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Wungong Urban Water Project

A major innovation in alternative water supply in WA

Wayne Schafer | GHD | Principle Water Resources Engineer

Stuart Devenish | Devenish Consulting |



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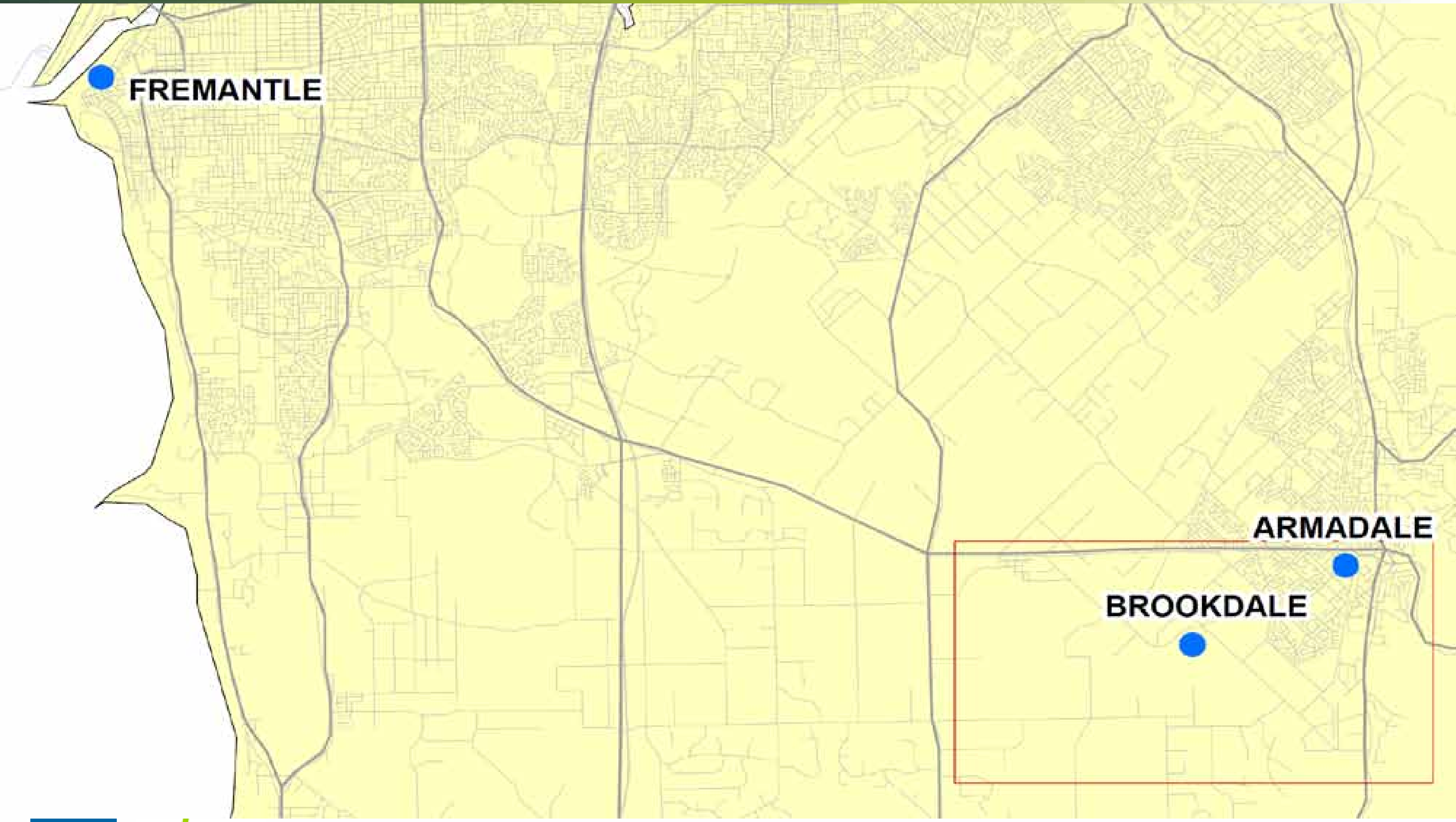
Content

1. **Overview**
2. **Water Demands**
3. **Options Assessment**
4. **Governance Issues**



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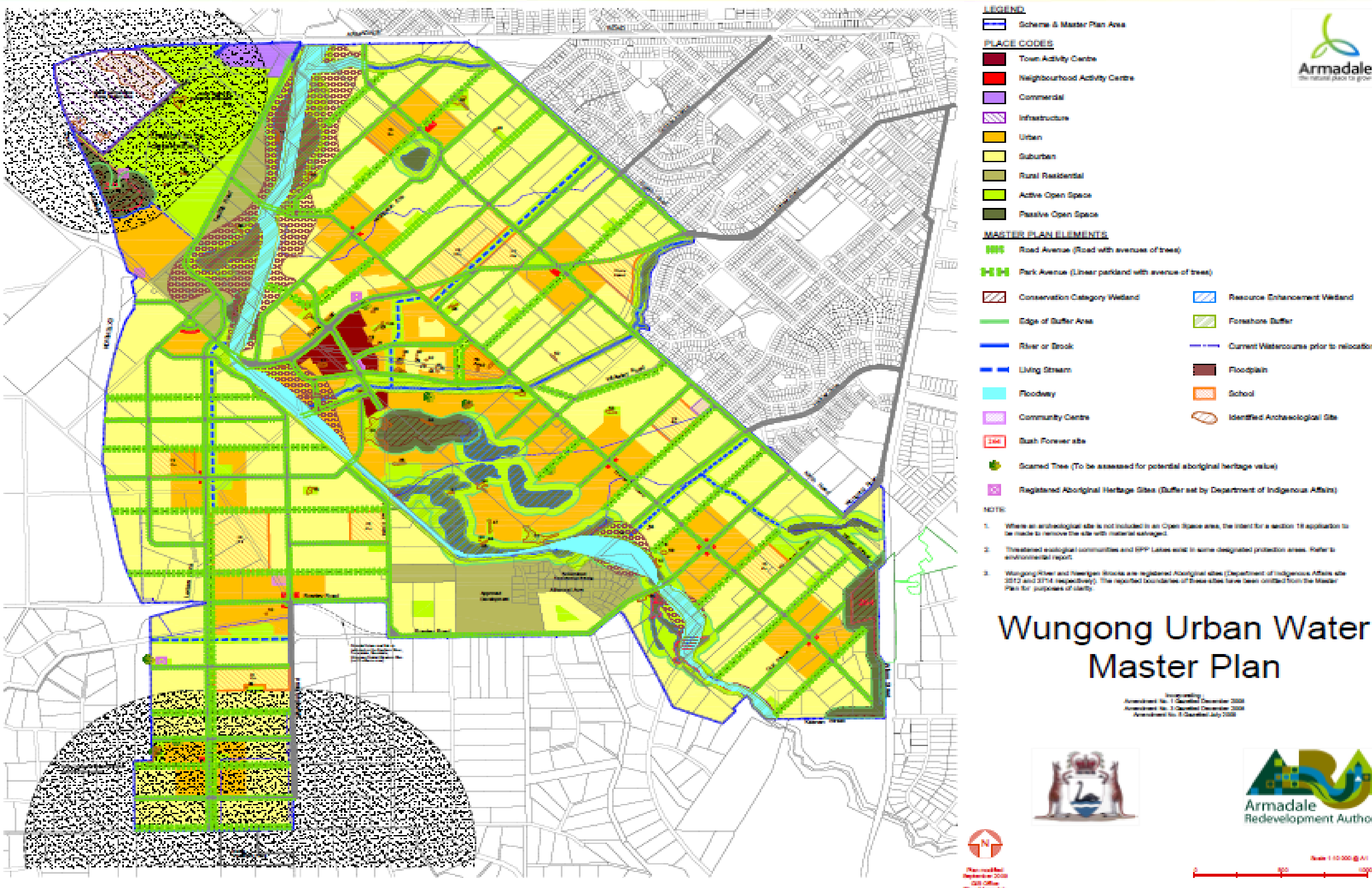
LEGEND
Scheme & Master Plan Area
PLACE CODES
Town Activity Centre
Neighbourhood Activity Centre
Commercial
Infrastructure
Urban
Suburban
Rural Residential
Active Open Space
Passive Open Space
MASTER PLAN ELEMENTS
Road Avenue (Road with avenues of trees)
Park Avenue (Linear parkland with avenue of trees)
Conservation Category Wetland
Resource Enhancement Wetland
Edge of Buffer Area
Foreshore Buffer
River or Brook
Current Watercourse prior to relocation
Living Stream
Floodplain
Floodway
School
Community Centre
Identified Archaeological Site
Bush Forever site
Scarred Tree (To be assessed for potential aboriginal heritage value)
Registered Aboriginal Heritage Sites (Buffer set by Department of Indigenous Affairs)
NOTE:
Wungong Urban Water Master Plan
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The Plan

- **Development:**
  - Area 1,580 ha
  - 16,000 dwellings
  - Population 40,000
- **Wungong Urban Master Plan**
  - Showcase best practice in sustainable urban development
  - Natural resource management
  - Energy-efficient housing
  - Water sensitive urban design
    - ü Park Avenues and Living Streams
    - ü Non-drinking water (NDW) supply

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The Objectives

- **Model to guide development in similar water sensitive areas**
- **Reduce potable water demand to 50 kL/person/yr by:**
  - **Adopting 'waterwise' practices**
  - **Utilising alternative water source**
- **Manage urban stormwater :**
  - **Innovative best management practices**
  - **Provide a sustainable NDW source**
  - **Protect water quality & quantity in receiving environment**

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The Project

- **NDW supply scheme (3rd pipe system)**
- **Alternative water sources**

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NDW Uses

- **In-house**
  - **Toilet flushing**
  - **Cold water inlet to washing machines**
- **Ex-house**
  - **Irrigation**
  - **Washing cars, paving etc.**
- **Irrigation of public areas**
  - **Public Open Space (POS)**
  - **Landscaping**
  - **Schools**

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NDW Demands (Basis for Design)

- **In-house**
  - **WC Waterwise Calculator**

H2O PTIONS
MAXIMISING WATER EFFICIENCY IN THE PERTH METROPOLITAN AREA

- **Ex-house - Irrigation**
  - **Application 730mm/yr**
  - **Peak week 30mm**
  - **Peak instant**
    - ü **20% houses irrigate on same day**
    - ü **Rate 0.5 L/sec/house**
    - ü **80% of controllers set to irrigate between 4am and 6am**
- **Ex-house - Other**

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NDW Demands – Cont.

- **Irrigation of public areas**
  - **Application**
    - ü **Turf 780 mm/yr (Active)**
    - ü **Other 400 mm/yr (Passive)**
  - **Area**
    - ü **Total area 238 ha**
    - ü **Irrigate 156 ha (83 ha turf, 73 ha landscape)**
  - **Peak week 40/30 mm/wk (active/passive)**
  - **Peak instant less than & does not coincide with domestic peak**

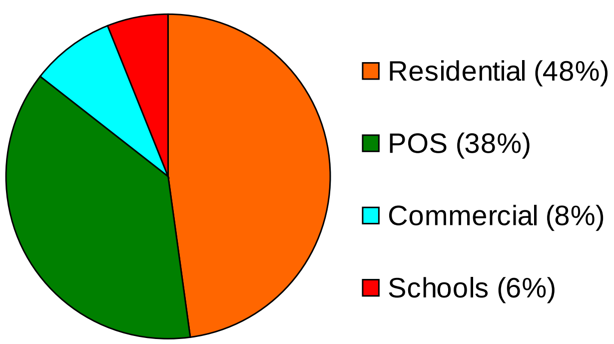
NDW Demands – Cont.

- **Residential lot yield & domestic irrigation area**

Type	Dwellings	Irrigation area/lot (m^2/lot)	Irrigation Area (ha)
R5	111	500	6
R20	9,839	175	172
R30	2,190	105	23
R35	1,894	91	17
R40	1,856	77	14
R60	456	56	3
			235

NDW Demands – Cont.

Total NDW Demand		Unit Res. Demand (R20)
Avg Annual	5.0 GL/yr (14 ML/d)	560 L/house/d
Avg Day Peak Week	27 ML/d	960 L/house/d
Max Day	29 ML/d	1090 L/house/d
Peak Instant	1,700 L/s	0.105 L/s per house



Peak instant NDW?

Review of design criteria

Seasonality of NDW Demand

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Options

- **Local groundwater**
- **Stormwater harvesting & aquifer storage and recovery**
- **Sewer mining**

Local groundwater

- **Availability:**
  - **Available allocation:**
    - ü **Superficial Aquifer - 650 ML/yr**
    - ü **Leederville Aquifer - 0 ML/yr**
  - **Trade existing water entitlements:**
    - ü **Superficial Aquifer - 291 ML/yr**
    - ü **Leederville Aquifer - 47 ML/yr**

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Stormwater harvesting & aquifer storage and recovery (ASR)

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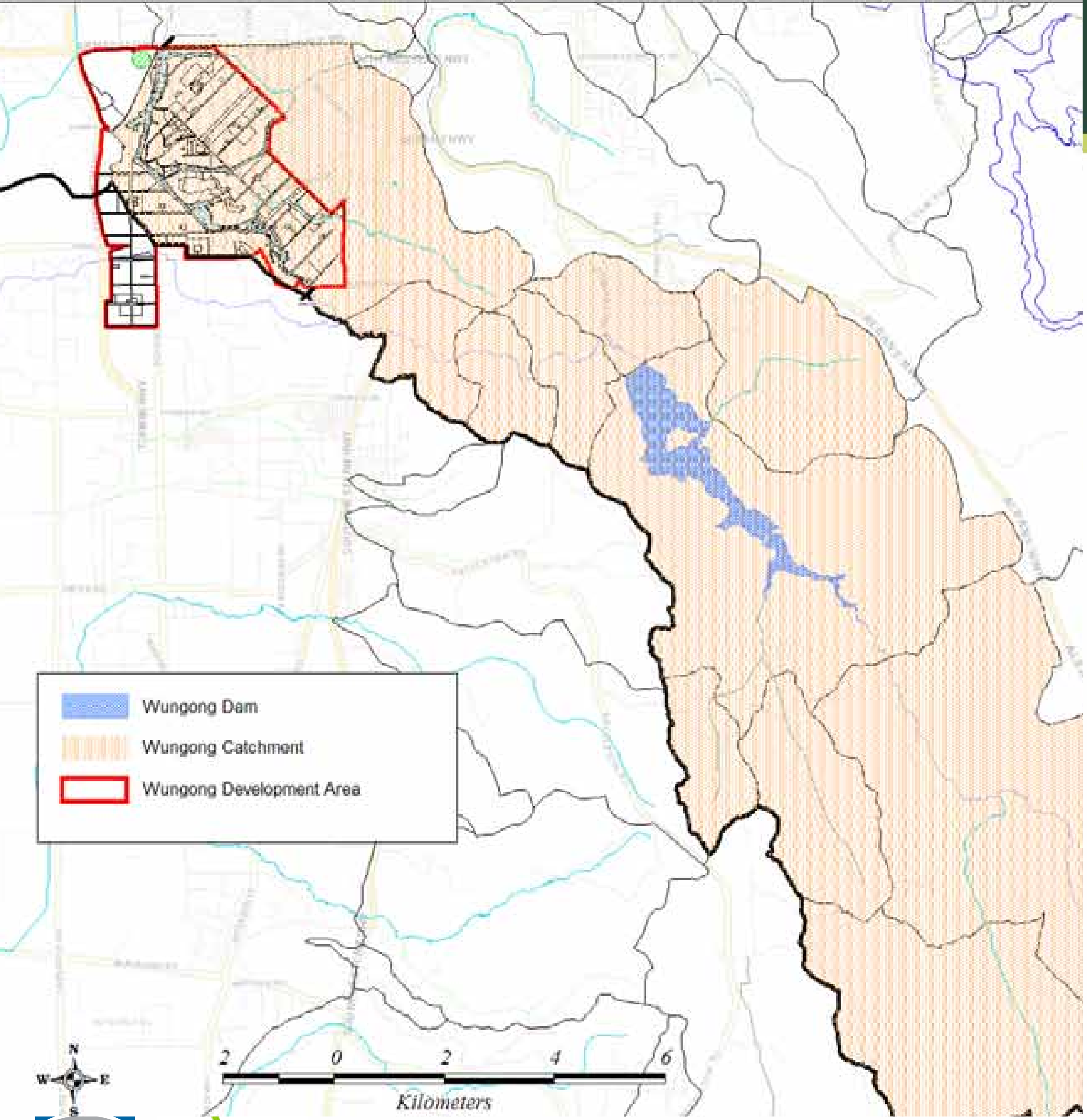
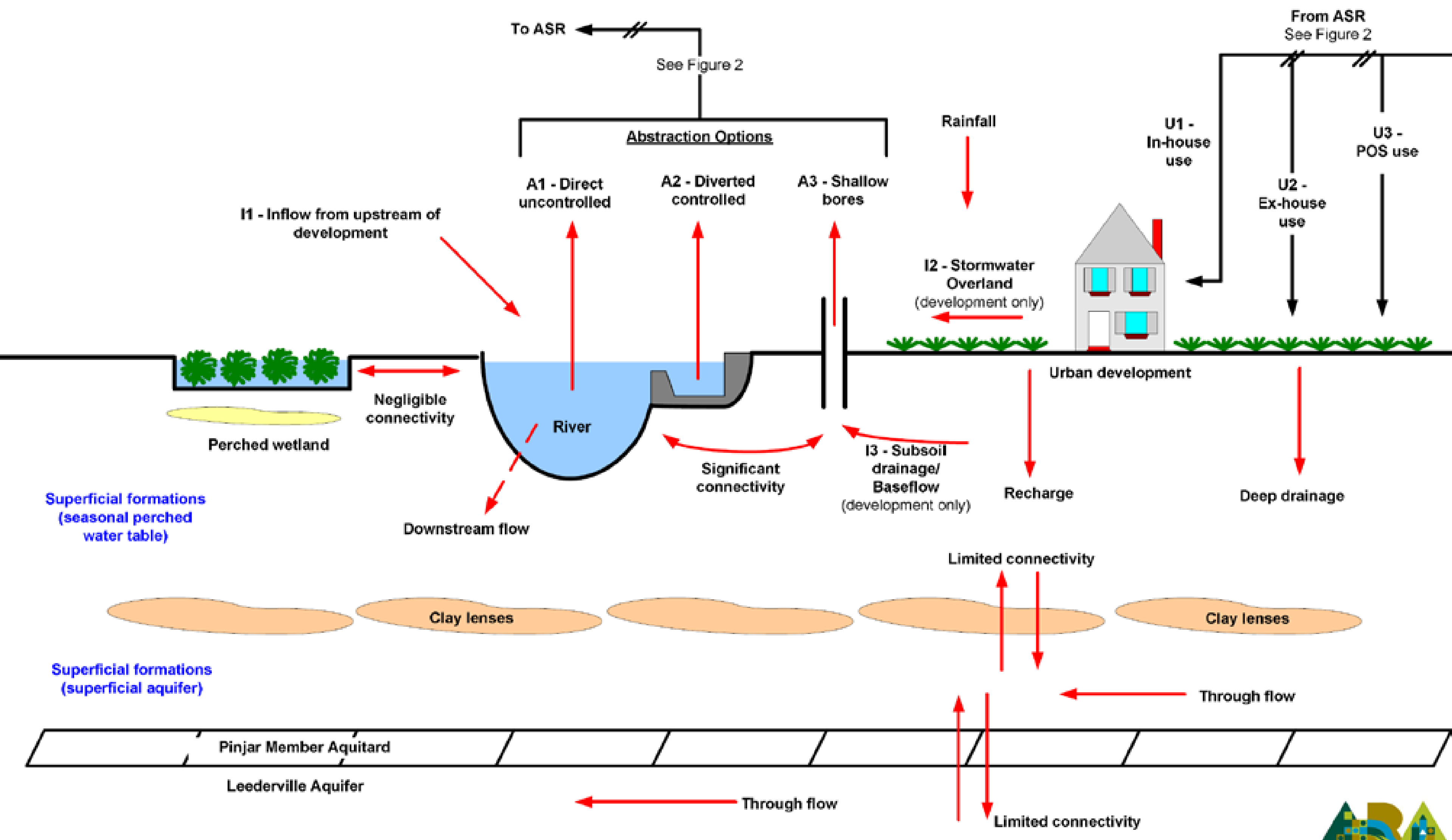
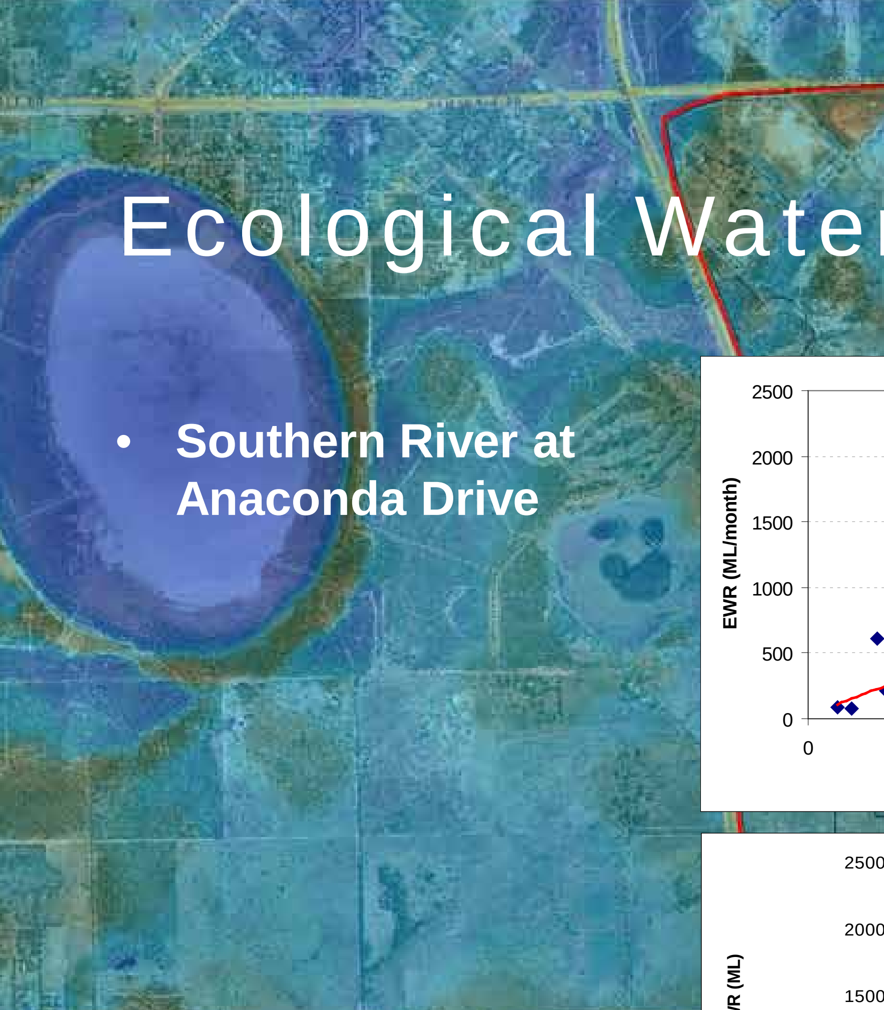
Catchments



Wungong Dam
Wungong Catchment
Wungong Development Area
N
W
E
S
2
0
2
4
6
Kilometers

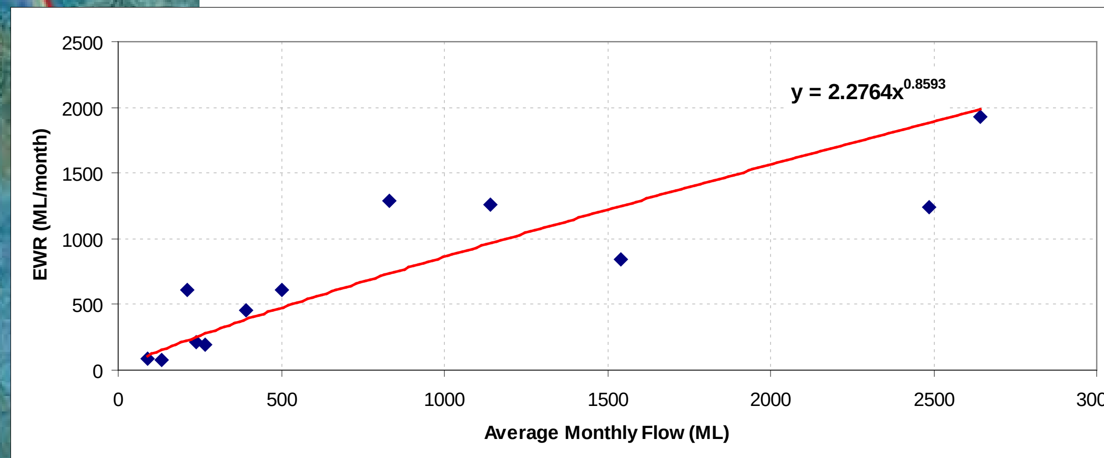
Stormwater harvesting

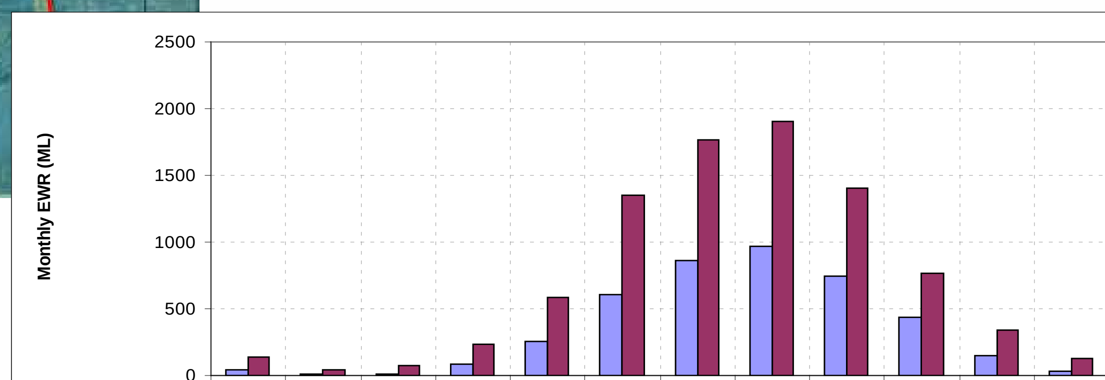




Ecological Water

- **Southern River at Anaconda Drive**





	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Pre Dev EWR	45	8	12	80	260	609	866	970	750	432	152	28
Post Dev EWR	139	40	76	229	589	1349	1767	1907	1408	762	340	129

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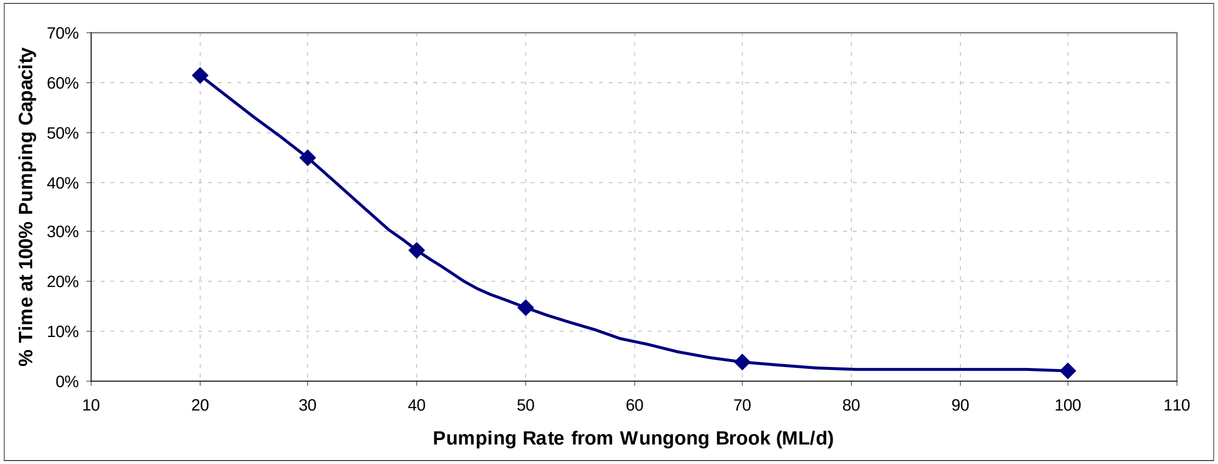
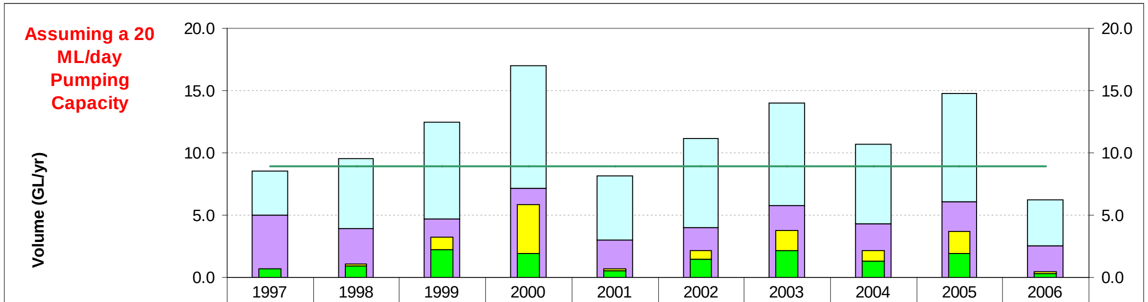
Yield Analysis

- **Diversion efficiency**

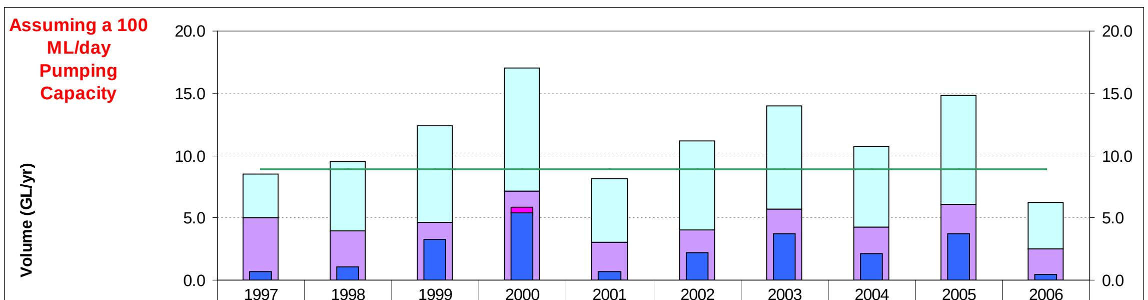


Yield Analysis (cont.)

Harvested volume (monthly)



	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Est Dev Discharge	3.5	5.6	7.8	9.9	5.1	7.2	8.3	6.4	8.7	3.7
Est Pre-Dev Flows	5.0	3.9	4.7	7.2	3.0	4.0	5.7	4.3	6.1	2.5
Est Vol Missed	0.0	0.2	1.0	3.9	0.1	0.7	1.6	0.8	1.7	0.1
Est Harvested Vol	0.7	0.9	2.3	1.9	0.6	1.4	2.2	1.3	2.0	0.3
Annual Est EWR	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9



	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Est Dev Discharge	3.5	5.6	7.8	9.9	5.1	7.2	8.3	6.4	8.7	3.7
Est Pre-Dev Flows	5.0	3.9	4.7	7.2	3.0	4.0	5.7	4.3	6.1	2.5
Est Vol Missed	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0
Est Harvested Vol	0.7	1.1	3.2	5.4	0.7	2.2	3.8	2.1	3.7	0.5
Annual Est EWR	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9

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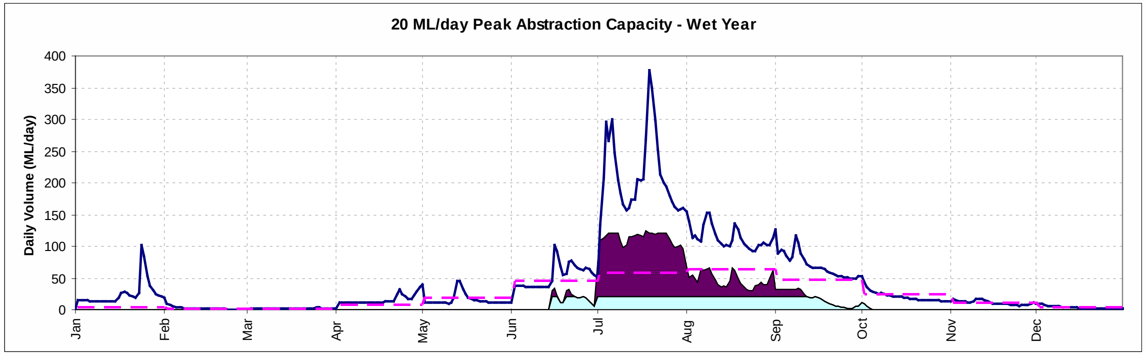
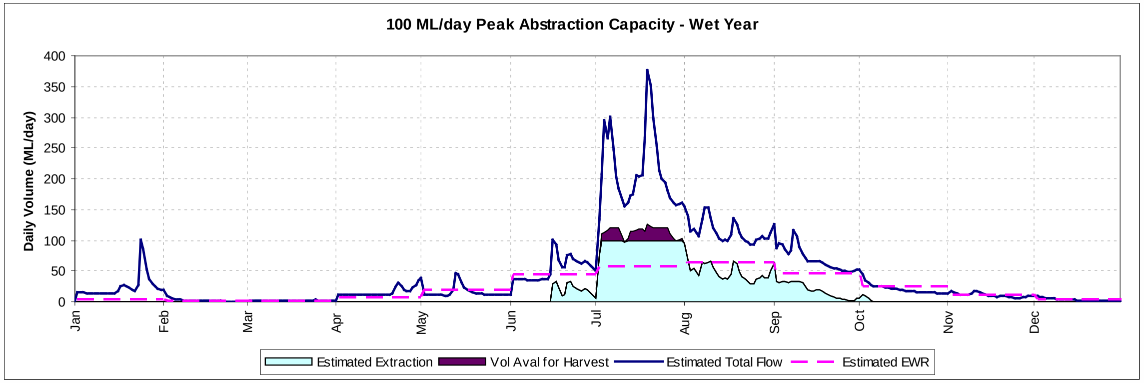
Yield Analysis (cont.)

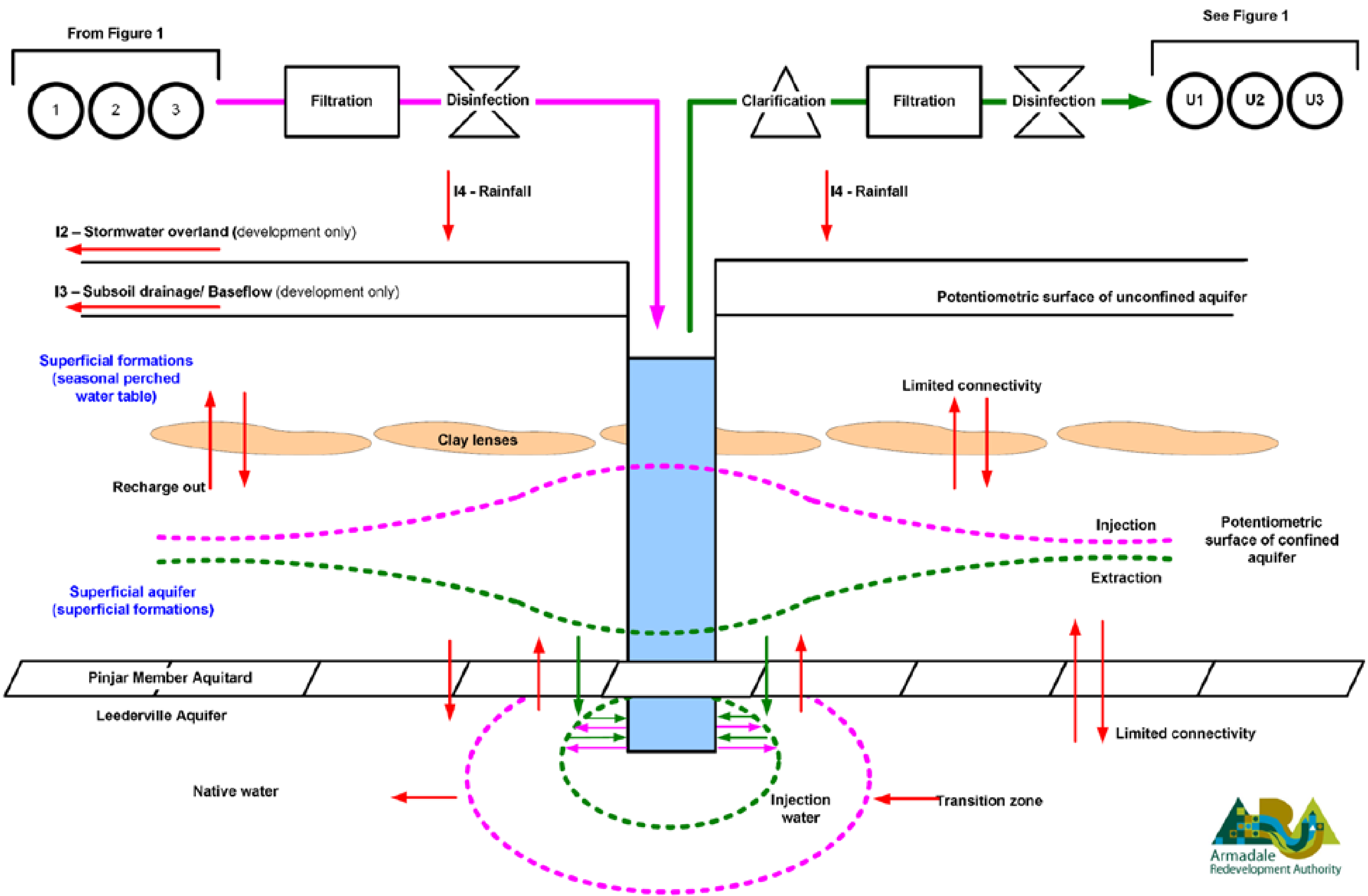
Harvested volume (daily)





- **Storage**
  - **250 – 1,000 ML**

Aquifer Storage and Recovery



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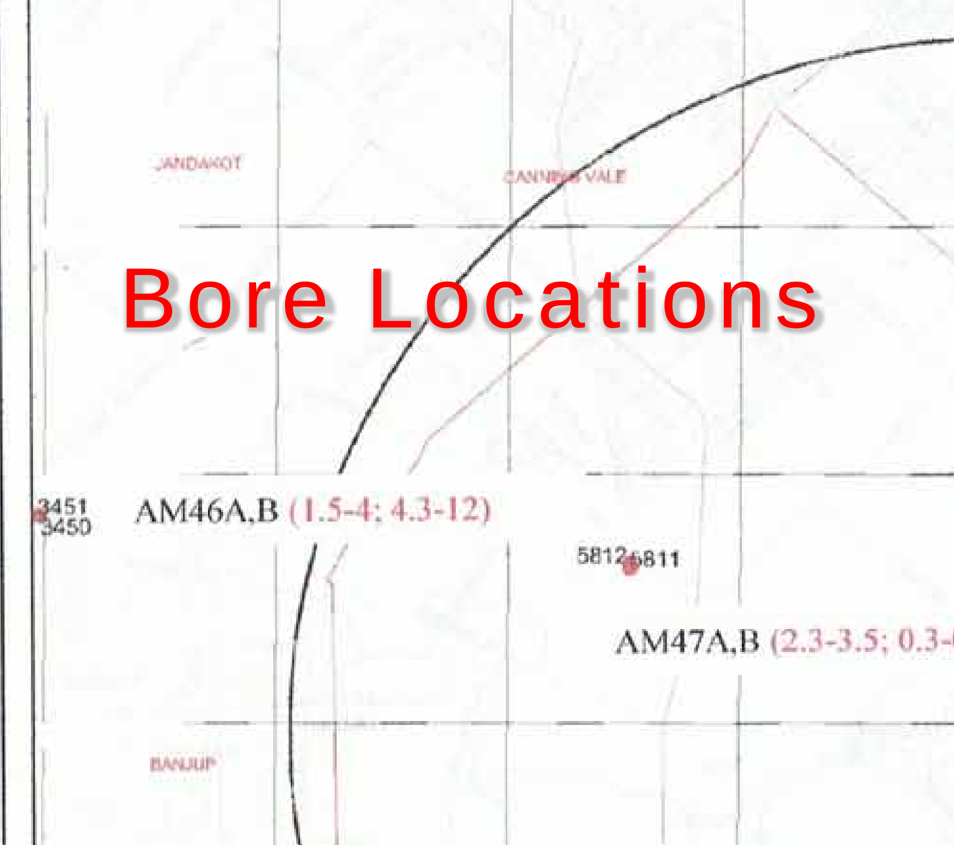
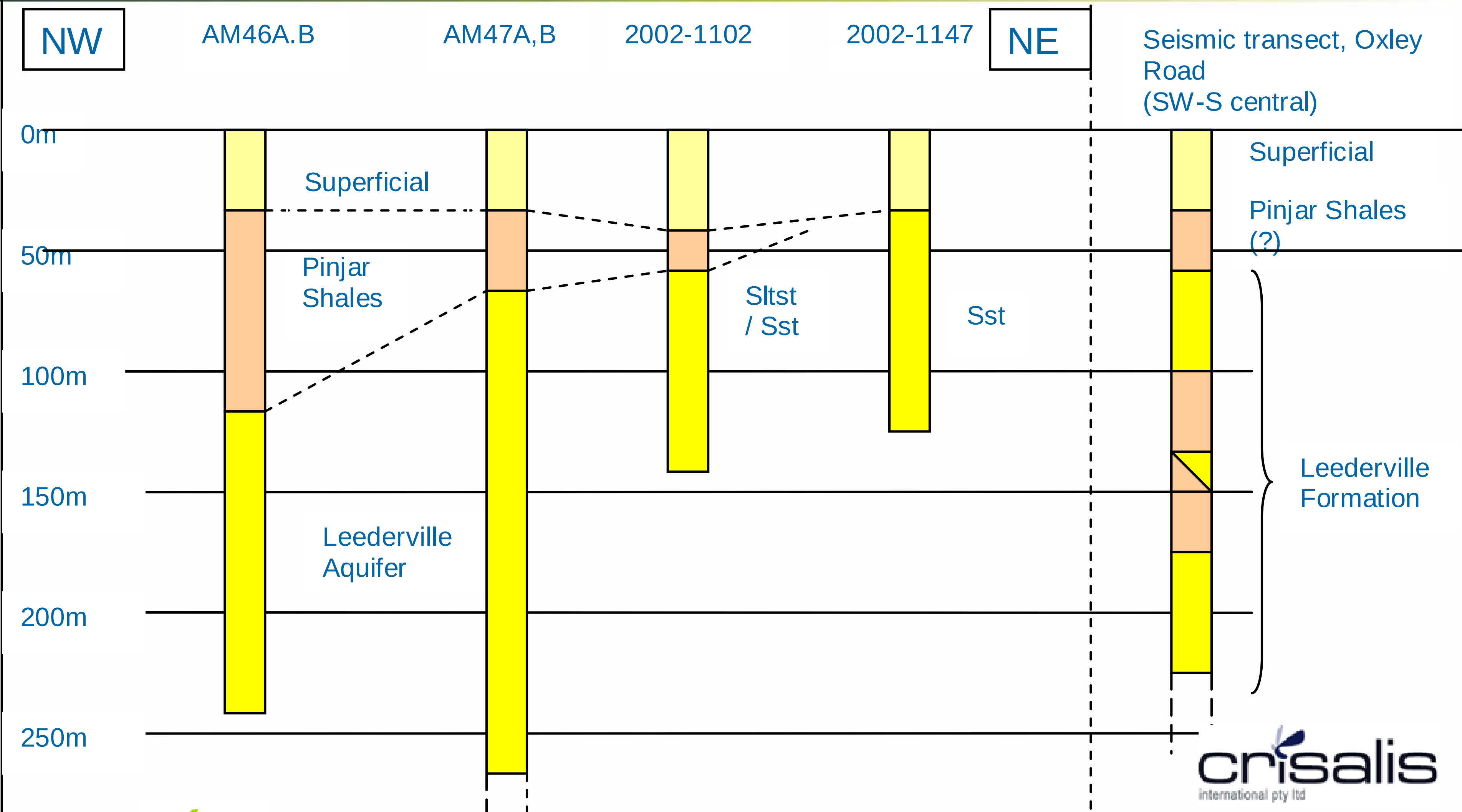
Bore Locations



Lithology



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Injection Rates

Location	Transmissivity (m^2 /day)	Injection Rate (ML/day)	Injection Rate (L/sec)
Jandakot (WC)	100	3 - 4	25 - 33
Midland (MRA)	13 - 22	0.5 - 0.8	6 - 9
Wungong	50	1.5 - 2.8	17 - 23

Water Quality

Parameter	Surface Water	Groundwater
pH		6
TDS	6	600
Ca		40
TN	0.74	1.8
TP	0.07	0.13
Fe		8
HCO3		111
TSS	150	55
SO4		30

- **Pesticides**
- **Hydrocarbons**
- **Heavy metals**

Target NDW Quality

Parameter	Target
TSS	< 2 mg/L
BOD	< 5 mg/L
TN	< 5-10 mg/L
TP	< 1 mg/L
Turbidity	< 0.5 NTU
E.Coli	< 1 TFC/100mL
Chlorine Residual	> 1.0 mg/L
Bacteria Removal	*> 5 log removal*
Virus Removal	*> 6.5 log removal*
Protozoa Removal	*> 5 log removal*

Nutrients: Resultant application rates within DoW guideline limits for irrigation of coarse grained soils near 'sensitive waters'

Microbiological quality: In accordance with Australian Guidelines for Water Recycling, and as informed by qualitative HRA

Treatment

- For injection:
  - Removal of TSS and Nutrients
  - Coagulation?
  - Filtration (< 5 micron to prevent clogging)
  - Disinfection?
- For NDW supply
  - Removal of iron and TSS
  - Clarification
  - Filtration
  - Disinfection
- Sludge disposal

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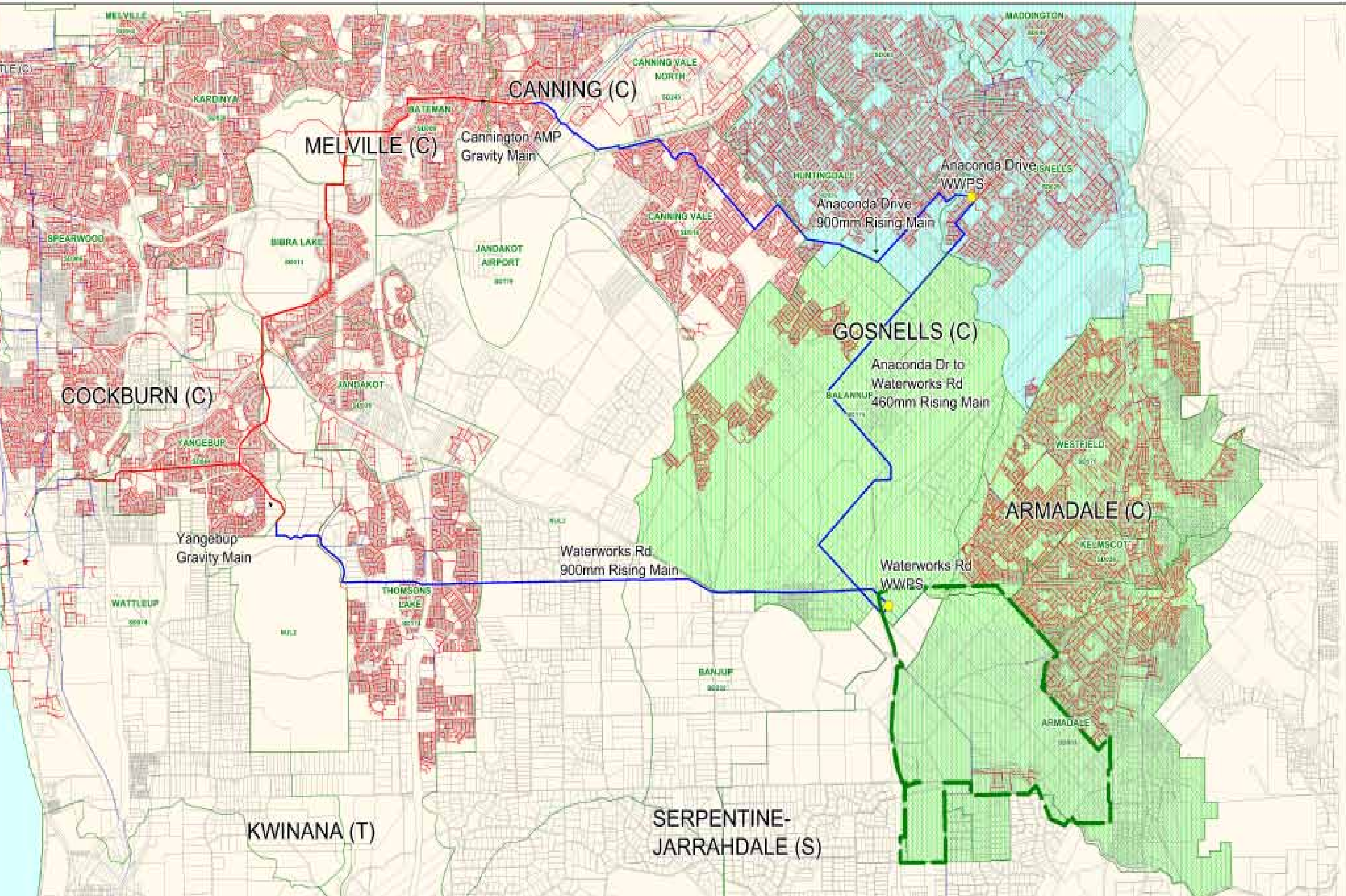
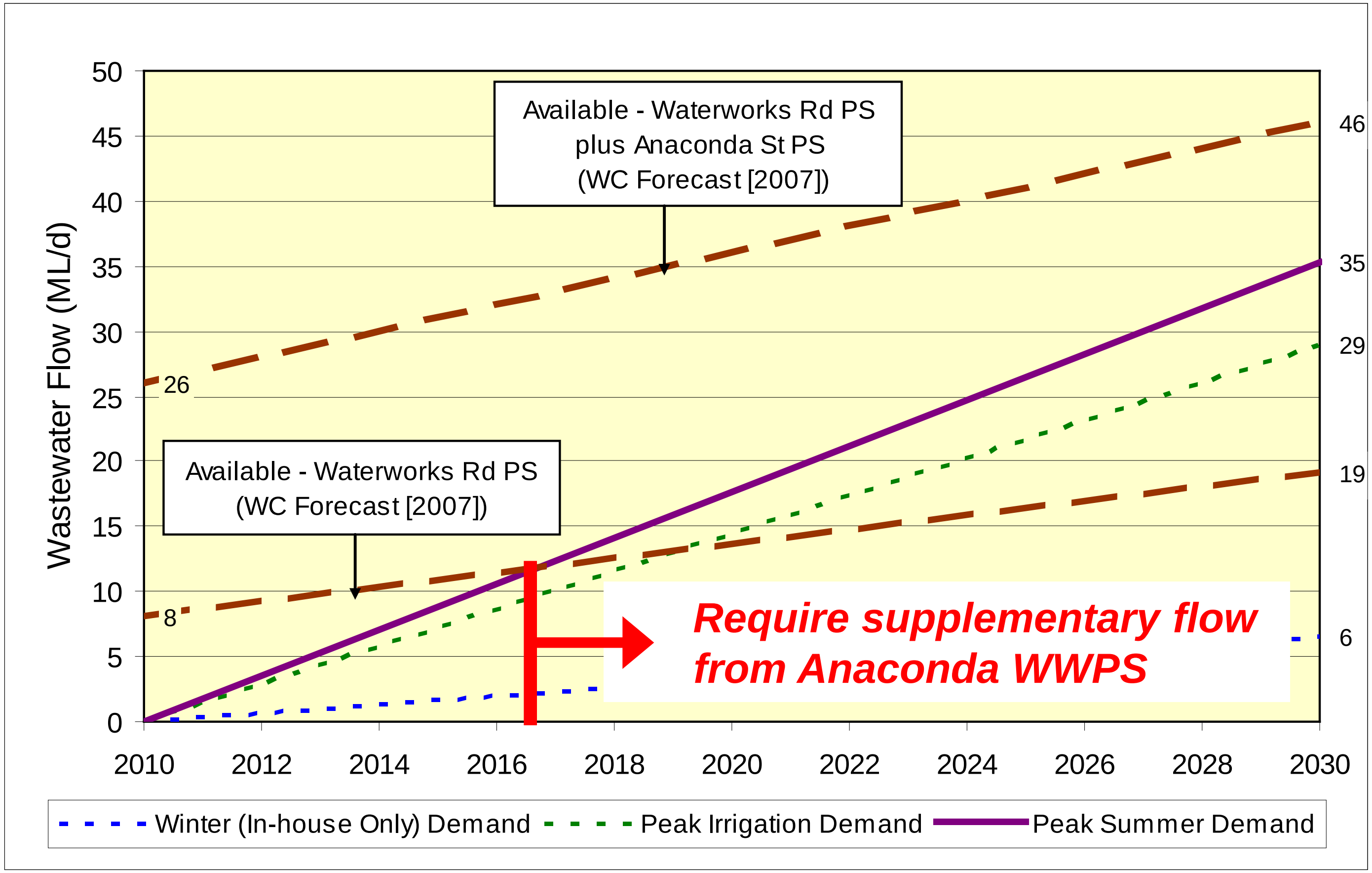
Sewer Mining

Existing WC Infrastructure



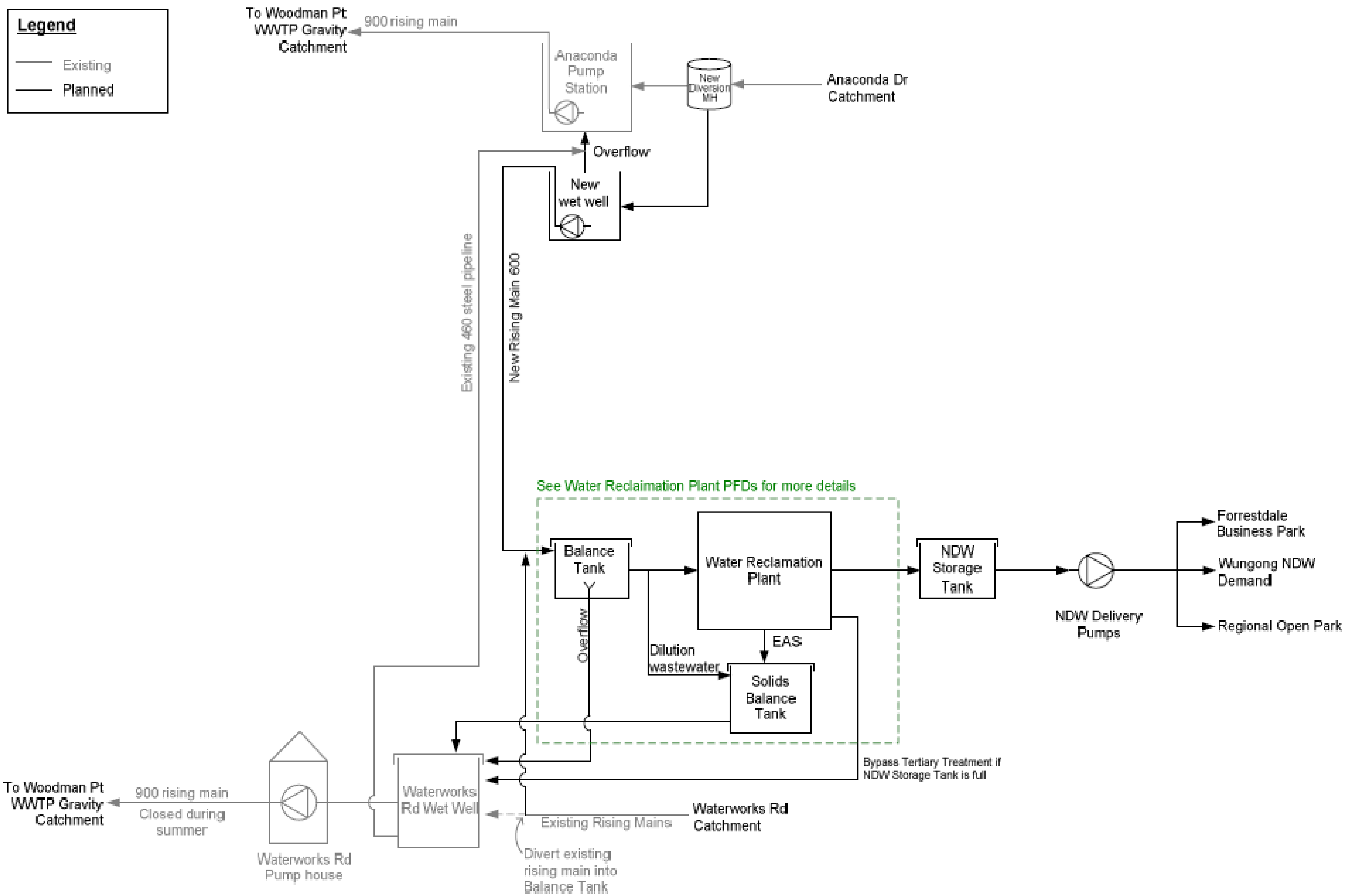
Wastewater Flows

Supply-Demand Balance



There is potential for sewer mining to increase detention times during peak NDW demand periods.

Process Flow



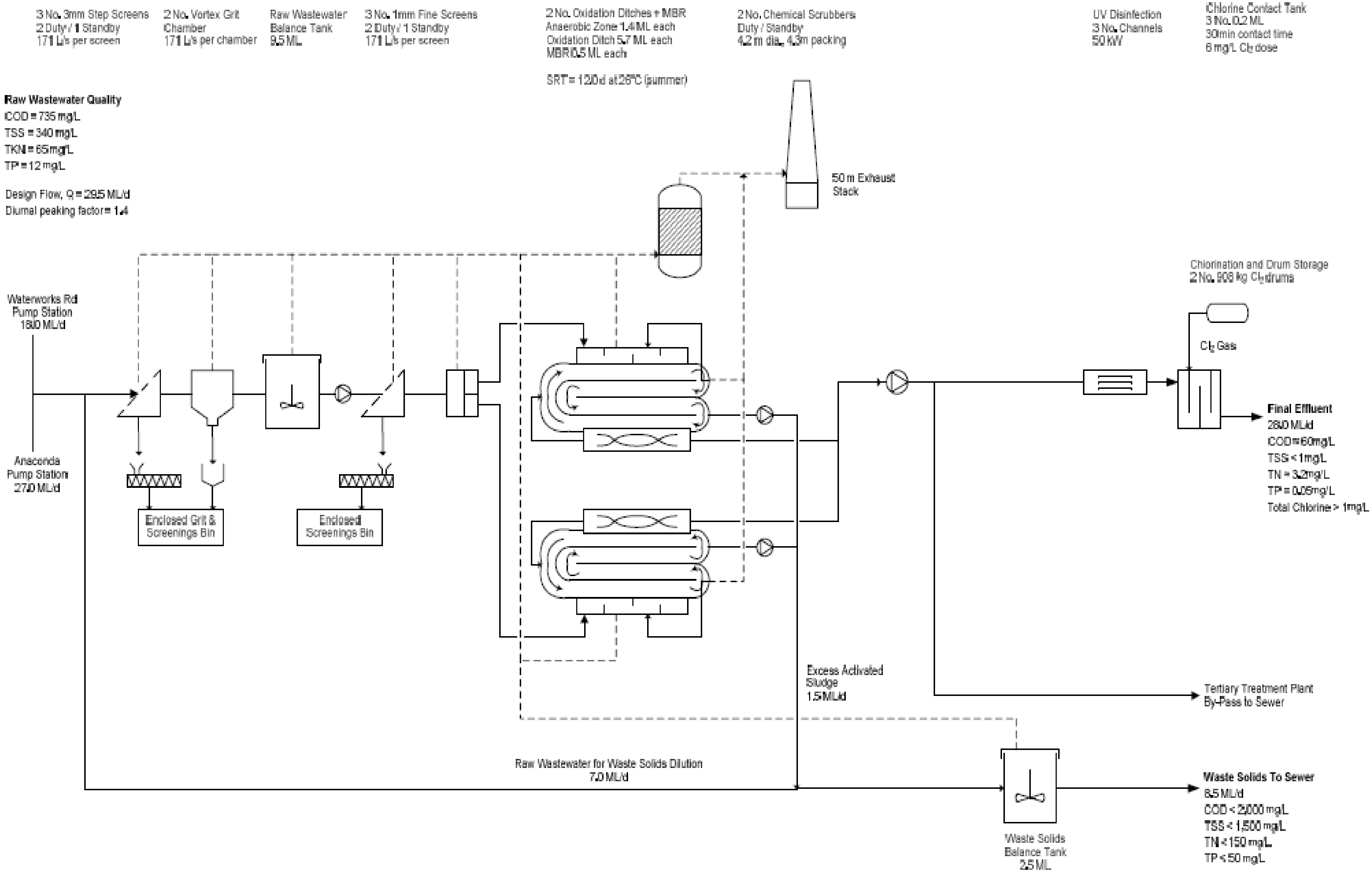
Water Reclamation Plant

- **Assumed wastewater characteristics:**
  - **No data, assume characteristics of Woodman Point**
    - ü **COD = 735 mg/L**
    - ü **TKN = 65 mg/L**
    - ü **TP = 12 mg/L**
  - **No significant trade waste in Waterworks Rd catchment, though more at Anaconda**
- **Two process options (both bio-P removal):**
  - **Conventional Oxidation Ditch + Tertiary UF + UV + Cl**
  - **Oxidation Ditch Membrane Bioreactor + UV + Cl**

Water Reclamation Plant

- **Redundancy**
  - **2 x 50% capacity process trains**
  - **Emergency backup from potable network?**
- **Sludge Management**
  - **EAS returned to sewer**
  - **Dilution required for quality of EAS to meet trade waste acceptance criteria**
  - **36 ML/d of wastewater required to produce 28 ML/d of NDW**
- **High level of odour control (covers, scrubber, stack)**

Process Flow – MBR Option



Concept Layout – MBR Option

Technical Issues & Risks

- NDW demands & staging
- WRP process:
  - Process validation (additional treatment barrier?)
  - Colour of recycled water
  - Low plant loading
- EAS:
  - Transfer of EAS & excess wastewater
  - Relaxation of trade waste acceptance criteria (dilution)
- Supply-demand balance
- Operation of Woodman Point WWTP

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Thank you for listening

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Governance and Project Management
Lessons Learned from Practical Experience – Wungong Urban Water Project

Stuart Devenish| Devenish Consulting

Stewart Dallas| Woodsome Management

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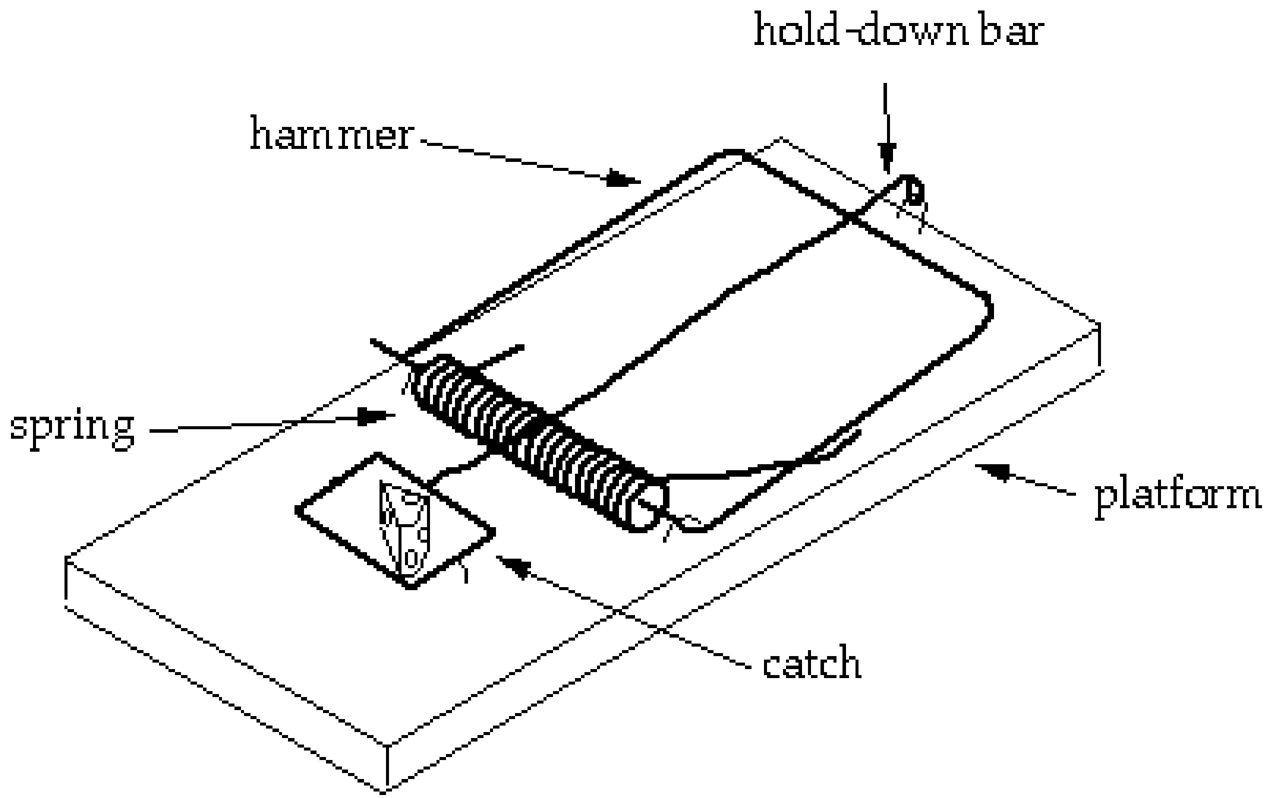
The Mouse Trap



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Lessons Learned:

Corporate Governance

Project Governance

Perspective: PROPONENT

Lessons Learned:

Corporate Governance

Motivations
Implications

$\Big\}$ *IMPORTANCE*

Importance → *Level of Commitment* → *Risk Profile*

- Direct costs
- Opportunity costs
- Time costs

Lessons Learned:

Corporate Governance

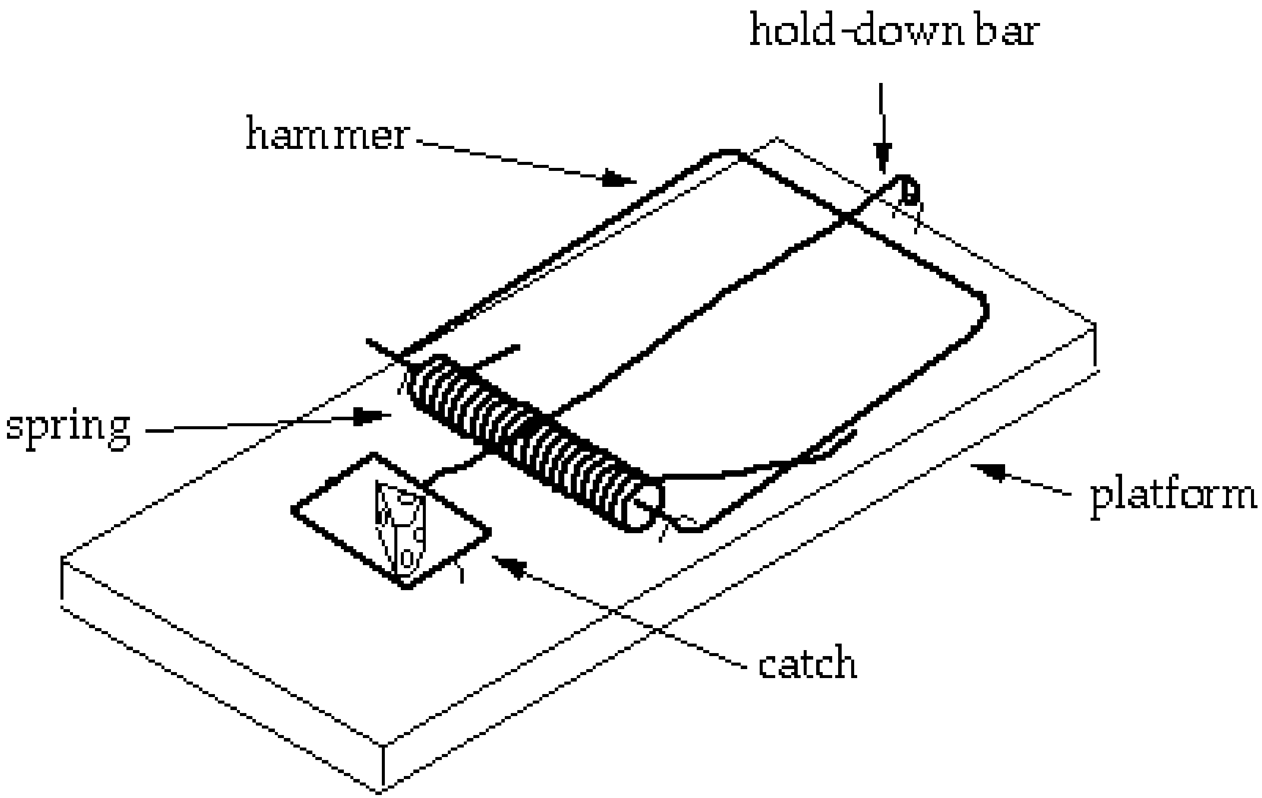
- Development Strategy: IP access, collaboration
- Incremental decision-making step points
- Cost parameters

Lessons Learned:

Corporate Governance – Wungong Urban Water

- Implementation of Total Water Cycle Management
- Potential for 85% water substitution
- Demonstration Project: large scale urbanisation
- Irrigation demand exceeds groundwater availability
- Federal funding assistance: Water Smart Australia program

Lessons Learned:



Lessons Learned:

Project Governance

Demand	*Water balance choices and 'level of service' choices*
Supply	*Feasibility of sources*
Technical	*Sourcing, treating, storing, distributing*
Environmental	*Risks and capacity to mitigate*
Health	*Risks and capacity to mitigate*
Regulatory	*Capacity to satisfy regulatory requirements*
Social	*Marketability of service to prospective purchasers*
Economic	*Costs, revenue, timing*

Lessons Learned:

Project Governance

H2Options:

Step 1 – Develop Plan

Step 2 – Determine Feasibility

Step 3 – Develop Business Case

Step 4 – Secure a Service Provider

Step 5 – Clearances and Approvals

Step 6 – Detailed Design

Step 7 – Review prior to implementation

Lessons Learned:

Project Governance

Draft Approval Framework for the use of Non-Drinking Water in WA:

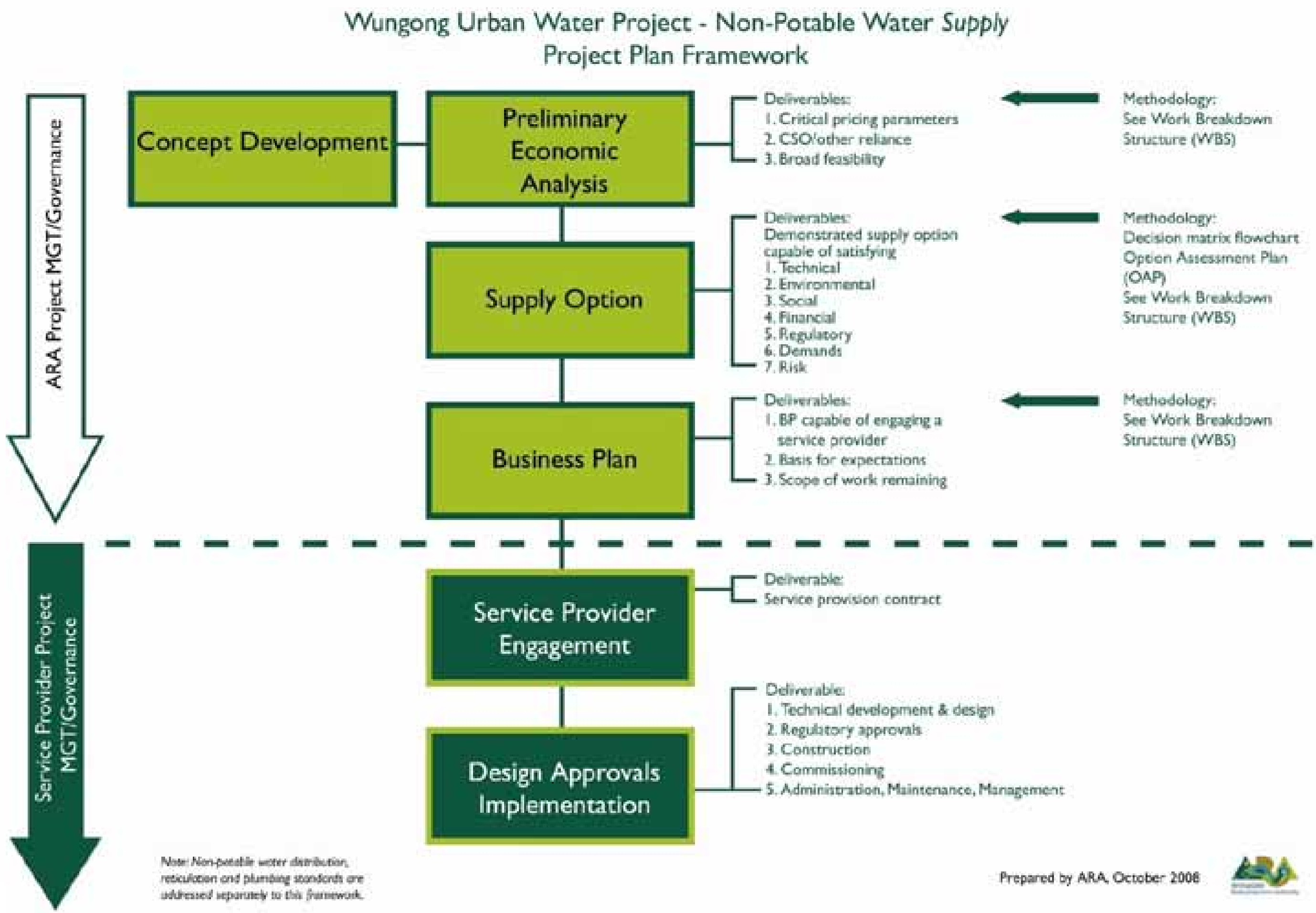
Step 1 – Option evaluation and Concept Design Study

Step 2 – Preliminary Design Study

Step 3 – Detailed Design Study

Step 4 – Implementation

Lessons Learned:



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Lessons Learned:

Project Governance

Economics:

Costs:

- Supply infrastructure
- Distribution headworks
- Reticulation mains
- On-lot costs

Revenue:

- Consumption charges
- Offsets
- Subsidies
- Developer contributions

Timing:

- Capital availability

Lessons Learned:

Project Governance

Economic Regulation Authority, *Inquiry into Pricing of Recycled Water in Western Australia*, 6 February 2009:

"It would generally be inefficient to develop recycling options that have a per kL cost that is higher than traditional sources …"

"… there is a risk that recycling targets could artificially encourage projects that are not the most efficient options to balance supply and demand (or discourage others that are)."

Lessons Learned:

Project Governance

Decision Criteria

Weightings

Points of view:

1. Proponent / Developer
2. Regulators
3. Providers
4. Consumers (Local Government)

Governance and Project Management

Lessons Learned from Practical Experience – Wungong Urban Water Project

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