

## **A vision for conservation and public enjoyment of the Greater Brixton Street Wetlands and an eventual Yule Brook Regional Park**

**This document is a Statement of The Beeliar Group – Professors for Environmental Responsibility.** It presents and argues in more detail themes introduced in the Group's 2017 Statement *The Greater Brixton Street Wetlands/Bush Forever 387: Causes for concern related to the Maddington-Kenwick Strategic Employment Area*, and presents its vision for a Yule Brook Regional Park based on the Greater Brixton Street Wetlands, and Yule Brook and its floodplain. It argues the case for a beneficial coexistence of the Maddington Kenwick Strategic Employment Area (MKSEA) with the globally-unique natural values of the Yule Brook Regional Park, provided that basic principles of conservation of the adjoining natural environments are followed in the MKSEA development.

## The vision at a glance

Creating industrial estates, like the proposed Maddington-Kenwick Strategic Employment Area (MKSEA), that minimise environmental impacts on adjacent or included high conservation value ecosystems may seem challenging. However, by undertaking simple, best-practice measures in water sensitive design, setbacks and ecologically sensitive fire prevention, not only can it be done, but it can also provide important benefits to the industrial area and its workers while protecting high biodiversity assets and legally-protected threatened ecological communities.

The MKSEA is set in wetland terrain, which puts significant constraints on and presents challenges to the development of an industrial area. The MKSEA also surrounds about 60% of the Greater Brixton Street Wetlands (GBSW): the most 'biodiverse', 'representative' and 'irreplaceable' Bush Forever Area of the Swan Coastal Plain. In an area of less than about 130ha, the GBSW includes globally significant biodiversity and the following national and state-recognised conservation values:

- 10 Threatened Flora Species, most of which are listed under the Commonwealth EPBC (Environment Protection and Biodiversity Conservation) Act, including three that are endemic to the GBSW. Another Threatened Flora Species listed under the EPBC Act also occurs nearby in the MKSEA footprint;
- 27 Priority Flora Species listed by the WA Department of Biodiversity, Conservation and Attractions (DBCA);
- Three Threatened Fauna Species listed under the EPBC Act;
- Four Threatened Ecological Communities (TECs) listed under the EPBC Act, including the critically endangered '*Claypans of the Swan Coastal Plain*'.

At least 550 different types (taxa) of native plants have been recorded in the GBSW.

Protecting the outstanding natural values of the GBSW while creating a highly productive industrial park requires a best-practice approach to the MKSEA design. Such a design should integrate the following *from the outset*.

### **1. Environmentally and economically sustainable water management in a best-practice Water Sensitive Urban Design (WSUD) for the industrial estate and its surrounds.**

The following are necessary.

- First, revision of the existing drainage system of the GBSW and the proposed MKSEA using contemporary methods so that it mimics the hydrological regime of the area that existed before its present rural subdivision and the installation of a 'pit, pipe and drain' system for Kenwick and Wattle Grove, and thereby restores the ecological connectivity and environmental water requirements of all the Conservation Category Wetlands (CCW) and Resource Enhancement Wetlands (REW) in the GBSW and the MKSEA. As part of this process, all watercourses in the MKSEA and GBSW should be restored to Living Streams.
- Second, the additional water management challenges posed by the proposed more intensive (industrial) development of the MKSEA should be met by the retention or restoration of native vegetation and existing trees, pervious surfaces, natural landforms and drainage features in the MKSEA; and other best-practice WSUD measures.

### **2. Buffer zones at least 100 metres wide reserved around all CCW, TECs, Threatened Flora and Bush Forever Areas as separation zones that effectively mitigate threats**

Identified threats posed by the MKSEA to these precious environments include: altered hydrology; decreased water quality, including salinity; increased urban heat island effect; proliferation and spread of weeds and pathogens; increased risk of wild fire and the direct loss and degradation of trees and other native vegetation due to potentially inappropriate fire hazard reduction measures;

increased risk of native-fauna road kills; and fragmentation and direct loss of native fauna and flora habitats and populations (especially threatened avifauna and threatened flora).

### **3. Bush fire protection measures that protect both the natural and the built environments.**

The MKSEA is located in a defined, bushfire prone area and has had two Bushfire Hazard Level Assessments. Despite some important differences between the two reports, they concluded that almost all of the native vegetation in the GBSW and in the MKSEA (apart from the grazed or mowed paddocks in the MKSEA) posed a 'Moderate' or 'Extreme' Bushfire Hazard to many of the proposed industrial lots of the MKSEA. However, there has been no assessment of the fire or fire-management hazard that the MKSEA poses to the very important natural values and ecological processes of the GBSW, the MKSEA and Yule Brook, which runs beside or through these areas.

The MKSEA Local Structure Plans must consider the requirements of the bushfire protection criteria, to ensure that appropriate Hazard Separation Zones and Asset Protection Zones can be established at a subsequent planning stage. Specifically, the issues that the relevant WA fire authorities consider should be addressed in all Structure Plans that are yet to be finalised for *any* MKSEA Precinct include:

- biodiversity issues and their interrelationships with bushfire prone areas; and
- means for accommodating biodiversity objectives and protecting areas with high conservation values by way of adequate separation of development from existing or proposed buffers for wetlands and foreshores.

While these issues have not yet been taken into consideration, it is likely that they will require higher levels of *built-in* fire protection in new industrial premises than has so far been envisaged.

### **4. Road planning that ensures wetland connectivity and respects buffer zones.**

The retrofit of the existing drainage system to WSUD standards and the restoration of the ecological connectivity of the wetlands and key populations of Threatened Flora Species populations with each other and with Yule Brook that existed before the rural subdivision of Kenwick and Wattle Grove will require sensitive planning of new and upgraded roads for the MKSEA. It will also require the closure of parts of existing roads where they already interfere with natural hydrology and fragment the natural connections of the GBSW with Yule Brook.

### **5. Planning for a Yule Brook Regional Park.**

A Yule Brook Regional Park would integrate all high conservation value areas in the GBSW, MKSEA and Yule Brook in one polygon and could eventually feature a 'Falls to Floodplain' ecological trail along Yule Brook from the Lesmurdie Falls National Park to the Canning River Regional Park via the GBSW. This plan is consistent with EPA recommendation M69.3 in the 1983 System 6 Report for what was then known as "Kenwick Swamp", and will also protect the more recently acquired Crown Reserves in and immediately adjacent to Bush Forever Area 387. A Regional Park with the added ecological trail would encompass approximately 8km of highly scenic, shared-use (pedestrians and cyclists) pathway and would showcase Perth's international status as a biodiversity hotspot and water sensitive design centre. It would also conserve for future generations of indigenous and other Australians, and visiting world citizens, important records of Australia's indigenous history and culture.

## The vision in detail

### Water management

Our vision calls for Water Sensitive Urban Design (WSUD) as part of an Australian best-practice MKSEA development that promotes the 'liveability', sustainability, resilience and productivity (Rogers et al, 2015; Brown et al, 2015) of the MKSEA and the GBSW. Contemporary WSUD has the potential to positively resolve many conservation issues in the current City of Gosnells MKSEA Indicative Local Structure Plan (2015), the TME (2014) Local Water Management Strategy Plan for the MKSEA and the Emerge Associates (2017) Precinct 3A Local Water Management Strategy. The drainage scheme currently operating in the GBSW and MKSEA (which has served the rural blocks of the area for about a century) wastes scarce and diminishing water resources by draining surface and ground waters out of the catchment and into Yule Brook by way of an extensive network of excavated drains, pipes, pits and tanks. This out-dated approach to flood control is not 'waterwise' in our present climate, will not benefit the industrial park and will severely endanger the GBSW if not upgraded to best practice WSUD in each MKSEA Precinct.

The current City of Gosnells MKSEA Indicative Local Structure Plan (2015) and District Water Management Strategy (TME, 2014) for Precincts 2 and 3B, and the approved Taylor Burrell Barnett (2016) Precinct 3A Structure Plan, must be changed to conform to best-practice WSUD. The planned expansion of the existing, out-dated roadside drainage system, which rapidly conveys most rainfall run-off from the rural areas of Kenwick and the GBSW through trapezoidal drains, pipes and pits into Yule Brook (which is used as a main drain) and thence to the Canning River, will increase the present 'theft' of part of the ecological groundwater requirements of the TECs and Threatened Flora of the GBSW and the MKSEA. This dewatering of very high conservation value vegetation and flora in the area and the associated salinity threat has been of concern for over 20 years (Trudgen and Keighery, 1995; VCSRG, 2001; Luu and English, 2004; TSSC, 2015; Bourke, 2017), and present plans will increase that concern.

Proper implementation of WSUD in MKSEA developments has substantial benefits.

#### **1. Reduction of waste of water and the associated habitat degradation and downstream water quality deterioration.**

Best-practice WSUD would retain and restore (wherever possible) the vegetation, landforms, topography, pervious surfaces and hydrologic regime that existed prior to rural development of the area; manage small rainfall events at source, and moderate to large rainfall events in road reserves and existing wetlands; maximise rainwater infiltration into the groundwater at source by retaining pervious surfaces and installing pervious surfaces and/or infiltration devices on industrial lots; minimize the volume and speed of run-off; permit the disconnection of stormwater conveyance; and remove the need to directly discharge stormwater (via pipes and drains) into Yule Brook.

#### **2. Avoidance of much of the expense of installing and maintaining an expensive, large network of water conveyance and retention infrastructure.**

The free ecosystem services provided by retained and restored vegetation, pervious surfaces, and natural drainage systems (waterways and wetlands, and their floodplains and buffers) provide a large degree of built-in economic sustainability. Retaining and detaining small and moderate rainfall events at source also means that most infrastructure is simple, small scale and easily maintained by individual landowners. Fewer resources are needed for maintenance of the drainage system. More land is also available for productive enterprise than when out-dated, inefficient and extensive drains and drainage basins are in place.

**3. Reduction in importation of expensive, and potentially polluting, sandy fill to implement a drainage system that relies on gravity-feeding the surface and ground water down to the lowest points in the landscape.**

The massive earthworks planned for the MKSEA (e.g. Cossill and Webley Consulting Engineers, 2017, p.12, for Precinct 3A of the MKSEA) would only be necessary to drain the greatly increased volumes of run-off created by a non-WSUD approach to the industrial development of a currently rural area, which unfortunately Precinct 3A is on present plans. WSUD retains and restores the pervious surfaces, vegetation, other natural features and the hydrologic regime that existed prior to rural development of the area; reduces, retains and infiltrates most run-off at source; disconnects conveyance; and thus eliminates the need to import the huge volumes of sand for fill and the extensive earthworks required by a non-WSUD drainage system.

**4. Elimination of the need for very large basins or Multiple Use Corridors (TME, 2014; Emerge Associates, 2017) to detain and retain the stormwater water harvested from large, up-gradient areas of the MKSEA until it can be conveyed out of the catchment area.**

WSUD eliminates the loss of large areas of productive land, otherwise used to construct large basins and Multiple Use Corridors, from the development because the volume of run-off is greatly reduced and mainly dealt with at source (on the industrial lots where the run-off is produced) or in adjacent road reserves and existing wetlands such as the extensive, multiple use palusplain or floodplain (mapped as UFI15254 in DBCA, 2018a) associated with Yule Brook on Lot 414 (previously Lot 2008 Grove Rd in MKSEA Precinct 3). Distribution of any run-off from large rainfall events along existing or restored watercourses into existing or restored wetlands increases the sustainability of these wetlands and increases the biodiversity they are able to support in the face of climate change impacts.

**5. Elimination of the need to convey, by way of deep excavated drains, stormwater concentrated by non-WSUD collection from a large catchment.**

The deep excavated drain currently traversing the Alison Baird Flora Reserve and other such drains (e.g. the proposed new drain through the Threatened Ecological Community of wetland UFI 7635 in Precinct 3B and then into Yule Brook; p.12, Cossill and Webley Consulting Engineers, 2017) would no longer be required. Such conveyance through reserves and TECs contributes to the degradation and loss of critical habitat and populations of Threatened Flora Species and TECs adapted to low nutrient waters and natural hydrological regimes.

In addition to the major drainage works detailed above, the proposed modifications to Yule Brook in TME (2014), which are listed below, also fall well short of all waterways protection principles and the conservation outcomes needed to protect the extremely high conservation values in nearby GBSW that are connected by wetland functional areas to Yule Brook.

- Reservation of only a 50 metres wide foreshore on each side of the Yule Brook channel that ignores the natural width of the Yule Brook floodplain, which (according to Water Corporation, 2013 modelling cited in TME, 2014) is actually about 120 to 150 metres wide in some places on both sides of the brook. This would preclude the restoration of Yule Brook to a Living Stream and locks in consequences (such as expensive maintenance of drains and further degradation of the ecological corridor currently provided by Yule Brook) that are economically and environmentally unsustainable.
- The filling of much of the mapped, natural extent of the Yule Brook floodplain to 1.2m above natural contours, and the planned industrial development along Brook Rd on this floodplain area. These developments will destroy much of the present and potential future ecosystem services provided by Yule Brook and lock in the separation of the Yule Brook floodplain from the GBSW,

which will destroy their ecological connectivity and the more sustainable water resource that the GBSW requires under climate change and Perth's increasing urbanization.

- Additional excavation of the Yule Brook channel and building of levee banks to border the brook. This approach has been shown repeatedly to be totally unnecessary, environmentally damaging and expensive to maintain. Instead, Yule Brook should be restored to a Living Stream between Welshpool Rd and Roe Highway and linked directly, via the Yule Brook floodplain, to the GBSW. A new public open space reserve (see Regional Park proposal below) would achieve this important linkage. Reserving a broad, re-vegetated floodplain for Yule Brook (unlike the narrow Yule Brook reserve shown in TME, 2014) will also result in reduced flow rates and a greater area for infiltration, so that even large rainfall events can be managed with little or no damage to the drainage system or receiving environments.

*The case for best practice WSUD in the MKSEA is clear. It will save on drainage infrastructure installation and drain maintenance costs, while also enhancing the extraordinary bio-physical environment of the Yule Brook catchment and improving the liveability of this area for all concerned.*

### **Separation (Ecological Buffer) Zones**

The present MKSEA Indicative Structure Plan (City of Gosnells, 2015) does not reserve any ecological buffer zones around the GBSW perimeter. The plan indicates that the CCWs and TECs of the GBSW and the Threatened Flora populations within them will be separated from industrial lots by, at best, a 20 metres wide road reserve. The MKSEA roads that are located immediately adjacent to the GBSW and other CCWs (City of Gosnells, 2015) are not valid buffers or Separation Areas (WAPC, 2005) for these wetlands, and have, themselves, significant impacts on the wetlands.

In general, roads through wetlands are highly compacted and impervious surfaces that prevent rainfall infiltration and are either built up above the highest inundation level of the wetland or have drainage measures, such as adjoining drains, to prevent road-surface flooding. Roads intercept and channel the rainfall, and cause the natural surface water and sub-surface water of wetlands to flow along novel pathways. Such hydrological changes, particularly where roads intersect wetlands in settings of complex stratigraphy (as in the MKSEA), usually compromise the hydrological maintenance of the wetlands and the ecological water requirements of wetland biota.

In particular, the present and planned roads, tracks, firebreaks, drains and pipes in, and adjacent to, the GBSW are known to intercept, dam and divert the surface and ground water of the GBSW and adjoining area (VCSR, 2000; Bourke, 2017) and directly threaten populations of Threatened Flora. Here are some examples.

- The Brixton St Bridge, built over 20 years ago, contributes to flooding and salinization upstream in the Wanaping Block and a reduced water supply to the (downstream) Brixton St Wetland Reserve in Alton St (Bourke, 2017).
- Bickley Rd separates the Alison Baird Flora Reserve from the Wanaping Block of the GBSW. Bickley Rd and its associated drainage measures are known to disrupt the natural flow of surface and ground waters between the upstream Alison Baird Flora Reserve and the downstream Wanaping Block (Bourke, 2017). Long term residents of Kenwick and Beckenham (T. and R. Drummond, and B. Dixon, personal communications.) recall the floods over this section of Bickley Rd before the open and piped drains that now run along Bickley Rd and through the Wanaping Block to a large underground water tank off Alton St were constructed to prevent flooding of Bickley Rd and other roads. They have also observed deterioration of the understory flora in the part of the Wanaping Block that adjoins Bickley Rd, which occurred after the hydrology was changed by these drainage works. Bickley Rd is expected to require upgrading and widening, as will most roads in the MKSEA, to carry RAV4-class vehicles and

the increased traffic volume predicted for the industrial area (Cardno, 2016a). Thus the impact of Bickley Rd on the hydrology of the GBSW is likely to increase.

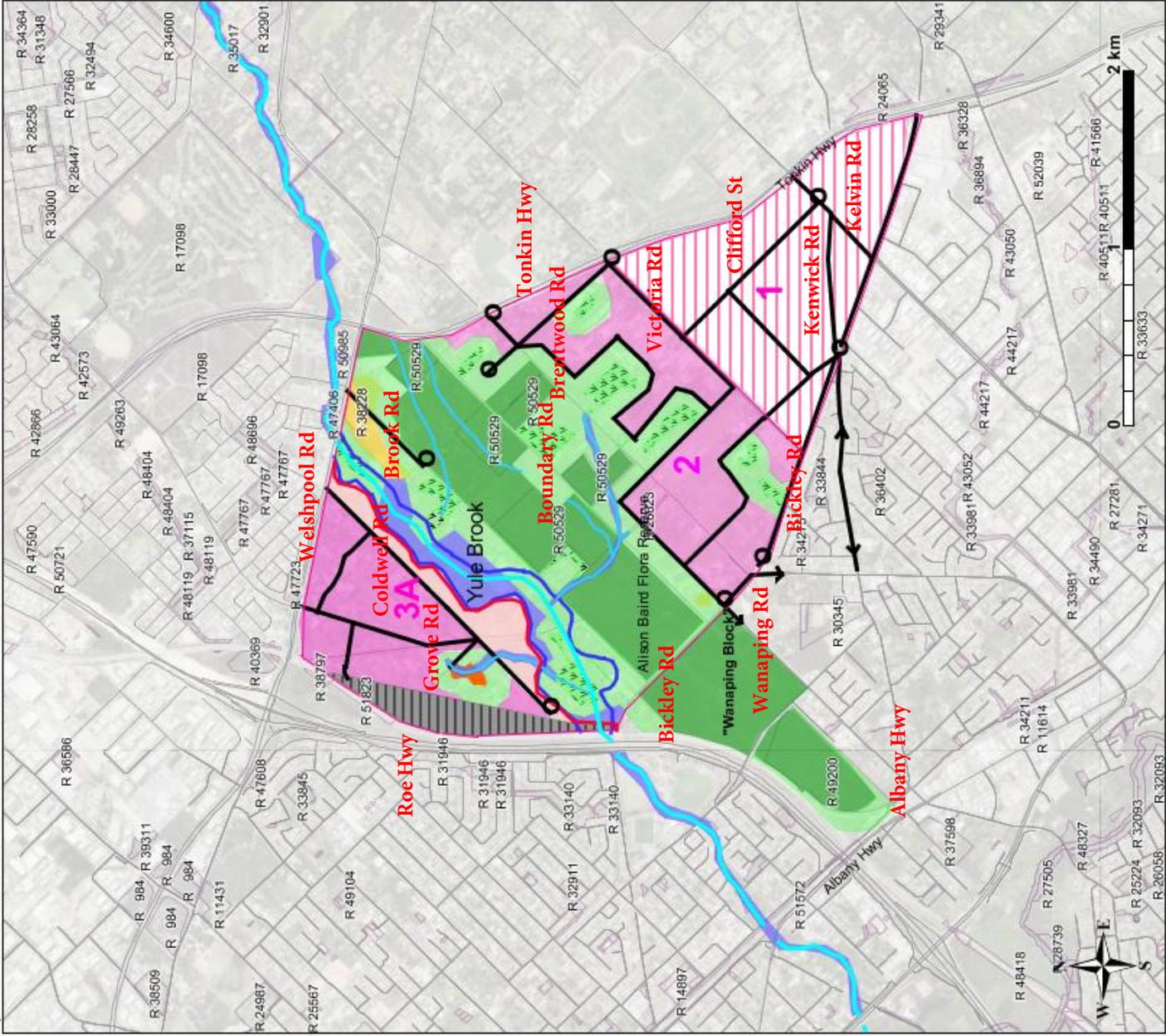
- The existing and proposed MKSEA roads, drains and pipes, and the Yule Brook main drain (City of Gosnells, 2015) effectively dissect the 'wetland function area' (term of WAPC, 2005) of most CCWs and REWs that are mapped in the DBCA Swan Coastal Plain Wetland Dataset (2018a) in the GBSW, in the MKSEA and in the vicinity of Yule Brook (VCSRG, 2001; Endemic, 2012; Douglas Partners, 2016; Bourke, 2017). This infrastructure also divides into multiple small islands the critical habitats of at least five listed Threatened Flora Species (DBCA, 2018b) and many more Priority Flora Species. This fragmentation is most clearly evident for *Calytrix breviseta* subspecies *breviseta* which is the rarest and most highly threatened of the five Threatened Flora Species as it is endemic to the GBSWA and the adjoining MKSEA Precinct 2. Its last extant population occurs on five wetland blocks, some still in private ownership and some Crown Reserves, located on both sides of Boundary Rd.

Road reserves in the areas proposed for the MKSEA currently accommodate a 10 metres wide sealed road and drains, either piped or open, along one (or both) of the 5m wide road verges. In Precinct 3A, some road verges will be expanded to a total width of 25m to 30 metres to accommodate the planned 8.4m to 15m wide conveyance "swales" (Emerge Associates, 2017). All of these roadside drainage measures require regular excavation or other intrusive maintenance to facilitate the maximum conveyance they are designed for. In addition, most roads in the implementation of the MKSEA will require upgrading, widening and possibly some re-alignment to carry the additional RAV4 class vehicles and greatly increased traffic volumes predicted for the MKSEA. As most road verges in Precinct 2 directly adjoin the GBSW and include native flora, some of them Threatened Flora Species, it is likely there will be direct impacts on multiple values from MKSEA roads and drainage works.

Clearly, roads do not constitute ecological buffers (separation zones) for wetlands and are sources of threat to wetlands in the MKSEA. Previous infrastructure, 'set in concrete' without sufficient prior awareness of the complex hydrological factors that maintained the wetlands and biodiversity in the GBSW, has proved difficult or impossible to remediate after its impacts have become known. *These are instances of environmental harm that no one would want to see repeated when better alternatives are not only available but can provide long term benefits both to the MKSEA and the GBSW.*

Recent research has shown that using a wider range of techniques to collect stratigraphic and hydrological data than has been used hitherto in the MKSEA can be cost-effective in exploring the area's critical knowledge gaps. UWA School of Plant Biology studies have shown that various flora species in the GBSW's Alison Baird Flora Reserve rely on the differing geochemical fingerprints of the many near-surface aquifers. The lateral extent, hydroperiod and depth of the aquifers that determine the abundance and distribution of flora species, especially the Threatened Flora, should be carefully determined so as to protect all of the vital water resources in and adjacent to the GBSW and other TEC areas in the MKSEA. Techniques such as ground penetrating radar and electrical resistivity imaging, supplemented by the more commonly used soil coring, have been shown to identify clay, water and other layers in the upper 10 to 20 metres of the soil, facilitate the mapping of their extent, and can distinguish between most substrates that have been identified in this complex setting.

**Figure 1: Greater Brixton St Wetlands, the Yule Brook and the MKSEA**



- Legend**
- My Annotations**
- Approx. 100yr floodplain of YULE Brook (Water Corp. 2013)
  - Indicative MKSEA roads
  - MKSEA
  - Other watercourses
  - Walk - cycle trail indicative location
  - YULE BROOK
  - 100m buffers
  - Greater Brixton St Wetlands (BFA 387)
  - MKSEA Precinct 1
  - MKSEA Precinct 2
  - MKSEA Precinct 3A & Wattle Grove Precinct
  - Managed landscape: retain trees & showcase low shrub biodiversity of GBSW
  - Other TECs
  - Other areas for Living Stream restoration
  - PTA Rail Freight Terminal
  - Red-Tailed Black Cockatoo roost
  - Resource Enhancement Wetlands
- Crown Reserves**
- State Roads**
- Other Roads**

**Note:** Map shows selected REW only and CCW, TEC and BFA in MKSEA Precinct 1 are not shown.  
**O** indicates a point of road closure

Imaging the sub-surface in a more thorough and comprehensive manner than previously attempted in the GBSW, around Yule Brook and in the other TEC areas of the MKSEA would enable a better understanding of the hydrogeology and the measures needed to meet the specific water requirements of the rare flora and ecosystems of the GBSW. This approach should be implemented to help determine valid buffer zones (for the GBSW, other CCWs and TECS in the MKSEA, and the area between the Yule Brook and the GBSW) prior to further structure planning in the MKSEA.

Without adequate stratigraphic and hydrological data and mapping, a minimum 100 metres buffer around all CCWs and TECs in the GBSW and the MKSEA and the riparian vegetation of Yule Brook (**Figure 1**) is required as a precautionary measure to support the hydrological maintenance of the wetlands. This approach is in accord with the Guideline for the Determination of Wetland Buffer requirements (WAPC, 2005). This Guideline specifies an ordered and scientific approach to: first, determine and accurately map the Wetland Function Area; second, to identify the role that separation from adjacent land uses (e.g. industry, roads and drainage infrastructure) plays in the protection of the wetland; and finally, to determine an appropriate width Separation Distance (buffer) between a wetland and the adjacent land uses.

### **Asset Protection and Hazard Separation for Bushfire Safety**

A 100 metres ecological buffer (Separation Distance) between the MKSEA industrial blocks and the Wetland Function Areas of all CCWs of the GBSW and the MKSEA, and the Wetland Function Area of Yule Brook (which includes the 100 year floodplain and foreshore of the brook) would also enable appropriate-width Asset Protection Zones and Hazard Separation Zones (WAPC et al., 2017) for industrial buildings adjacent to “bush fire prone vegetation” to be planned in an informed and biodiversity conscious manner *before* local structure planning, as recommended by WAPC et al., 2017.

‘Bushfire Prone Area’ is defined (WAPC et al., 2017) as an area that has been designated by the Fire and Emergency Services Commissioner under s. 18P of the *Fire and Emergency Services Act 1998* as an area that is subject, or likely to be subject, to bushfires. These areas are identified on the *Map of Bush Fire Prone Areas* on the DFES website. ‘Bushfire Hazard Level’ is defined (WAPC et al., 2017) as the potential or existing flammability of vegetation that, in association with topography and slope, when ignited may cause harm to people or damage property or infrastructure.

Bushfire Hazard Level Assessment for the MKSEA (Ecological Australia, 2014; after WAPC et al., 2010) identified all the scrub and woodland vegetation in the GBSW and around Yule Brook as posing a ‘Moderate’ bushfire hazard; and the woodland vegetation in the MKSEA remnants in Precinct 2 as posing an ‘Extreme’ bushfire hazard. For Precinct 3A of the MKSEA, the bushfire hazard in the Woodlupine Brook Reserve (immediately west of the planned Public Transport Authority Rail Terminal) and the woodland on the Yule Brook side of Coldwell Rd were both re-assessed as ‘Extreme’ (Emerge Associates, 2016; after WAPC et al., 2015).

For bushfire safety, Asset Protection Zones and Hazard Separation Zones, within which reduction of vegetation (including such measures as clearing or thinning, lopping, mowing or burning for fuel reduction) is prescribed, will be mandatory around many buildings in the MKSEA due to the Bushfire Hazard Levels identified above. Such protection zones are normally confined within the boundaries of the relevant private landholdings or, where this is not possible, within the boundaries of the overall development. It is evident however that limiting these protection zones to the relevant industrial properties of the MKSEA may not be feasible. For example the current Indicative Structure Plan for the MKSEA (City of Gosnells, 2015) shows the limited size of many of the proposed industrial properties and their location immediately adjacent to, or even surrounded by native vegetation determined as ‘Moderate’ or ‘Extreme’ Bushfire Hazards. These ‘Moderate’ or ‘Extreme’ Bushfire Hazards are the highly significant, conservation value native vegetation in the GBSW and the MKSEA,

and the ecologically important riparian vegetation of the Yule Brook. In many cases, even limiting the mandatory fire protection zones to being within the boundaries of the overall MKSEA development appears infeasible given the development footprint (City of Gosnells, 2015).

The WAPC et al. (2017) guidelines for planning bushfire prone areas state that it is important that *Local Structure Plans* consider the requirements of the bushfire protection criteria to ensure that Hazard Separation Zones and Asset Protection Zones can be established at a subsequent planning stage. Specifically, the issues that should be considered include:

- Biodiversity issues and their interrelationships with bushfire prone areas;
- Means of protection for areas with high conservation values to accommodate adequate separation [of development] from existing or proposed buffers for wetlands and foreshores; and
- Accommodation of biodiversity objectives such as adequate separation [of development] from existing or proposed buffers for wetlands and foreshores.

With careful planning that applies valid ecological buffers, as discussed above, and is fully informed regarding the highly significant biodiversity at stake in the MKSEA and its interrelationships with bushfire prone areas, there should be no need for any Hazard Separation Zone or Asset Protection Zone to encompass:

- Any area of the extremely high conservation value vegetation (TECs, CCWs, Threatened Flora and Fauna critical habitats) that comprise the GBSW;
- Remnant vegetation in good condition or better as mapped in the MKSEA; and
- The foreshore and 100 year floodplain of the Yule Brook (as modelled in Water Corporation, 2013, and cited in TME, 2014). It is important to note that the full extent of the existing 100 year floodplain of the Yule Brook with no constructed levee banks as shown in Figure 19 of TME (2014) extends, in some places, to nearly 150 metres beyond the Yule Brook channel.

The creation of a managed vegetation, Public Open Space area along the Yule Brook side of Coldwell Rd (Figure 1) will enable the planning of Separation Areas that protect both industrial buildings and the native or restored vegetation of the MKSEA, the GBSW and Yule Brook. There are also building standards solutions to these issues, under AS 3959 (Standards Australia, 2009), that could protect both the natural and the built environments.

### **Environmentally sustainable road design**

Currently, vehicles up to classes RAV2 and RAV3 have access to roads in the proposed MKSEA. These roads include Coldwell Rd, Grove Rd, Brook Rd, Bickley Rd, Boundary Road and Brentwood Rd of Precincts 2 and 3 of the MKSEA. In the area surrounding the MKSEA, RAV4 vehicles are permitted on Welshpool Road and RAV7 vehicles are permitted on Roe Highway only. To facilitate development of the proposed industrial land uses within the MKSEA, it has been recommended that vehicles up to RAV4 be permitted on all internal MKSEA roads. Roads in the MKSEA will require upgrading and widening and potentially some re-alignment to cope with the anticipated RAV4 vehicle usage and the greatly increased traffic volumes predicted for the new industrial area (Cardno, 2016a, 2016b). This presents an opportunity for a rethink of the road system to produce environmental benefits as well as infrastructure compliance.

Being located immediately adjacent to the GBSW and to other CCWs, most of the MKSEA roads already have important impacts on the natural values of the area by:

- Altering the hydrology of the GBSW and adjacent high conservation value wetlands with adverse consequences for Threatened Flora Species and TECs – particularly Bickley Rd (Bourke 2017) and Brook Rd, Boundary Rd and Brentwood Rd (VCSR, 2001; Luu and English, 2004; Endemic, 2012);

- Separating the GBSW from Yule Brook and compromising the connectivity of the GBSW with the existing natural corridor along Yule Brook, albeit narrow and modified by drainage measures, that connects the Darling Range to the Canning River – particularly Brook Rd and part of Grove Rd;
- Fragmenting the TECs of the MKSEA from each other and/or from the GBSW – particularly Brook Rd, Bickley Road, Boundary Rd and part of Brentwood Rd; and
- Contributing to other impacts such as the urban heat island effect; noise pollution; the transport of pathogens, weeds, nutrients and other contaminants into the wetlands; native fauna road kills; arson and littering.

These adverse effects have the potential to become much worse if the MKSEA roads are implemented as planned in City of Gosnells (2015) and the roads are, of necessity, upgraded. The Cardno reports (Cardno 2006, 2016a, 2016b), the main sources of guidance for road planning in the MKSEA, do not consider the environmental impacts of the proposed road system. In addition to the existing impacts listed above, there will be important environmental impacts of implementing the industrial roads.

- The road reserves in the MKSEA footprint are currently 20 metres wide and include road pavements about 10 metres in width (Cardno, 2016a). Where it is proposed to incorporate roadside conveyance “swales” within the road reserve in Precinct 3A, a 30 metre wide road reserve has been proposed (Emerge Associates, 2017). A similar approach to drainage may be taken in Precinct 2 and 3B. Thus, an additional 5 to 10 metres wide strip along one or both sides of the verges of Grove Rd, Brook Rd, Bickley Rd, Boundary Rd and Brentwood Rd in Precincts 3B and 2 may also be required. Along many Precinct 2 road verges, the native vegetation, which includes several Threatened Flora Species and numerous Priority Flora Species, extends onto the present road verge and thus may be removed or degraded by road works and the construction and later maintenance of MKSEA drainage infrastructure.
- The upgrade of Brook Rd to allow industrial traffic from Welshpool Rd into MKSEA Precinct 2 would perpetuate the artificial separation between Yule Brook and the GBSW and thus take away the last remaining opportunity to restore the wetland (functional area) linkage of the CCWs and TECs of the GBSW with the Yule Brook wetlands. It would also prevent the proposed Yule Brook Regional Park, a new and highly valuable community resource, from encompassing the GBSW and directly linking it to an ecological corridor from Lesmurdie Falls to the Canning River along Yule Brook and its floodplain.

It is very important to note, in addition, that roads, as they are now or as they may be when upgraded, are not the valid buffers or separation areas that are required to mitigate the general impacts of the proposed industrial development on the wetlands.

It is difficult to judge the road capacity needed for the MKSEA, given the widely varying assumptions about MKSEA employment and the lack of justification provided for these assumptions: Cardno (2016a) estimates employment at full build in 2031 at 4,190; Gosnells Mayor, Glenn Dewhurst, has mentioned 30,000 new jobs (City of Gosnells, 2018). However, regardless of the precise numbers, careful reading of Cardno (2016a) reveals several non-environmental issues which include:

- Mixing RAV4 and other heavy transport from MKSEA 3A, which is intended as a transport logistics park (TBB, 2016), with the much lighter transport traffic associated with the business development and light industry areas proposed for MKSEA 2 and 3B;
- “Rat-running” through MKSEA using Brook Road and Bickley Road. Tables 4.4 to 4.21 of Cardno 2016a show that the intersections between MKSEA roads and Welshpool Road have LOS (level of service) ratings up to level E, while southern entrances to and exits from MKSEA by way of Bickley Road are rated at LOS A and B. This means that waiting times at the southern

end will be lower than at the northern end. Under these circumstances, the southern junctions would be traffic magnets and this would impact on the adjoining residential areas;

These traffic related issues are exacerbated by potential phasing issues, which are not addressed in the Cardno reports (Cardno 2006, 2016a, 2016b). They relate to the switch from rural residential to some form of industrial or business development zoning and to the time that elapses prior to the expected upgrades of the Welshpool Rd/Tonkin Hwy intersection, which are not projected to be completed until 2031 (Cardno 2016a). If the preferred strategy is to keep MKSEA traffic out of the residential areas located to the south of the MKSEA, which would appear to be highly desirable, then strong disincentives to the use of the southern roads by MKSEA traffic are necessary.

These environmental and non-environmental impacts of the MKSEA road system can be addressed by the following actions (Figure 1).

1. Reservation, as detailed above under “Ecological buffers”, of 100 metres buffers around all of the GBSW and the TECs identified in the MKSEA to link these TECs to the GBSW. This action would require the closure or relocation of Boundary Rd and parts of Brentwood Rd.
2. Closure of Brook Rd from the City of Gosnells boundary to Bickley Rd to provide direct ecological linkage between Yule Brook and the GBSW.
3. Closure of Grove Rd south of Coldwell Rd and of Bickley Rd from Brook Rd to Wanaping Rd so that MKSEA and other traffic does not use the Bickley Rd/Grove Rd linkage as a rat-run, with increased traffic across Yule Brook and the core conservation areas of the GBSW. These closures would also benefit residents of parts of Kenwick and Beckenham (which could otherwise be accessed by heavy Precinct 3A traffic by way of Wanaping Rd and Brixton St) and reduce the volume of MKSEA traffic entering the highly-congested Albany Highway.

The changes we propose will sever the connection between MKSEA Precinct 3A, which is designated for transport logistics, and Precinct 2 and other areas, which have been designated for lighter industry. They will also prevent traffic from using the long route from Welshpool Rd along Brook Rd to enter and exit from Precinct 3A or Precinct 2.

Access to MKSEA is retained, however. Precinct 3A will retain two routes from and to Welshpool Road, one by way of Grove Rd, which is planned to extend to Welshpool Rd at the Hale Road junction, and one by way of Coldwell Rd (Taylor Burrell Barnett, 2017). Precinct 2 retains access by way of: Wanaping Rd, Kenwick Rd, Kelvin Rd and Bickley Rd, which will give good access to and from: Albany Highway; Tonkin Highway by way of Kelvin Road; and Roe Highway by way of Tonkin Highway and Welshpool Rd. Additional emergency access ways could be achieved from cul-de-sacs to the nearest cross roads in both precincts in the manner recommended by Ecological Australia (2014).

The proposed layout provides greater liveability for residents of suburbs adjacent to MKSEA as the volume of industrial traffic on their streets would fall in comparison with what it would be under the Cardno (2016a) plan. In addition, the plan we propose reduces any motivation for RAV4 class vehicle traffic (which MKSEA planning proposes to permit in the MKSEA) to take short cuts through the residential suburbs, where it is not permitted, to RAV4 sections of Albany Highway.

It is important that infrastructure planning also addresses the heat island effect that the roads and buildings of the MKSEA would otherwise have on the MKSEA and the GBSW. This can be done by retaining existing trees and other natural vegetation and incorporating landscape elements (including water-harvesting green roofs, green walls, and shaded streets) into the MKSEA design. In addition to

the wider environmental values that these innovations would support, they would greatly enhance the 'liveability' of the planned industrial developments to the benefit of workers in them and visitors to them. As part of this strategy, roadside trees, such as the mature Marri used for foraging by the Forest Red-Tailed Black Cockatoos (a Threatened Fauna Species) from the roost in Precinct 3A, can also be conserved to support the continued presence of Red-Tailed and Carnaby's Black Cockatoo as important ecological agents in the GBSW and much loved community assets.

*Early and effective planning with regard to these matters is essential for efficacy, cost effectiveness and to ensure the integrity of the GBSW.*

### **A 'Falls to Floodplain' ecological trail along Yule Brook and a Yule Brook Regional Park**

As an alternative to the increased fragmentation of the GBSW by industrial service roads and the high risk of degradation of highly significant conservation values and losses of natural ecosystem services inherent in MKSEA plans to date (City of Gosnells, 2015; Taylor Burrell Barnett, 2017) we have a vision that will safeguard the GBSW and adjacent natural values while greatly increasing the sustainability, productivity and liveability of Kenwick, Beckenham and Wattle Grove (Figure 1). This vision is consistent with:

- The City of Gosnells' original concept of the MKSEA (City of Gosnells 2008);
- The long-standing interest of the local community in a Foothills Regional Park; and
- EPA recommendation M69.3 in the System 6 Report (EPA and DCE, 1983) for what was then known as "Kenwick Swamp" (now the Alison Baird Flora Reserve on Brook Rd) and the more recently acquired Crown Reserves R50529, R49200 and the Wanaping block; and other lands of Bush Forever Area 387 (Government of Western Australia, 2000).

The vision is for a Regional Park, perhaps a 'Yule Brook Regional Park', that protects the GBSW, Yule Brook and remnant high conservation areas of the MKSEA, and provides recreational and other liveability benefits for the community. The first stage of this Regional Park plan, as part of the final MKSEA structure plans, would make provision for reserve lands on both sides of Yule Brook (from Coldwell Rd to Brook Rd) for most of the 2.4km course of the brook between Welshpool Rd and Roe Highway. This reservation should encompass the foreshore and existing 100 year floodplain of Yule Brook (as modelled in Water Corporation, 2013; and cited in TME, 2014) to secure the future restoration of the Yule Brook main drain to a 'Living Stream' in this zone.

To be most effective as a conservation and recreation reserve, the Regional Park should bring together into a single polygon the entire GBSW Bush Forever Area 387 (from the Wanaping Block and north east to Welshpool Rd *without* Bickley Rd as an intersecting road), the Yule Brook Living Stream linked directly to the GBSW, and the smaller TEC occurrences and Threatened Flora populations of the MKSEA. The Brixton St Wetlands Reserve (R49200) at Alton St would also be part of the Regional Park, albeit separated from the single polygon by Brixton St, closure of which is unlikely to be feasible.

The level of native vegetation clearing in the Perth Metropolitan Region now exceeds the critical 70% ecological threshold beyond which ecological functions begin to exponentially decline (EPA, 2000; Perth Biodiversity Project, 2010). Moreover, in the eastern Swan Coastal Plain (where the GBSW and MKSEA are located) the level of clearing (greater than 95%) qualifies all remaining native vegetation, in good or better condition, to be classed as endangered or even critically endangered under all Australian and international definitions. Securing and enhancing the connectivity of high quality vegetation as part of ecological corridors, such as that defined by the Perth Biodiversity Project (2010) from the Darling Range to the Canning River link along Yule Brook via the GBSW, is one of the most effective measures that remains available to mitigate the decline in native vegetation (Perth Biodiversity Project, 2010; EPA, 2000).

We seek ecological connectivity for the Yule Brook flood plain from Lesmurdie Falls to the Canning River and active planning of a dual-use, pedestrian and bicycle track along Yule Brook. Further, consolidation of the Yule Brook flood plain and the GBSW into a single, contiguous entity would enable best-practice Living Stream restoration of the brook and support the ecological connectivity of the Darling Range National Parks, via Yule Brook and the GBSW, to the Canning River Regional Park.

The area of this proposed Regional Park is a natural corridor with great ecological, aesthetic, cultural and historical appeal. In addition to the GBSW and the Alison Baird Flora Reserve, its attractions include:

- Lesmurdie Falls, which is often referred to as the finest waterfall in the Perth Metropolitan Region;
- The existing walking trail along Yule Brook in the foothills at the base of the Falls, which has outstanding aesthetic and biodiversity values;
- The Jerban ceremonial and mythological indigenous site at the Falls;
- Hartfield Park active recreation area;
- Hartfield Park 'Bush Forever' area, which is also the former Maamba Aboriginal Reserve and includes scarred trees and other indigenous values and historical links with the significant 19th-century indigenous figures Balbuk and Joobaitch, and anthropologist Daisy Bates;
- The former Chinese market garden (Reserve 47406) along Yule Brook just east of Welshpool Rd;
- The Greater Brixton St Wetlands that provide outstanding educational and passive recreational potential due to their outstanding native flora and fauna richness and their illustration of ecological processes;
- Mills Park, which is an outstanding sporting and community recreation facility; and
- Beckenham Open Space and Canning River Regional Park floodplain at the confluence of Yule Brook and the Canning River. The mythological and cultural sites along this journey of the Waugul are highly significant to the indigenous people and Australian cultural history.

This natural corridor lends itself to the notion of a 'journey of discovery' through space, time and human culture. The Living Stream concept for Yule Brook would also include relatively inaccessible and quiet natural areas to enable wildlife to traverse, forage in and inhabit the corridor.

While planned now and fully provided for in implementation of the MKSEA, this public open space proposal could be implemented in stages. It is critical to note, however, that realisation of this vision is absolutely contingent on best-practice WSUD and ecological buffer zones being implemented now in Precinct 3 of the MKSEA and in the structure planning of the remaining MKSEA precincts.

## **Conclusion**

*Shaping Perth as a Water Sensitive City Perth* states that the benefits of WSUD include 'water security, flood risk minimisation, biodiversity, public green space, healthy waterways and connected communities' (p. 60). This working plan for the Greater Brixton St Wetlands and the MKSEA that we have outlined is based on the integration of environmental protection, best practice drainage and sympathetic road planning, and is designed to achieve these WSUD outcomes. Such an approach could be a world best practice exemplar, delivering the benefits of urban liveability, sustainability and resilience to the local community and Perth in general.

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