Managed Aquifer Recharge (MAR) examples supporting Integrated Water Management (IWM) across Australia and New Zealand

WALLBRIDGE GILBERT AZTEC

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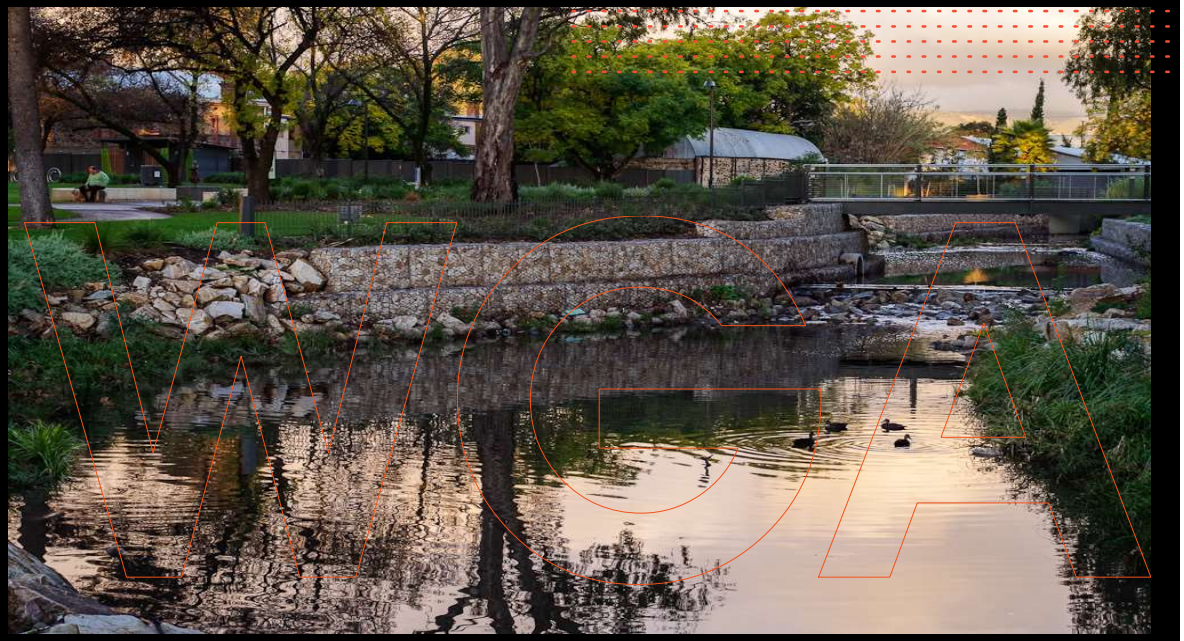
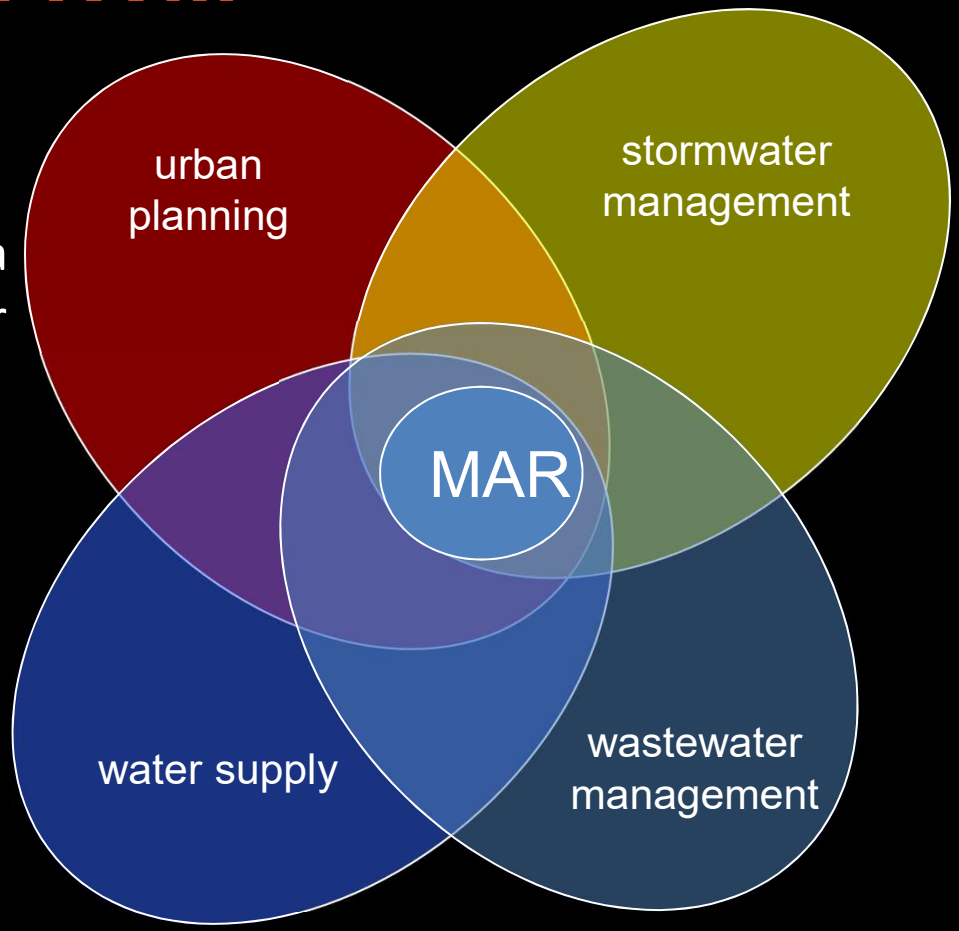


Integrated Water Management (IWM)

- Globally, all growing cities and rural sectors are facing major challenges including:
  - modernising water supply infrastructure;
  - modernising water treatment infrastructure;
  - improving urban design (liveability);
  - feeding growing populations; and
  - Managing discharges of treated wastewater.
- Integrated Water Management (IWM) approaches sustainable resource management from a catchment perspective in contrast to a piecemeal approach that artificially separates land management from water management.
- IWM approaches vary from country to country and catchment to catchment but they are all fundamentally based on management options that deliver environmental, cultural, and social outcomes for all users of the resource.

The Role of MAR in IWM

Managed Aquifer Recharge (MAR) as a tool to better utilize all available water resources sits firmly in the nexus between water supply, wastewater management, urban planning and stormwater management.



Why MAR

- Increasingly, across greenfield urban development sites MAR is incorporated into IWM solutions to improve liveability and deliver alternative sources of water for irrigation and third pipe use within households.
  - A tool to replenish aquifers and provide security of supply
  - Generally the cheapest form of new water supply available. Less than 40% cost of equivalent volume of surface water storage
  - Can help offset the costs of flood mitigation in urban catchments and of water reclamation costs where demand is out of balance with supply.
- This presentation highlights three examples of MAR projects supporting IWM

MAR examples supporting IWM across Australia and New Zealand

Nambeelup Industrial Area south of Perth

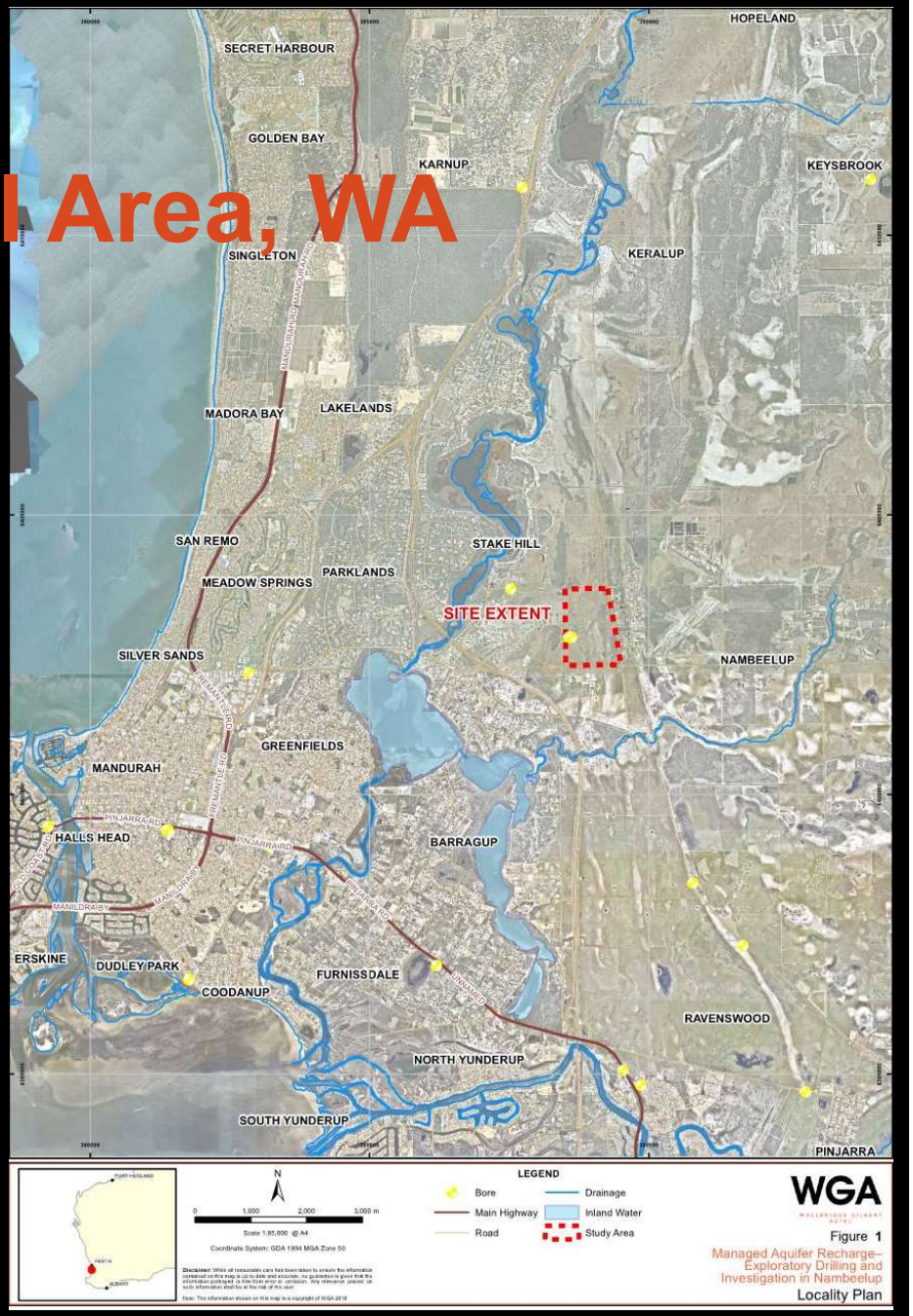
Waterproofing Adelaide

Black Forest Road Stormwater Harvesting Scheme

Hinds catchment project (NZ) MAR

Nambeelup Industrial Area, WA

- The proposed Nambeelup Industrial Area south of Perth (WA), is a modern industrial estate comprising approximately 1,000 ha (10 km^2) of industrial land.
- The area is subject to seasonal inundation and several wetlands of significance occur downgradient.
- Initial solution involved placing fill to a depth of 800 mm across the site to protect building infrastructure from inundation.
- The estimated to cost to apply the fill is ~AUD$80 million.



Nambeelup Industrial Area, WA

- An alternative integrated solution has been proposed for half the cost involving MAR and water reuse to provide a more sustainable development outcome.
  - Subsurface drainage seen as a solution to manage inundation
  - Wetland levels at predevelopment conditions
  - Not increase inundation offsite
  - No adverse impacts on terrestrial GDEs vegetation
  - Landuse in surrounding areas is not impacted
- Subsurface drainage generates ~3.5 GL/a of high quality water (<600 mg/L) which can be stored in the deep confined aquifer and used to support irrigated horticulture in the Perth/Peel region.

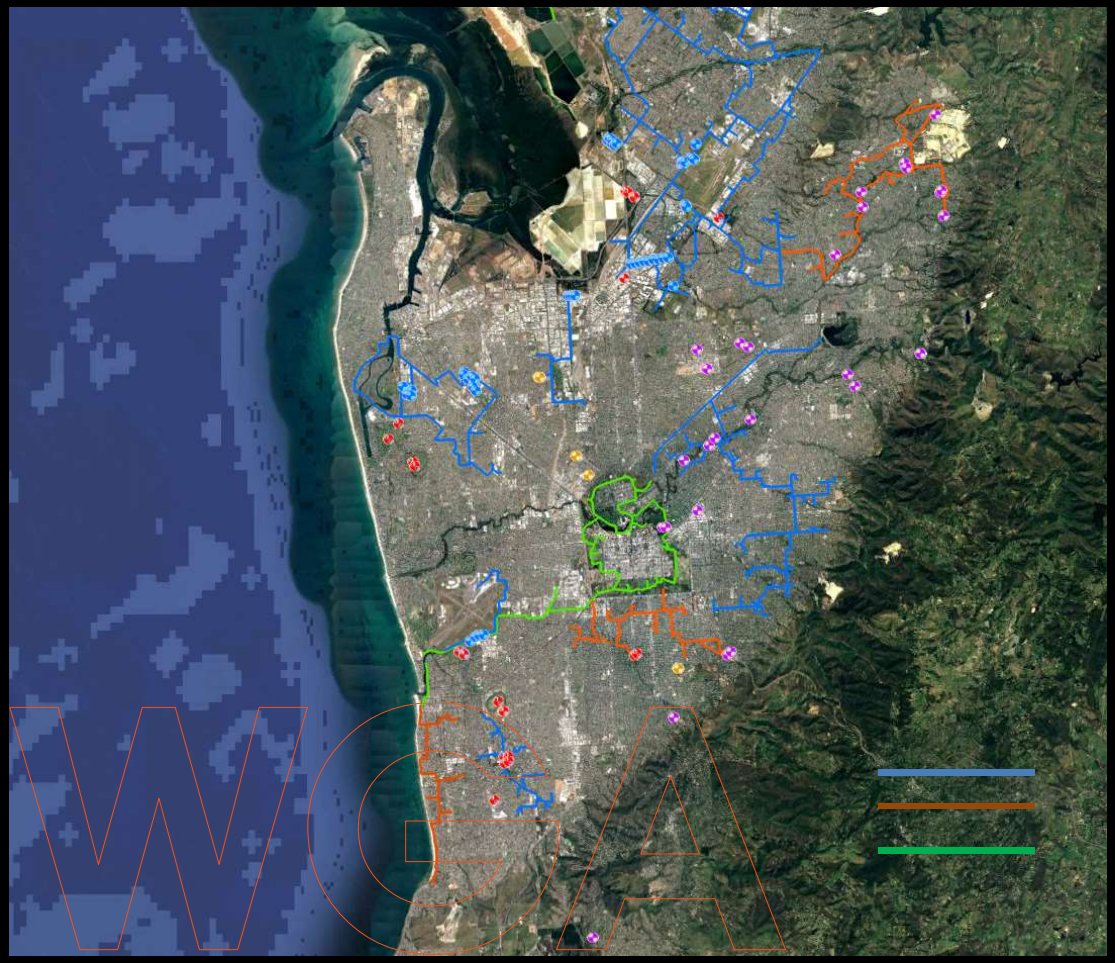
Nambeelup Industrial Area, WA

- Preliminary investigations have identified main target aquifer Cattamarra Coal measures at 225 to 246m bgl.
- Preliminary hydraulic testing identified that at 50 L/s after 100 days of continuous injection the impress head would be around 29 m above the initial standing water level assuming a well efficiency of 60%.
- Key risk is managing iron precipitation associated with recharging the drainage water
- Preliminary numerical modelling has shown the predicted recharge volumes (even with a proportion of banking) for 20 years is sustainable.

Nambeelup Industrial Area, WA

- Outcomes include:
  - Significantly lower cost to develop the site and manage inundation.
  - Improved environmental outcomes i.e. reduce the impacts of discharging stormwater runoff.
  - Additional economic benefits for the region through development of sustainable irrigated horticulture to the tune of AUD$21 to AUD$35 million at the farmgate.
  - Resource enhancement options in managing the deeper aquifer system.

Waterproofing Adelaide



- Combination of Stormwater Harvesting and Recycled Waste Water across metropolitan Adelaide
- Scheme to the North, East, South and West of the city
- Not many schemes are link currently, but some could be link in the future to allow further integrated network
- Most are Council owned and operated, others Water Authority (SA Water) and smaller private and operated.
- Many scheme are constructed and operate across Council boundaries and are in joint Council partnership

Waterproofing Adelaide

March 1998

March 2004

March 2010

Reference. www.nearmap.com.au

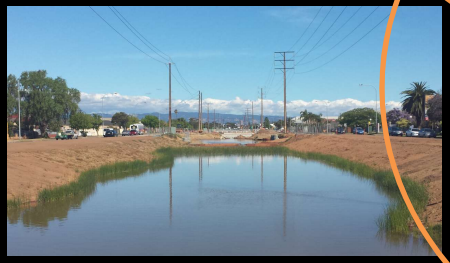
- Initiated to source alternate water supply during the drought and water restrictions.
- Many Council's had to stop irrigation to public open space and ovals, leading to poor public amenity, loss of environment, biodiversity, heat island.
- Along with impact to public, there were significant financial losses in reinstating grass, gardens and significant tree loss.
- SWH integrating MAR offered a water security for irrigation and maintenance of Council assets.
- The benefit of MAR included higher storage potential (and annual yield), longer term storage and supply during prolonged drought, reduced losses and no impact to available land.

Waterproofing Adelaide

WGA

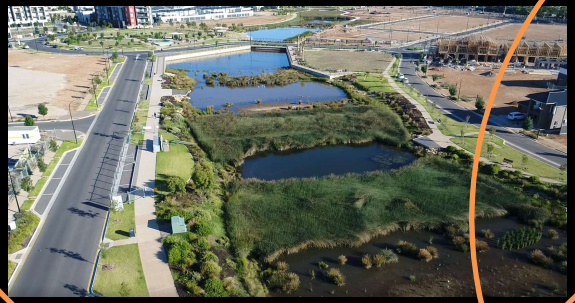
NORTH

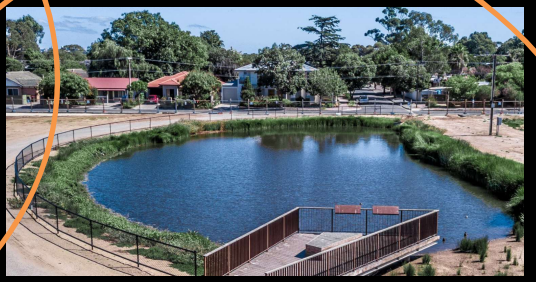
Waterproofing the North >10 GL/a



WEST

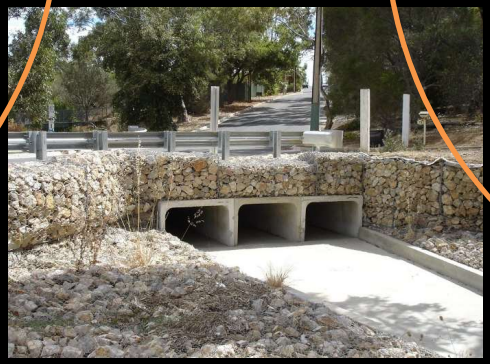
Waterproofing the West 2.3 GL/a





Waterproofing the East – 0.5GL/a

EAST



Waterproofing the South 2.8GL/a

SOUTH

Waterproofing the West

Waterproofing the West

2010

2018

Reference. www.nearmap.com.au

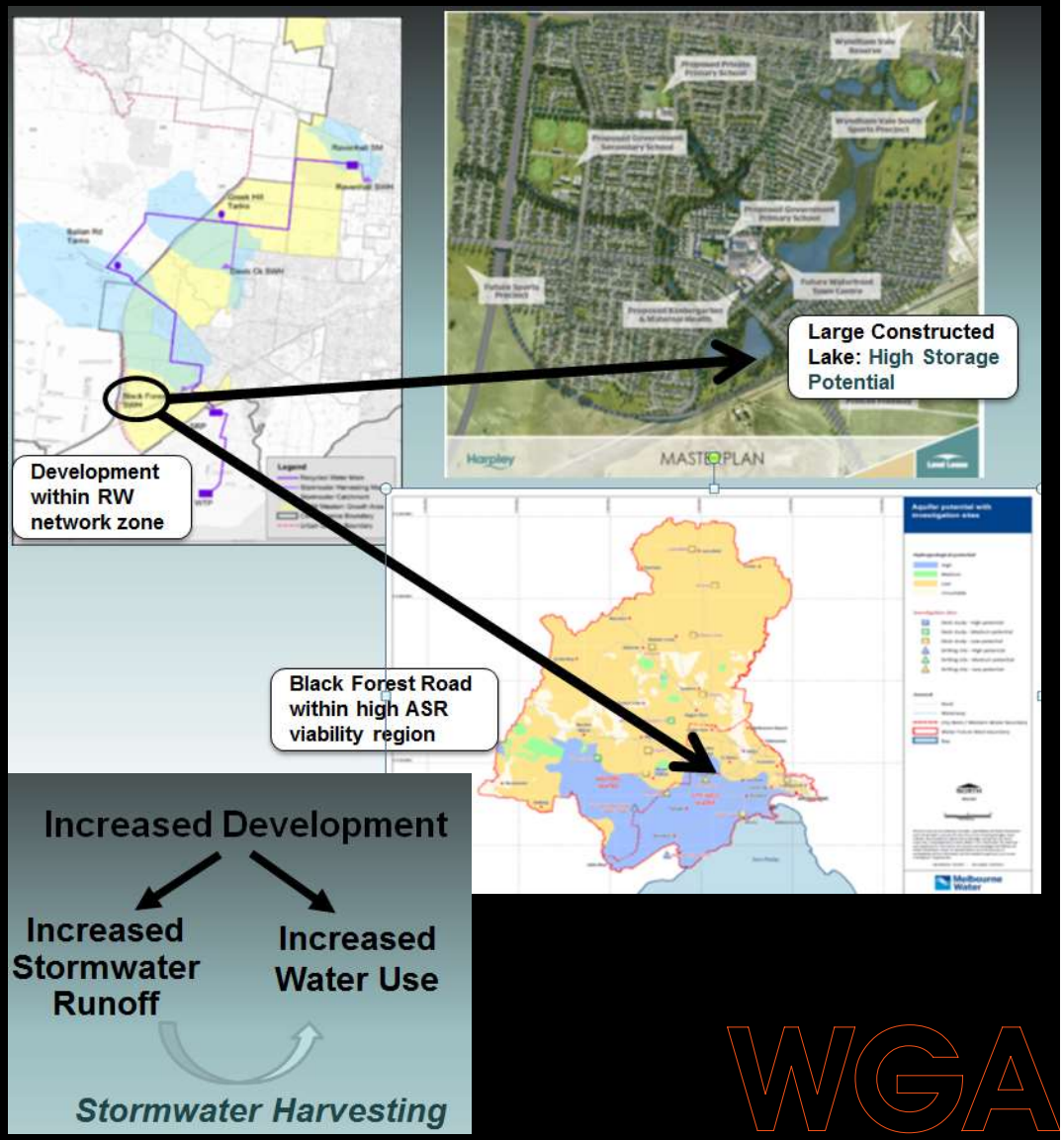
Waterproofing the West

- Collaborative project between Local, State and Federal Governments.
- Manage of flooding in area around lower Port Road.
- Manage additional stormwater loadings from the St Clair urban development ~1km^2
- Treatment using wetlands and biofiltration beds.
- Reticulation network linking council parks and Public open space
- 10 km pipeline supplying water diverted from River Torrens – increase yield due to availability in MAR and treatment

Black Forest Road, Werribee, Vic

The Opportunity:

- Utilise the increased urban stormwater runoff with growth area for stormwater harvesting to supplement recycled water supply
- Development included large lake (amenity), basin/wetland (flood mitigation and WQ)
- Potential to use the water bodies for storage & treatment
- Close the loop by harvesting increased runoff for reuse.
- Provide alternate water source for growing urban demand.
- MAR would provide increased yield



Black Forest Road, Werribee, Vic

The Outcome:

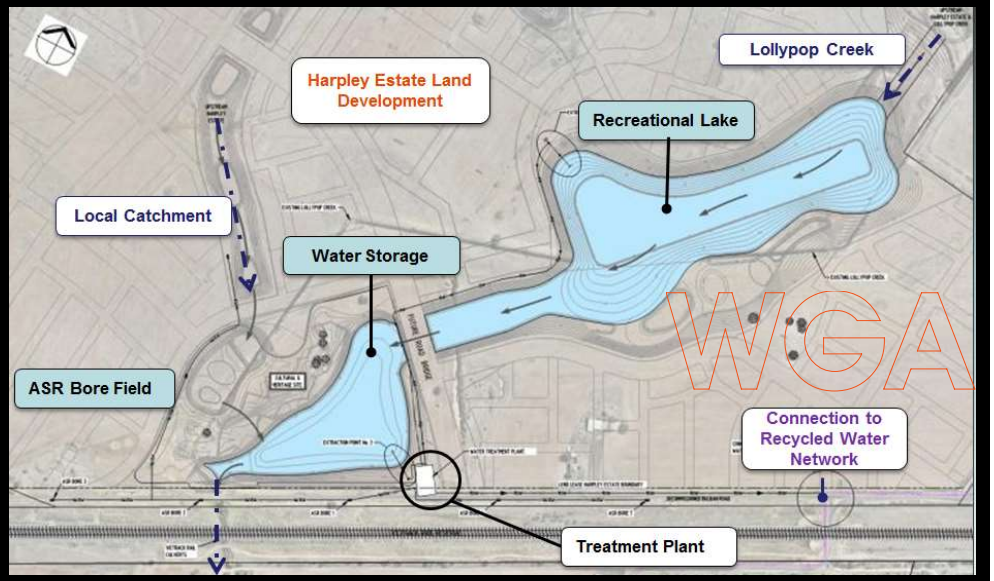
- Potential Annual **Yield** Recycled Stormwater Water up to 3.3GL/a (when upstream catchment is fully developed)

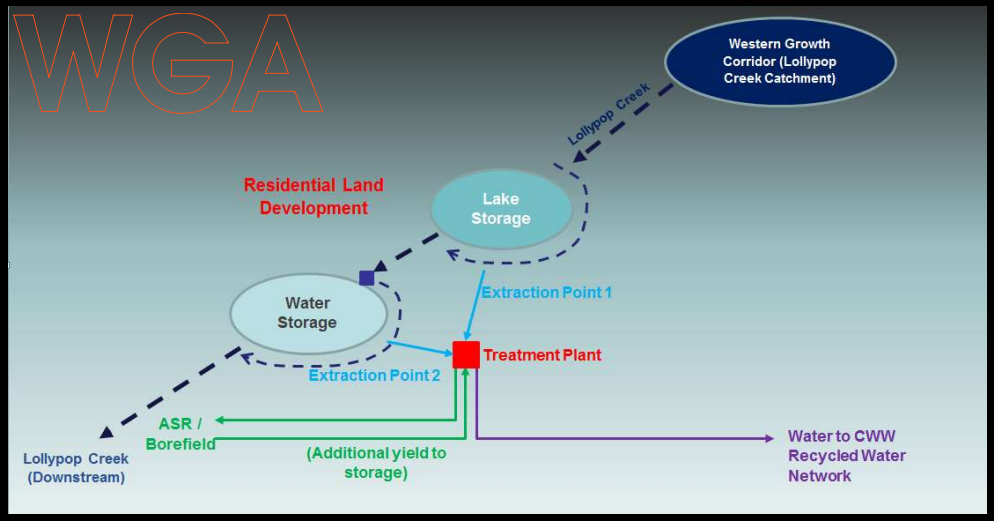
Benefit of MAR

- increase volume of yield by 1GL/a and reliability of supply through 'banking'
- Staging of the scheme over time with growth (no need for a large storage upfront).

Other Benefits

- Multiple benefits – flood management, water quality, water supply, aesthetics, water security.
- Collaboration Multiple Stakeholders – Water Authority, Council, Developer





Hinds Catchment, New Zealand

The Hinds MAR project is a community-driven catchment-scale approach to improving water storage and quality conditions whilst seeking to enhance and protect the environmental and cultural values.

Specifically the project aims to:

1. Increase groundwater levels and overall groundwater storage near the site.
2. Decrease concentrations of nitrate-N in groundwater near the site.
3. To increase baseflows and improve water quality in the down-gradient coastal spring-fed waterbodies (drains).

Hinds Catchment, New Zealand

- The pilot trial aimed to infiltrate up to 500 L/s[3]
- Water is sourced from the Rangitata River
- Recent intensification of farming based on irrigation, and the transition to dairy farming, has resulted in
  - significant changes to the water quality and ecological health of the catchment.
  - Agricultural-related contaminants in groundwater, rivers, and spring-fed waterbodies include nitrate-nitrogen (nitrate-N),
  - phosphorus, sediments and faecal bacteria, and have shown increasing trends

Hinds Catchment, New Zealand

- Trial outcomes:
  - Significant stakeholder engagement leading to strong community ownership of the MAR option.
  - Recharge rate of 200 L/s^3 sustainably achieved.
  - Minimal clogging but infiltration rates lower than anticipated due to underlying subsurface features.
  - Achieved nitrate-nitrogen (nitrate-N) reductions of over 50% across multiple zones.
  - Achieved groundwater replenishment levels.
  - Did not achieve objective 3 (improving quality and flow in down-gradient spring fed watercourses due to lower than anticipated injection volumes.

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ANY QUESTION?

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