Asset 9: Norgrove Park wetland

General information

Description

Wetland located online downstream of an old urban catchment. Stormwater runoff passes through the wetland, and it also has a recirculation system which feeds a secondary arm of the wetland.

The wetland was built by the LDA who developed the Kingston Foreshore site, and is still maintained by the LDA.

Asset type	Wetland	**Asset context**	Urban renewal
Year built	2004	**Year of handover to TAMS**	Not yet handed over
Catchment area	Approx. 125 ha	**Catchment type**	Urban – mixed use
Normal water level (NWL)	TBC	**Top of extended detention**	TBC
Surface area at NWL	Approx.. 2,300 m^2 (stormwater treatment area) + 900 m^2 (additional recirculating treatment area)	**Open water approx. %**	50%
Volume at NWL	TBC	**Volume at top of extended detention**	TBC
Average depth at NWL	TBC	**Maximum depth at NWL**	TBC
Construction cost	TBC	**Cost per sqm**	TBC
Inlet/s	Online – 4 pipes discharge into wetland	**Outlet/s**	Overflow weir to Lake Burley Griffin
Expected performance	TBC	**Source**	

Information reviewed to date

Information	Requested	Received	Reviewed
Design reports	✓		
Design drawings	✓		
Monitoring data (LDA)	✓		

Site inspections

Site inspections have been undertaken on the following dates:

- 28 September 2008 – dry weather
- 8 April 2012 – dry weather
- 3 December 2014 – wet weather

Design objectives

At this stage, the design objectives of the Norgrove Park wetland are unclear. It pre-dates the ACT's WSUD Code, however it was clearly designed for water quality treatment in some form. It appears that it was intended to have the dual purpose of:

- Treating flows from the external stormwater catchment
- Treating recirculated flows from the open water pond between the wetland and Eyre Street

It is also clear that the wetland has landscape objectives – it includes boardwalks, a viewing area and formal landscaped edges.

The wetland provides habitat value, but it is unclear whether this was a key objective which drove its design.

Performance issues

Norgrove Park wetland operates in two different modes:

- During dry weather, it functions as a recirculating system, with a low flow rate
- During wet weather, stormwater inflows vastly exceed recirculating flows and water in the system is replaced with stormwater inflows

In the dry weather recirculation scenario, the wetland appears to be functioning reasonably well. Recirculated flows follow a long flowpath (approximately 150 m) through a secondary arm of the wetland, which is offline and protected from stormwater flows. This part of the wetland has healthy vegetation growth and recirculating flows appear to be pumped at a reasonably low flow rate, where they pass through the system with reasonably low velocity. This part of the wetland probably has a healthy biofilm system which would be effective at processing nutrients.

In the wet weather scenario, there are significant limitations to the wetland's performance:

- There is limited pre-treatment of sediment upstream of the wetland (the Wentworth Avenue GPT appears to be within the wetland catchment), so the wetland could potentially be accumulating high sediment loads within the macrophyte zone

- The wetland has no (or inadequate?) high flow bypass, so high flows pass directly through the macrophyte zone. The velocities are high and would not allow this wetland to sustain an effective biofilm system

- The wetland has no extended detention, so there is only a short residence time for stormwater flows and limited contact time in the macrophyte zone

- Storm flows are effectively short-circuiting within the wetland; following the shortest possible path through the system, out-flanking weirs and following lines of open water through the system. Figure 1 and Figure 2 show some examples where this is occurring.

- Macrophyte coverage in the wetland is mixed, with around half the macrophyte zone currently open water. TAMS noted there have been problems with plant establishment due to ducks and weed infestations.

Figure 1: High flows passing around vegetation, outflanking a weir and causing bank erosion in two locations

Figure 2: High flows outflanking vegetation and passing around macrophyte zone in dominant flowpaths either side of the vegetated zone

On site we also observed some other minor performance issues:

- Some erosion on the bank opposite the inlet pipes
- Significant flows surcharging from a pit within the wetland (unclear whether this is in keeping with the design intent, but appears unintentional)
- Damage to vegetation and loss of mulch around the wetland perimeter where water levels rise above the normal water level during a storm event
- Water inundates the bottom tier of the viewing area

These issues are shown in Figure 3.

Figure 3: Minor issues at Norgrove Park wetland – clockwise from top left – erosion opposite inlet; surcharging pit; vegetation damage at edges; inundated viewing area

There has been some Waterwatch monitoring at Norgrove Park over 2013-14, which highlights some water quality issues in the wetland:

- Nutrient concentrations are often high
- Dissolved oxygen is often low
- One sampling event notes that there was a putrescible odour and gas emanating from sediment
- Turbidity is often high
- One sample notes an outbreak of algae/floating weed

- One sampling event notes an environmental incident – chemical spill

All of the Waterwatch monitoring was done near the inlet to the wetland.

TAMS has also noted that the main pond section at Norgrove Park becomes smelly and they receive frequent complaints. This suggests poor water quality and potentially anaerobic decomposition occurring in the pond.

The LDA has also undertaken some monitoring which is reported in brief in the *Investigation into the state of the watercourses and catchments for Lake Burley Griffin* (Commissioner for Sustainability and the Environment, 2012). These results suggest that pollutant loads were monitored in stormwater inflows and outflows (i.e. in wet weather conditions). The brief results indicate that the wetland was achieving the following:

- 66% *increase* in total suspended solids loads (thought to be associated with construction in the catchment, however this does not fully explain why the wetland was a source of sediment)

- 77% reduction in total phosphorus loads

- 62% reduction in total nitrogen loads

The nutrient load reductions appear to be very high, and much higher than would be expected for a wetland with no extended detention or high flow bypass, poor flowpaths and poor macrophyte coverage. It is unknown whether true event-based pollutant load monitoring was completed and whether enough events were sampled for a statistically significant estimate of pollutant load removal.

Key causal factors and constraints

The key factor which leads to limited performance of the Norgrove Park wetland is its design, which includes no (or inadequate?) high flow bypass and no extended detention. These two key omissions significantly restrict the potential of this wetland to perform as an effective stormwater treatment system. It is a small treatment system for its catchment, therefore these features are particularly important.

Other issues are also associated with the design – lack of pre-treatment for suspended solids, short-circuiting, erosion and inundation of "dry" areas around the wetland perimeter.

If the hydraulics of the system were improved, it is also likely to improve the conditions for macrophyte establishment.

This system could be modified relatively easily to improve its performance, however the following key constraints will need to be accommodated:

- Levels of major structures

- Existing vegetation including established trees

- Value of the existing landscape

Potential improvement options

The following options are recommended for further consideration and analysis at Norgrove Park (in approximate priority order in terms of their ability to improve the stormwater treatment performance):

1. Retrofit a high flow bypass

2. Modify water levels in the system to incorporate extended detention and increase the notional detention time (include a riser outlet)

3. Retain a separate sediment pond upstream of the macrophyte zone

4. Re-establish macrophytes where they have failed. Consider incorporating an ephemeral zone.

5. If feasible, add a maintenance drain to facilitate both desilting of the sediment pond and maintenance of the macrophyte zone (including both establishment and long-term maintenance)

6. Re-design edges where they are periodically inundated

7. Review the recirculation pump rate to ensure it remains appropriate

References

Commissioner for Sustainability and the Environment 2012 *Investigation into the state of the watercourses and catchments for Lake Burley Griffin*

Asset 10: Emu Bank wetland

General information

Description

Wetland located offline downstream of an old urban catchment, at an inlet to Lake Ginninderra. Stormwater runoff (low flows) pass through the wetland, and there is also a recirculation system recirculates flows from Lake Ginninderra.

The wetland was built by the ACT government as part of the Belco Skate Park project.

Asset type	Wetland	**Asset context**	Urban renewal
Year built	2013	**Year of handover to TAMS**	TBC
Catchment area	~350 ha	**Catchment type**	Old urban
Normal water level (NWL)	577.45	**Top of extended detention**	577.70 250 mm above NWL
Surface area at NWL	4,857 m^2	**Open water approx. %**	95%
Volume at NWL	TBC	**Volume at top of extended detention**	TBC
Average depth at NWL	Approx. 1 m	**Maximum depth at NWL**	1.94 m
Construction cost	TBC	**Cost per sqm**	TBC
Inlet/s	Low flow diversion from central channel Several small pipes directly into wetland	**Outlet/s**	Riser? overflow weir to Lake Ginninderra
Expected performance	TBC	**Source**	

Information reviewed to date

Information	Requested	Received	Reviewed
Design reports	✓		
Design drawings		✓	✓

Site inspections

Site inspections have been undertaken on the following dates:

- 12 July 2014 – dry weather
- 24 November 2014 – wet weather
- 3 December 2014 – wet weather

Design objectives

We have some information on design objectives from a brief interview with the design consultant (Ralph Williams, DesignFlow) and presentation materials which he has provided to us.

We understand that the key driver for the construction of the wetland was the upgrade of the public realm at this site. The Lake Ginninderra inlet is at the centre of the public domain, but was a significant detractor from the amenity of the area, with poor water quality, poor circulation, floating litter collecting in dead zones, low dissolved oxygen, high levels of nutrients and suspended solids, outbreaks of algae and weeds. Therefore the wetland is designed to address these issues and provide a more attractive feature of the public realm.

A second issue was that significant sediment had accumulated in the inlet area, which would have been difficult and costly to remove.

Significant constraints had to be accommodated in the design, including:

- Management of high flows through the inlet area
- Tight levels between the lake operating level and adjacent development
- The wetland is significantly under-sized for its catchment

The wetland project involved separating the inlet zone from the rest of Lake Ginninderra. This has been achieved with a weir located under the pedestrian bridge at the end of the inlet zone. The weir allows water levels in the inlet zone to rise up to 250 mm higher than the lake's normal water level.

The inlet zone has then been divided into:

- A central channel, similar to the previous inlet zone but smaller in area. This operates as a sediment basin upstream of the wetland, and includes a diversion structure to allow low flows to pass into the wetland. There is heavy machinery access along the side of the central channel for sediment removal (note that this area cannot be drained by gravity, however it could be pumped out now that it is separated from the Lake).
- Wetland cells on either side of the channel. These have been filled to create a shallower water level and more varied bathymetry, including shallow macrophyte zones. They have also been designed so that flows follow a long flowpath through the wetland.

Low flows pass from the central channel into the western wetland cell via a grated pit at the downstream end of the channel. These flows then move south through the western wetland and pass into the eastern wetland via an underground linking pipe. They flow north through the eastern wetland and then out into the lake via a riser outlet.

High flows flow directly through the central channel and over the overflow weir into the Lake.

In dry weather, there is a recirculation pump which pumps water from the lake back into the upstream end of the central channel. These flows would then pass through the wetland as described above, before re-entering the lake via the riser outlet.

Figure 1 shows the general movement of water in wet weather. Figure 2 shows water movement in dry weather.

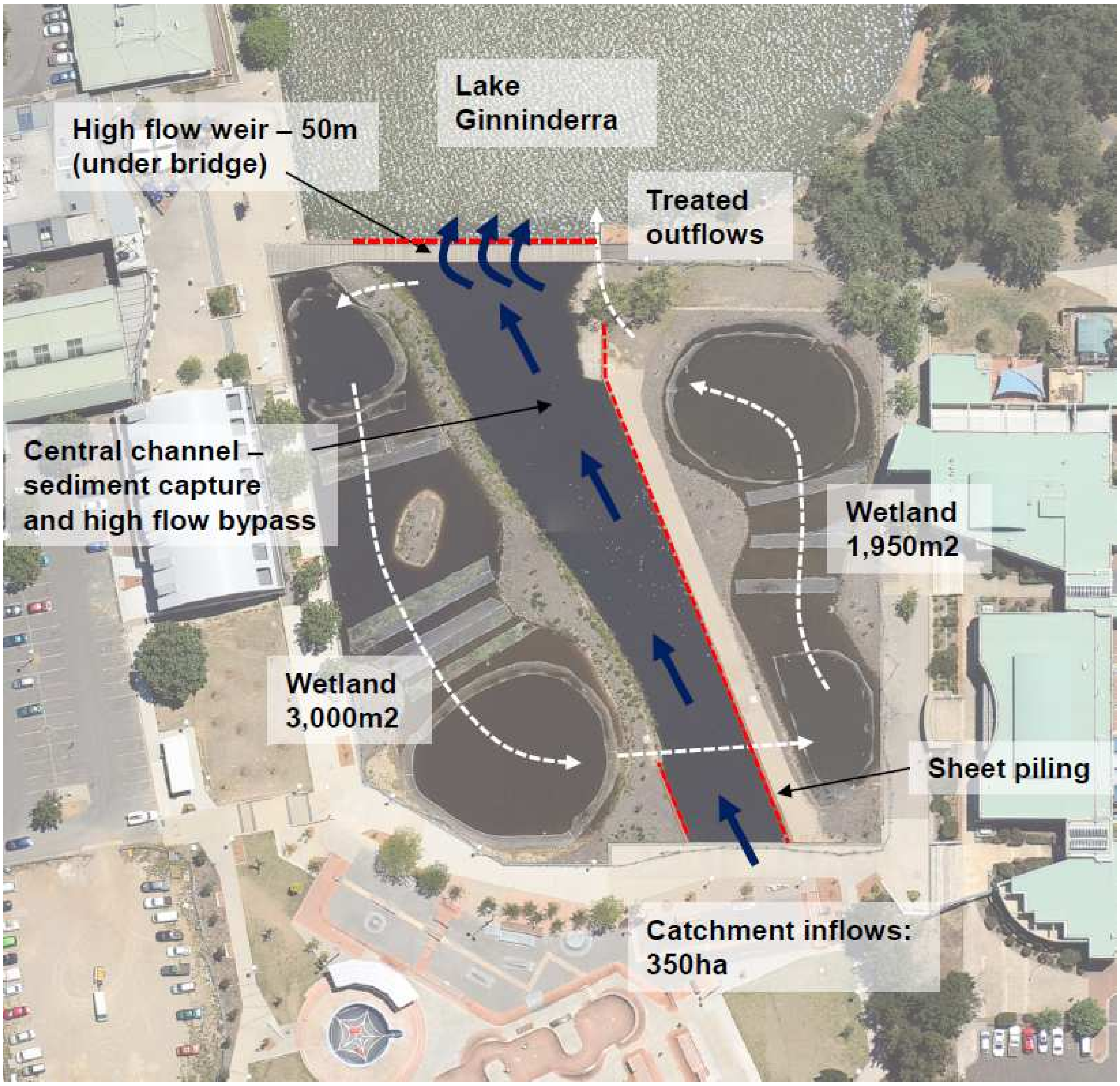

Figure 1: Emu Bank wetland stormwater flows (DesignFlow 2014)

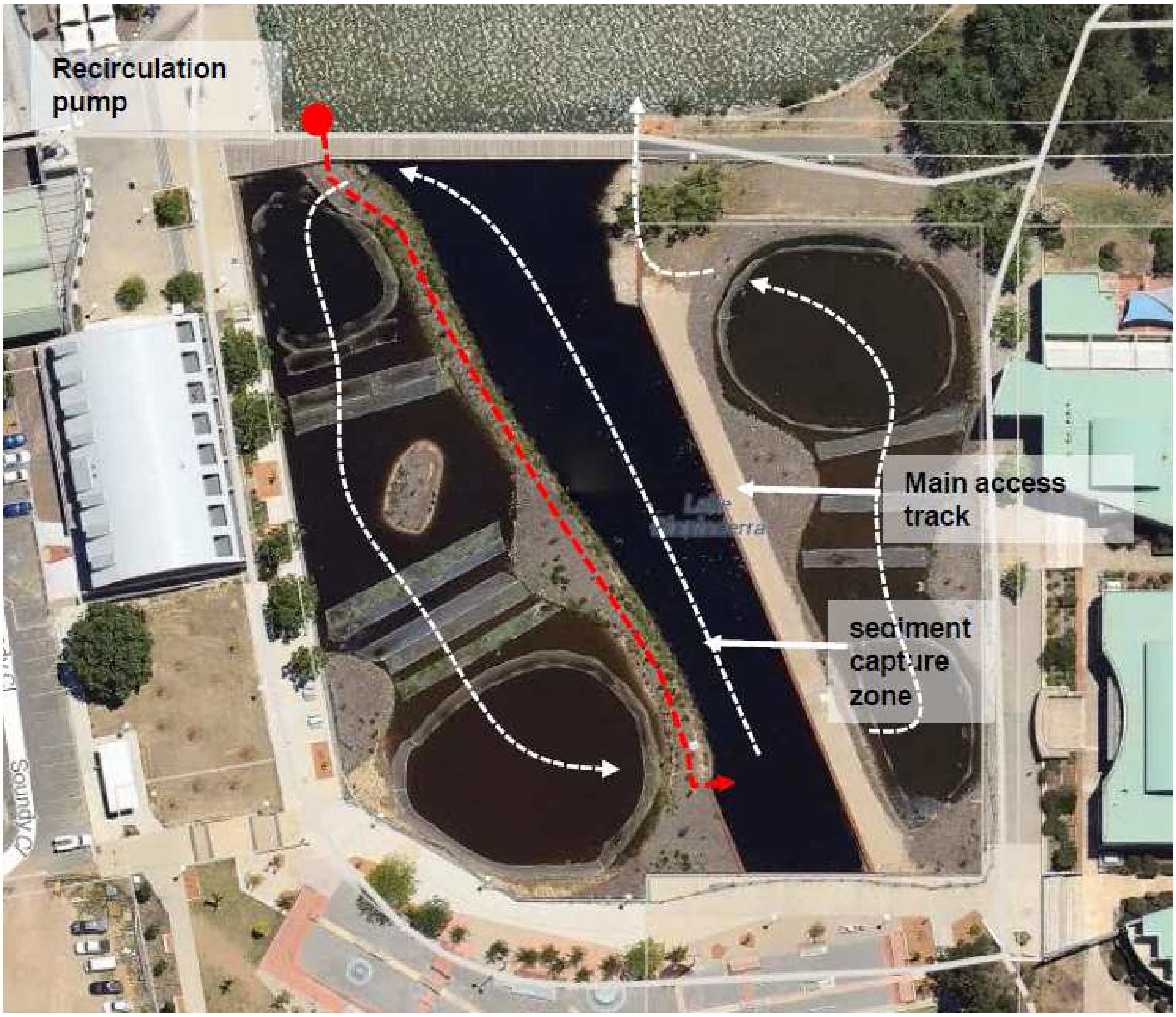

Figure 2: Emu Bank wetland recirculating flows (DesignFlow 2014)

Performance issues

Emu Bank wetland operates in two different modes (wet weather and dry weather) as described above, however as the wet weather flowrate is limited, these two conditions are essentially very similar on paper. However we have observed some differences in performance in the field.

In dry weather, TAMS has noted that in hot conditions, the water in the wetland turns black. TAMS has suggested that the recirculation pump is too small. When we are able to review the design drawings for the wetland we will be able to comment on the size of the recirculation pump and whether it is the appropriate pump for the system. When we checked the pump during our site visit on 24/11/14, it wasn't operating and a build-up of sludge in the pit suggests that it had not operated for a while. A picture is shown in Figure 3. This could also be an important factor contributing to poor water quality in dry weather.

Figure 3: Recirculation pump in Lake Ginninderra

During wet weather, we have observed that there is a low flowrate through the wetland. Water movement was visible/audible through the diversion inlet and riser outlet, suggesting that the wetland is functioning as it was designed from a hydraulic perspective.

The key factor which affects this wetland's stormwater treatment performance is the limited macrophyte coverage. This is also a key issue in recirculating flow conditions. The macrophyte coverage is discussed further below.

On site we also observed some other minor performance issues:

- Some of the edge vegetation has also established poorly
- Some erosion around the wetland edges
- Some mulch washed into the wetland during high water conditions
- Floating leaf litter accumulating at the upstream end of the central channel

These issues are shown in Figure 4.

Figure 4: Minor issues at Emu Bank wetland – clockwise from top left – poor establishment of edge vegetation; bank erosion; mulch washed into wetland; floating leaf litter in central channel

Key causal factors and constraints

In terms of hydraulics, this wetland has been designed well so that it is protected from high flows, there is adequate pre-treatment upstream of the wetland itself, there appears to be a long residence time in the wetland and there is a long flowpath through the wetland, with limited opportunity for short-circuiting.

Some of the issues affecting this wetland's performance are key constraints of the site (e.g. limited area and limited extended detention). However there is one key performance limitation which could easily be improved: the wetland has very limited macrophyte coverage. This system should be able to function effectively as a biofilm system, which would remove significant nutrients from low flows. However in order to achieve this, an extensive and dense cover of healthy macrophytes is required.

It appears that macrophytes were only ever planted in relatively small areas of the wetland. It is not known why planting was so restricted. Design and Work as Executed drawings show that planting extended across most of the surface area (other than the deep pools) – approximately 70% of the wetland area. However this area of planting does not appear to have gone ahead. An aerial image from 25 April 2013, shown in Figure 5, shows bird netting in the wetland, which appear to be protecting the areas where macrophytes were planted. The macrophyte areas cover only about 15% of the total wetland area.

Analysis of subsequent aerial images from Nearmap suggests that water levels were raised too quickly within the wetland, before plants were fully established. Macrophytes need to establish in shallow water so that a large part of the plant is always emergent. If seedlings are drowned, they are not able to establish. Normally in wetlands, water levels are therefore raised very slowly during the establishment phase to assist macrophyte establishment.

Figure 5: Aerial image from Nearmap, 25 April 2013, showing bird netting over areas where macrophytes were planted

Nearmap images suggest that planting was undertaken around March 2013, then water levels were raised to the normal operating level by July 2013. A few macrophytes survived (perhaps in shallower zones of the wetland), however most failed to establish. Figure 6 shows an aerial image from 29 October 2014, showing very limited remaining macrophyte coverage.

Note that the design drawings include notes specifying that maintenance of wetland vegetation was to be the responsibility of the contractor for 18 months following planting and that during this time, water levels were to be controlled so that deep marsh plants would be 50% inundated and shallow marsh plants were to remain moist. The notes also specify that at the completion of the establishment phase, the vegetation cover needed to be at least 95% of that which is shown on the plans. It appears that these procedures have not been followed. It is not known whether the wetland vegetation has been handed over from the contractor to government in its current state.

Figure 6: Aerial image from Nearmap, 29 October 2014, showing that most macrophytes have failed to establish

Potential improvement options

From a hydraulic perspective, there is probably limited scope to improve the function of this wetland. This can be reviewed in more detail once we have access to the design drawings and can undertake our own calculations to check design flows, residence times and the sizing of key structures.

Two main actions are recommended for further investigation:

- Check the operation of the recirculation pump:
  - Arrange a pump service and check whether the exiting pump is functional
  - Check whether the pump is appropriately sized and whether it is appropriate for the conditions
- Re-plant and establish macrophytes within the wetland:
  - Use those species which have established well at this site and at other relevant sites in the ACT
  - If possible, plant a more extensive area than was done previously

- Use a contractor with experience establishing wetland vegetation
- Ensure the contractor is responsible for maintenance during a longer establishment period, and that their contract includes performance targets rather than being purely time-based
- Manage water levels more carefully through the establishment period (note that this requires some thought as to how this will be most effectively achieved, in the context of site specific constraints)
- Use bird netting as done previously
- Our experience establishing vegetation in other wetlands is that it is often more effective to plant a smaller number of larger individual plants (e.g. 150 mm pots) instead of trying to establish wetland vegetation from tubestock.

Asset 11: David Street Pond

General information

Description

Pond located offline beside a tributary of Sullivans Creek (O'Connor Channel) near David Street, O'Connor. Low flows are diverted from the channel through the pond and it also receives runoff directly from the adjacent development.

The pond was conceived by the Sullivans Creek Catchment Group and built by developer of an adjacent residential site, to offset their on-site stormwater management requirements.

Asset type	Pond	**Asset context**	Retrofit
Year built	2001	**Year of handover to TAMS**	2002
Catchment area	Approx.. 300 ha	**Catchment type**	Approx. 30% urban
Normal water level (NWL)	564.8 m AHD	**Top of extended detention**	565.3 m AHD
Surface area at NWL	3,032 m^2	**Open water approx. %**	90%
Volume at NWL	2680 m^3	**Volume at top of extended detention**	4,280 m^3
Average depth at NWL	0.88 m	**Maximum depth at NWL**	1.3 m
Construction cost	$156,000	**Cost per sqm**	$51
Inlet/s	Diversion from channel and direct inflows from small local catchment.	**Outlet/s**	Slot weir and spillway returning to channel
Expected performance	70% reduction in suspended solids, total phosphorus and organic material (BOD); 60% reduction in nitrogen for flows which pass though the pond (35% reduction for the catchment as a whole)	**Source**	Preliminary Assessment Report, SCCG 2001

Information reviewed to date

Information	Requested	Received	Reviewed
Design reports		✓	✓
Design drawings		✓	✓

Site inspections

Site inspections have been undertaken on the following dates:

- 9 March 2013 – dry weather
- 16 November 2014 – wet weather
- 17 November 2014 – with Joel Kelly, PACS ACT Government
- 24 November 2014 – wet weather

Design objectives

The David Street Pond was originally conceived by the Sullivans Creek Catchment Group, whose goals were broadly focused on the restoration of Sullivans Creek. The vision of the Sullivans Creek Catchment Group (SCCG 2000) was “An involved community creating and maintaining a healthy catchment where Sullivans Creek flows clear through native vegetation and wetlands, providing joy and inspiration for ourselves and future generations”.

The SCCG’s objectives for the wetlands were (SCCG 2000):

- improving and providing variety to the landscape character along the creek and its watercourses;
- improving water quality;
- increasing biodiversity;
- enhancing the visual and recreational values of the creek corridor;
- reducing peak flows; and
- increasing public awareness and community education regarding the environmental, economic and social value of Sullivans Creek.

According to the design brief for David Street wetland, the project was considered a demonstration project with the following specific objectives:

- Test/demonstrate:
    - pollutant (organic material, SS, nutrients, metals, toxicants) interception benefits
    - flow attenuation benefits
    - landscape values/enhancement benefits
    - ecological conservation values

- educational facility values

- Raise wider community awareness of restoration opportunities

- Provide opportunities for community participation/partnership in the management of local areas.

Quantitative performance objectives given in the Preliminary Assessment Report (SCCG 2001) are:

- reduce pollutants (suspended solids, total phosphorus and Biological Oxygen Demand) discharged by the O'Connor sub-catchment to Sullivans Creek by 35%;

- delay the peak discharge from the O'Connor tributary and reduce it by 50% for the 1 in 3 month storm event, and by 40% for the 1 in 6 month storm event;

The David Street pond has a small size for its catchment, however this is often the case with retrofit projects. It is located offline and protected from high flows. Upstream there is limited treatment within the catchment, however there is another similar small pond/wetland at Banksia Street, O'Connor. Immediately downstream of the David Street pond, the O'Connor Channel joins Sullivans Creek.

Performance issues

Considering the multiple objectives at David Street, it is performing well against some of those objectives:

- Media reports indicate that it is seen as a community asset and valued for its habitat and biodiversity, landscape and aesthetic objectives

- There has been significant community involvement in the site. It is unclear whether significant community involvement is continuing since the SCCG was wound up in 2011, however Waterwatch monitoring is ongoing

- Interpretive signage at the site helps raise wider community awareness

- TAMS report that it is generally low maintenance (although desilting presented a significant one-off cost in recent years)

In terms of in-pond water quality, Waterwatch data indicates that generally water quality is typical of an urban pond, however there have been some particular issues recorded including:

- A bloom of red algae was reported in Autumn 2010

- Gambusia are often noted in significant numbers

- DO is sometimes low

- Observations of native fauna have generally been species common to urban ponds (e.g. ducks, cormorants, turtles, spotted marsh frogs). Macroinvertebrate sampling was undertaken in October 2010 and notes indicate that there were few taxa present and no "good" bugs

In terms of the pond's performance as a water quality treatment and flow attenuation system, this has never been measured, however our site observations indicate that there are some significant limitations. The key performance issue at David Street is the performance of the diversion structure from the stormwater channel. The diversion structure has the following key limitations:

- There is a very small level difference between the diversion weir and the overflow weir, so it bypasses very easily.

- The trash rack blocks easily. The design of the trash rack is such that at the base of the rack there is a very small opening between the lowest rail and the concrete structure underneath, which is the first part to block.

Figure 1 shows the condition of the diversion structure when we visited the site on 16 November 2014. Almost all inflows were bypassing the wetland due to significant blockage of the trash rack. We cleaned the trash rack on 16 November and observed that after this, most of the inflows entered the wetland. However we returned to the site during the next rain event on 24 November to find that even with minimal blockage of the trash rack, significant flows were still bypassing the wetland due to a very small level difference between the diversion level and the overflow weir. Design drawings indicate a 100 mm level difference, however it appears to have been constructed with effectively no level difference. The detailed issues are highlighted in Figure 2.

The Preliminary Assessment Report for David Street pond indicated that the design flow intended to be diverted into the system was 300 L/s prior to any overflow of the weir in the main channel (SCCG 2001), however our observations indicate that the actual diversion flowrate is well below this.

Figure 1: Flows bypassing the pond after rain event on 16 November 2014

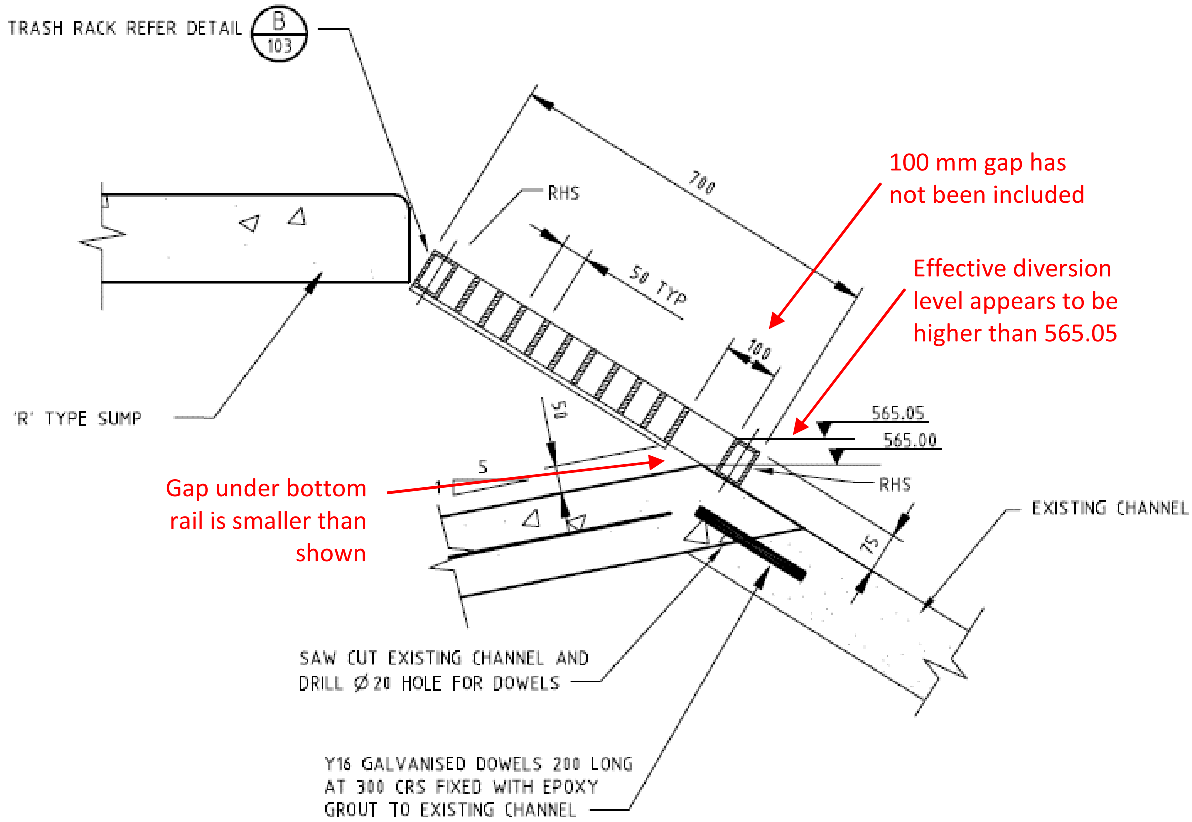

Figure 2: Trash rack details

The ineffective diversion and small quantities of stormwater actually diverted into the pond would be significantly reducing its performance in terms of both water quality treatment and flow attenuation. In addition, the lack of flows through the pond could potentially be exacerbating conditions conducive to algal blooms, by leading to long residence times within the pond. However the small stormwater inflows would also be limiting the pollutant loading on the pond, which could also be protecting the in-pond water quality.

A second aspect of the David Street pond which could be improved is the effectiveness of the pond itself as a water quality treatment system. It currently has relatively deep water and limited macrophyte coverage. Greater macrophyte coverage would improve its ability to remove fine, colloidal and dissolved pollutants, including nutrients. Due to its offline location which protects it from high flows, it could easily be converted to a wetland, however this would change its landscape character.

A third aspect which could be modified at David Street to improve the treatment performance is the extended detention. The riser outlet has been designed with a relatively large opening (a 100 mm slot) and therefore allows only short residence times within the pond. Longer detention times allow more time for physical, chemical and biological pollutant removal pathways to be effective.

Figure 3: Water flowing out the riser outlet at approximately the same rate that it enters the pond (after cleaning the trash rack on 16 November 2014)

Key causal factors and constraints

The key factor which has led to the limited performance of the David Street pond is a poor diversion design. The water depth, dominance of open water and lack of macrophytes reflect best practice in stormwater treatment system design at the time.

This system could be modified relatively easily to improve its performance, however the following key constraints will need to be accommodated:

- Levels of major structures
- Existing vegetation including established trees
- Value of the existing landscape

Potential improvement options

The following options are recommended for further consideration and analysis at David Street (in approximate priority order in terms of their ability to improve the stormwater treatment performance):

1. Re-design the diversion to function as originally intended
2. Increase the notional detention time by re-designing the riser outlet

3. Establish a more extensive macrophyte zone to convert the pond to a wetland. Reduce the water depth (probably by a combination of raising bed levels and lowering the normal water level within the pond). Consider incorporating an ephemeral zone.

4. Retain a sediment pond upstream of the macrophyte zone

5. Add a maintenance drain to facilitate both desilting of the sediment pond and maintenance of the macrophyte zone (including both establishment and long-term maintenance)

References

Sullivans Creek Catchment Group (SCCG) 2000 “Sullivans Creek Catchment Management Plan for Public Comment”, prepared by Jennie Gilles, May 2000.

Sullivans Creek Catchment Group (SCCG) 2001 “Constructed Urban Wetland Block 6 Section 88 & Blocks 1 & 3 Section 39 O’connor Preliminary Assessment” May 2001

Asset 12: Dickson Pond

General information

Description

Pond located offline beside a tributary of Sullivans Creek (Dickson Channel) between Dutton Street and Hawdown Street, Dickson. Low flows are diverted from the channel through the pond.

The pond was conceived by the Sullivans Creek Catchment Group and built as part of the Inner North stormwater harvesting scheme with grant funding.

Asset type	Pond	**Asset context**	Retrofit
Year built	2011	**Year of handover to TAMS**	2012
Catchment area	670 ha	**Catchment type**	280 ha rural and 390 ha urban; 17% total impervious
Normal water level (NWL)	582.7 m AHD	**Top of extended detention**	583.45 m AHD (0.75 m depth)
Surface area at NWL	10,840 m^2	**Open water approx. %**	95%
Volume at NWL	14,374 m^3	**Volume at top of extended detention**	23,900 m^3
Average depth at NWL	1.33 m	**Maximum depth at NWL**	2.0 m
Construction cost	$3,641,000	**Cost per sqm**	$336
Inlet/s	Diversion from Dickson Channel in 5m width open channel	**Outlet/s**	Riser orifice plate with overflow weir at top of extended detention. 5 x 1200 mm RCPs returning to channel
Expected performance	28.1% reduction in total suspended solids; 22.2% reduction in total phosphorus; 12.1% reduction in total nitrogen	**Source**	URS Final Sketch Plan Report, 2010

Information reviewed to date

Information	Requested	Received	Reviewed
Design reports		✓	✓
Design drawings		✓	✓

Site inspections

Site inspections have been undertaken on the following dates:

- 6 April 2012 – dry weather
- 16 July 2014 – dry weather
- 16 November 2014 – wet weather

Design objectives

The Dickson pond was originally conceived by the Sullivans Creek Catchment Group, whose goals were broadly focused on the restoration of Sullivans Creek. The vision of the Sullivans Creek Catchment Group (SCCG 2000) was “An involved community creating and maintaining a healthy catchment where Sullivans Creek flows clear through native vegetation and wetlands, providing joy and inspiration for ourselves and future generations”.

The SCCG’s objectives for the wetlands were (SCCG 2000):

- improving and providing variety to the landscape character along the creek and its watercourses;
- improving water quality;
- increasing biodiversity;
- enhancing the visual and recreational values of the creek corridor;
- reducing peak flows; and
- increasing public awareness and community education regarding the environmental, economic and social value of Sullivans Creek.

According to the DA Report for Dickson pond (Purdon Associates 2010), the project had the following objectives:

- Improve water quality
- Regulate peak stormwater flows
- Create habitat and improve biodiversity
- Improve amenity for local communities
- The project is also aiming to harvest stormwater to substitute potable water used for irrigation of playing fields and other Broadacre uses.

Quantitative water quality performance was estimated in the URS Final Sketch Plan Report (2010) as:

- 28.1% reduction in total suspended solids;
- 22.2% reduction in total phosphorus;
- 12.1% reduction in total nitrogen

We understand that this is based on the pollutant removal within the pond itself, excluding any impact of the stormwater harvesting scheme.

We have classified this system as a pond due to the water depth and proportion of open water in the system. The Dickson pond has a very small size for its catchment (approximately 0.3% of the urban catchment area) but is located offline where it is protected from most high flows. Upstream there are no other treatment systems within the catchment, however downstream is the Lyneham pond.

Performance issues

Considering the multiple objectives at the Dickson pond, it is performing well against some of those objectives:

- Media reports indicate that it is seen as a community asset and valued for its habitat and biodiversity, landscape and aesthetic objectives
- There has been significant community involvement in the site including planting days, school visits and community education sessions
- Interpretive signage at the site helps raise wider community awareness
- TAMS report that it is generally low maintenance and we understand that the GPT has been easy to maintain at this site

In terms of in-pond water quality, there has been very little monitoring undertaken to date (one Waterwatch sample) but there have been no known water quality issues in the pond.

In terms of the pond's performance as a water quality treatment and flow attenuation system, this has never been measured, however our site observations indicate that there are some significant limitations. The key performance issue at Dickson is the performance of the diversion structure from the stormwater channel. The diversion structure has the following key limitations:

- The trash rack easily becomes almost 100% blocked. Each time we have visited the site it has been almost fully blocked. Figure 1 shows the trash rack on 16 November 2014 immediately after a rain event. Despite a high water level behind the trash rack and ongoing flows down the stormwater channel, almost no flows are getting through into the wetland.
- When the trash rack is blocked, water bypasses the wetland over the bypass weir before overtopping the trash rack. Figure 2 shows flows overtopping the bypass weir at the same time that the trash rack was blocked in Figure 1.

The Final Sketch Report (URS 2010) indicated that the design flow intended to be diverted into the system was 8-10 m^3/s, equivalent to the 1 in 3 month ARI, however our observations indicate that the actual diversion flowrate in most events would be well below this, due to blockage of the trash rack. It appears that blockage may not have been factored into the design calculations. Design drawings indicate that:

- The trash rack extends between 582.85 and 583.80 m AHD
- The bypass weir has a level of 583.45 m AHD, 0.35 m below the top of the trash rack and the same level as the top of extended detention

Figure 1: Blocked trash rack letting very little flow into the Dickson Pond on 16 November 2014

Figure 2: Flows overtopping the bypass weir on 16 November 2014

The ineffective diversion and small quantities of stormwater actually diverted into the pond would be significantly reducing its performance in terms of both water quality treatment and flow attenuation. In addition, the lack of flows through the pond could potentially exacerbate conditions conducive to algal blooms, by leading to long residence times within the pond. However the small stormwater inflows would also be limiting the pollutant loading on the pond, which could also be protecting the in-pond water quality.

A second aspect of the Dickson pond which could be improved is the effectiveness of the pond itself as a water quality treatment system. It currently has relatively deep water and limited macrophyte coverage. It is unclear why it was designed this way. Interestingly the Preliminary Sketch Plans (URS 2009) showed a macrophyte bench in the centre of the wetland, however the final designs include macrophytes only around the edges.

Greater macrophyte coverage would improve the system's ability to remove fine, colloidal and dissolved pollutants, including nutrients. Due to its offline location which protects it from high flows, it could easily be converted to a wetland, however this would change its landscape character.

Key causal factors and constraints

The key factor which has led to the limited performance of the Dickson pond is a poor diversion design. The water depth, dominance of open water and lack of macrophytes are a second key limitation, however this is an intentional feature of the system's design.

This system could be modified relatively easily to improve its performance, however the following key constraints will need to be accommodated:

- Levels of major structures
- Existing vegetation
- Value of the existing landscape

Potential improvement options

The following options are recommended for further consideration and analysis at Dickson (in approximate priority order in terms of their ability to improve the stormwater treatment performance):

1. Re-design the diversion to function as originally intended
2. Establish a more extensive macrophyte zone to convert the pond to a wetland. Reduce the water depth (probably by raising bed levels within the pond). Consider incorporating an ephemeral zone.
3. Retain a sediment pond upstream of the macrophyte zone
4. Modify the maintenance drain to facilitate both desilting of the sediment pond and maintenance of the macrophyte zone (including both establishment and long-term maintenance)

Option 1 could be implemented relatively easily in the short-term. Options 2-4 could be left until significant sediment has accumulated in the pond some time in the future, and a re-design could obviate the need for costly sediment removal and disposal.

References

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