6. Drainage Concept Plan

6.1 Overall approach

The approach adopted for the stormwater management in the proposed Maddington-Kenwick Industrial Area is closely based on the approaches suggested in the *Stormwater Management Manual for Western Australia* (Department of Environment, 2004). The manual includes the following stormwater management hierarchy approach for application in Western Australia:

» Retain and restore natural drainage lines: retain and restore existing valuable elements of the drainage system, including waterways, wetland and groundwater features and processes.

» Implement non-structural source controls: minimise pollutant inputs principally via the planning, organisational and behavioural techniques to minimise the amount of pollution entering the drainage system.

» Minimise runoff: infiltrate or re-use rainfall as high in the catchment as possible. Install structural controls at or near the source to minimise pollutant inputs and the volume of stormwater.

» Use in-system management measures: includes vegetative measures, such as swales and riparian zones, structural quality improvement devices such as gross pollutant traps.

To minimise runoff, reduce peak flows and improve water quality from the development area it is recommended that all stormwater runoff be retained and infiltrated as high in the catchment as possible. The requirement for the retention and infiltration of runoff from low flow events within the property boundary provides an equitable sharing of responsibility and costs for stormwater management throughout the catchment. Road drainage within the development area is conveyed using a traditional piped drainage system adopting bottomless side entry pits which will promote infiltration of small rainfall events. The piped road drainage network should be sized to convey the 10 year runoff from the road catchment and overflow from property OSR measures, providing a high level of serviceability to the local road network.

6.2 Property bioretention basins

It is proposed that a condition of development should be that each property provide an on-site stormwater retention (OSR) system with a capacity to retain (for infiltration or reuse) runoff up to the 2 year ARI rainfall event. The volume of storage required to retain this rainfall event is estimated at 340m^3 per hectare this volume is based on calculation of required storage using a infiltration/bio-retention system as outlined below. In order to maintain the integrity of the proposed downstream design, alternative OSR must reproduce hydrology associated with the infiltration/bioretention basin design.

It is recommended that OSR comprise of vegetated infiltration/bioretention basins within each property boundary. A bioretention/infiltration basin comprises a broad shallow basin and a trench filled with a suitable filter/treatment media. Runoff is first filtered through surface vegetation and then through the filter media before infiltrating. Bioretention basins are particularly efficient at removing sediment and nutrients (Melbourne Water, 2004).

For moderate rainfall events (>2 year ARI), the bioretention/infiltration basins will overflow to the roadside drainage. If property development occurs before the upgrading of the fronting road and drainage, the property bioretention basin will initially overflow to the existing open roadside drain. After the fronting road is upgraded all property bioretention basins will overflow to the piped drainage network.

Vegetation that grows in the basin and filter media prevents erosion, minimises clogging and encourages biological uptake of nutrients and pollutants. Vegetation is critical to maintaining the porosity of the filter media and generally the denser the vegetation the better the performance of the system. The planting of deep-rooted perennial vegetation, including trees, should be encouraged to aid infiltration and minimise inundation of the basins in areas of high groundwater table.

Given the relatively high groundwater table in some parts of the development area, the shallow depth and additional surface area of the bioretention basins makes them more suitable than deeper infiltration systems such as soakwells. To prevent prolonged inundation of bioretention/infiltration basins in soils with limited capacity to infiltrate water due to high clay content or shallow groundwater it may be necessary to include a perforated pipe in the base of the filtration/infiltration trench that will collect treated runoff and discharge to the piped road drainage network (see Section 6.3 below).

A conceptual design for a vegetated swale/bioretention system is presented in Figure 6. The basin design provides capacity to overflow to the road drainage for flows greater than the 2 year ARI event. The bioretention basin will have sufficient freeboard to contain the 10 year ARI event, providing a high level of serviceability to adjacent paved areas. The proposed bioretention basin design would be typically 0.6 m deep and 11 m wide with side slopes of 1 (V) in 9 (H). The area required for the proposed design is 1264 m^2/ha (13%). Vegetated bioretention basins can be incorporated into the property landscaping and could be included in development set-back conditions.

Runoff from roof areas and other impervious areas should be directed to the bioretention basin for treatment and infiltration. By using flush- or discontinuous kerbs in parking areas, runoff can be directed to the bioretention basin by overland flow increasing the opportunity for infiltration and water quality improvement.

Noting the industrial/commercial land-use in the development area, the requirement for OSR at each property provides an effective initial barrier to pollution incidents.

Although bioretention basins are the recommended form of OSR, other forms of OSR should be considered providing that the use of rainwater tanks to harvest runoff from roof areas is encouraged and should be supported by planning guidelines for the proposed development. Rainwater tanks are most practical when the harvested runoff can be used during winter months, not just for landscape irrigation. In residential areas, the use of rainwater for toilet flushing can substantially reduce demand on potable water supplies. The challenge in industrial/commercial areas is to find appropriate winter demand for rainwater.

6.3 Piped road drainage system

Two concepts were considered for the minor road drainage:

- roadside vegetated swales and bioretention basins, or
- a piped drainage network.

Although roadside swales deliver improved stormwater quality and reduce peak flows, they would require a 30 m wide road reserve. The 20 m width of the existing road reserve, together with the fragmented ownership of the development area would make it difficult to implement roadside vegetated swales and bioretention basins. Furthermore, the requirement for on-site retention of the 2 year ARI event will achieve significant improvements in stormwater quality, compared with traditional drainage strategy allowing discharge to the road drainage network.

It is proposed that a piped drainage system, adopting bottomless side entry pits to promote infiltration of small rainfall events, be provided along main road corridors (Boundary Road, Brentwood Road, Victoria Road and Kenwick Road and other roads that may be constructed at the time of development). This system should be designed to convey flows from the road reserve catchment and overflow from property OSR during moderate to high rainfall events (2 to 10 year ARI). The pipe network should be sized to convey the 10 year ARI flow, allowing for compensated flows from property OSR. Layout of the proposed piped drainage system is presented in Figure 7.

The piped drainage system will also provide for the conveyance of treated stormwater from areas with clay soils, where perforated pipes installed in the property bioretention filter trenches will to discharge to the piped drainage system.

The introduction of the piped drainage system reduces the invert level of the catchment outlet, reducing flexibility and increasing excavation depths required for catchment treatment and discharge options. The piped road drainage system could be replaced in some areas by continuous roadside bioretention swales, although additional measures would be necessary to protect the swales from disturbance during moderate and high flow events and to provide for conveyance of subsoil flows. The omission of the piped drainage network would reduce the depth of excavation and deliver substantial savings in the cost of the drainage system.

6.4 Multiple Use Corridors

Multiple Use Corridors (MUC) should be located at the outlet to each major subcatchment. These areas comprise relatively wide corridors of land that provide:

- water quality treatment of road runoff,
- flood conveyance and detention,
- wildlife habitat and corridors,

» pedestrian and cycle paths, and

» public open space.

In the Maddington-Kenwick Industrial Area it is proposed to locate multiple use corridors at the outlet from each major subcatchment. The piped road drainage system from each subcatchment will discharge into a length of open channel within the Multiple Use Corridor, constructed to function as an ephemeral living stream. These lengths of ephemeral living stream will provide water quality treatment of flows from the road drainage network. These ephemeral living streams will be constructed above the groundwater table and will only flow after significant rainfall events.

The living streams will be constructed in the base of broad channels with side slopes of 1 (V) in 12 (H). The invert level of the ephemeral living stream is set by the level of the catchment outlet and the base of the stream channel should be designed to convey flows similar to the 2 year ARI event from the road catchment. The ephemeral streams and the gentle side slopes should be appropriately landscaped and vegetated to provide habitat. The side slopes can include pedestrian and cycle paths that also provide access for maintenance.

The Multiple Use Corridors also provide for conveyance of moderate and high flow events (10 year to 100 year ARI). In the Maddington-Kenwick Industrial Area, the proposed property bioretention basins are likely to provide sufficient detention capacity within each subcatchment to compensate the 10 year ARI and 100 year events to pre-development peak flows. The Multiple Use Corridors provide, additional capacity (if required) to detain the 100 year event and conveyance of flood waters towards the catchment outlets.

The proposed Multiple Use Corridors are described below and their locations are shown on Figure 7. Design discharge is equal to the 10 year ARI pre-development peak flow for each MUC catchment, these design flows are presented Table 6. Storage volumes required for additional detention of the 100 year event will need to be calculated at detailed design stage. Indicative areas required for each sub-catchment are shown in Table 7. The conceptual design of a typical Multiple Use Corridor is presented in Figure 8 showing in plan, the major features of MUC 2 and MUC 3.

No MUCs have been proposed for drainage catchments Yule 7, Yule 6 and Yule 1. These catchments have relatively small flows and small areas. During detailed design, consideration must be given to appropriate water quality treatment measures for these small catchments.

MUC 1: Grove Road

Created at the end of the existing drainage easement where it discharges to the natural waterway and comprising of a short length of ephemeral living stream.

MUC 2: Boundary Road to Brentwood Road

Created by widening the existing drainage reserve south of Lot 501 between Boundary Road and Brentwood road to 40 m. It includes a living stream that conveys flow from MUC 3 to the Yule Brook Nature Reserve.

MUC 3: Brentwood Road to Victoria Road

Created by widening the existing drainage reserve north of Lot 227 between Brentwood Road and Victoria Road to 120 m (the full width of Lot 227). Although the Figure 7 shows this MUC only extending to the rear of Lot 227, by widening the existing drainage reserve as far as Victoria Road, a continuous MUC would be created linking the residential areas south of Bickley Road to the Yule Brook Nature Reserve. This would create a significant community asset, providing an attractive area for passive recreation and an important habitat area.

MUC 4: Victoria Road to Bickley Road

Created by widening the existing drainage reserve and comprising of a short length of ephemeral living stream. MUC 4 is immediately adjacent to an existing Resource Enhancement wetland and will run through the buffer for that wetland. Although drainage is not normally considered compatible with wetland buffers, the proposed MUC follows the alignment of an existing open drain and should be maintained to preserve the current hydrologic regime of the area.

Although not shown on Figure 7, there is an opportunity to link MUC 4 and MUC 3 with a linear park, providing a continuous corridor from Bickley Road to Boundary Road and the Greater Brixton Street wetlands. This corridor would follow the alignment of an existing drainage reserve, although the length of drain has limited capacity and is not critical for the proposed drainage strategy.

MUC 5: Kenwick Road

Created by acquisition of property on the corner of Kenwick Road and Bickley Road which forms part of Lot 5 (Number 231) Kenwick Road, Maddington, and comprising of a short section of ephemeral living stream.

6.5 Drainage outlets

The proposed drainage system will discharge at the same locations as the current open unlined drains, as shown in Figure 7. Detention storage distributed through the catchment in property bio-retention basins and multiple use corridors ensures that peak flow at these outlets will not be greater than the existing peak flows.