Framework for the Integration of Flood and Stormwater Management into Open Space

Version 1.1 August 2011

waterbydesign

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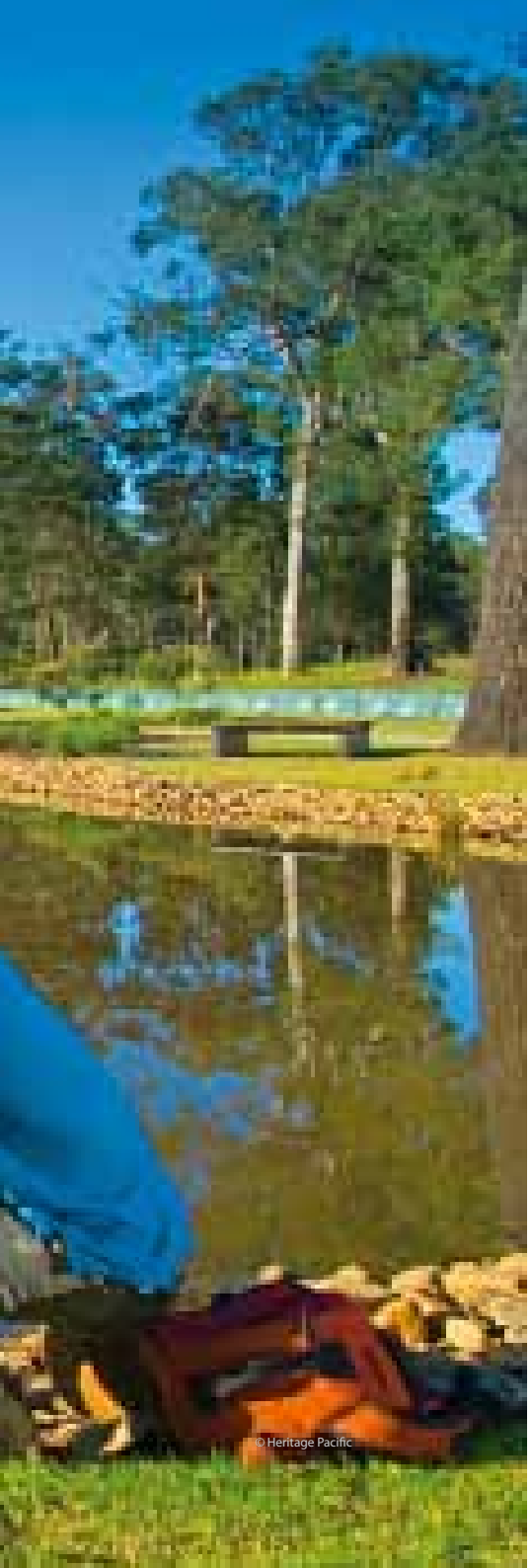
“Public open space provides a variety of opportunities to incorporate water sensitive urban design”



1.0 Introduction

The Framework for the Integration of Flooding and Stormwater Management into Open Space details best practice approaches for integrating water sensitive urban design (WSUD) elements into multiple use open spaces.

Water Sensitive Urban Design (WSUD) is the preferred approach for mitigating the impacts of urbanisation on the natural water cycle and to reconnect communities to the landscape and the management of local water. Best practice stormwater water management objectives are set out in the South East Queensland Regional Plan 2009–2031 Implementation Guideline No. 7: Water Sensitive Urban Design and the State Planning Policy 4/10 Healthy Waters. To comply with these objectives, land is needed to accommodate the treatment measures. In an urban development, the physical integration of WSUD systems into the surrounding landscape competes for space with additional lots, roads, pathways, service corridors, environmental reserves, open space and flood management.

Public open space provides a variety of opportunities to incorporate water sensitive water design which have been explored and developed within the discussion paper Multiple Uses of Open Spaces.

This discussion paper explores the issues and opportunities associated with the integration of WSUD into multiple-use open spaces. Focusing on the tension arising from competing demand for land uses in South East Queensland, a review of current research was undertaken within the context of the existing regulatory framework.

Policy Context

The framework is based on that discussion paper and responds to the following policies of the SEQ Regional Plan 2009 - 2031:

Compact Development

Policy 8.1 Conserve land by making the most efficient use of land allocated to urban development.

Urban Greenspace

Policy 8.4.2: Ensure urban community greenspace is integrated into the urban structure of development areas to provide for land use efficiencies and long-term sustainability.

Policy 8.4.6 Identify new standards of service based on quality of experience, functions, diversity of settings, and connectivity of urban greenspace networks.

Total Water Cycle Management

Policy 11.1.1 Incorporate total watercycle management and water sensitive urban design principles in land use and infrastructure planning.

Policy 11.1.2 Ensure that planning and management of urban stormwater complies with the design objectives as set out in the SEQ Regional Plan 2009 – 2031 Implementation Guideline No. 7: Water Sensitive Urban Design.

2.0 Objectives of Public Open Space & Water Sensitive Urban Design

2.1 Design principles for public open space

Open space corridors serve multiple functions. Therefore, they must be carefully planned and designed to generate the best net benefit to the community and to the natural environment. Contemporary design principles for public open space include:

- being meaningful to place and community
- being multi-functional and adaptable
- being connected to desirable routes and other nodes
- providing diversity
- encouraging social interaction
- promoting health and wellbeing
- providing equity and accessibility
- embodying environmental sustainability (e.g. waterwise)
- providing connectivity within strategic open space network.

2.2 Types of public open space

There are different types of open space, each with different purposes and needs. This paper confines the discussion to public open space — that is, open space in public ownership and accessible to many. Public open space is commonly separated into four categories: active public open space, passive public open space, conservation public open space, or operational public open space. These are defined in Table 1.

Table 1: Types of Public Open Space

Type of public open space	Definition	Characterised by
Active public open space	Primarily designed for users to participate in physical and social activity. It has a focus on activation of the body.	Sporting fields, playgrounds, dog exercise areas, sports courts and practice walls, wide, high-use walking and cycling tracks, large clusters of picnic and BBQ shelters, sport playing amenities including ablutions and lighting
Passive public open space	Primarily designed for its natural or created amenity and views. It has a focus on activation of the senses such as the mind and the eyes. It can also allow for social gathering and interaction.	Gardens (whether exotic or natural), viewscapes, informal lawn areas, narrow informal walking and cycling tracks, small-scale seating and picnic facilities
Conservation public open space	Primarily natural areas with conservation values (not designed).	Natural, largely unmodified bushland areas
Operational public open space	Primarily retained for infrastructure purposes. It is often viewed as wasteland, without regard for other open space attributes. There are few opportunities for shared uses.	Land under power line easements, buffers to adjacent land uses, constructed drainage lines such as concrete-lined channels

2.3 Common objectives

Table 2 outlines the generally accepted objectives for public open space, WSUD and flood protection. Comparing the objectives helps define areas of common interest. These are defined in Table 1.

Table 2: Objectives of public open space, WSUD, and flood protection

	Public Open Space	Water Sensitive Urban Design Objectives	Flood Protection (Sub-Objectives of WSUD)
amenity	Provide amenity for the community	Improve amenity through appearance of water infrastructure and the aesthetics of better water quality	Improve amenity
connectivity	Provide active and recreational opportunities	Retain waterway connectivity	Protect people, property and infrastructure
	Provide transport connectivity	Provide improved waterway ecology	Save costs by protecting people, property, and infrastructure
environment	Provide environmental protection and enhancement opportunities	Protect property and infrastructure	Minimise costs
safety	Provide public safety	Minimise costs	
costs	Minimise costs through effective design		

3.0 Discussion

This section discusses the issues and opportunities associated with integrating WSUD into public open space.

3.1 Community Amenity

'Amenity' is both the usability of an area for community purposes and the level of enjoyment the community gets from the aesthetics and other qualities of the public open space. A number of the case studies described in Section 4 are perceived as having high levels of community amenity, with both an emphasis on design and aesthetics and useable community facilities.

Public open space must be able to be used for its intended community purposes. For example, active recreation areas subject to inundation must be able to recover quickly, particularly if the area is used for sporting fixtures.

Designing places for people to gather and socialise is beneficial for community activation. Interpretative signage and educational material can contribute to community amenity as well as community stewardship.

Effective public open space must be designed to incorporate aesthetics. Good aesthetic experiences can result from formal designs (sculptural elements, boardwalks) as well as more natural features (wetlands, revegetation areas).

Effective inclusion of WSUD in public open space requires careful design to meet community amenity expectations.

3.2 Connectivity

Waterways provide obvious connectivity through the landscape, and WSUD elements are often required to be placed adjacent to, or near, waterways. Through good design, public open space can connect with associated WSUD elements through pathways, boardwalks and interpretive elements. For WSUD elements to be considered for credit, it is important that this connectivity be provided so that the WSUD forms a meaningful part of the open space experience.

It is worth noting that some of the most well connected public open spaces in our cities are located along waterways and are subject to frequent inundation.

3.3 Environmental Management

WSUD can contribute to the environmental attributes of public open space via:

- improved water quality
- biodiversity benefits from using vegetated stormwater management measures
- reduced potable water consumption for irrigation through passive irrigation and/or stormwater harvesting.

These WSUD outcomes can be integrated into the public open space design so that the overall parkland experience, as well environmental qualities, are improved.

3.4 Safety and Risk Assessment

The speed, velocity and depth of inundation of public open space, particularly when the area is used for active recreation, are legitimate concerns. For safety, public open space should be designed to allow for the public to safely and easily exit an area before it becomes dangerously inundated.

However, weather conditions that inundate WSUD (rain) also discourage the use of public open space, reducing the risk at the outset.

There is a disparity between the inundation standards applied to engineered roads and the standards applied to public open space. Typical Council design standards are for access streets to be at least flood-free in a 2 yr ARI storm event, but many Councils require public parklands to remain flood-free in the 100 yr ARI storm event. Many consider this requirement to be

illogical, since in a 10 yr ARI storm event, whilst the park wouldn't be inundated, it would typically be too wet to utilise and the roads to the parkland would be impassable.

A recent and concerning trend for WSUD infrastructure is the use of steep walls and safety fences to be space-efficient and 'safe'. For public open space, this approach may present safety concerns if users trespass onto WSUD infrastructure areas becoming trapped during a sudden inundation due to high walls and fences. Using shallower devices with free access to all sides, which are also more aesthetically pleasing, is one way of ameliorating this concern.

The ongoing maintenance and structural integrity issues associated with engineered infrastructure is also an issue. Devices with stable, shallow batters reduce the risk of structural failure.

Careful design is also required for areas with permanently ponded water to ensure edges are shallow, well planted or fenced to discourage access.

Crime prevention through environmental design (CPTED) is also an issue for WSUD infrastructure. Traditional stormwater devices are concealed, whereas the inclusion of WSUD infrastructure as part of open space demands casual surveillance from neighbouring residents and users. Using WSUD as part of the open space experience also emphasises the importance of aesthetics in the design of WSUD infrastructure.

3.5 Life cycle and Maintenance costs

Combining WSUD and public open space into a single area can reduce the amount of land in public ownership, and therefore, reduce maintenance requirements. Rather than requiring duplication of land for both WSUD and public open space, their integration is efficient from a maintenance perspective.

An emerging trend of concern is the squeezing of stormwater treatment measures into the smallest possible footprint via the use of steep walls (and safety fences) as mentioned in section 3.4. Such systems often require intensive and difficult maintenance, and very high replacement costs. These solutions are often a direct result of developers attempting to minimise the impact of land-take for stormwater management on development yield. This is often referred to as the 'WSUD squeeze'. Preliminary assessments of the value of land being used for stormwater management range between $135,000 and $255,000 per hectare (the range is large because of the large number of factors). Nevertheless, it may be possible to achieve a win-win scenario by allowing WSUD in public open spaces, which reduces the squeeze. However, in return, it is suggested that half the monetary value saved could be required to be reinvested as a contribution for enhanced maintenance, or to achieve higher standards for the design of public open spaces, which also provides a community benefit.

Local authorities often have separate budgets and separately assigned maintenance responsibilities for WSUD and public open space — usually the parks departments maintain open spaces and while the engineering or works departments maintain WSUD assets. These departments typically have different objectives. For example, engineering objectives such as efficiency are often at odds with park objectives such as quality of experience. Successfully integrating WSUD into public open space requires integrated or aligned departmental objectives.

The inclusion of community groups in managing public open space areas can assist local governments with active maintenance and improvement, and create a sense of stewardship, which helps to deter vandalism and damage.

4.0 Framework: Multiple Use Public Open Space for WSUD

4.2 Proposed Framework

A proposed framework has been developed detailing key factors and parameters that should be considered when integrating flood and stormwater management into public open space.

This framework is presented pictorially in the following pages to assist with interpreting the framework and detailed criteria are provided in subsequent tables.

- A high standard of open space design and construction is required;
- The engineering design standards for public open space have been setup as either:
  - Acceptable solution: i.e. if these criteria are adopted no further evidence of compliance is required;
  - Meets Criteria: i.e. evidence (by calculations, drawings or otherwise) that criteria are met is required to be submitted to achieve compliance;
  - Point at which Risk Assessment is required: i.e a formal risk assessment, generally in accordance with Australian Standards, is to be undertaken to demonstrate that the adopted design criteria are satisfactory and do not introduce unsafe or non-functional outcomes
- Constructed Works must be completed generally in accordance with the agreed and approved designs

Active Public Open Space

Primarily designed for users to participate in physical and social activity. It has a focus on activation of the body.

Passive Public Open Space

Primarily designed for its natural or created amenity and views. It has a focus on activation of the senses such as the mind and the eyes. It can also allow for social gathering and interaction.

Image supplied by PLACE Design Group

Conservation Public Open Space

Primarily natural areas with conservation values (not designed).

Operational Public Open Space

Primarily retained for infrastructure purposes. It is often viewed as wasteland, without regard for other open space attributes. There are few opportunities for shared uses.


5
8
9
1
3
7
4

Multiple Use Public Open Space - Normal (Dry) Conditions

Illustration annotations refer to Framework Tables of suggested Performance Criteria - 4.2.1, 4.2.2,4.2.3, & 4.2.4 - following this section.

Performance

In normal conditions, this suggested parkland demonstrates integrated uses: Passive, Active and Conservation Spaces, with a constructed wetland, and stormwater treatment train including swales, and sediment traps, and some bio-retention.

Areas of activity are suggested as orientating towards the central water feature / stormwater system wetland; or are directly intended for use as part of stormwater management in specific events as detention areas. This dry state scenario should be the predominant state of the parkland, specifically returning to a similar level of function following storm events, as will be described in the next two scenarios.

Annotations

1. Constructed Wetland - standing water at maximum depth of 40cm
2. Inlet channel with maximum water velocity of 0.3m/sec in Passive Open Space (Conservation). Dry in normal conditions
3. Maximum batter is 1 in 6 at this Passive Open Space area
4. Maximum batter is 1 in 10 at this Active Open Space area
5. Inlets/ Outlets and grate openings are to be no more than 10cm around activity areas
6. General use area free of inundation for storm event occurrences up to 1 year ARI
7. Path free of inundation for storm event occurrences up two 5 year ARI
8. Formal activity areas need to be designed to Australian standards
9. Passive open spaces need to emphasise the aesthetic and opportunities for social interaction (water + picnic shelter)
10. Conservation areas to remain in most natural state without impact from inundation or excessive stormwater engineering

Image supplied by PLACE Design Group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6
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4

Multiple Use Public Open Space - Minor Storm Event

Illustration annotations refer to Framework Tables of suggested Performance Criteria - 4.2.1, 4.2.2, 4.2.3, & 4.2.4 - following this section.

Performance

In a minor event, the public open space and integrated stormwater management should manage overflow and minor inundation. WSUD features in this suggested system include a naturalised grass channel for conveying overflow of the sedimentation phase of the wetland system. Detention is also a considered design feature to protect downstream systems and lands.

This suggested criteria should return the intentionally inundated parts of public open space quickly to a functioning state.

Annotations

1. Wetland must demonstrate performance and undergo risk assessment if rain events raise water levels beyond 40cm.
2. Water velocities (inlet channel or grass swale) must undergo risk assessment if water velocity will exceed 1m/sec
3. General use area potential for inundation for events 1 year ARI and quick draining (<30mins) else risk assessment is required.
4. Path free of inundation for event occurrences up to 5 year ARI
5. This formal activity area has been designed to perform a detention function, and must drain in 30mins for consideration under the framework.
6. Playground area and picnic shelter should be inundation free in this event to protect people and structural elements from damage.

Image supplied by PLACE Design Group


4
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1

Multiple Public Open Space - Major Storm Event

Illustration annotations refer to Framework Tables of suggested Performance Criteria - 4.2.1, 4.2.2, 4.2.3, & 4.2.4 - following this section.

Performance

A major storm event will impact significantly on public open space and with integrated stormwater elements the risk is increased.

For creditable public open space, stormwater elements are proposed to follow WSUD principles, and further these must demonstrate appropriate performance beyond acceptable standards, and must undergo risk assessment according to the likelihood of peak storm events.

Inundated areas should be quick draining and reusable within a short period after rain ceasing.

Annotations

1. Wetland must demonstrate performance and undergo risk assessment if rain events raise water levels beyond 40cm.
2. Water velocities (inlet channel or grass swale) must undergo risk assessment if water velocity will exceed 1m/sec
3. Paths exposed to risk of inundation must be trafficable within 24 hours and to achieve should be designed with min 2% slope and sub soil drainage.
4. Any areas should be quick draining. Where formal activity areas, drainage must occur in 30 mins.
5. Playground area and picnic shelter should be inundation free in this event to protect people and structural elements from damage.

Image supplied by PLACE Design Group

4.2.1 Framework for Active Public Open Space

Item	Performance criteria for including WSUD elements in creditable public open space	Acceptable solution	Meets criteria	Point at which risk assessment is required
General: Areas used for WSUD and active public open space must: • be fit-for-purpose in size, slope and surface for the active recreation uses • be sufficiently safe for the speed, depth and velocity of any inundation • have rapid inundation recovery, particularly for playing surfaces.				
Engineering standards				
1	Water velocity (m/sec)	Nil	1	> 1
2a	Maximum water depth (m) in Major Storms (except in permanent pools)	0.1	0.4	> 0.4
2b	Maximum water depth (m) in Major Storms (except in permanent pools)	0.4	1.2	>1.2
3	Depth by velocity (m2/sec)	0	0.4	> 0.4
4	Minimum time from rain onset to water shows in the normally dry open space (mins)	n/a	15	>15
5	Minimum time from water starting to inundate normally dry areas until water reaches maximum depth (mins)	n/a	30	> 30
6	Time from maximum water depth to being trafficable by pedestrians and vehicles (hrs).	Min slope > 2%, with substantial sub-soil drainage provided	24	Max is 24
7	Maximum batter slopes anywhere (vertical:horizontal)	1:10	1:6	Steeper than 1:6
8	Ratio of max. water area to catchment area (water area:catchment area)	> 0.25	n/a	n/a
9	Inundation only occurs in general use areas for an ARI greater than (yrs)	1	1	Less than 1 yr ARI
10	Inundation only occurs in connecting pathways for an ARI greater than (yrs)	5	5	Less than 5 yr ARI
11	Inlets and outlets, grate openings maximum dimension (m)	0.1	0.1	> 0.1
12	Fencing, barriers or walls preventing access and egress	None	None or undertake a risk assessment	None or undertake a risk assessment
Landscape design standards				
13	Area is designed allow for active recreation. Examples include: • formal playfields field or courts • areas that allow informal active recreation such as playing with balls or Frisbees • pathways that provide opportunities for walking and cycling.	For formal playing fields and courts meet standard Australian criteria for dimensions, thresholds and gradient.		
		For informal active open space • has a slope less than 5% gradient, • minimum area of 600 m2 not intruded by at- or aboveground services or trees • minimum width of 20 m.		
		For pathways: • the route is placed to follow desire lines and link obvious nodes • they are constructed to a standard for pedestrian and cyclist movement.		
		Design is to be consistent with CPTED, as well as having a planned maintenance regime.		

4.2.2 Framework for Passive Public Open Space

Item	Performance criteria for inclusion of WSUD elements in creditable public open space	Acceptable solution	Meets criteria	Point at which risk assessment is required
	General: Areas used for WSUD and passive public open space must: • be designed to be attractive and allow for social interactions and gatherings • be sufficiently safe for the speed, depth and velocity of any inundation.			
	Engineering standards			
1	Water velocity (m/sec)	0.3	1	> 1
2a	Maximum water depth (m) in Minor Storms (except in permanent pools)	0.4	0.4	>0.4
2b	Maximum water depth (m) in Major Storms (except in permanent pools)	0.4	1.2	>1.2
3	Depth by velocity (m2/sec)	0.12	0.4	> 0.4
4	Minimum time from rain onset to water shows in the normally dry open space (mins)	n/a	n/a	n/a
5	Minimum time from water starting to show in the normally dry open space to water reaches a maximum depth (mins)	n/a	n/a	n/a
6	Time from maximum water depth to being trafficable by pedestrians and vehicles (hrs).	n/a	n/a	n/a
7	Maximum batter slopes anywhere (vertical:horizontal)	1:6	1:4	Steeper than 1:4
8	Inundation only occurs in general use areas for an ARI greater than (yrs)	1	1	Less than 1yr ARI
9	Inundation only occurs in connecting pathways for an ARI greater than (yrs)	5	5	Less than 5yr ARI
10	Inlets and outlets, grate openings maximum dimension (m)	0.1	0.1	> 0.1
11	Fencing, barriers or walls preventing access and egress	None	None or do a risk assessment	None or do a risk assessment
	Landscape design standards			
12	Area is designed with an emphasis on aesthetics and opportunities for social interaction. Examples include: • attractive water features that provide a focus • flower and plant gardens • revegetation areas • land art particularly with sculptural forms • amphitheatres or public squares • strolling gardens.	No specific acceptable solution provided. However, it is expected that a landscape architect is involved in the design of the open space to create design aesthetics and a design suitable for social interaction. The design should be consistent with CPTED, as well as having a planned maintenance regime. WSUD is explained with signage that is educational to encourage community knowledge and participation. Spaces are expected to be connected with other nearby open spaces and nodes.		

4.2.3 Framework for Conservation Public Open Space

Item	Performance criteria for inclusion of WSUD elements in creditable public open space	Acceptable solution	Meets criteria	Point at which risk assessment is required
General: Areas used for WSUD and conservation public open space need to protect existing conservation features and values.				
Engineering standards				
1	Water velocity (m/sec)	0.3	1	> 1
2a	Maximum water depth (m) in Minor Storms (except in permanent pools)	0.4	0.4	> 0.4
2b	Maximum water depth (m) in Major Storms (except in permanent pools)	0.4	1.2	>1.2
3	Depth by velocity (m2/sec)	0.12	0.4	> 0.4
4	Minimum time from rain onset to water shows in the normally dry open space (mins)	n/a	n/a	n/a
5	Minimum time from water starting to inundate normally dry areas to water reaches maximum water depth (mins)	n/a	n/a	n/a
6	Time from maximum water depth to being trafficable by pedestrians and vehicles (hrs).	n/a	n/a	n/a
7	Maximum batter slopes anywhere (vertical:horizontal)	1:6	1:4	Steeper than 1:4
8	Inundation only occurs in general use areas for an ARI greater than (yrs)	1	1	Less than 1yr ARI
9	Inundation only occurs in connecting pathways for an ARI greater than (yrs)	5	5	Less than 5yr ARI
10	Inlets and outlets, grate openings maximum dimension (m)	0.1	0.1	> 0.1
11	Fencing, barriers or walls preventing access and egress	None	None or do a risk assessment	None or do a risk assessment
Landscape design standards				
12	Area is retained in its natural state for conservation purposes, for example retained bushland and wetlands. Area is retained in its natural state free from intrusion by services and infrastructure. Inundation does not impact environmental values. Works in the area are limited to conservation works to retain or enhance conservation values.	Area is retained in its natural state free from intrusion by services and infrastructure. Inundation does not impact environmental values. Works in the area are limited to conservation works to retain or enhance conservation values.		

4.2.4 Framework for Operational Public Open Space

Item	Performance criteria for inclusion of WSUD elements in creditable public open space	Acceptable solution	Meets criteria	Point at which risk assessment is required
General: Operational public open spaces are areas used solely for drainage or other infrastructure and do not form creditable public open space. Examples: • rock or concrete-lined channels • headwall or inlet structures • areas under overhead power line easements. However, areas used for WSUD and operational public open space must be safe for the speed, depth and velocity of any inundation.				
Engineering standards				
1	Water velocity (m/sec)	0.3	1	> 1
2a	Maximum water depth (m) (except in permanent pools)	0.4	0.4	> 0.4
2b	Maximum water depth (m) in Major Storms (except in permanent pools)	0.4	1.2	>1.2
3	Depth by velocity (m2/sec)	0.12	0.4	> 0.4
4	Minimum time from rain onset to water shows in normally dry the open space (mins)	n/a	n/a	n/a
5	Minimum time from water starts to inundate normally dry areas to water reaching maximum depth (mins)	n/a	n/a	n/a
6	Time from maximum water depth to being trafficable by pedestrians and vehicles (hrs).	Min slope > 2%, with substantial sub-soil drainage provided	12	Max is 12
7	Maximum batter slopes anywhere (Vertical:horizontal)	1:6	1:4	Steeper than 1:4
8	Inundation only occurs in general use areas for an ARI greater than (yrs)	5	Assess nature of operations and demonstrate appropriate access is available	
9	Inundation only occurs in connecting pathways for an ARI greater than (yrs)	n/a	n/a	n/a
10	Inlets and outlets, grate openings maximum dimension (m)	0.1	0.1	> 0.1
11	Fencing, barriers or walls preventing access and egress	None	None or do a risk assessment	None or do a risk assessment
Landscape design standards				
12	Nil.	Nil Not creditable public open space		

4.3 Implementing the Framework

The framework in section 4.2 shows the complex interrelationship between design standards and approaches to achieve acceptable outcomes for integrating WSUD within public open space. Successful implementation requires considered planning provisions and an integrated design approach across multiple disciplines, taking into account the maintenance onus for end-asset owners.

Effective implementation of the framework requires:

- recognition of the desire for multiple uses of public open space and WSUD areas as part of state planning legislation and policies
- consistent provisions within local government planning schemes that provide credit for WSUD as public open space when design requirements are met
- an integrated design process that includes regulators, engineers, landscape architects and open space planners and end-asset owners and maintainers.
- The framework will require an investment of time and money from local government to achieve better-integrated processes. In addition developers will be required to work with design and consultancy teams.

4.3 Taking the Framework Forward

The framework and related discussion paper was developed to further the debate about the interrelationship between public open space, WSUD and flood protection.

Further comment on this framework is welcomed.

Bibliography

Australian Institute of Landscape Architects 2008/9, Queensland Sites and Projects Bellvista Estate - Stages 3 and 4, viewed 27 July 2009 <http://www.aila.org.au/projects/qld/EDAW-bellvista/default.htm>.

Brisbane City Council 2003, Know Your Creek Kedron Brook V8, Brisbane, viewed 26 June 2009 < http://www.brisbane.qld.gov.au/bccwr/environment/documents/know_your_creek_kedron_brook_2008.pdf>.

Hamlyn-Harris D 2004, Sunnybank Grove (Devine Homes), presentation notes Stormwater Industry Association Awards, Bligh Tanner, Brisbane.

Landcom 2009, Water Sensitive Urban Design Book 2 Planning and Management, Melbourne, viewed 23 July 2009, <http://www.landcom.com.au/downloads/uploaded/WSUD_Book2_PlanningandManagement_0409_1a73.pdf>.

Landcom 2009, Water Sensitive Urban Design Book 3 Case Studies, Melbourne, viewed 23 July 2009, <http://www.landcom.com.au/downloads/uploaded/WSUD_Book3_CaseStudies_0409_3da4.pdf>.

Landcom 2007, The Water Cycle Victoria Park - Sustainable Water Challenge Projects and Other WSUD Case Studies, fact sheet, Water Sensitive Urban Design in the Sydney Region from the Sydney Metropolitan Catchment Management Authority, viewed 31 July 2009 <http://www.wsud.org/downloads/Case%20Studies/Vic%20Park%20(Landcom)%20WaterCycle.pdf>.

Land Systems EBC Pty Ltd 1993, Better Drainage: Guidelines for the Multiple Use of Drainage Systems, New South Wales Government, Department of Planning, New South Wales.

Leinster S, and O'Neill A 2009, The "Credit Crunch" WSUD in parks, presentation notes, Workshop for Water by Design, undertaken on 10 June 2009.

Regional Urban IWCM Program 2006, Water Sensitive Urban Design Demonstration Site Fact Sheet: Wahgunyah Road, Nelson Bay, case study fact sheet, Urban Water Info, viewed 02 June 2009 <http://www.urbanwater.info/engineering/WSUD%20Fact%20Sheet%20-Wahgunyah%20Road.pdf>.

South East Queensland Healthy Waterways Partnership 2009, Concept Design Guidelines for Water Sensitive Urban Design Version 1, Brisbane, viewed 06 June 2009, <http://www.waterbydesign.com.au/conceptguide>.

Thompson, S 2008, Design for Open Space, fact sheet, Your Development Project, CSIRO and the Australian Department of the Environment, Water, Heritage, and the Arts, viewed 22 June 2009 <http://yourdevelopment.org/factsheet/view/id/72>.

Weirick J 2004, 'Watering Sydney', Architecture Australia, vol.93, no. 1, viewed 23 July 2009 <http://www.archmedia.com.au/aa/aaissue.php?issueid=200401&article=12&typeon=2>.

2008 Victoria Park, Sydney, fact sheet, Your Development Project, CSIRO and the Australian Department of the Environment, Water, Heritage, and the Arts, viewed 23 July 2009 <http://yourdevelopment.org//view/id/89>.