

Article

Place-Making through Water Sensitive Urban Design

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Received: 28 August 2009 / Accepted: 25 September 2009 / Published: 30 September 2009

Abstract: The paper aims to develop a practice and evaluation model for public open spaces in residential areas that considers water sensitive urban design techniques contributing to place-making.

Keywords: water sensitive urban design; place-making; public open spaces

1. Introduction

Water sensitive urban design was originally a component of a policy initiative concerning water demand management [1]. However, based on an understanding that the natural environment forms an important part of sense of place, water sensitive urban design has evolved into a planning response to the natural environment of the Swan Coastal Plain [1].

The current driving force regarding water sensitive urban design techniques is their ability to contribute to water conservation. By incorporating water sensitive urban design initiatives into residential areas including streets, public open spaces and other facets of the urban environment, water sensitive urban design can contribute to place-making, a sense of place and local identity.

‘Sense of Place’, which is the objective for any place-making exercise is essential for community well being by generating feelings of security, safety, sense of pride and ownership [2]. Place-making is concerned with not only the physical elements of a place that give it the functional value, but how those elements create an atmosphere by enhancing the ‘sense of place’ (psychological value). Thus the combination of addressing physical/functional and psychological needs of the users is critical to creating an attractive place. In this sense water sensitive urban design techniques or initiatives need to contribute to the physical structure and as such create an appropriate atmosphere.

As a result of the physical structure, the level of human activity can indicate the success of place-making; however, human activity can also contribute to the creation of atmosphere and as such can be an important element in a place.

This paper will investigate residential public open spaces and the way in which water sensitive urban design techniques have enhanced their sense of place for the community.

2. Questions

We address the question: *How can place-making be achieved through the use of water sensitive urban design techniques?*

In order to appropriately discuss key aspects of the stated question and develop criteria for assessing the degree of place-making evident in public open spaces, a review of current literature and an exploration of case studies were carried out with regards to the water sensitive initiatives adopted, the maintenance required, social use and spatial impact. A practice model was developed against which the two case studies were evaluated.

3. The Notion of Water Sensitive Urban Design

The literature on water sensitive urban design varies considerably. However, the two common themes that emerge are the physical environment and the social considerations from implementing water sensitive urban design techniques. These two themes will form the basis for discussion.

Mouritz [3] describes water sensitive design as:

...an approach to an ecologically sustainable urban form that is responsive to the regional landscape and environmental resource limitations.

Cities should create an urban form that extends its ecological processes. Stormwater and drainage should be seen as opportunities to enhance the regional and local landscape with waterways that provide recreational and wildlife spaces [3].

Campbell [4] addresses problems regarding water sensitive urban design specifically in relation to public open spaces. Firstly there are issues with the dual use of public open space (POS) for recreation and drainage. According to Campbell [4] this adversely affects the quality of POS in relation to distribution, variety, useability and flexibility of the open space system. Campbell [4] supports this statement with a critique of Western Sydney where the introduction of dual use open space has apparently occurred since the 1970s. Problems arising from this, according to Campbell [4] included:

- *Open space which lacks variety and tends to be monotonous and simplistic;*
- *Inadequate distribution of open space, concentrated along drainage channels;*
- *Lack of consistency (by Local Authorities) in the application of dual use policy;*
- *Reduced useability and flexibility of open space;*
- *Wholesale removal of creek line vegetation; and*
- *Increased maintenance costs.*

Whelans *et al.* [5] however recognise some of these limitations regarding dual use POS, however a greater understanding of careful planning of this dual use space is recognised in comparison to Campbell [4] who simply states a problem. Thus Whelans *et al.* [5] state opportunities regarding dual use POS such as linking private open space with public open space. This in turn creates a landscaped

link between the two spaces [5]. Due to this integration of open space the opportunity to link and share the space for a variety of activities is possible, but as Whelans *et al.* [5] note, networked spaces may be unsuitable for active recreational purposes.

Secondly, Campbell [4] claims there are recreational and social problems associated with networked POS, and according to Manidis Roberts [6] they have previously lacked equitable distribution. Campbell [4] supports this claim with the observation of POS in the form of long narrow strips, which result in reduced recreational opportunities and higher maintenance costs [4]. Notably, these areas can also act as thoroughfares for criminal activity similar to public access ways and thus reduce residential security [4]. Despite these concerns however, Whelans *et al.* [5] and the National Capital Planning Authority [7] recognise the opportunity networked POS presents. While acknowledging the limitations and problems associated with these spaces they should not be perceived as stifling encumbrances but used to recognise that thoughtful planning of these spaces is required. Whelans *et al.* [5] and the National Capital Planning Authority [7] accordingly recognise the networking of POS as contributing to the rationalisation of irrigation requirements, maximising the drainage function of POS, enhancing amenity and reducing pollution.

Thirdly, local governments such as the City of Gosnells have experienced problems with verge swales in the post-subdivision stages [4]. According to Campbell [4] this has been seen whereby some landowners decided to fill in the swales attempting to restore the verge to a traditional appearance. Another example involves builders who have filled in the swale to gain access to the site [4]. These examples however simply highlight practical issues that local government and developers need to address. Access to a site is vital and including a swale prior to construction of a building simply adds to additional on site difficulties and costs. Arguably swales should be implemented upon construction completion.

Integrating residences and public open space is arguably an attractive feature of water sensitive urban design. Importantly as Campbell [4] notes, there are opportunities for anti-social behaviour in secluded public open spaces. However, through thoughtful design and planning, such a technique could create to an attractive urban environment. Thus the design process should consider the function of the space and contribute to designing out crime through techniques such as passive surveillance and space activation through place-making.

Non-continuous residential development can be an effective means of achieving a sense of place or identity within a community. This is achieved whereby the public open space acts as a means of identifying a community. Furthermore it provides a degree of separation and as such diverts from typical and arguably monotonous residential development. As a result residential areas are clustered and public open space serves as a method for linking the residential clusters, thereby ensuring development still conforms to sustainable objectives.

It is entirely possible to decrease the amount of residential infrastructure. This can be achieved with the integration of characteristics such as swales that allow stormwater to infiltrate, rather than capturing the stormwater and directing it to soak wells under the road. This dramatically decreases development costs and the amount of residential infrastructure. It should be noted that residential infrastructure is however required in various circumstances and using techniques such as swales is subject to site conditions.

Providing natural treatment is a critical element in minimising water consumption. According to Edmiston [8] low water gardens provide the opportunity to create attractive spaces by utilising a range of native and exotic species, which require little watering. Edmiston [8] further highlights the importance of using native species that are adapted to the climatic conditions of Western Australia, and as such require less maintenance, watering and have a greater chance of survival. It is important to note the various climatic regions of Western Australia and as such native vegetation should be selected based on the applicable climatic region.

Further to the design characteristics of a water sensitive residential subdivision, a number of authors highlight various specific drainage practices that can be incorporated in development projects (namely residential) in collaboration with the common urban form features mentioned by Hedgcock [1]. Evangelisti [9] notes the general types of stormwater management practices, which include vegetative control (overland flow and grassed channels), detention (wet basins and wetlands) and retention (infiltration basins). It should be noted that these management practices however are the most efficient and cost effective solutions according to Evangelisti [9]. Evangelisti [9] adds that in some cases it may be necessary to combine a number of management techniques to achieve a greater level of stormwater treatment as a number of physical and biological processes can be incorporated.

Vegetative controls can include grassed channels and overland flow. A grassed channels is simply a channel or swale that has a cover of grass to prevent erosion and enhance settling of suspended soil particles [9]. An overland flow is much like a filtration strip whereby strips of grass filter pollutants from the runoff [9]. Importantly it is noted that these vegetative controls are encouraged whenever practical, and are influenced by topography, soils, space and climate [9]. These characteristics are supported by Whelans *et al.* [5] who similarly state the purpose of the vegetative controls is to improve water quality and maintain groundwater recharge.

Wet detention basins are an effective means of controlling stormwater runoff quality according to Evangelisti [9], and they also maintain a permanent pool of water that reduces the peak flow rates of runoff [5]. These basins according to Evangelisti [9] and Whelans *et al.* [5] improve water quality through a number of process that occur at the same time such as biological uptake and physical settling. Importantly these basins should be provided as close as possible to the source [10]. Evangelisti [9] however notes other benefits of wet detention basins such as aesthetical appeal, irrigation potential, and possible recreational opportunities such as fishing or boating if large enough. These characteristics are supported by Whelans *et al.* [5], however it is also suggested that maintaining a permanent pool of water is needed to maintain aesthetic values and minimise possible odours.

Constructed wetlands (also referred to as artificial wetlands) incorporate large quantities of stormwater runoff and associated materials, whether they are dissolved pollutants or suspended products [9]. The treatment or removal of such pollutants however occurs primarily through sediment retention and biological uptake [5,9]. The distinction between constructed wetlands and detention systems according to Evangelisti [9] and Whelans *et al.* [5] includes the slow moving flow within the wetland, the use of vegetation as a method of pollutant removal, and wetlands are also shallower. Importantly according to both Evangelisti [9] and Whelans *et al.* [5], the constructed wetlands are well suited to areas where the water table is close to the surface.

Table 1. Additional water sensitive urban design techniques.

Water Sensitive Urban Design Technique	Description
Dry Detention Basin	Provides temporary storage for stormwater runoff, which is released at a controlled rate. The basins empty completely between storms and as a result are predominately dry, with the exception of during storm events.
Extended Dry Detention Basin	These basins are similar to dry detention basins. Extended dry detention basins however hold water for a longer period of time to improve the pollutant removal capabilities. Importantly, they are not recommended to remove dissolved pollutants.
Parking Lot Storage	This simply directs stormwater runoff into a detention area within the parking area. This can however pose as an inconvenience for users of the parking area. The technique does however have the potential to supplement irrigation water in terms of providing additional water for plants.
Urban Forestry	Preserving existing trees during construction or planting new trees, particularly understorey vegetation after construction.
Stream Rehabilitation	Rehabilitating or restoring a stream system to natural equilibrium. This provides positive results for aquatic life and increases the value of land overlooking the water feature. It can also provide multiple open space functions including recreation.
Turfing	This can prevent erosion and sediment transportation. It also serves to reduce the movement of dust associated with bare soil.
Retention of Existing Vegetation	This can assist in reducing water consumption as it avoids the need for irrigation of new plants. Existing vegetation is also typically adapted to local conditions and as such needs minimal irrigation. Importantly it also provides shelter for new plants and minimises disturbance to fauna.
Xeriscaping	This can reduce water consumption by selecting plants that are adapted to the local conditions and as a result require minimal or no irrigation.
Hydrozones	Water consumption can be reduced by determining irrigation requirements based on aesthetic predominance and the intensity of use of landscaped areas or zones.
Water Harvesting	Replaces irrigation water by utilising rainfall runoff from the built environment.
Regulated Self-Supply	Reduces the consumption of scheme water by using private water supplies such as dams, wells or bores. Care must be given to minimise the risk of overuse of the water source.
Grey Water Re-Use	Reduces water use at an individual lot level by re-using lightly polluted 'grey water'
Windbreaks	Reduces water use by sheltering vegetated areas from prevailing winds that can remove moisture from the soil. It also serves to create a sheltered environment for human enjoyment and can positively influences plant growth.

Adapted from: [5]

An infiltration basin according to Evangelisti [9] is used to temporarily store stormwater runoff, thereby allowing it to infiltrate into the ground. Whelans *et al.* [5] further support Evangelisti [9] by stating that the basins increase groundwater recharge, but importantly add that these basins are designed for selected storm events or runoff volumes. Evangelisti [9] also adds that the infiltration and retention system are an alternative to wet detention basin in the circumstance where there is no opportunity for discharge. This retention and infiltration system is commonly referred to as a sump [5]. Other water sensitive urban design techniques are described in Table 1.

Although Dreiseitl and Dreiseitl [11] similarly highlight such solutions, they mention that integrated design solutions should be effective in achieving the aims of water sensitive urban design. Dreiseitl and Dreiseitl [11] add that water management in building construction or installation is another option.

In conclusion Dreiseitl and Dreiseitl [11] importantly add a unique human element to water sensitive urban design, by stating that water is valuable in sensory terms or impressions. According to Seddon [1] a planning response should be based on an understanding of the fragile natural conditions of the Swan Coastal Plain, as these characteristics have contributed to the sense of place across the Perth Metropolitan Region.

4. Notion of Place-Making

Place-making according to Norberg-Schultz [2] is concerned with space, which is the organisation of physical elements that make up a place. These elements contribute to the creation of an atmosphere, which can be defined as the intangible elements such as human feelings, emotions, or moods [2]. Importantly Norberg-Schultz [2] refers to the combination of atmosphere and space-defining elements as character.

Places also have a function [2], however in some cases a number of functions may be evident. According to Simonds [12] form should ideally following the function of a space. In this sense an object, space, or thing should be designed to achieve the function. The function importantly also extends to atmosphere in terms of feelings or moods [2] and according to Simonds [12] such moods or feeling can be defined as '*tension, relaxation, fright, gaiety, contemplation, dynamic action, sensuous love, sublime spiritual awe, displeasure and pleasure*'. These spatial impacts are detailed in Table 4, which also highlights the characteristics that contribute to the creation of such impacts.

The spatial characteristics are similarly expressed by Lynch [13] who suggests that such techniques are imperative to the structuring and identification of environments. According to Lynch [13] techniques such as visual sensations of colour, shape, motion, polarisation of light and other senses such as smell, sound and touch are important for orientation. In contrast, disorientation can lead to a sense of anxiety [13]. As Thomas and Bromley [14], Hollands [15], Pain [16] and Comedia [17] highlight, people don't participate in places where they don't feel safe, thus, elements such as lighting, passive surveillance, and pedestrian movement are important elements of the physical form.

As Lynch [13] further highlights, the physical setting can play an important social role. In this sense Lynch [13] suggests an environmental image that is distinct and legible can contribute to a sense of emotional security and increase the quality of experience in such a place. It is important to note that environmental image is developed as an observer, mindful of their purpose, select, organise and give meaning to what they see [13].

Thus an environmental image involves identity, structure and meaning according to [13]. However, as Lynch [13] identifies, physical qualities are related to the characteristics of identity and structure in generating a mental image. In this sense Lynch [13] further adds the involvement of imageability, which he defines as:

That quality in a physical object which gives it a high probability of evoking a strong image in any given observer. It is that shape, colour, or arrangement which facilitates the making of vividly identified, powerfully structured, highly useful mental images of the environment. It might also be called legibility, or perhaps visibility in a heightened sense, where objects are not only able to be seen, but are presented sharply and intensely to the senses.

Relph [18] supports the notions identified by Norberg-Schultz [2] as space and character, by similarly suggesting that places encompass human and natural order and also act as centres for immediate human experiences of the world. Importantly place is not simply defined by a location, but it is the focusing of experiences into particular settings [18]. Relph [18] adds that places are full with meanings, real objects and ongoing activities because places are not concepts but direct experiences of the immediate world. In this sense they add to individual and shared identity, which people can often have emotional or psychological connections.

Identity according to Relph [18] is comprised of a mixture of natural and artificial objects, activities, functions and incorporated meaning. However, these are merely the physical elements that contribute to identity but they do not define this identity of a place [18]. As Relph [18] reveals it is the quality and intensity of experience that distinguishes places from space. Importantly it is this combination that can describe the essence of a sense of place.

In relation to the making of places, Rapoport (cited in [18]) defines this as '*the ordering of the world*'. In this sense, place-making distinguishes between the qualitative elements that create a structure to simultaneously reflect and guide experiences [18].

In order to create a variety of places that give rise to orientation and identity there is an assumption according to Nairn (cited in [18]) that suggests each place is different and as such must be developed based on its individual qualities. As a result Nairn (cited in [18]) highlights that seemingly similar circumstances may call for entirely different solutions. In light of this, according to Relph [18] guaranteeing things will be right in places is not possible, however there is the possibility of providing conditions that allow care for places to occur.

According to Hough [19] creating a sense of place involves connections between regional identity and sustainability. As a result the design according to Hough [19] should incorporate ecological values and principles, environmental and social health and the relationship people share with nature. In addition it is important to recognise how people use different places to fulfil their living needs in order to create a distinctive sense of place [19]. Different places for different people or social groups are needed according to Hough [19], as this offers a choice between a number of places.

As Hough [19] adds however, the characteristics of a location can suggest the physical and social elements that contribute to the creation of a place. Thus the natural and social process encompasses how such processes interact with a locality and as such adapting to the living environment, which consequently changes the locality to a unique place [19]. It is therefore evident according to Hough [19] that it is this combined process between the environment and social elements that contribute to regional identity.

5. Practice and Evaluation Model

In order to develop a model that links the capability of water sensitive urban design techniques contributing to place-making, the literature concerning place-making and water sensitive urban design has been examined. From the literature an explanation of various water sensitive urban design techniques has covered the physical condition of such techniques and some of the social considerations. In addition place-making has addressed the physical design characteristics and atmosphere. As a result the model must address:

- Water sensitive urban design techniques and the relevant principles to highlight the purpose of the technique;
- Place-making design characteristics; and
- Place-making spatial impacts.

Whelans *et al.* [5] and Evangelisti [9] have addressed in detail the different water sensitive urban design techniques and the purpose of such techniques including achieving water balance, improving water quality and endeavouring to minimise water consumption. This is detailed in Table 2 below.

Table 2. Water sensitive urban design techniques and related purpose.

Principle	Technique
Water Balance	Swales
	Overland Flow/Filter Strip
	Dry Detention Basin
	Extended Dry Detention Basins
	Wet Detention Basins
	Parking Lot Storage
	Infiltration Retention Basin
	Urban Forestry
Water Quality	Stream Rehabilitation
	Artificial/Constructed Wetland
	Turfing
Water Conservation	Retention of existing infrastructure
	Xeriscaping
	Hydrozones
	Water Harvesting
	Regulated self-supply
	Re-use grey water
	Windbreaks

Adapted from: [5], pp. 25-26.

According to Gold [20] the design and management of spaces should provide convenience, health, safety and pleasure for the users. Gold [20] also adds that the design should achieve energy conservation and reflect concern for people with regard to elements such as passive surveillance and disabled access. Gold [20] importantly highlights social factors in contributing to the success of an urban park, and as such, consideration of characteristics such as territoriality, conflict, comfort, class and lifestyle, will result in a design that achieves a successful space or place.

Gold [20], as a result, has synthesised the community needs and community values into a table. This table highlights the general needs of a community and the specific elements or values that need to be addressed to achieve the community needs. Importantly, the presence or absence of these needs ultimately reflects the success or failure in terms of place-making. As a result, Table 3 is used to address the physical or structural elements in relation to place-making.

Table 3. Structural Place-making design characteristics.

COMMUNITY NEEDS	COMMUNITY VALUES	DESCRIPTION
Health and Safety Needs	<i>Hazards</i>	Environments in which threats from fire, flood, earthquake, unfenced heights and deep water are minimised
	<i>Crime</i>	Protection from criminal activities such as assault, burglary and car theft
	<i>Traffic</i>	Protection from traffic, especially in residential areas with children or elderly people
	<i>Health</i>	Sufficient sun, light, clean air, pure water, sanitation, and garbage control to maintain public health standards
	<i>Exercise</i>	Adequate space and facilities for walking, jogging, cycling, and active sports
Liveability Needs	<i>Space</i>	Adequate space to engage in desired activities
	<i>Quiet</i>	Ambient noise and vibration levels to carry out desired activities such as talking, reading, or relaxing
	<i>Light</i>	Sufficient light for activities such as reading. Avoidance of excessive light or glare where darkness is valued such as residential areas at night
	<i>Climate</i>	Climate controls that protect people from or reduce unacceptable heat, cold, wind, sun, rain, fog or draught
Access Needs	<i>Cycle and pedestrian</i>	Safe and pleasant conditions for cyclists and pedestrians to circulate within and between communities
	<i>Public access</i>	Sufficient public access to valued resources such as lakes, rivers and viewpoints
	<i>Orientation</i>	Visible access or clear signage of important and desired facilities and destinations

Table 3. Cont.

COMMUNITY NEEDS	COMMUNITY VALUES	DESCRIPTION
Identity Needs	<i>Conservation</i>	Environments which are familiar, stable, predictable, where severe disruptions of continuity do not take place, are not threatened, or are managed with full participation
	<i>Territory</i>	Places which people and communities feel “belong” to them, for which they can care and feel responsible, even if they are not owned
	<i>Expression</i>	Environments which and encourage the expression of personal, family, community, or cultural identities
	<i>Mastery</i>	Environments which are responsive, which can be easily changed to accommodate changing needs
	<i>Choice</i>	Individual, family and community freedom to express particular desires or to explore alternative lifestyles
	<i>Privacy</i>	Protection from intruding eyes, noise and distracting events for desired activities, personal, family and community life
Aesthetic and Symbolic Needs	<i>Attractiveness</i>	Environments which are pleasurable and inviting to the senses such as sight, sound smell and touch
	<i>Imageability</i>	Environments which are unique, vital, vivid and distinctive
	<i>Purity</i>	Environments which are ordered, simple structured, clean and well-maintained
	<i>Natural character</i>	Environments related to nature by natural materials, open air, vegetation and views
	<i>Sense of place and history</i>	Environments which have a strong sense of identity, whose history is significant and evident
Community Needs	<i>Resource conservation</i>	Conservation of natural, energy and atmospheric resources
	<i>Economy</i>	Low capital-costs for easily maintained and durable environments

Adapted from: [20], pp. 293-294.

As mentioned in the place-making section, the physical elements of a space contribute to the creation of an atmosphere [2]. Simonds [12] investigates various spatial impacts, and defines the spatial characteristics that contribute to the creation of such impacts, feelings, or moods. As the spatial characteristics are rather lengthy, only the spatial impacts are shown in Table 4. However, the relevant spatial characteristics are defined in the case studies.

From these three tables an initial model is developed that assesses the place-making capabilities of water sensitive urban design techniques. This initial model is then applied to the case study sites to develop an initial assessment of the degree of place-making evident from the water sensitive urban design techniques. The initial model is shown below, followed by the assessment of Ascot Waters and Bridgewater National Lifestyle Village.

Table 4. Place-making spatial impacts.

Tension
Relaxation
Fright
Gaiety
Contemplation
Dynamic action
Sensuous love
Sublime spiritual awe
Displeasure
Pleasure

Adapted from: [12], pp. 137-139.

6. Initial Model

Table 5. Initial Model.

WATER SENSITIVE URBAN DESIGN		PLACE-MAKING ELEMENTS					
Principle	Technique	Health and Safety Needs	Liveability Needs	Access Needs	Identity Needs	Aesthetic and Symbolic Needs	Community Needs
Water Balance	Swales						
	Overland Flow/Filter Strip						
	Dry Detention Basin						
	Extended Dry Detention Basins						
	Wet Detention Basins						
	Parking Lot Storage						
	Infiltration Retention Basin						
	Urban Forestry						

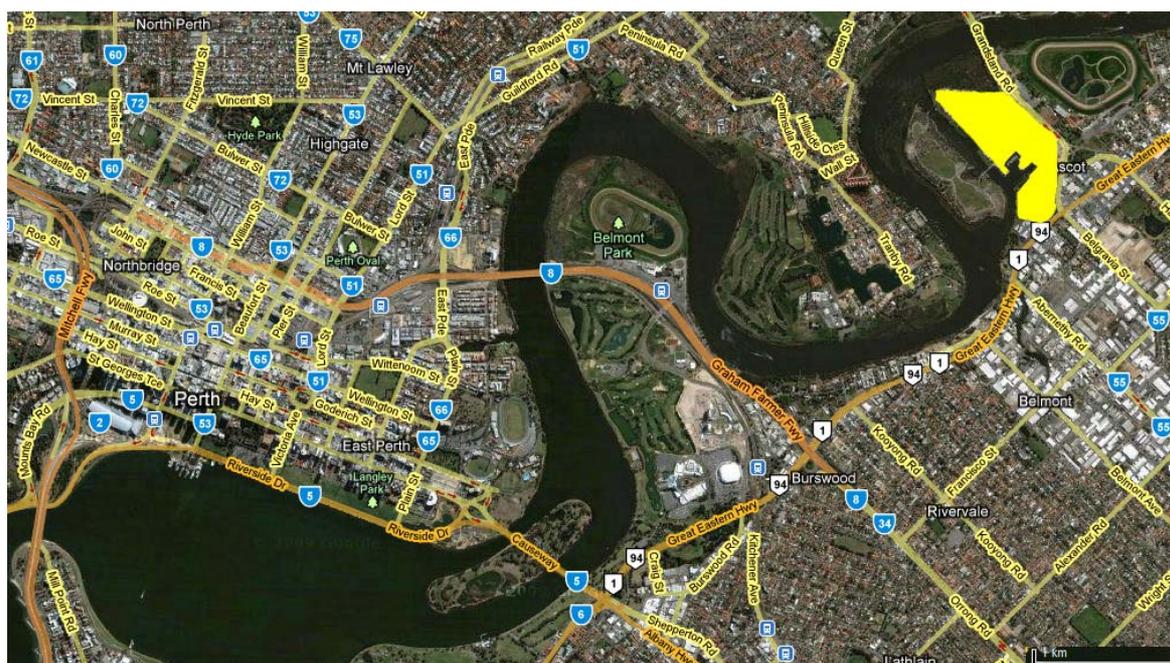
Table 5. Cont.

Principle	Technique	Health and Safety Needs	Liveability Needs	Access Needs	Identity Needs	Aesthetic and Symbolic Needs	Community Needs
Water Quality	Stream Rehabilitation						
	Artificial/Constructed Wetland						
	Turfing						
Water Conservation	Retention of existing infrastructure						
	Xeriscaping						
	Hydrozones						
	Water Harvesting						
	Regulated self-supply						
	Re-use grey water						
	Windbreaks						

7. Case Study One: Ascot Waters

Ascot Waters, as shown in Figure 1, is located approximately 5 km east-northeast of the Perth Central Business District (CBD).

Figure 1. Aerial photo highlighting Ascot Waters in relation to Perth.



The areas that were analysed included the constructed wetlands and Belmont creek (living stream) located at the southern portion of the site, the freshwater irrigation lake located south of Waterway Crescent and a linear park between Lakewood Avenue and Sedgeland Way. These areas are highlighted in Figure 2. At this stage of the discussion it should be mentioned that both case studies utilise qualitative observations.

Figure 2. Aerial view of Ascot Waters highlighting the subject areas.



The maintenance required for the subject site involves the dual use paths, the stormwater system, and watering and mowing of the grassed areas. As irrigation is provided from the freshwater lake careful monitoring is required to ensure the water does not become too saline. The purpose of the constructed wetlands is to remove pollutants in stormwater through sediment retention and utilising vegetation as a biological uptake, thus removing runoff nutrients. As a result stormwater is effectively treated before entering the Belmont creek, from which it then enters the Swan River. The linear public open space incorporates swales as a design feature, along with detention basins and urban forestry. The detention basin serves as a stormwater treatment infiltration device during major and extreme storm events. Importantly it also acts as a small-scale amphitheatre for community purposes. Accessibility to the various areas is provided for transport modes including cars, cyclists and pedestrians. The major uses that occur in the spaces include walking, cycling, relaxing and socialising.

Overall the design elements observed in the public open space areas, along with the spatial impact are detailed in the tables below. It should be noted, an answer of “yes” is a good outcome, and means the provision has been achieved based on the description in Table 3. An answer of “no” means the provision has not been achieved, and an answer of “partly” means the provision has only been achieved to a small degree.

Table 6. Place-making design elements.

Community Needs	Community Values	Overall Provision
Health and Safety Needs	<i>Hazards</i>	Yes
	<i>Crime</i>	Generally yes
	<i>Traffic</i>	Yes
	<i>Health</i>	Yes
	<i>Exercise</i>	Generally partly
Liveability Needs	<i>Space</i>	Generally partly
	<i>Quiet</i>	Yes
	<i>Light</i>	Yes
	<i>Climate</i>	Partly
Access Needs	<i>Cycle and pedestrian</i>	Generally yes
	<i>Public access</i>	Yes
	<i>Orientation</i>	Yes
Identity Needs	<i>Conservation</i>	Generally partly
	<i>Territory</i>	Partly
	<i>Expression</i>	Partly
	<i>Mastery</i>	Generally no
	<i>Choice</i>	Partly
	<i>Privacy</i>	Generally partly
Aesthetic and Symbolic Needs	<i>Attractiveness</i>	Yes
	<i>Imageability</i>	Yes
	<i>Purity</i>	Yes
	<i>Natural character</i>	Yes
	<i>Sense of place and history</i>	Yes
Community Needs	<i>Resource conservation</i>	Yes
	<i>Economy</i>	Generally yes

Table 7. Spatial impacts.

Spatial Impact	Spatial Characteristics Evident
Relaxation	Simplicity
	Fitness
	Flowing lines
	Curvilinear forms and spaces
	Soft light
	Soothing sound
Gaiety	Free spaces
	Smooth, flowing forms and patterns
	Sparkling, shimmering, shooting or glowing light

Table 7. Cont.

Spatial Impact	Spatial Characteristics Evident
Contemplation	Total space mild and unpretentious
	Space providing a sense of isolation, privacy, detachment, security, and peace
	Soft, diffused light
Pleasure	Spaces, forms, textures, colours, symbols, sounds, light quality, and odours all suited to the use
	A resultant quality of beauty

The constructed wetland system contributes very successfully to the creation of an attractive public open space. The paths throughout the area and the car park enhance accessibility throughout the site by accommodating various transport methods, and as such, facilitate active and passive recreational pursuits. While walking and cycling were common activities for people living and working close by, some people specifically drove to this area, and while some stayed in their car, others drove there to eat lunch, walk with a partner or colleague, walk the dog, or came to play with friends or family. The freshwater irrigation lake and linear park are also uniquely identifiable places within Ascot Waters, yet these places are used primarily by residents in the area, as opposed to the area with the constructed wetlands. This is most likely due to the location of the places, as the area with the constructed wetlands is easily accessible for people in the surrounding areas. Ascot Waters has undoubtedly created a degree of local identity, and as such, a sense of place and community.

Figure 3. From left to right, the constructed wetland, freshwater irrigation lake, and the linear park.



8. Case Study Two: Bridgewater National Lifestyle Village

Bridgewater National Lifestyle Village is located in Erskine, approximately 79 km south of the Perth CBD. The major area that was analysed encompassed the main entry area. The streetscape of the village was also examined. While the streetscape was applicable to the entire village and presented common features, the main entry analysis area is highlighted in Figure 5.

The main water sensitive urban design feature utilised throughout the site are swales. The maintenance issues regarding this element are concerned with irrigation and stormwater. Importantly swales are used to recharge nearby water bodies and also use considerably less infrastructure in comparison to traditional engineering solutions, and as such minimise ongoing costs due to lack of road soak wells that require annual cleaning.

Figure 4. Aerial photo highlighting Bridgewater National Lifestyle Village in relation to Mandurah.

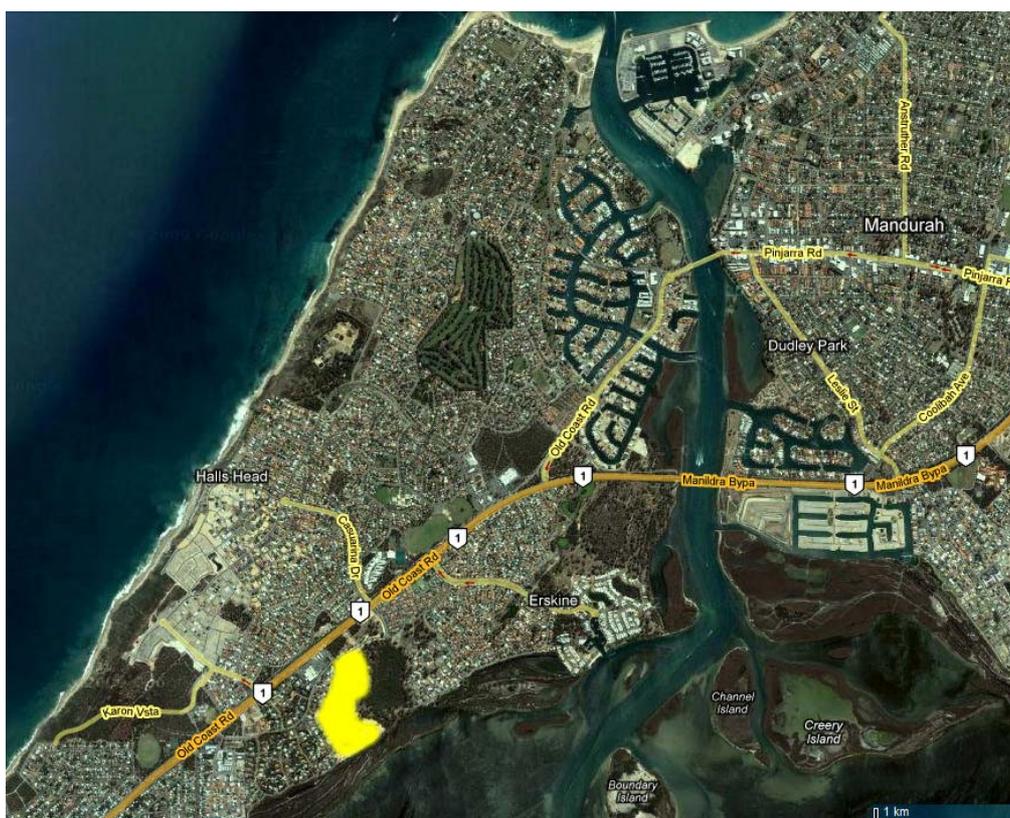


Figure 5. Map of Bridgewater National Lifestyle Village highlighting the entry analysis area.



Swales are integrated into the site along with landscaping utilising native Australian species, which are appropriate in order to achieve water conservation. These swales also use a filtering material and coarse mulch to filter out nutrients, sediment and pollutants. Road soak wells have been successfully replaced by the swales in this instance, and also serve to create a sense of place and local identity. With regard to social usage, residents walk along the path through the entry statement area to access

the shopping centre. However, Bridgewater differs from Ascot Waters in that social activity is more organised or formalised. For example people utilise the facilities of the clubrooms and participate in activities such as bowls and tennis. The design elements observed in the entry area and streetscape, along with the spatial impact are detailed in the tables below.

Table 8. Place-making design elements.

Community Needs	Community Values	Provided
Health and Safety Needs	<i>Hazards</i>	Yes
	<i>Crime</i>	No
	<i>Traffic</i>	Yes
	<i>Health</i>	Partly
	<i>Exercise</i>	Yes
Liveability Needs	<i>Space</i>	Yes
	<i>Quiet</i>	Yes
	<i>Light</i>	Yes
	<i>Climate</i>	Partly
Access Needs	<i>Cycle and pedestrian</i>	Partly
	<i>Public access</i>	Partly
	<i>Orientation</i>	Yes
Identity Needs	<i>Conservation</i>	Yes
	<i>Territory</i>	Yes
	<i>Expression</i>	Partly
	<i>Mastery</i>	No
	<i>Choice</i>	Partly
	<i>Privacy</i>	Partly
Aesthetic and Symbolic Needs	<i>Attractiveness</i>	Yes
	<i>Imageability</i>	Yes
	<i>Purity</i>	Yes
	<i>Natural character</i>	Yes
	<i>Sense of place and history</i>	Yes
Community Needs	<i>Resource conservation</i>	Yes
	<i>Economy</i>	Yes

The main entry area and the streetscape contributed very effectively to the structural elements of place-making, as every element was incorporated. With regard to the spatial impact, generally positive characteristics such as relaxation, contemplation, and pleasure were evident; however, tension was also evident. The main entry area and the streetscape were aesthetically appealing, yet the degree of local identity is less successful than Ascot Waters. This is most likely due to the way in which the water sensitive urban design elements are incorporated. While Bridgewater National Lifestyle Village is very subtle, Ascot Waters displays the features in a rather dominant manner, with the exception of techniques in the linear park. Regardless of this, there is still a degree of local identity. The sense of

community however is much higher, as residents are typically retirees. Given this demographic and the nature of the village, residents interact with each other on a far more regular basis, in comparison to Ascot Waters, and this interaction contributes to the high level of sense of community. The contribution of water sensitive urban design elements to local identity and sense of place is more of a dominant element for visitors.

Table 9. Spatial impacts.

Spatial Impact	Spatial Characteristics Evident
Relaxation	Simplicity
	Fitness
	Flowing lines
	Curvilinear forms and spaces
	Soft light
	Soothing sound
Contemplation	Total space mild and unpretentious
	Space providing a sense of isolation, privacy, detachment, security, and peace
	Soft, diffused light
Pleasure	Spaces, forms, textures, colours, symbols, sounds, light quality, and odours all suited to the use
	A resultant quality of beauty
Tension	Harsh, blinding, or quavering light

9. Feedback from Professionals

Following the case study analysis, interviews were conducted with the leaders involved in these projects. This served to investigate the purpose of water sensitive urban design initiatives incorporated into the subject sites. The interviews also explored the elements of water sensitive urban design that contribute to the pattern of urban development, place making, the applicability of a range of initiatives and the multi-use possibilities of public open space. In addition, interview with staff from the Water Corporation, WA aimed to provide an objective overview of the abovementioned investigation into water sensitive urban design and place making in public open space. Two interviews were undertaken with leaders of the two projects and one interview with the Director of Water Corporation. People for interviews were selected based on their knowledge of the projects and expertise in the area of water sensitive urban design.

A general consensus shared between industry professionals was the view that water sensitive urban design elements are site specific. In addition, it was noted that there was the need for a holistic approach to the provision of public open space and drainage. These two areas need to be considered together, rather than providing public open spaces and then fitting a drainage function into the public open space. The success of the public open spaces, however, also depends on the provision of passive surveillance in order to provide users with a sense of safety, and a distinction between the public and private domain to additionally offer privacy and security.

Due to the unique nature of water sensitive urban design elements, the techniques contribute to providing a sense of place and identity. As a result they can add value to an area, and in some cases reduce predevelopment costs and future maintenance costs.

As a result of feedback and further critique, a practice model has been finalised and is presented below. With regard to the abbreviations, WB, WQ and WC respectively stand for Water Balance, Water Quality and Water Conservation.

Table 10. Practice Model.

Water Sensitive Urban Design		Place-Making							
Principle	Technique	Health and Safety Needs	Liveability Needs	Access Needs	Identity Needs	Aesthetic and Symbolic Needs	Community & Environmental Needs	System Needs	Spatial Impact
WB, WQ, WC	Swales	✓			✓	✓	✓	✓	✓
WB, WQ, WC	Living Stream	✓			✓	✓	✓	✓	✓
WB, WQ, WC	Stream Rehabilitation	✓	✓			✓	✓	✓	✓
WB	Dry Compensation Basin				✓	✓	✓	✓	✓
WB, WQ	Extended Dry Compensation Basins				✓	✓	✓	✓	✓
WB, WQ	Wet Compensation Basins		✓			✓	✓	✓	✓
WQ, WB	Constructed Wetland	✓				✓	✓	✓	✓
WQ, WB	Natural Wetland	✓				✓	✓	✓	✓
WQ	Turfing	✓	✓			✓		✓	✓
WB, WQ	Urban Forestry		✓			✓	✓		✓
WC	Retention of Existing Vegetation		✓			✓	✓		✓
WC	Xeriscaping		✓			✓	✓		✓
WB, WQ, WC	Permeable Surfaces					✓	✓	✓	
WB, WQ, WC	Infiltration Retention Basin/Sump					✓	✓	✓	
WC	Hydrozones					✓	✓	✓	

Table 10. Cont.

Principle	Technique	Health and Safety Needs	Liveability Needs	Access Needs	Identity Needs	Aesthetic and Symbolic Needs	Community & Environmental Needs	System Needs	Spatial Impact
WC	Stormwater Re-use					✓	✓	✓	
WC	Regulated Self-Supply		✓			✓	✓		
WC	Windbreaks		✓				✓		✓
WC	Water Harvesting						✓	✓	
WC, WQ	Grey Water Re-use				✓		✓		

10. Conclusions

The aim of the research was to bridge the gap between place-making and water sensitive urban design in terms of highlighting how water sensitive urban design can contribute to place-making. As the case studies highlighted, water sensitive urban design techniques contribute to the physical structure of a place and importantly they also contribute to the creation of an appropriate atmosphere. These two aspects of place-making are effectively incorporated into the practice model and as such individual water sensitive urban design techniques are individually analysed to determine the precise place-making elements they contribute to and if they assist in the creation of an atmosphere. In addition, as the model shows not all water sensitive urban design elements contribute to creating an atmosphere, however they do contribute to various physical design elements of place-making. The water sensitive urban design techniques and their success in contributing to place-making are ranked in Table 9. It should be noted that none of the techniques contributed to access needs.

The determining factor regarding the success of individual water sensitive urban design techniques in contributing to place-making, was the purpose of the technique. Techniques including swales, living streams, compensation basins, stream rehabilitation, natural and constructed wetlands and turfing, have a number of purposes such as drainage, stormwater runoff treatment, adding aesthetic quality and even wildlife enhancement. As a result, by their nature and through thoughtful design, these techniques contribute effectively to both structural and spatial place-making elements.

Table 11. Ranking the success of water sensitive urban design techniques in contributing to place-making.

Score – number of contributions to Place-Making	Technique	
6	Swales	
6	Living Stream	
6	Stream Rehabilitation	
5	Dry Compensation Basin	
5	Wet Compensation Basin	
5	Constructed Wetland	
5	Natural Wetland	
5	Turfing	
4	Extended Dry Compensation Basin	
4	Urban Forestry	
4	Retention of Existing Vegetation	
4	Xeriscaping	
3	Permeable Surfaces	
3	Infiltration Retention Basin/Sump	
3	Regulated Self-Supply	
3	Stormwater Re-Use	
3	Hydrozones	
3	Windbreaks	
2	Grey water Re-Use	
2	Water Harvesting	

Score	Score Meaning	Colour Rank
7	Very High	
6	High	
5	Medium-High	
4	Medium	
3	Medium-Low	
2	Low	
1	Very Low	

The remainder of the techniques generally have a single purpose, which in most cases relates to water conservation. Consequently, techniques including permeable surfaces, sumps, urban forestry, retention of existing vegetation, xeriscaping, water harvesting, stormwater re-use, grey water re-use and windbreaks contribute to fewer place-making elements. However, elements such as urban forestry, retention of existing vegetation, xeriscaping and windbreaks, are important elements in contributing to a positive spatial impact or atmosphere. In addition, the techniques that scored high were designed to achieve primarily system needs. The other elements of place-making that the water sensitive urban design techniques contributed to were arguably secondary functions. The secondary functions, however, are just as critical as this has led to contributing very successfully to place-making.

Furthermore, the techniques that contributed to spatial impact were ranked medium and above. Contribution to this element of place-making generally highlights the highly successful nature of many of the techniques in contributing to place-making in terms of both physical structure and spatial impact, or atmosphere.

Turfing proved to be a unique technique in the sense that it scored medium-high in achieving place-making; however, it was the only technique that did not contribute to community and environmental

needs. This was due to maintenance issues such as irrigation, which conflicts with the purpose of water conservation. It does, however, permit infiltration and in this sense it does contribute to the conservation of natural resources by recharging the groundwater. It is also an important element for other techniques such as grassed swales and compensation basins for example, and as such, it is a valuable technique when contributing to other water sensitive urban design techniques. On a large scale, however, it does not contribute to community and environmental needs. As Bridgewater National Lifestyle Village revealed, grassed swales can be substituted with vegetated swales. It is important to note, that in some instances vegetation needs to be monitored to ensure that it does not become too dense and as such minimise water movement. Therefore, turfing is important to facilitate other water sensitive urban design techniques; however, when used in singularity it does not contribute successfully to community and environmental needs. Regardless of this, turfing is a technique that contributes to successful place-making.

The remaining water sensitive urban design techniques and their contribution to place-making are synthesised in Table 11. This table enables the techniques to be compared to other techniques and reveals the relevant elements of place-making, both physical and spatial. This effectively highlights the strengths of each technique.

Table 12. Water sensitive urban design techniques and contribution to place-making.

TECHNIQUE: SWALES AND LIVING STREAMS	
Health and Safety Needs	Environment in which threats from flooding are minimised.
Liveability Needs	
Identity Needs	Environments that are familiar, stable, predictable, where severe disruptions of continuity do not take place, are not threatened, or are managed with full participation. Places which people and communities feel “belong” to them, for which they can care and feel responsible, even if they are not owned.
Aesthetic and Symbolic Needs	Environments are pleasurable and inviting to the senses such as sight. Environments are unique, vital and distinctive. Environments that are ordered, simple structured, clean and well maintained. Environments relate to nature by natural materials, open air, vegetation and views. Environments have a strong sense of identity
Community Needs	Conservation of natural resources. Low costs for easily maintained and durable environments
System needs	Water balance, water quality and water conservation
Spatial Impact	Relaxation, gaiety and pleasure.
TECHNIQUE: STREAM REHABILITATION	
Health and Safety Needs	Threats from deep water minimised through gradual slope.
Liveability Needs	Ambient noise to carry out desired activities
Identity Needs	
Aesthetic and Symbolic Needs	Environments are pleasurable and inviting to the senses such as sight and sound. Environments are unique, vital and distinctive. Environments relate to nature by vegetation.
Community Needs	Conservation of natural resources.
System needs	Water balance, water quality and water conservation
Spatial Impact	Relaxation, gaiety, contemplation and pleasure
TECHNIQUE: DRY COMPENSATION BASIN	

Table 12. Cont.

Health and Safety Needs	
Liveability Needs	
Identity Needs	Environments that are familiar, stable, predictable, where severe disruptions of continuity do not take place, are not threatened, or are managed with full participation. Individual, family or community freedom to express particular desires.
Aesthetic and Symbolic Needs	Environments are unique, vital and distinctive. Environments are simple structured, clean and well maintained Environments relate to nature by natural materials and vegetation. Environments have a strong sense of identity.
Community Needs	Conservation of natural resources.
System needs	Water balance
Spatial Impact	Relaxation, gaiety, and pleasure
TECHNIQUE: EXTENDED DRY COMPENSATION BASIN	
Health and Safety Needs	
Liveability Needs	
Identity Needs	
Aesthetic and Symbolic Needs	Environments are unique, vital and distinctive. Environments are simple structured, clean and well maintained. Environments relate to nature by natural materials and vegetation. Environments
Community Needs	Conservation of natural resources.
System needs	Water balance
Spatial Impact	Relaxation, gaiety, and pleasure
TECHNIQUE: WET COMPENSATION BASIN	
Health and Safety Needs	
Liveability Needs	Adequate space to engage in desired activities.
Identity Needs	
Aesthetic and Symbolic Needs	Environments are unique, vital and distinctive. Environments are simple structured, clean and well maintained. Environments have a strong sense of identity.
Community Needs	Conservation of natural resources.
System needs	Water balance and water quality
Spatial Impact	Relaxation, gaiety, and pleasure
TECHNIQUE: NATURAL WETLAND AND CONSTRUCTED WETLAND	
Health and Safety Needs	Threats from deep water minimised through gradual slope.
Liveability Needs	
Identity Needs	
Aesthetic and Symbolic Needs	Environments are pleasurable and inviting to the senses such as sight. Environments are unique, vital and distinctive. Environments relate to nature by vegetation. Environments have a strong sense of identity.
Community Needs	Conservation of natural resources.
System needs	Water balance and water quality
Spatial Impact	Relaxation, gaiety, contemplation and pleasure
TECHNIQUE: URBAN FORESTRY AND RETENTION OF EXISTING VEGETATION	
Health and Safety Needs	

Table 12. Cont.

Liveability Needs	Sufficient light for activities. Shade provided. Climate control by reducing the effects of heat, wind, sun and rain.
Identity Needs	
Aesthetic and Symbolic Needs	Environments are pleasurable and inviting to the senses such as sight. Environments are unique, vital and distinctive. Environments relate to nature by vegetation. Environments have a strong sense of identity.
Community Needs	Conservation of natural resources.
System needs	Water balance and water quality
Spatial Impact	Relaxation and pleasure
TECHNIQUE: XERISCAPING	
Health and Safety Needs	
Liveability Needs	Climate control by reducing the effects of heat, wind, sun and rain.
Identity Needs	
Aesthetic and Symbolic Needs	Environments are pleasurable and inviting to the senses such as sight. Environments are unique, vital and distinctive. Environments relate to nature by vegetation. Environments have a strong sense of identity.
Community Needs	Low capital-costs for easily maintained and durable environments.
System needs	Water conservation
Spatial Impact	Relaxation and pleasure
TECHNIQUE: PERMEABLE SURFACES AND STORM WATER RE-USE	
Health and Safety Needs	
Liveability Needs	
Identity Needs	
Aesthetic and Symbolic Needs	Environments are pleasurable and inviting to the senses such as sight. Environments are unique, vital and distinctive Environments relate to nature by vegetation. Environments have a strong sense of identity.
Community Needs	Low capital-costs for easily maintained and durable environments. Conservation of natural resources.
System needs	Water balance, water quality and water conservation
Spatial Impact	Relaxation and pleasure
TECHNIQUE: SUMP (INFILTRATION RETENTION BASIN) AND HYDROZONES	
Health and Safety Needs	
Liveability Needs	
Identity Needs	
Aesthetic and Symbolic Needs	Environments are pleasurable and inviting to the senses such as sight. Environments are unique, vital and distinctive. Environments relate to nature by vegetation. Environments have a strong sense of identity.
Community Needs	Low capital-costs for easily maintained and durable environments. Conservation of natural resources.
System needs	Water balance, water quality and water conservation
Spatial Impact	Relaxation and pleasure
TECHNIQUE: REGULATED SELF-SUPPLY	
Health and Safety Needs	Threats from deep water minimised through gradual slope.
Liveability Needs	
Identity Needs	

Table 12. Cont.

Aesthetic and Symbolic Needs	Environments are pleasurable and inviting to the senses such as sight. Environments are unique, vital and distinctive. Environments relate to nature by vegetation. Environments have a strong sense of identity.
Community Needs	Conservation of natural resources.
System needs	Water conservation
Spatial Impact	
TECHNIQUE: WIND BREAKS	
Health and Safety Needs	
Liveability Needs	Climate control by reducing the effects of heat, wind, sun and rain.
Identity Needs	
Aesthetic and Symbolic Needs	
Community Needs	Conservation of natural resources.
System needs	Water conservation
Spatial Impact	Relaxation and pleasure
TECHNIQUE: GREY WATER RE-USE	
Health and Safety Needs	
Liveability Needs	
Identity Needs	Environments that are familiar, stable, predictable, where severe disruptions of continuity do not take place, are not threatened, or are managed with full participation
Aesthetic and Symbolic Needs	
Community Needs	Conservation of natural resources. Low capital-costs for easily maintained and durable environments
System needs	Water conservation and water quality
Spatial Impact	

From all of the water sensitive urban design techniques, they generally achieved aesthetic and symbolic needs and community and environmental needs. As a result the variable elements of place-making were health and safety needs, liveability needs, identity needs, system needs and spatial impact.

It was evident at Ascot Waters that the water sensitive urban design techniques contributed to, or enhanced, the sense of place. This was evident due to the high degree of usage by residents and people travelling to the area from other suburbs. Bridgewater National Lifestyle Village, however, created this sense of place at the entry area, ultimately symbolising the transition into the village, and as such, created a distinction from the surrounding areas.

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