TABLE: Summary of key issues with water sensitive urban design (stormwater quality and quantity assets) lifecycle

Strategic catchment planning is becoming an increasingly important issue for the ACT and Region. Lake Burley Griffin is one example of a need to work in collaboration to effectively deal with the water quality issues such as blue-green algae between the Commonwealth (NCA), the NSW and ACT governments. At present developments do not consider the cumulative impacts on the catchment or a catchment treatment train to deal with stormwater quantity and quality issues.

	Summary of key issues	Implications		Potential Solutions
Strategic catchment planning	• Lack of catchment and treatment train information • Lack of catchment scale analysis	• Difficult to understand physical context of each asset • Cumulative impact • Assets may be over designed or under designed for its serving catchment		• Improved spatial information • Catchment scale analysis – data from Basin Priority Project (BPP) priority sub catchments will better inform other "non priority" catchments.
	• Poor linkages between receiving water values and stormwater treatment objectives	• Treatment system design is generic and does not take into account catchment-specific issues		• Catchment specific stormwater treatment targets based on downstream receiving waters
	• No clear framework for determining stormwater treatment objectives for retrofit projects	Retrofit projects have been designed for a wide range of objectives, not all of which are clear	**Cost implication example** **Inner North Reticulation Network** was originally focused at stormwater reuse during the drought but shifted its objective to also deal with water quality - $11 million.	• Clear stormwater treatment targets for every catchment in the ACT • Opportunity for targets with bordering councils through the ACT and Region Catchment Strategy
	• Newer suburbs have overly complex treatment trains which include redundant systems	Inefficient investment in infrastructure	**Cost implication example** **Weston Pond** – members of the public have complained about the lack of adequate landscaping works, which were scaled back due to cost escalations resulting from asbestos conditions on the site.	• Catchment-scale analysis should drive infrastructure planning based on treatment train principles
	• Multi-purpose assets have competing objectives	"Performance" is difficult to define. Different stakeholders have different views on what a well-performing system should look like	**Cost implication example Lake Burley Griffin** lake closure cost annual economic cost to Canberra $25,513,500 (OCSE, 2012). Lake closures in 2007-2014 have increased, on average by approximately 9 days per year for the ACT urban lakes (**Lake Burley Griffin, Tuggeranong and Ginninderra**).	• Clarify the multiple roles and objectives of stormwater assets

Design Issues

Fundamental issues are arising at the design stage. Many systems lack the fundamental features which are standard practice for stormwater treatment systems including high flow bypass, extended detention and adequate pre-treatment. Inlets and diversions systems are consistently poorly designed. Maintenance is given inadequate consideration at the design stage.

<table>
<tr><th rowspan="7">Design issues</th><th>Summary of key issues</th><th colspan="2">Implications</th><th>Potential Solutions</th></tr>
<tr><td rowspan="2">Limitations in design capacity in industry and government</td><td>Systems are poorly designed and fail to perform at their full potential.</td><td>ACT Government does not have WSUD design specialist to assess development applications.</td><td rowspan="2">• Local design guidance (WSUD Review Priority Project 1 Territory Plan variation and WSUD Practice Guideline – to be released and Priority Project 5 update TCCS design standards)
• Local training and other capacity building, especially within government
• Re-design, rectification and renewal of existing assets
• Introduction of assessment tools such as the Model for Urban Stormwater Improvement Conceptualisation (MUSIC-link)</td></tr>
<tr><td>Design issues are not picked up by Officers at key review stages.</td><td>Cost Implication example Lyneham GPT Ecosol Net Tech life expectancy of five years but had to be replaced at the cost of $3,000 after two years. Incorrect type of asset.</td></tr>
<tr><td>Outdated design standards and specifications</td><td colspan="2">• Varying quality in designs; problematic issues are repeated
• Dated design standards do not reflect technological advances, climate change impacts and maintenance requirements in a budget constrained environment.
• Asset Acceptance unable/unwilling to accept innovative approaches to stormwater WQ assets that are outside of the design standards.</td><td>• New design standards and specifications for new types of treatment systems (WSUD Review PP5)
• TCCS have progressed the Municipal Infrastructure Standards which deals with certain aspects of stormwater WQ assets such as ponds and wetlands but does not deal with bioretention systems such as raingardens.</td></tr>
<tr><td>Poor integration and coordination between design teams</td><td colspan="2">• Stormwater, landscape and ecological outcomes suffer.
• Stormwater treatment systems are poorly integrated into the landscape and with other systems.</td><td>• Restructure contracts to encourage an integrated approach
• WSUD Review Priority Project 8 recommended a WSUD asset management transfer guideline.</td></tr>
<tr><td>Design outputs are of a poor standard</td><td colspan="2">• Construction outcomes are poor and there is limited recourse to demand higher standards of the construction contractor</td><td>• Design standards and specifications should set the bar at a higher level</td></tr>
</table>

Construction Issues

The most significant construction issue is the staging of construction in development projects. Vegetated stormwater treatment systems such as wetlands, bioretention systems and swales are not designed to capture construction sediment and are easily over-loaded with sediment during the construction stage, causing significant damage which is not easily rectified. Many GPTs can also be damaged by construction-stage sediment loads.

<table>
<tr><th rowspan="5">Construction Issues</th><th>Summary of key issues</th><th colspan="2">Implications</th><th>Potential Solutions</th></tr>
<tr><td rowspan="2">• Soil stabilisation in developments are not always effective due to a lack of knowledge and to poor on-site practices</td><td colspan="2">• Poor water quality and environmental outcomes.</td><td rowspan="2">• WSUD Review Priority Project 7:
o Review Environment Protection Guidelines for Construction and Land Development in the ACT
o Work with construction industry to improve their performance in erosion and sediment control
o Investigate building certifiers to ensure compliance with site management requirements, including erosion and sediment control.</td></tr>
<tr><td>Damage to water quality infrastructure.</td><td>Cost Implication example Coombs GPT – Developer GPT that has never been cleaned out leading to major sediment and water quality issues. Audit showed 100% failure. Failure to capture gross pollutants has many cost and environmental implications (2015).</td></tr>
<tr><td>• Vegetated stormwater treatments systems are routinely completed too early in the development process and subsequently damaged by construction sediment loads.</td><td>Revegetating systems due to vegetation failure. Resourcing implications.</td><td>Cost Implication example Pond A Coombs – Rectification costs due to sedimentation and requirement to re-establish vegetation $28,199. Example of cost break down is provided at <u>Attachment A1.</u>

The dam inspection carried out for Coombs Pond A (2015) estimated $210,000 of recommended works to rectify previous design flaws including erosion.</td><td>• New requirement for erosion and sediment control measures to be established during either the capital works or estate development phase by civil contractors and left in place until house construction is largely complete (up to 85% of the estate development).</td></tr>
<tr><td>• Poor staging of stormwater treatment system construction in new estates</td><td colspan="2">• Systems overloaded with construction-stage sediment loads</td><td>• As above.
• Adopt appropriate staging techniques based on experience elsewhere (e.g. Water by Design's Construction and Establishment Guidelines 2009)</td></tr>
</table>

Establishment Issues

Establishment is a key stage in the lifecycle of a vegetated treatment system, but it is a stage that appears to receive relatively little attention in the Territory. This is likely because establishment is a less critical issue for other public assets and therefore systems are generally not set up to deal with a long establishment phase.

	Summary of key issues	Implications	Potential Solutions

Establishment issues	• Poor establishment practices at handover e.g.
	  ○ Establishment of wetland vegetation in particular is a specialist skill which is not widely understood in the industry.
	  ○ Along with maintenance, establishment is given inadequate consideration at the design stage. For example, there is often no provision to take systems offline, drain permanent water or manually control water levels during plant establishment.
	  ○ Construction contracts do not typically include a meaningful allowance for plant establishment.
	  ○ Construction timelines often encourage early handover before establishment is complete.
	  ○ The establishment phase is maintenance intensive and unless it is clearly identified as part of the implementation cost (e.g. as part of a specific contract), it may be difficult to resource.
		• Poor treatment outcomes if vegetation fails to establish
		• Higher maintenance costs if rectification is required
		• Industry standard for best practice establishment (up to 2 years) differs with ACT Government practice of (13 weeks).
		
		Cost Implication example Pond B Coombs – Ratification costs due to sedimentation and requirement to re-establish vegetation $29,498. Example of cost break down is provided at Attachment B1.
		
		The dam inspection carried out for Coombs Pond B (2015) estimated $250,000 of recommended works to rectify poor establishment of vegetation which does not allow for assessment of critical dam safety features.
			• Acknowledge establishment as a critical phase
			• Adopt best practice guidelines (existing guidelines such as Water by Design's *Construction and Establishment Guidelines* 2009)
			• The ACT WSUD Practice Guideline recommends a two-year establishment period.
			• Allocate appropriate funding to establishment including operation and maintenance
			• Include establishment in contracts

Asset Handover Issues

Asset handover is an important process which begins with the review of concept design information. EPD will refer the concept design information to TCCS Asset Acceptance for comment. It concludes with the completion of asset acceptance. Asset acceptance has been a critical issue for the ACT Government.

	Summary of key issues	Implications	Potential Solutions

Asset Handover Issues	• Inconsistency and gaps in internal asset handover processes
	  ○ Consult Australia raised the question "… *if industry is following the code and standard why are ACT Government not making decisions on accepting assets?"*
	  ○ Consult Australia raised the question *"…why are incorrectly designed and engineered assets being accepted while correct ones weren't?"*
	  ○ Consult Australia raised the issue of inconsistency. For example a raingarden was accepted by ACT Government 500 metres down the road however the newer raingarden with the same design currently not being accepted.
		• Stormwater quality outcomes could change significantly between DA and asset acceptance, and this wouldn't be picked up in the process
		• Potential maintenance issues are identified until handover is complete
		• Poor concepts, designs and constructed outcomes can be approved at each stage of the process
			• Review and improve asset handover processes from the DA stage to asset acceptance final stage.
			• Allow maintenance officers to influence the design phase, however acknowledging that existing resources is already tight to take on this added task.

	• Lack of capacity for meaningful review	• Key issues can easily be missed during approval process	• Improve guidelines and tools • Build internal capacity
	• Assets are currently not being built to specification and questions rose over whether the quality and standard of assets handed to TCCS.	• Incorrectly design and engineered assets being accepted by the Territory	• Asset handover certification currently being reviewed and revised by TCCS
	• Capital Works do not need to go through TCCS Asset Acceptance	• Different process for Capital Works. Raises the question why private developers have to go through a different process.	• A transparent process for government and industry.

Operation and Maintenance Issues

The operation and maintenance stage is crucial to the long-term performance of stormwater treatment systems and poor maintenance is a primary cause of poor performance in many of the systems. The number of stormwater treatment systems has increased rapidly in the ACT over the past decade, and the maintenance budget has not kept up with this increase. Lack of operation and maintenance examples includes:

- In ponds, lakes and wetlands there is no routine maintenance undertaken within the water body itself. Systems are only desilted occasionally, when sediment builds up to a level which demands some action. However well before sediment reaches this level, many ponds and lakes appear to have water quality issues associated with re-release of pollutants from materials building up within the water body.
- There is no capacity to maintain raingardens. No funding is allocated for maintenance of raingardens. Bioretention systems are low maintenance, but prone to failure if not maintained at all.

O&M	Summary of key issues	Implications		Potential Solutions
	• Inadequate funding for operation and maintenance stage ○ TCCS are responsible for an increasing number of assets without a commensurate increase in budget ○ Other cost pressure and other competing priorities	• Poor performance of existing assets • Limited opportunity to improve asset management systems or build capacity	**Cost Implication example** **GPT Eastern Valley Way and general GPTs –** GPT clean out costs $250,000 per clean. Waste disposal is between $150,000 to $350,000. General TCCS standard and proprietary GPTs clean outs cost $950,000 (excludes the expensive GPTs such as Wentworth Ave, Eastern Valley Way GPTs) per clean. Total of 205 GPTs on the asset register. The ACT has a relatively low frequency cleaning rate compared with industry standards for GPTS (up to 2 clean outs when compared to the recommended 4). **GPTs** require a biannual inspection (separate contract) and cleaning if required, plus a full inspection (separate cost) after a rain event of 25mm or more (and cleaning if required). This is an unpredicted cost. In 2016 alone, Canberra Airport gauge station has had 5 days of rainfall over 25mm, with one of these days (6 June) receiving 65.2mm)	• New funding model • Investment is required into systems and capacity-building as well as the O&M workload itself
	• No routine monitoring or review	• Poorly function assets go undetected • Investment in infrastructure is not translating into anticipated water quality outcomes		• Investment is also required into monitoring and review (BPP is partially addressing in the short-term)

Asset renewal and decommissioning

It is anticipated that stormwater WQ assets will need to be renewed once they reach the end of their useful life. The useful life for each stormwater WQ asset will be different and related to:

- Whether the system has been designed, constructed and maintained according to best practice.
- Catchment characteristics (influences the quality of the stormwater).
- General health of the system – the type of plants that have been used in the system.

Most stormwater WQ assets will be renewed and never decommissioned as they are constructed to comply with environmental regulations, either as part of a development or as part of a responsible authorities relevant plan. However, it is recognised that well established assets such as wetlands and ponds may continue to function effectively well beyond this time and not require renewal so long as they are maintained effectively. Conversely, some assets may have failed from due to poor design, construction or establishment issues leading to premature failure. These assets may need to be renewed or decommissioned before their expected useful life.

Asset renewal and decommissioning	Summary of key issues	Implications		Potential Solutions
	• Inadequate funding for asset renewal or decommissioning ○ Refurbishment and/or asset renewal is classified as capital works – requires business case	• Poor performance of existing assets and possible liability to the asset manager • Limited opportunity to improve asset management systems or build capacity	**Cost implications** Advice from TCCS regarding the Cravens Pond requested a longer establishment period, instead the contract added in rectification payment to TCCS of $100,000.	• New funding model • Existing business case model needs to make asset renewal and decommissioning a higher priority
	• Established assets such as wetlands or ponds may appear to be operating well and can take many years before issues are realised.	• Poorly function assets go undetected • Investment in infrastructure is not translating into anticipated water quality outcomes		• Introduce monitoring of asset condition.

Coombs Ponds Defects Ratification and Recurrent Costing (provided by TCCS, 2015)

POND	TASK	STAFF	RATE	MACHINE / MATERIALS	RATE	AREA OF WORKS / M2	HOURS	SUB TOTAL
	Defect Rectification							
Pond A	Removal of destroyed shrub beds					726 M2		
		2 X gso 3/4	$73 ph				32 Hours	$2,336
				Bobcat	$80 ph		32 Hours	$2,560
Pond A	Tree protection during works							$5,000
Pond A	Removal of sediment from bike paths					240 M2		
		2 x gso 3/4	$73 ph				10 Hours	$730
				Bobcat	$80 ph		10 Hours	$800
Pond A	Establishment of new dryland grass / Re-Establishment of dryland grass areas					3,329 M2		
		3 x gso 3/4	$109 ph				48 Hours	$5,232
				Bobcat	$80 ph		48 Hours	$3,840
Pond A	Re-Establishment of damaged Macropyhte zones					88 M2		
		2 X gso 3/4	$73 ph				32 Hours	$2,336
Pond A	Disposal - plants / sediment							
		1 X GSO 3/4	$36.50				10 Hours	$365
				tip fees				$5,000
	Total defects pond A							**$28,199**
	Recurrent Costs							
Pond A	Tree watering			Contract				$5,000
Pond A	Tree basin maintenance	2 X gso 3/4	$73 ph				30 Hours	$2,190
Pond A	Weed Spraying	2 x gso 3/4	$73 ph				48 Hours	$3,504

POND	TASK	STAFF	RATE	MACHINE / MATERIALS	RATE	AREA OF WORKS / M2	HOURS	SUB TOTAL
				Chemical				$6,000
Pond A	Mulching	4 x gso 3/4	$146				30 Hours	$4,380
				Bobcat	$80 ph		30 Hours	$2,400
Pond A	Fire weed inspections & removal	2 x GSO 3/4	$73.00				96 Hours	$7,000
Pond A	Mowing	1 x gso 3/4	$36.50				96 Hours	$3,504
				Machine costs				$850
	Total Recurrent Pond A							$34,828
	Total for Pond A - defects & recurrent							$63,027

POND	TASK	STAFF	RATE	MACHINE / MATERIALS	RATE	AREA OF WORKS / M2	HOURS	SUB TOTAL
	Defect Rectification							
Pond B	Removal of destroyed shrub beds					1,026 M2		
		2 X gso 3/4	$73 ph				40 Hours	$2,920
				Bobcat	$80 ph		40 Hours	$3,200
Pond B	Tree protection during works							$5,000
Pond B	Removal of sediment from bike paths					240 M2		
		2 x gso 3/4	$73 ph				10 Hours	$730
				Bobcat	$80 ph		10 Hours	$800
Pond B	Establishment of new dryland grass / Re-Establishment of dryland grass areas					4,061M2		
		3 x gso 3/4	$109 ph				48 Hours	$5,232
				Bobcat	$80 ph		48 Hours	$3,840
Pond B	Re-Establishment of damaged Macropyhte zones					108 M2		
		2 X gso 3/4	$73 ph				32 Hours	$2,336

POND	TASK	STAFF	RATE	MACHINE / MATERIALS	RATE	AREA OF WORKS / M2	HOURS	SUB TOTAL
				Truck/Fuel/Rego	$8.40ph		9 Hours	$75
Pond B	Disposal - Plants / Sediment							
		1 X GSO 3/4	$36.50				10 Hours	$365
				tip fees				$5,000
	Total Defects Pond B							**$29,498**
	Recurrent Costs							
Pond B	Tree watering			Contract				$5,000
	Tree basin maintenance	2 X gso 3/4	$73 ph				30 Hours	$2,190
Pond A	Weed Spraying	2 x gso 3/4	$73 ph				48 Hours	$3,504
				Chemical				$6,000
Pond B	Mulching	4 x gso 3/4	$146				30 Hours	$4,380
				Bobcat	$80 ph		30 Hours	$2,400
Pond B	Fire weed inspections & removal	2 x GSO 3/4	$73.00				96 Hours	$7,000
	Mowing	1 x gso 3/4	$36.50				96 Hours	$3,504
				Machine costs				$850
	Total Recurrent Pond B							$34,828
	Total for Pond B - defects & recurrent							$64,326
	TOTAL FOR ALL WORK BOTH PONDS 1ST YEAR							**$127,353**
	Total for both ponds second year onwards							$69,656