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## Stormwater Management Solutions at Coastal Landfill Sites in Queensland



### Overview

- Regulatory design requirements for stormwater management on landfill sites
- Importance of erosion and sediment control for ecosystem protection in Queensland
- Implications for landfill stormwater design in regions with high rainfall climate conditions
- Waste disposal options in high rainfall regions
- Regulator supported alternative water sensitive urban design guidelines
- Case studies
- Summary of key issues





## Landfill Design Requirements – Queensland

Department of Environment and Resource Management (DERM)  
 Guideline ERA 60 – Waste Disposal (September 2010)  
*“Landfill siting, design, operation and rehabilitation”*

Prevention of water contamination through separation of:

- “leachate and contaminated runoff; **clean and sediment laden stormwater**; and groundwater”
- “minimise contamination of stormwater runoff by sediment”
- **sediment** ponds sized for ARI of 1 in 10 years, 24 hr duration
- reuse of stormwater on-site or off-site
- release of stormwater after water quality testing

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## Landfill Design Requirements – Victoria

Environment Protection Authority (EPA) Best Practice Environmental  
 Management (Sept 2010)  
*“Siting, Design, Operation and Rehabilitation of Landfills”*


- avoid mixing stormwater and leachate and groundwater
- reuse water on-site
- **Storage ponds** to contain run-off for:
  - 1 in 20 year storm event for putrescible landfill
  - 1 in 10 year storm event for a solid inert landfill
  - Consideration of 1 in 100 year recurrence
- Batch discharge after water quality testing

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## Importance of Sediment Control



**South East Queensland**  
The southernmost city of Queensland, located on the New South Wales border to the east.

**Great Barrier Reef**  
The world's largest remaining natural structure of calcium carbonate.

**Central Queensland**  
The area with both unemployment and lowest life expectancy.

**North Queensland**  
The northernmost city of Queensland, located on the New South Wales border to the east.

**World Heritage Protected Regions**  
The Great Barrier Reef Marine Park and Wetland of International Importance.


**RAMSAR Wetlands/Marine Parks**  
The Great Barrier Reef Marine Park and Wetland of International Importance.

**Fisheries/Marine Plants Protection**  
The Great Barrier Reef Marine Park and Wetland of International Importance.

- Queensland Coastline:
  - World Heritage Protected Regions
  - RAMSAR Wetlands/Marine Parks
  - Fisheries/Marine Plants Protection

“Increased sediments cause damage to the ecosystem by limiting light penetration, smother coral and other small invertebrates and transport nutrients and pesticides to the Great Barrier Reef”  
*GBRMPA Website*

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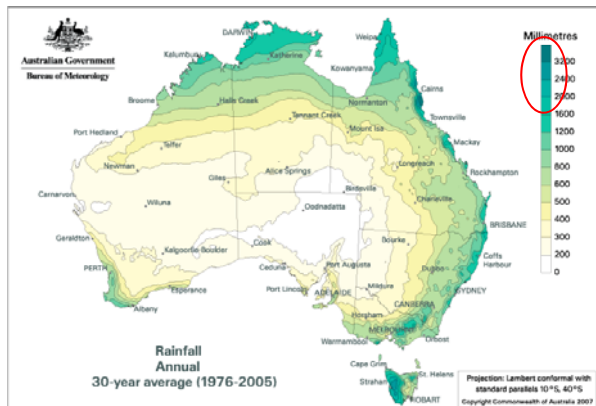


## Rainfall Variation Across Australia

- Average annual rainfall across Australia
- High rainfall areas > 1,600 mm (1.6 m per year)

**Capital Cities**


- Adelaide: 546 mm
- Brisbane: 1,186 mm
- Canberra: 616 mm
- **Darwin: 1,732 mm**
- Hobart: 617 mm
- Melbourne: 649 mm
- Perth: 867 mm
- Sydney: 1,214 mm

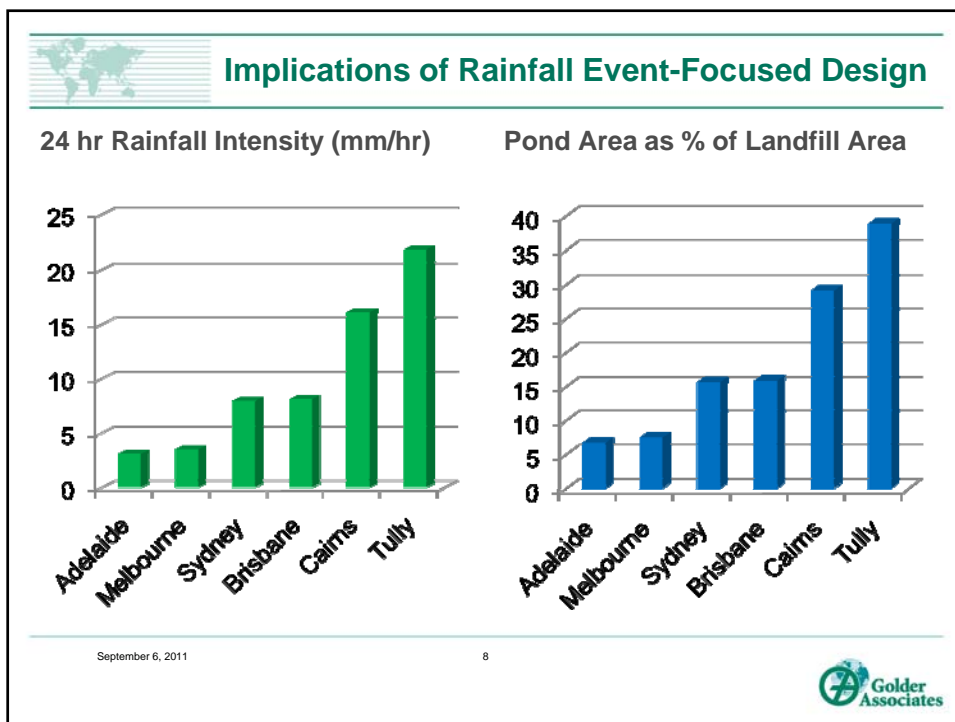
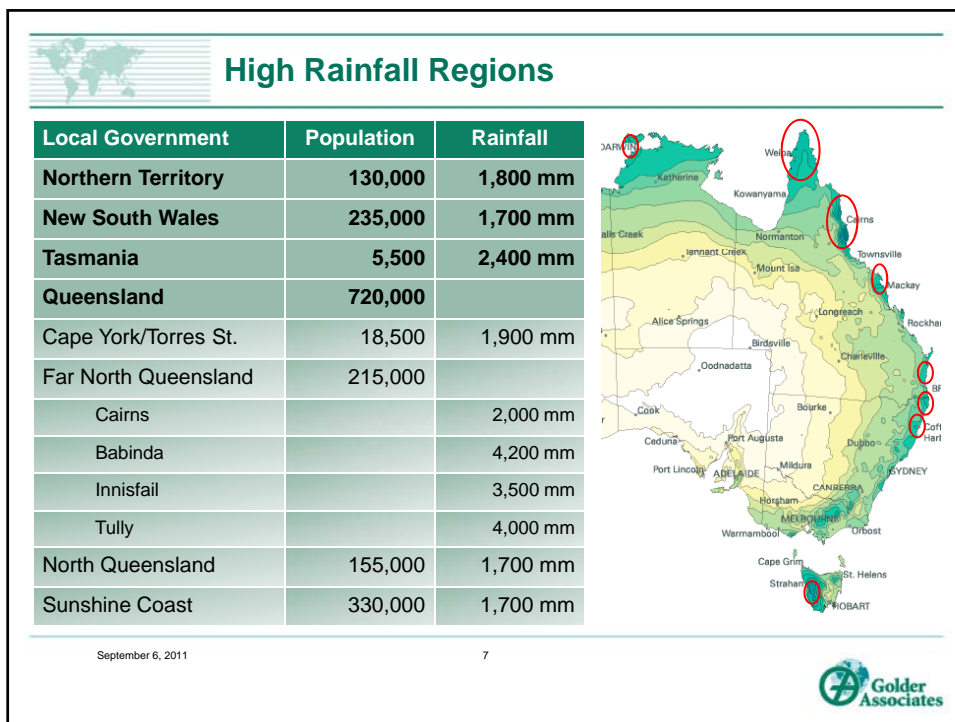


Rainfall Annual  
30-year average (1976-2005)



Projection: Lambert conformal with standard parallels 10°S, 40°S  
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**Case Study A – Upgrade of Existing Landfill**

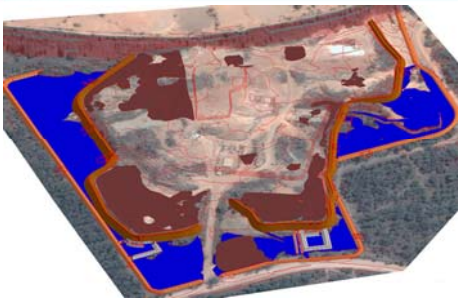

**Background**

- Non-engineered landfill
- 20 ha site area
- 13 ha landfill area
- Operated for 20+ years
- Foreshore area

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**Case Study A – Upgrade of Existing Landfill**





**Design Issues**


- Most of the non-landfill areas incorporated into water storage for high rainfall events
- No areas left for new waste cells outside landfill footprint
- Further landfill development will require use of piggyback liners
- No surface water discharge during first wet season

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## Other Options – Regionalised Waste Disposal




- Cooktown to Atherton Tablelands: 290 km
- Yarrabah to Atherton Tablelands: 125 km
- Innisfail to Townsville: 260 km
- Tully to Ingham: 100 km
  
- Key impediments to consolidation:
  - Queensland regional highways roads subject to flooding and prolonged closure
  - Considerable transport costs for waste and recycled materials
  - Local landfills part of disaster planning

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## Other Options – Alternative Waste Treatment



**Cairns Post, 4 August 2011.**  
 “CAIRNS will discover it's not easy being green as a new levy threatens to add more than \$1 million a year to the cost of keeping household rubbish out of landfill.”

- One large scale AWT in Queensland
- Economies of scale generally not viable in regional areas
- Commercial operations will attract waste levy on residual material disposed to landfill

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## Other Options – Queensland Urban Stormwater Quality Planning Guidelines, 2010.

### Urban Stormwater Framework

The flowchart illustrates the Urban Stormwater Framework across five levels: State, Regional, Local, Site planning, and Operation/Construction. At the State level, it includes Reef Water Quality Protection Plan, National Strategy for ESD 1992, and National Water Quality Management Strategy. Regional level includes Sustainable Planning Act 2009 and Environmental Protection Act 1994. Local level includes Council water plans (UGMP & TWQMP) and Regional plans. Site planning includes Council planning schemes (land-use zones, stormwater policies, code provisions, CA triggers) and Council corporate planning (community plans, capital works, operations, business plans). Operation/Construction includes development assessment (site-based stormwater quality management plans, approval conditions).

### Structural Treatment Measures

Level	Document
State	<ul style="list-style-type: none"> <li>Engineers Australia 2006, Australian Run-off Quality, A Guide to WSUD</li> <li>IECA 2008, Best Practice Erosion and Sediment Control, International Erosion Control Association (Australasia), NSW</li> <li>Department of Natural Resources and Water (2007) Queensland Urban Drainage Manual</li> <li>Department of Transport and Main Roads (2010), Road Drainage Manual—A Guide to the Planning, Design, Operation and Maintenance of Road Drainage Infrastructure 2nd Edition</li> </ul>
Regional	Regional specific structural treatment guidelines including: <ul style="list-style-type: none"> <li>SEQ Healthy Waterways 2006, Water Sensitive Urban Design, Technical Design Guidelines for South East Queensland</li> <li>Water by Design Construction and Establishment Guidelines: Swales, Bioretention Systems and Wetlands Version 1.1 (2010)</li> <li>Water by Design Asset Handover Guideline 2010</li> <li>Water by Design Rectification Guideline 2010</li> <li>Water by Design Maintenance Guideline 2010</li> <li>Water by Design Data Capture Guideline 2010</li> <li>Water by Design Asset Management Guideline (proposed)</li> </ul> Regional NRM Plans and Water Quality Improvement Plans <ul style="list-style-type: none"> <li>Townsville-Thuringowa (WSUD Guidelines)</li> <li>Mackay-Whitsunday (WSUD Guidelines)</li> </ul>
Local	<ul style="list-style-type: none"> <li>Local and regional councils planning schemes and local guidelines on structural treatment measures e.g.:</li> <li>Gold Coast City Council 2007, WSUD Guidelines and WSUD Design Manual</li> <li>Brisbane City Council 2005, WSUD Engineering Guidelines</li> </ul>

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## Engineered Sediment Basin Design

- Most guidelines adopt similar design practices
- Provide separate sediment basin design procedures based upon soil type (e.g. Type C, D and F)
- Take into account peak stormwater discharge requirements
- Specify the design of the settling zone volume using the three month ARI storm event and various recommended area factors
- Specify the design of a sediment storage zone
- Specify a length to width ratio of 3:1
- Must have a depth of at least 0.6m

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## Stormwater Management Plans

- Segregation of landfill areas into two distinct categories:
  - Stable areas
  - Active or disturbed areas
- Revegetation of any permanent or long term surface
- Construction of check dams along the drains
- Regularly inspect drainage structures for scour and/or blockages
- Use of bio-retention basins coupled to sediment basins

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## Case Study B – Upgrade of Existing Landfill



### Background

- Engineered landfill
- Household, commercial, industrial waste
- 70 ha site area
- 6 ha landfill area
- Operated for 20 years
- Located within tidal zone

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## Case Study B – Upgrade of Existing Landfill



### Design Issues

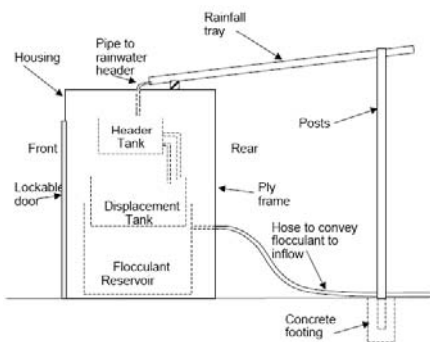
- Replacement of damaged cell liner not cost effective
- Support staged closure of landfill
- New sediment basins would require clearing mangroves
- Takes advantage of existing infrastructure
- Target of collecting 80% of rainfall run-off
- Loss of airspace

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## Other Options – In Line Flocculation Treatment



- Chemical dosing system
- Initial primary sediment removal
- Secondary sediment basin for flocculation treatment
- Automated flocculent release system based upon actual rainfall
- Floating decant which preferentially releases the cleanest water

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### Other Options – In Line Treatment

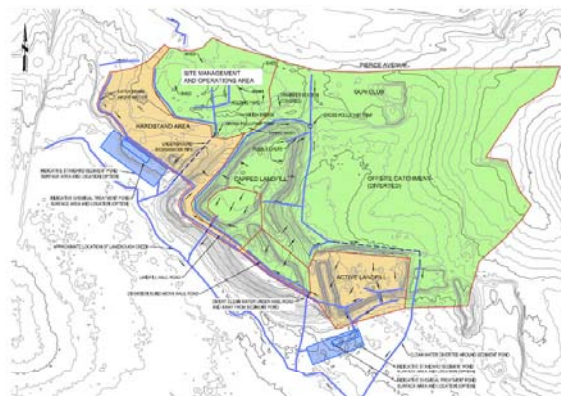
- Based on the Auckland City Council (2004) “TP-90 Flocculation Guideline”
- DERM approval based upon treating 90% of the annual runoff volume
- Design based upon peak flow rather than total volume
- Typically an ARI of three months = 50% of the 1 year ARI
- Uniform loss method for infiltration rate used in the peak flow model
- The Laurenson method used for the hydrograph routing

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### Case Study C – Upgrade of Existing Landfill



#### Background

- Implement a new stormwater management plan
- Upgrade existing sediment basins
- Large blue outline shows required sediment basin size for the operational area (orange)
- Smaller blue outline shows indicative size for in line flow sediment basins trial

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## Summary

- Queensland landfill design guidelines adopt arbitrary sediment basin sizing requirements
- Do not adopt best practice mechanistic assessment
- Provide no certainty of sediment discharge compliance
- DERM and various local governments have robust policies and design guidelines for sediment containment
- Landfill operators need to be able to adopt stormwater management and sediment control measures suited to specific site conditions