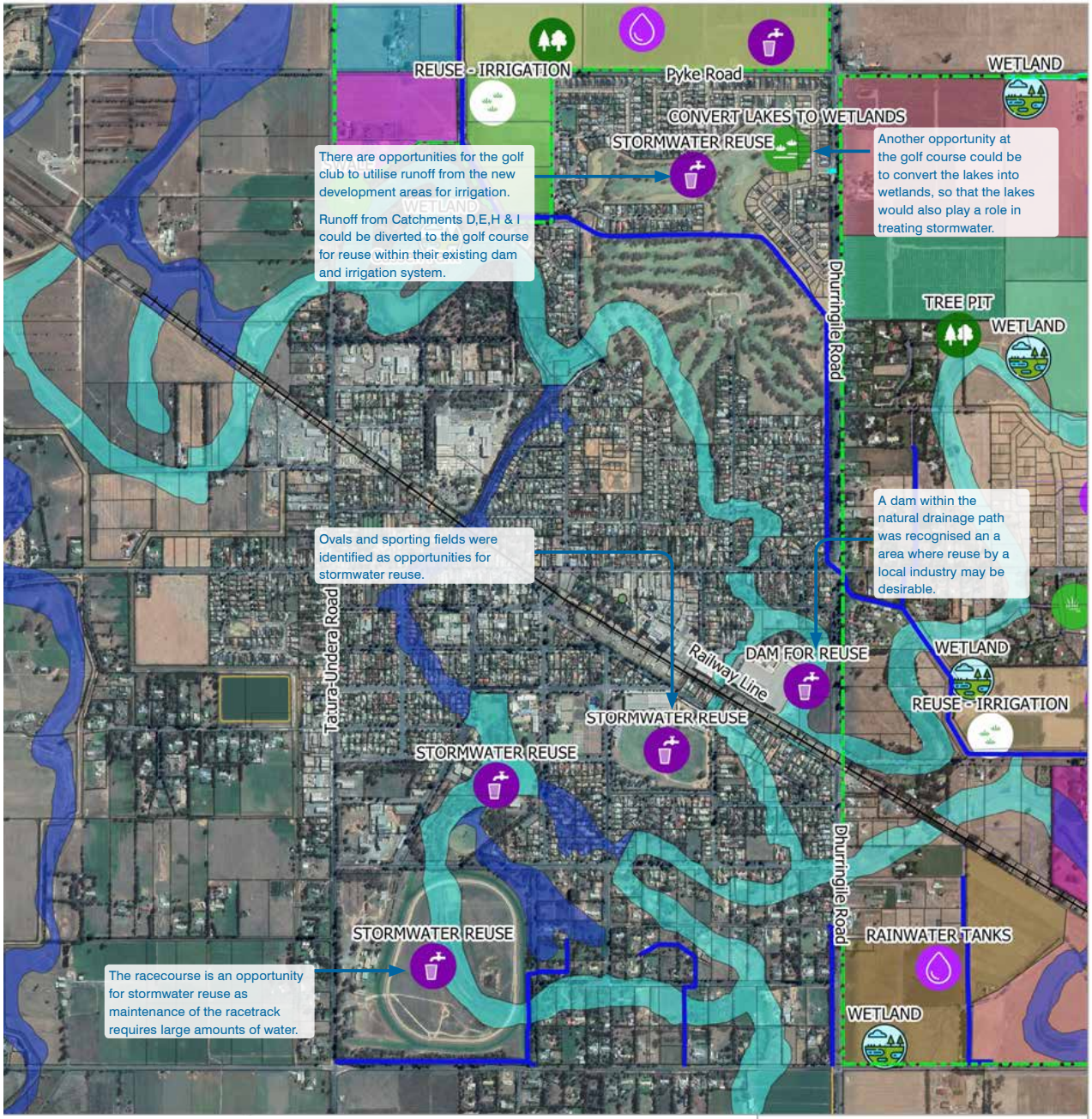
Alternative Options

Stormwater reuse in township

As discussed the development of Tatura will generate approximately 743ML of additional stormwater a year. This stormwater has the ability to provide a water resource to the development as well as the broader community. Potential projects can be brought online in Tatura as the development occurs to offset the potable water use within the township. These projects are identified on the map on the right.

The biggest potential for reuse was the golf course, as golf courses require significant amounts of water in order to maintain the lawns and there were already ponds which could be utilised. This strategy investigated diverting several catchments (D, E, H and I) from the new development areas to the golf course. This option would divert runoff from approximately 170ha of land to the golf course which could be used for irrigating the lawns.

In addition to the golf course other areas were identified, including the racecourse, show grounds, ovals and recreation areas, amongst others. These options for stormwater reuse were discussed with Council, however were not pursued further at this stage due to the uncertainty of formalising agreements with private entities. Further feasibility and design would be required by Council to implment these projects.



Summary and Next Steps

Tatura is a high priority township within the Greater Shepparton Townships Framework Plan Review 2019 and Council is facilitating the growth of the town and is developing an structure plan for the area. This document has been developed to inform the Council Structure Plan, and to incorporate innovative opportunities for the conservation and utilisation of water within the township, prevent the increasing of flood conditions and provide infrastructure that will contribute to more vibrant and liveable communities. To achieve this an Integrated Water Management (IWM) approach was identified by Council as a key step in implementing a sustainable development framework for Tatura.

As a result of consultation with council and stakeholders the key objectives of this IWM are to:

- Integrate and promote strategic water use.
- Provide effective and affordable wastewater systems
- Provide effective stormwater management that protects our waterways.
- Create cool, green and water sensitive landscapes.
- Create climate change resistant systems.

A range of IWM measures have been investigated and adopted in this plan aim to address the key components of IWM whilst also being appropriate for the site conditions and context. The selected measures are:

- Waterway and Flood plains - Above ground onsite detention or linear retarding basins to create biolinks.
- Major Drainage - Swales and piped drainage
- Catchment Management and Land use - Diverse vegetation, pathways interfacing assets and wayfinding
- WSUD Assets - Wetlands and tree pits
- Potable Water - Standard system, with rainwater tanks and demand management to offset drinking water demand
- Sewerage - Utilise existing recycling systems
- Alternative Water - Stormwater and rainwater harvesting
- Education and policy programs

It is acknowledged, that further IWM opportunities are available for Tatura, however, the opportunities analysed in this report were selected in consultation with Council, as best aligning with the IWM vision and stakeholder priorities.

The investigation found that through the development of Tatura, the town would use up to 727ML of additional potable water per year and generate 687ML of sewerage per year, increasing the demand on existing water and wastewater infrastructure in Tatura. Further to this, the development will generate an additional 743 ML of stormwater a year, which is available for reuse within the development and the community. One way that this additional stormwater can be utilised is through the use of rainwater tanks which if installed on every property, can provide up to 170ML per year as an alternative water source for activities such as toilet flushing and laundry.

The options provided in this report, focus on utilising this runoff as a resource, whilst implementing ways to decrease water consumption and wastewater generation. For example, implementing stormwater harvesting for irrigation of ovals and community reserves, has the benefit of not only decreasing potable water usage but also improving public amenity and community spaces. These IWM opportunities can also be developed with supporting options, such as wetlands to treat stormwater, swales along connected roads and tree pits to create biolinks through the community. The location of these opportunities can be further developed, as the Structure Plan is finalised.

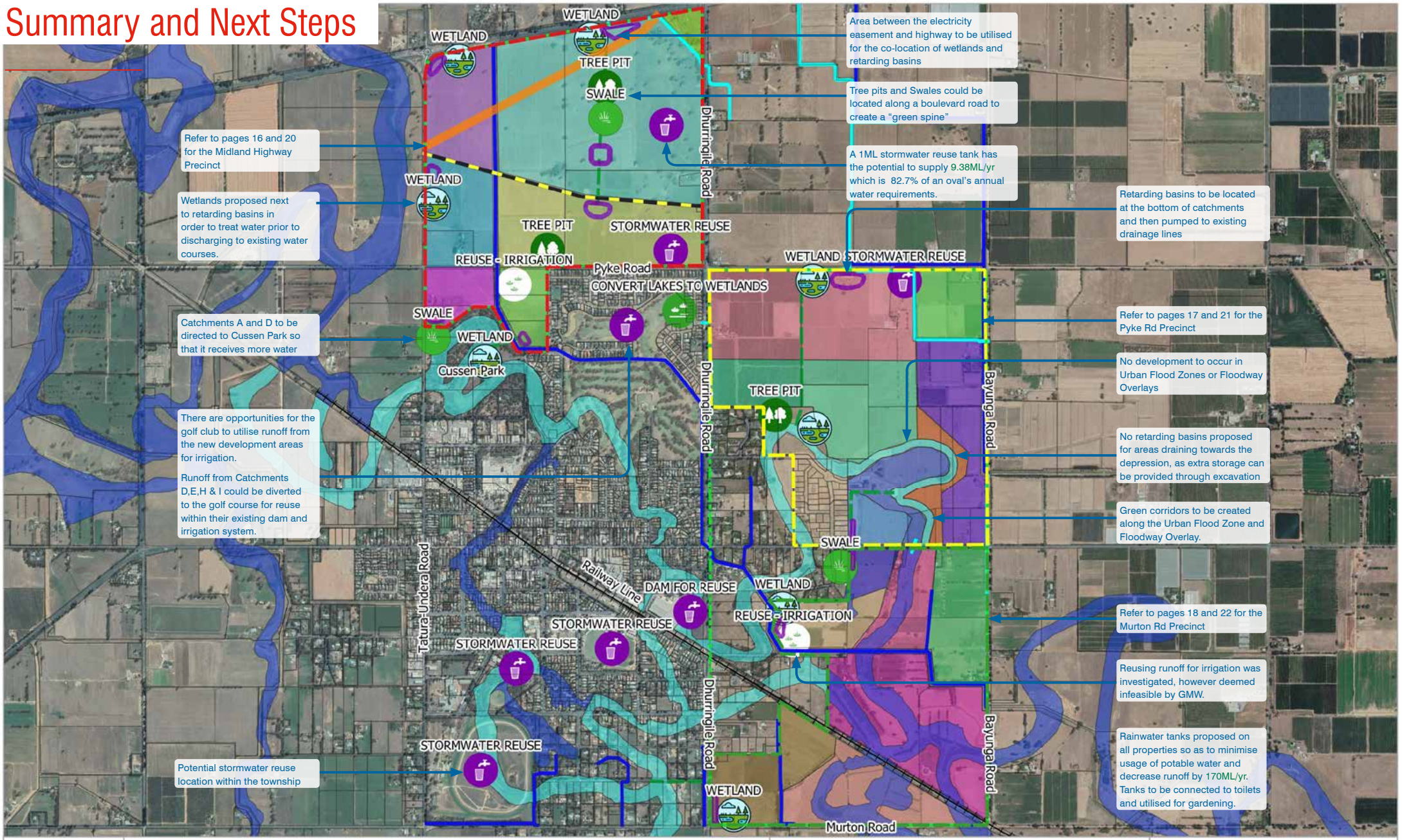
Complimenting these options for utilising the runoff as a resource, other opportunities focusing on water consumption are recommended, such as the implementation of rainwater tanks on all properties for non-potable water uses within the household. Along with these rainwater tanks, a minimum energy and water efficiency is proposed for development to decrease water consumption with households.

Decreasing water consumption will help to decrease the sewerage generated in the new developments. It is noted that the Tatura Wastewater Treatment Plant currently treats the sewerage for irrigation purposes only. This is recommended to continue for the sewerage generated from the development area too.

Following the development of this report, the next steps are:

- To formalise a Structure Plan for the Tatura Growth area.
- Council to decide on the preferred IWM options for Tatura.
- Further investigations to be undertaken to refine the stormwater and IWM Infrastrcuture within the Tatura growth area based on the structure plan.
- Council to develop polices to ensure that new developments incorporate new WSUD and IWM asseets into their develoments.

Summary and Next Steps



NOTATIONS

File Ref: 307990
Plan: W GIS 307990
Rev: A
Date: 01.04.2021

Designed: J.Carroll
Checked: M.Yule
Authorised: J.Espagne

LEGEND

- INVESTIGATION AREA
- RETARDING BASIN
- CULVERTS
- GMW IRRIGATION CHANNELS
- GMW STORMWATER DRAIN
- SW RISING MAIN
- URBAN FLOOD ZONE (UFZ)
- FLOODWAY OVERLAY (FO)
- MIDLAND HIGHWAY PRECIN
- MURTON ROAD PRECINCT
- PYKE ROAD PRECINCT
- ELECTRICITY EASEMENT
- GAS MAIN

205 0 205 410 615 m

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