

Using Municipal Reclaimed Water for Cooling Water Applications: Review of Two Case Studies

McIlvaine Company Hot Topic Hour on “Power Plant Cooling Towers and Cooling Water Issues”

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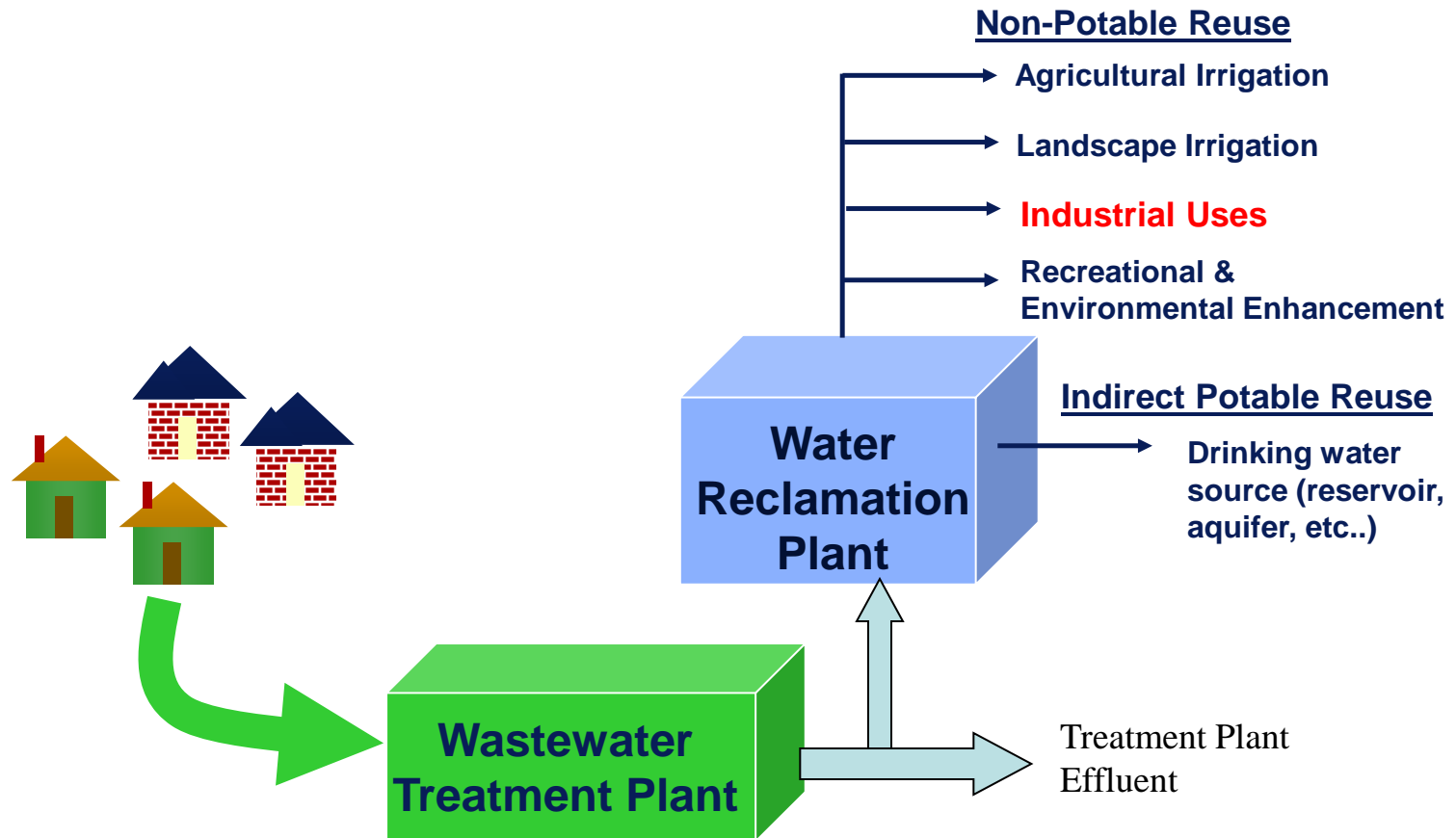
Agenda



- Background on reuse of municipal wastewater
- Typical Water Quality Concerns for Cooling Water Applications
- Case Studies
 - Denver Water Recycling Plant
 - Western Corridor Recycled Water System



Water Reuse is the Recycling of Treated Wastewater for Beneficial Use



Typical Water Quality Requirements for Cooling Water Applications

- Water quality requirements for cooling water applications vary depending on the metallurgy utilized at the power plant
- Typical concerns when using reclaimed water:
 - Low ammonia (typically non-detect)
 - Low TDS, especially for boiler feed applications
 - Chloride less than 150 mg/L
 - Low phosphorus (<0.5 mg/L) to limit calcium phosphate scaling in heat exchangers.

Raw Water Supply:

Customer is responsible for treating the water to meet the following raw water specification or ensure suitable design and metallurgy/materials:

Parameter	Maximum Allowable Concentration in any Raw Water allowed by SPG.	Units
Arsenic	0.025	mg/l
Biological Oxygen Demand (5 day)	20	mg/l
Cadmium	0.025	mg/l
Calcium	70	mg/l
Chemical Oxygen Demand	50	mg/l
Chloride	150	mg/l
Chromium	0.1	mg/l
Copper	0.1	mg/l
Cyanides	0.2	mg/l
Electrical Conductivity	1150	S/cm
Fecal Coliform Bacteria	150	NMP/100 ml
Greases and oils	2	mg/l
Hexavalent Chromium	0.1	mg/l
Iron (total)	0.2	mg/l
Lead	0.05	mg/l
M-alkalinity (as CaCO ₃)	200	mg/l
Magnesium	20	mg/l
Manganese	0.05	mg/l
Mercury	0.001	mg/l
Nickel	0.5	mg/l
pH	Min = 6 / Max = 8	pH
Phenols	0.1	mg/l
Sediment Solids	0.2	mg/l
Silica Colloidal	10	mg/l
Silica Reactive	20	mg/l
Silica Total	20	mg/l
Sulfate	300	mg/l
Total Dissolved Solids	750	mg/l
Total Nitrogen as N	8	mg/l
Total Organic Carbon	5	mg/l
Total Phosphorus as PO ₄	0.5	mg/l
Total Suspended Solids	10	mg/l
Water Temperature	Min = 10 / Max = 35	C
Zinc	0.25	mg/l

Limits are stated as the constituent unless noted.

Case Studies

- Denver Water Recycling Plant (Denver, Colorado)
 - Provides cooling water to the Cherokee Power Plant
- Western Corridor Recycled Water Project (Brisbane, Australia)
 - Provides cooling water to Swanbank and Tarong Power Stations



Denver Water Recycling Project

Background

- Integrated Resource Plan (1996)
 - Additional water supply needed by 2013
 - Supply to be provided by conservation, **recycling**, and misc. improvements
- Recycling water reduces potable water demands
 - At buildout, potable demand reduced by the equivalent of 40,000 households
- Customers identified
 - Xcel Energy – 10 mgd cooling water
 - Parks
 - Golf courses
 - Zoo
 - Commercial and industrial users



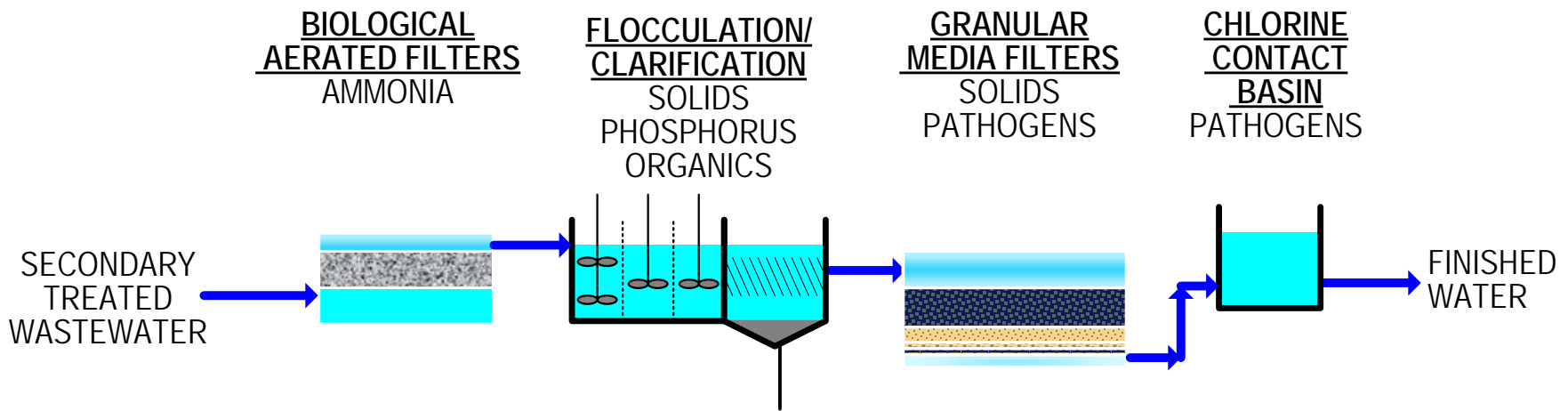
Water Quality Requirements

- **Irrigation Use** (Colorado Regulation 84 for Category 3 unrestricted access areas):
 - E. Coli: none in 75% of samples and 126/100 ml max
 - Turbidity: < 3 NTU (monthly average)
 - Filtration and disinfection required

- **Power Plant Cooling Water:**
 - Phosphorus: < 0.6 mg/l to prevent calcium phosphate scaling
 - Ammonia: non-detectable to avoid stress corrosion cracking of admiralty metals

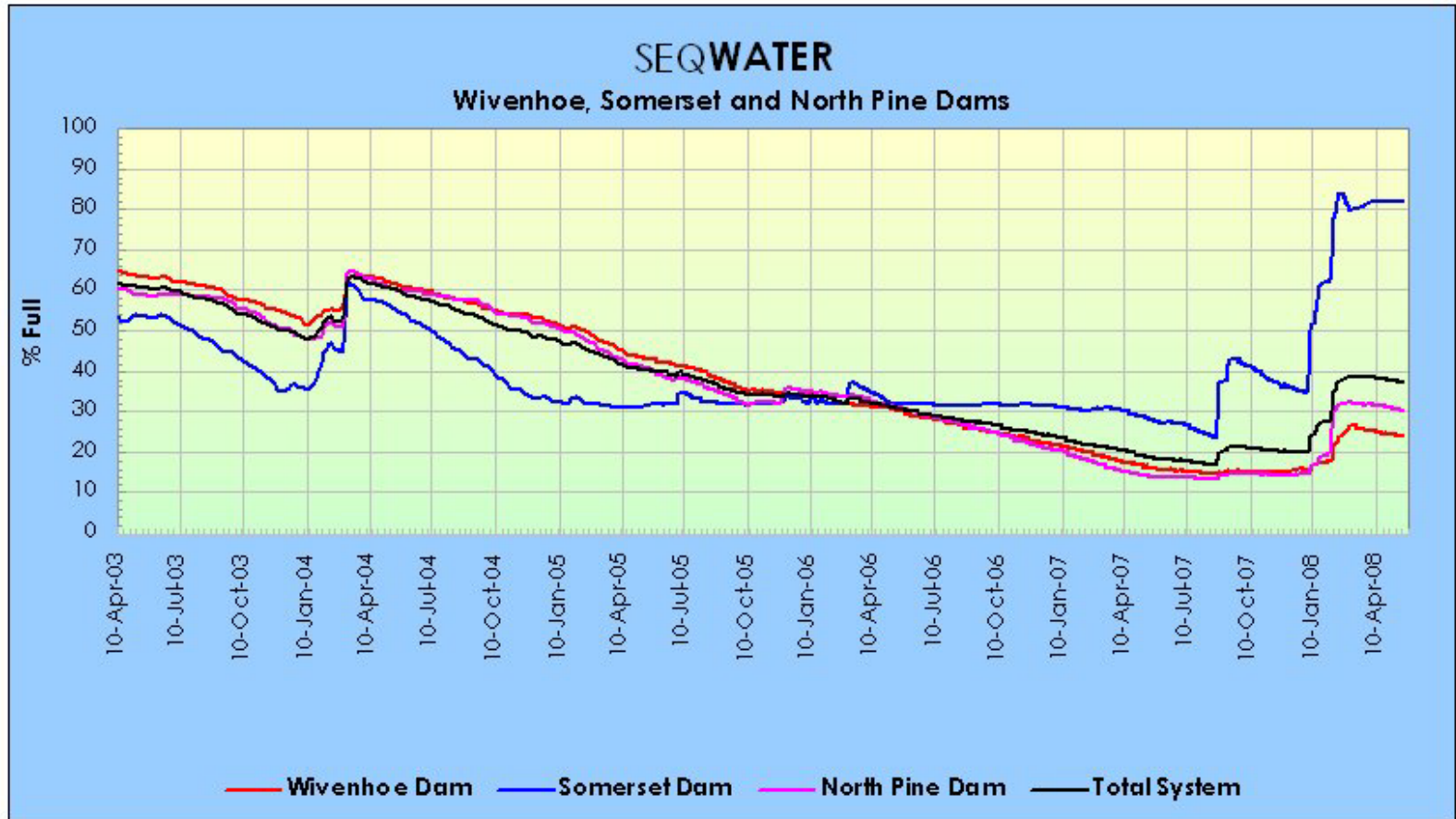
Denver Water Recycling Plant

- Treatment capacity = 30 MGD, non-potable reuse
- Cooling water = 10 MGD, supplied to Xcel Energy's Cherokee Power Plant



Western Corridor Recycled Water Project - Background

- Southeast Queensland has had the worst drought on record from 2001 – 2008





Tarong

- Three new AWTs
- Nine storage tanks
- 12 pump stations
- 200 km of pipe
- 232 MLD (61 mgd) of purified recycled water supplies:
 - two power plants
 - Wivenhoe Dam (if required)

— Aug 2007
— Jun 2008
— Oct 2008

Wivenhoe Release

Luggage Point

Gibson Island

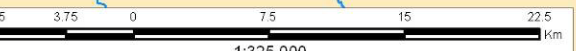
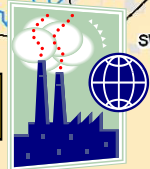
Wacol

Oxley

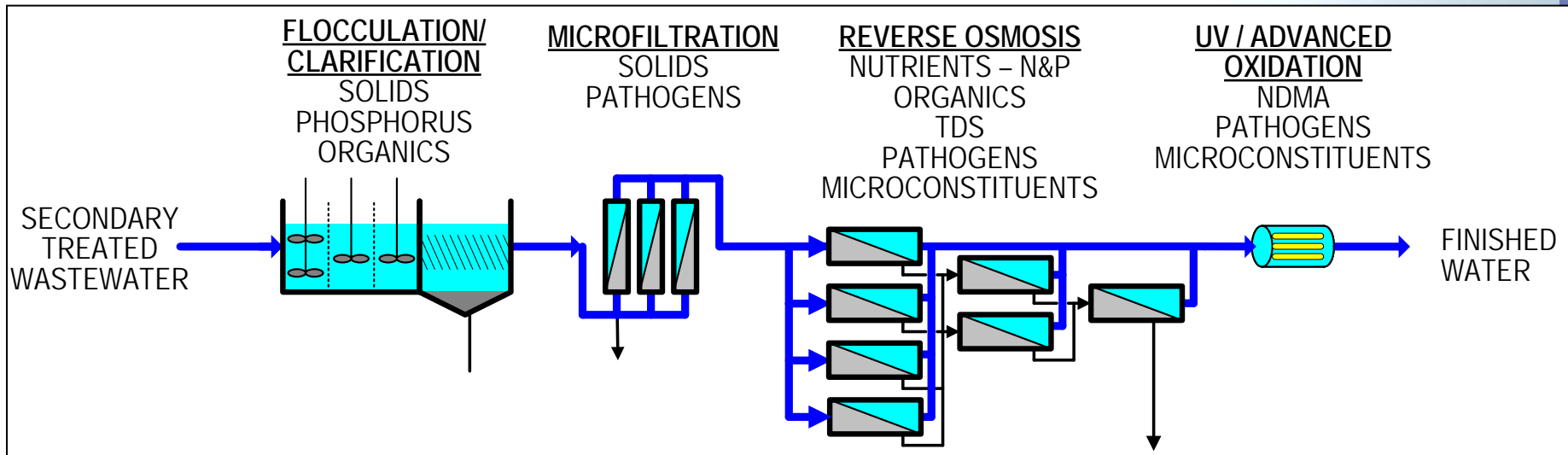
Bundamba

Swanbank

Goodna



Major Treatment Processes



- Production capacity of 70 ML/d (18.5 mgd)
- Provide multi-barrier treatment process
- Very high quality water (low TDS and hardness) for power plant uses
- Meet all Australian drinking water guidelines

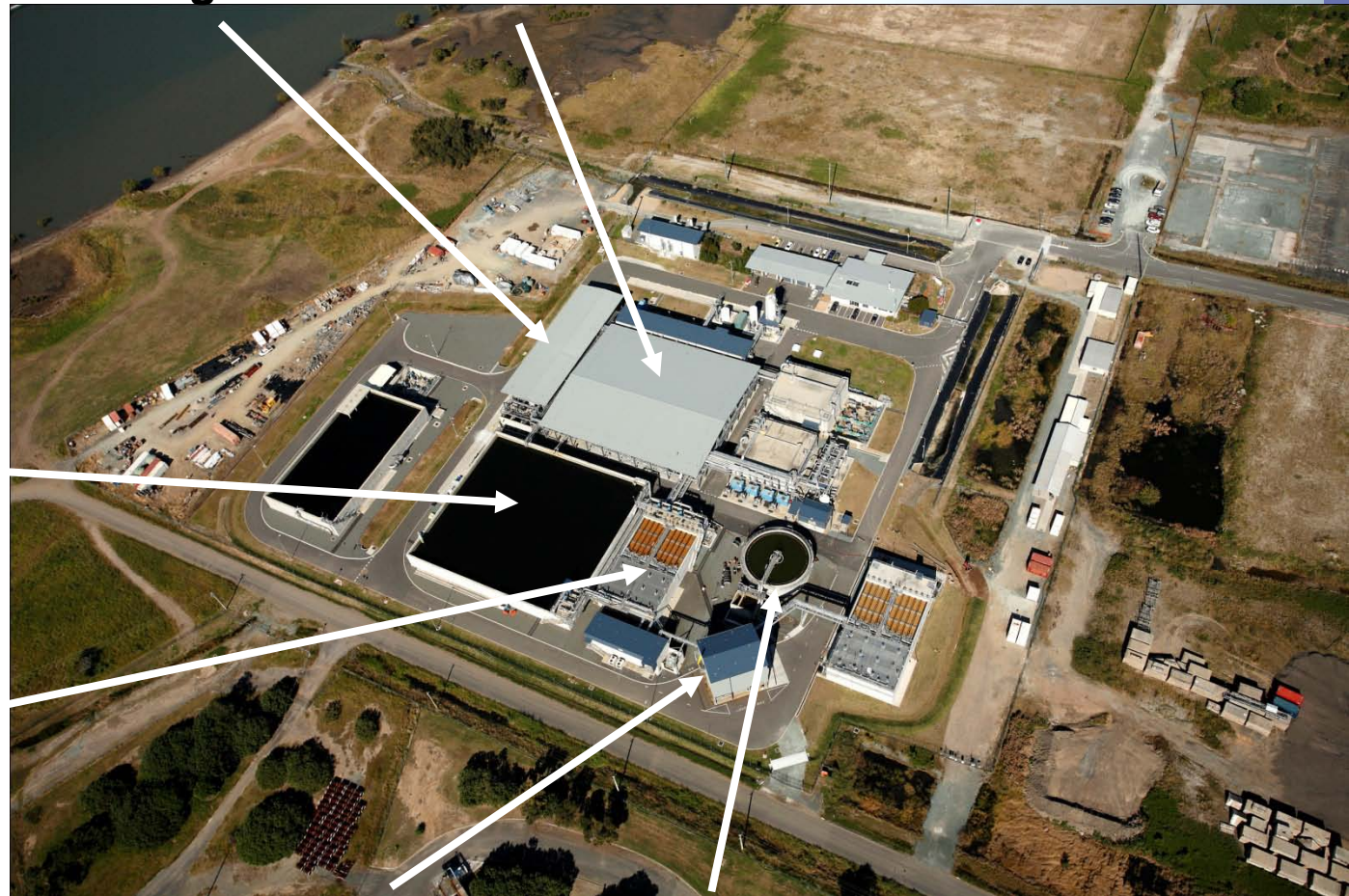
Luggage Point AWTP Site

**Chemical
Building**

**Membrane &
UV Building**

**Raw Water
Storage**

**Flocculation /
Clarification**



Centrifuge Building

Thickener

Luggage Point AWTP

Flocculation / Clarification



Reverse Osmosis



Microfiltration



UV / Advanced Oxidation



Summary



- Reclaimed municipal wastewater is a good candidate for power plant cooling water
- Water scarcity is increasing its use in this application
- Typical water quality concerns include TDS, chloride, ammonia, orthophosphate, bacteria – all can be addressed with proper treatment



Questions?

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