Murdoch
Specialised Activity Centre
Structure Plan

6. Resource conservation

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This chapter principally considers the resource (energy, water, waste) and natural habitat strategies and opportunities available to the key landowners and future developers within Murdoch Activity Centre. It takes into account topics within *State Planning Policy 4.2* as well as the themes and outcomes of a stakeholder workshop held during the initial stages of the consultation program. The workshop sought to highlight conservation issues, promote greater collaboration among parties and identify the potential for cross-stakeholder initiatives with respect to using precious resources more wisely.

6.1 Key environmental issues

The major known environmental constraints to land use and development within the study area at Murdoch are water quality (surface water and groundwater), wetlands, flora and fauna habitat, vegetation reserves and other areas of conservation significance.

Some of these constraints may be overcome with further detailed investigation and the implementation of appropriate environmental management measures, while others will need to be carefully integrated with the mix of uses proposed in the structure plan and designed for appropriately at subsequent stages of the planning and development process.

A landscape-scale approach to the protection of flora and fauna habitat should be considered outside existing reserves and areas of conservation significance. Further surveys are required to assess vegetation community types and condition, determine the presence of significant trees, and identify populations and habitat of threatened fauna. These considerations are best addressed at district-wide scale as habitat fragmentation will likely continue where detailed flora and fauna assessments are left to subsequent stages of the planning process, for example, subdivision and/or development.

Quenda Wetland (otherwise known as Hospital Swamp), Chelodina Wetland and Melaleuca Swamp are all classified as conservation category wetlands and require full protection from direct and indirect impacts from development. It is appropriate that further work is undertaken to assess the functions and values of these wetlands and determine appropriate buffers from adjacent future land uses.

The maintenance and/or enhancement of water quality and quantity in the context of the Murdoch wetlands should be an integral component of the structure planning for the area. An overarching management framework for surface and groundwater should be addressed via a district water management strategy. Ultimately any modified drainage network should be designed such that it does not introduce elevated levels of nutrients and other pollutants into these systems.

The structure plan area contains existing reserves such as those within Beeliar Regional Park and areas of conservation significance such as environmentally-sensitive areas, and is also in proximity of an adjacent Bush Forever Site 244. These will influence the layout and composition of land uses within the activity centre. The structure plan strategy should ensure the maintenance of the values and functions of these key areas (Figures 6.01 and 6.02).

Recommendations about additional surveys of the natural environment to inform strategic planning and precinct level design are set out in Section 6.10.

Figure 6.01: Gateway to Beeliar Regional Park

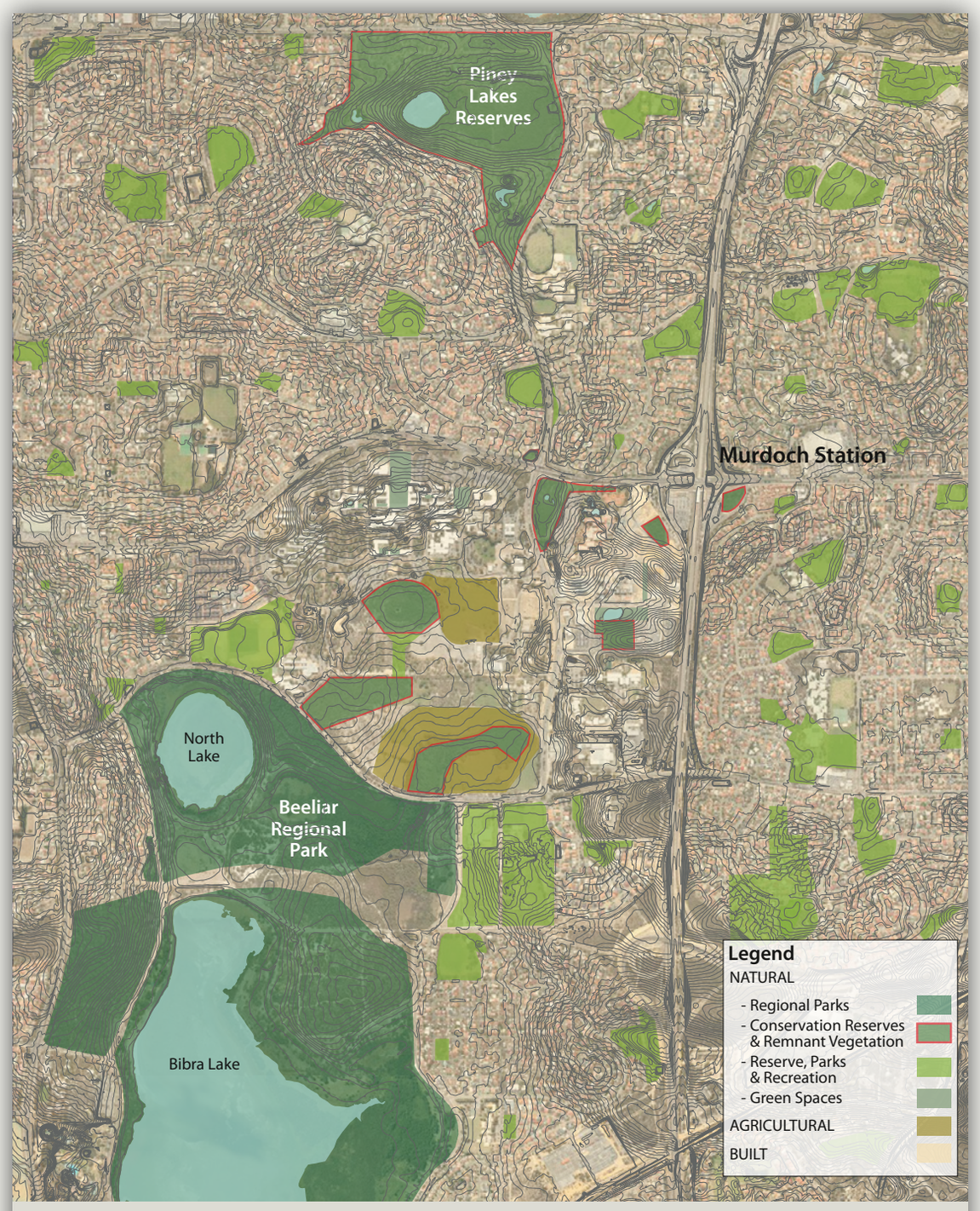

Figure 6.02: Conservation landscapes, parks and reserves

6.2 Energy generation and carbon control

Australia is currently in an unprecedented 'carbon tax' period of change, with a number of national policy measures being introduced by Federal Government to tackle the twin challenges of reducing carbon emissions and enhancing the country's energy efficiency. In 2011, the Government revealed its emissions trading scheme and also expanded its commitment to renewable energy by targeting a 20 per cent output from renewable sources by 2020. A number of measures have also been announced to help create economic incentives for businesses to invest in low and zero emissions innovation, including a proposal for an Australian renewable energy agency to manage a $3.2 billion research and development fund. A Next Generation Plant feasibility study will be conducted as part of the suite of recommended further studies (Table 7-3).

Within this context there are both opportunities and significant challenges to achieving a cleaner and leaner energy profile for major urban centres of the future, such as Murdoch. The structure plan can set some important benchmarks as statewide and local policies take shape, but it can also go further and put in place strategies and targets that, if adhered to by public and private consumers alike, can foster real change in consumption and generation behaviour. It is therefore recommended that a further study is undertaken to inform a target based strategy for the activity centre, leading to carbon commitments that can be adopted by major stakeholders.

Outside of the CBD, there are few sites in Perth with a concentration of energy demand like Murdoch. Between the University, St John of God Hospital and the new Fiona Stanley Hospital, there is around 50 megawatts (MW) of peak cooling demand, 20 MW of heating demand and 20 MW of electrical power demand in very close proximity, equivalent to the load demand of 10,000 typical houses. With further development in the pipeline, such as the mixed use precinct, the peak load demand could be equivalent to around 15-20,000 typical houses.

At present, the current focus of the major institutions such as St John of God Hospital and Murdoch University is on demand management, especially with air conditioning networks. The promise of a move to more sustainable energy use lies in the next phase of campus development. For example, Murdoch University currently has a district cooling system which serves the central area of the campus, and this could be expanded to serve its eastern precinct or other areas. With St John of God Hospital set to double its current peak cooling demand of around 5 MW under their proposed expansion plans, there may be scope for the University and hospital to coordinate during the design stage.

Whilst implementing controls over new development is practical, it is less easily applied to existing sites, particularly those of institutional scale. The University and hospitals at Murdoch are power thirsty with specialist needs that are not easily satisfied through alternative means. However, advancements in renewable energy technologies mean that there are no longer good reasons for these organisations to delay the switch, or transformation, to a greener energy existence. The new Fiona Stanley Hospital has set a significant lead with the adoption of a tri-generation plant, which uses natural gas instead of electricity. This system is new to Australia and is the first of its kind in an Australian tertiary hospital. It supplies approximately 40 per cent of the site's peak load demand and recycles waste heat to provide cooling.

With energy use and performance, the focus can often be too narrow on Green Star ratings alone, with the risk that broader sustainability objectives and opportunities are overlooked, such as economies of scale that may exist at the whole-of-centre level. Outside of individual buildings and boundaries, there may be scope to supplement the existing tri-generation plant that has been built to serve the new hospital, with the development of a next generation power plant that harnesses renewable sources and provides power to the entire activity centre. The development of a district cooling and heating system, for example, which interconnects Fiona Stanley Hospital, Murdoch University, St John of God Hospital and other major Murdoch users, would be a bold and unprecedented concept in this country.

The ambitions for growth at Murdoch need to be matched by resource (not just transport or economic) systems that optimise efficiency and take advantage of the diversity of lower carbon or more sustainable sources of fuel. In spite of Perth's sunny and breezy weather characteristics, solar and wind power as viable alternative means of energy remain limited and in small scale across the centre. These renewable sources tend to require large land or surface areas to hold the infrastructure that would supply power at scale and can often be incompatible with dense urban locations. Even so, the academic organisations are well placed to pursue research into, and ultimately trial the potential of, other renewable energy technologies such as geo-thermal, hydrogen cell or bio-gas (extracting methane from human and other organic waste). There is capacity within the expertise of these organisations to help Murdoch become a centre of excellence in clean energy applications.

There are a number of areas where immediate measures can be implemented with respect to carbon reduction and energy efficiency being:

- better traffic or travel management; and
- passive urban form and design responses.

The motor vehicle is one of the highest carbons emitters (15 per cent in Australia). In a culture and road based environment such as exists in Perth, a focus on reducing the climate related effects of private car use is an essential element of an integrated sustainable movement strategy (Figure 6.03). The strategy should embrace approaches to:

- reduce the need to travel in the first place;
- limit the degree of traffic access within or through the activity centre;
- promote car sharing as an attractive and cost effective means of getting to Murdoch;
- incentivise mode shift from private car to public or active transport;
- enhance low/zero polluting travel modes such as cycling or electric powered vehicles; and
- encourage short internal trips within the centre to be public transit or active based.

Even before the challenges of managing travel in our increasingly congested urban centres is contemplated, there are urban design opportunities to ensure that new development across the activity centre is more sustainable and energy efficient in layout, form and performance. For example:

- attention to solar orientation of urban blocks;
- ensuring solar access, especially in winter, to open spaces and courtyards;
- increasing natural landscape coverage, green spaces and corridors; and
- various measures to cool the urban heat effect – additional street tree planting, green walls, rooftop gardens, soft (not hard) landscape, underground car parking, surface water detention.

Figure 6.03: Traffic on Kwinana Freeway at Murdoch

6.3 Green building credentials

Australia has a national Green Star rating code for buildings managed by the Green Building Council of Australia (GBCA) which is increasingly an industry benchmark for a more proactive approach to sustainable architectural design. This is reinforced by national standards for energy efficient commercial buildings, embedded within the building regulations, which are more frequently being applied to other development types. Within the context of these national codes, individual states have started to set targets for energy efficiency and develop guidelines to inform architectural design standards as well as wider built environment policy.

The GBCA has also recently piloted a Green Star rating tool for communities that is being developed in two stages. Stage 1 involves the development of a national framework for sustainable communities that establishes five best practice principles to guide sustainable communities in Australia (Figure 6.04). Stage 2 will see the development of the rating tool to provide best practice benchmarks for assessing sustainable communities. Stage 2 will also define appropriate governance processes for accreditation, certification, review and continual improvement (GBCA, 2011).

Murdoch Activity Centre is a major State Government led development project and the structure plan should set the context for appropriate standards and expectations for a sustainable approach to all planned building and infrastructure across the centre.

St John of God Hospital, as well as the two large educational campuses — Murdoch University and Challenger Institute of Technology — are entering a phase of detailed planning for long-term expansion of their campuses. Whilst precinct masterplanning throughout the activity centre will consider green building standards within the context of the national codes, this will normally be applicable to individual buildings and infrastructure at later stages of the development process (Figure 6.05). What is needed are guidelines to inform earlier stages of the site-wide design to ensure that the urban form across the centre is consistent with strategic objectives for resource conservation.

There is therefore scope to develop detailed sustainability design guidelines for the activity centre to complement the urban form guidelines in this structure plan. These guidelines would address district scale design, principles for new buildings and infrastructure within precincts, appropriate minimum star ratings and performance targets for new buildings, and standards for the refurbishment of the existing

Figure 6.04: New Green Star code

Figure 6.05: High quality building design at Murdoch University

building stock. This work is recommended to be undertaken in conjunction with the State Government Architect's Office which is developing general design standards for public buildings as part of its Design Quality Program.

6.4 Materials and waste

Waste collection and management at Murdoch Activity Centre is currently undertaken by a variety of public and private contractors, reflecting the specialist nature of some of the organisations and their material outputs. Clinical waste, for example, from St John of God Hospital is disposed of off-site at a dedicated facility. It is understood that Fiona Stanley Hospital will have a similar arrangement, so there is immediate scope for the hospitals to partner in that respect.

Aside from major institutional or commercial organisations, domestic and business users in the area benefit from the location within the South Metropolitan Regional Council's catchment for its Canning Vale waste management facility. The Regional Resource Recovery Centre is a unique site with composting for organic waste, greenhouse gas abatement and green waste processing for mulching, and materials recovery and recycling. While predominantly set up for household waste, the facility also receives hazardous household waste including paint, oil and pesticides as well as hospital waste such as clinical, general, and paper and cardboard.

Figure 6.06: Vacuum waste and recycling system – Hammarby, Stockholm

As with most facilities of this type, the quality of resource recovery relies on the quality of separation of materials prior to processing. This could be improved with education, not just investment in 'at source' local facilities. The Canning Vale plant is part of the State's overall policy goal of a zero waste by 2020. Currently, around 30 per cent of all received material goes to landfill. The goal is to reach 10 per cent. This includes plastic in volume from domestic green bins.

In terms of Murdoch, there remains a need to coordinate and collaborate waste management practices within the centre, firstly starting with organic and general household waste, then potentially other areas. Other measures that could be employed through the planning system include:

- mandating a requirement for waste management plans for all development;
- incentivising waste reduction and maximising the use of waste bi-products;
- implementing appropriate education programs to promote responsible waste management at the local level, e.g. recycling and sorting, bin usage; and
- applying conditions to require a proportion of recycled materials in newly constructed buildings.

The specialist activities and institutions make it problematic to develop and coordinate a waste management strategy across the centre, yet there is scope for the local and regional councils to prepare a code which could be applied at precinct level. For example, targets could be set for new commercial and residential developments, including trialling of pilot schemes within the urban core.

6.5 Water resources

Groundwater

Rainfall in Perth is declining along with the natural watertable. This is in evidence at Murdoch where the natural bushland has been systematically cleared for large development projects and replaced by buildings and hardstanding areas. Rainfall which would normally drain directly into the aquifer, therefore lands on roofs and car parks and is piped to the mains stormwater drainage system, which ends up in the river or ocean. Whilst this water is not lost, it is lost from the local aquifer and results in declining watertables in inland areas, causing disruption and devastation to the natural flora and fauna (Figure 6.07).

Desalination plants may not be the complete answer to water shortages as the energy required to put water through the reverse osmosis process is excessive, along with the associated carbon dioxide emissions. The most significant benefits in terms of water savings, apart from the principle of reducing consumption habits, can therefore be achieved by capturing and recycling rainwater and grey water on-site and ultimately releasing it into the soft landscape and natural garden areas of the activity centre. This should mimic the native environment as much as possible.

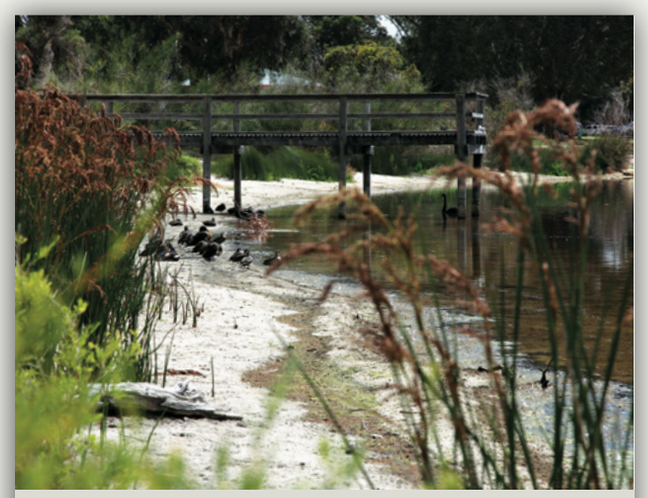

Figure 6.07: Bibra Lake wetland

Bioswales and reed beds can provide a natural filter for the wastewater before it returns to the local aquifer. Other water conservation measures include the option of a water treatment plant (in collaboration with Water Corporation) where wastewater is partially treated and then reticulated onto a forested area for further bioremediation. The area would have to be supplemented with wetland vegetation.

Creating a water-sensitive urban environment with maximised natural vegetation also has other benefits such as reducing the 'heat island' effect and improving local micro-climates which ultimately reduces energy usage by active air conditioning systems.

Wetlands

Murdoch is uniquely positioned to capitalise on the multiple assets of its surrounding natural landscape. Protection and restoration of this habitat's ecological value and clever integration with urban development areas can provide natural places for both wildlife and the community to access, while facilitating water detention and urban drainage in a passive environmental system.

The Murdoch wetlands are of exceptional importance as habitat and an ecological corridor between the Beeliar Regional Lake system and neighbouring bushlands. The outcomes of flora/fauna surveys will inform and need to be reflected in local structure plans. The broader context of ecology across the MAC Structure Plan area is to be investigated through the proposed Biodiversity Assessment (refer to Table 7-3 Further Studies). Additionally they have a wide scope of recreational, aesthetic, cultural and social values. Management of the wetland habitat and their linkages to maintain biodiversity and ecological functions, while also offering a range of human use benefits, will require adoption of best practices in response to changing environmental conditions. This should yield many sustainable benefits for the natural and urban systems within the future Murdoch.

Urban wetlands have become increasingly used as a method to accommodate passive ecosystems within the built environment, and local and international examples offer the scope and inspiration as to what can be created using

this type of approach. Wetland environments can provide attenuation for urban drainage, a habitat for local species and recreational space for human exploration (Figures 6.08 and 6.09).

The medical profession, as well as environmental designers, are beginning to question the 'health' of the wider urban environment — as seen in the increasing volume of study into how urban environments can better promote walking and exercise, and how nature influences health and wellbeing. The Heart Foundation in Australia has recently commissioned a discussion paper that explores the economic benefits of making streets more walking and cycling friendly.

There is a unique opportunity to create an urban wetland corridor through the heart of the Activity Centre which provides habitat and ecological function and also an attractive landscape setting for new development, while offering recreational and cultural opportunities. An urban wetland system could be designed in such a way as to allow the flow of water and wildlife through the precinct but within a man-managed environment as opposed to an unimpeded natural one. This key piece of green infrastructure could allow for development close to the edges of the corridor, including routing of the drainage system through the new town centre at Murdoch Square as a feature within the urban realm.

Local water management strategy

There is currently a lack of stormwater infrastructure across the activity centre and available information is insufficient to provide an overall view of the drainage network across the activity centre within private and public estates.

The underdeveloped stormwater system can be viewed as an opportunity to implement a new and robust sustainable urban drainage strategy to support the further development of the centre. In order to inform the design of a district-wide system, a regional/district water management study is recommended to be carried out under the direction of the Department of Water with the full support of the major landowners in the area.

In addition, investigations should be made with Water Corporation about the capacity of the wastewater network to serve further development at Murdoch. The underground sewer mains within the University grounds may require modification to support development within the southern and south-eastern part of the campus. However, opportunities to provide a long-term connected system across the activity centre should also be explored as part of the next stage of strategic planning for Murdoch.

Figure 6.08: Point Fraser – water-sensitive urban design

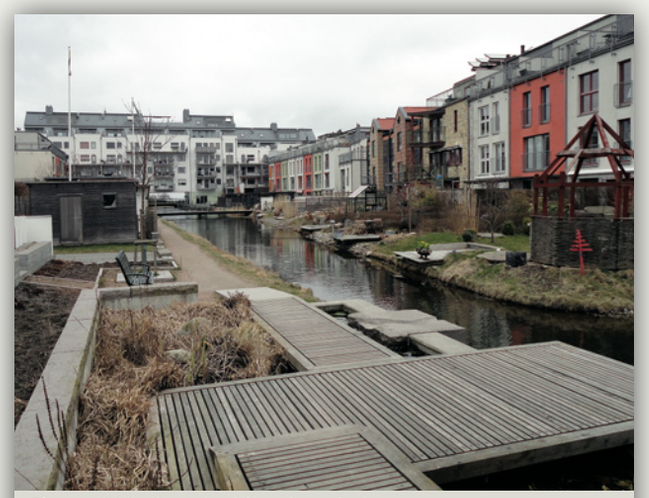

Figure 6.09: Sustainable urban drainage – Bo01, Malmo, Sweden

6.6 Flora and fauna protection

Previous surveys in and around the study area have revealed the presence of rare and priority fauna species and a number of protected vegetation types. This is expected given the extent and quality of the natural landscape. However, habitat fragmentation has continued to occur and this is threatening fauna in particular, with some populations reduced to critical levels. The outcomes of flora/fauna studies will inform and be reflected in Local Structure Plans. The broader context of ecology across the Structure Plan area is to be investigated through the proposed Biodiversity Assessment (refer to Table 7-3 Further Studies).

A level 2 flora and vegetation survey of remnant native vegetation is recommended in support of local structure planning and following the structure planning stage to properly inform the final selection of land-use options and achieve conservation outcomes at the landscape scale. This will be particularly important in identifying the presence of significant trees providing habitat for threatened and priority fauna such as Carnaby's white-tailed black cockatoo as well as other significant plants such as *Nuytsia floribunda*.

In addition, a framework of actions to help redress the current situation is as follows.

1. Preserve critical natural environmental zones for the conservation of important wetlands and forests that serve a multitude of functions and values. Link preserved areas to surrounding development so that their values can be appreciated and used.
2. Restore or create suitable habitat for local threatened flora species to enable Department of Environment Regulation to undertake formal translocation of these species. Present populations of threatened flora or threatened ecological communities should be targeted for restoration that is focused at improving the general condition of the local habitat; therefore increasing the chance of long-term survival.
3. Maintain local green corridors that link important wetlands within the study area as well as the maintenance of an existing regional ecological linkage that connects the Swan River with North and Bibra lakes. Although important for fauna movement within and through the study area, these green easements can be constructed along compatible pedestrian paths for enhanced aesthetics, enjoyment and sense of place.
4. Investigate the potential for subterranean fauna corridors and connectivity along/across key transport routes, e.g. a green link with fauna access beneath Murdoch Drive or Farrington Road.
5. Assess a fee on land owners, developers and tenants for the management and enhancement of natural resources within the study area. The monies could be used to fund environmental initiatives, including the planting of native vegetation to enhance wetland buffers and recreational areas.
6. Enhance wetlands and forests to improve aesthetics, stormwater storage, groundwater recharge and other functions and values.

The landscape strategy set out in this structure plan provides for protection and enhancement of wildlife habitat and corridors across the activity centre. The above actions are for relevant planning authorities and major stakeholders in the Murdoch area to consider implementing through their local policies, plans and systems.

Figure 6.10: Fiona Stanley Hospital viewed from Murdoch University

6.7 Conservation areas and other regional landscapes

The broadscale urban structure and ecological and hydrological corridors existing within the Murdoch area have been outlined. In response, a conceptual landscape framework has been proposed to manage the growth of the activity centre, as explained in Chapter 2: Strategy. This respects the dominant scale of the regional Beeliar Lake system and its influence on the environmental conditions of Murdoch (Figure 6.11).

The key design principle for the urban expansion of the activity centre is that development occurs within the setting, ecology and drainage role of a rehabilitated landscape. Fire management should be taken into account in local structure planning and the use of perimeter roads is recommended between conservation areas and urban development to suppress fire. This will ensure not only a more considered response to the indigenous environment, but a more sustainable manner of urban growth which is in harmony with its local ecosystem. Fire management should be taken into account in local structure planning. Perimeter roads are recommended between conservation areas and urban development to suppress fire.

In relation to designated conservation areas, the Department of Environment Regulation sets appropriate buffers around natural wetlands and guidelines for determining buffer requirements. Currently there is a 50 metre minimum standard but further analysis of the wetland characteristics within the study area is required to inform precinct development limitations. Generally, the preservation of remnant vegetation will add value and amenity to the area and its users/visitors in terms of recreation, educational pursuits and aesthetics. Conservation areas are shown in Figure 6.12 as part of the strategic landscape and open space structure.

Figure 6.11: Murdoch landscape frame concept

6.8 Open space structure and links

The connections associated with the proposed landscape structure for Murdoch work at three main levels.

- Broadscale urban structure and legibility.
- Ecological and hydrological corridors.
- Active transport.

Active transport, such as walking and cycling, will be given priority throughout the centre and is illustrated with the schematic circulation and connection areas shown on the open space structure (Figure 6.12).

The preparation of future local structure plans, masterplans or detailed area plans will need to ensure that the active transport is systematically integrated and continuous and is given priority over private vehicular transport. In addition to the active circulation demarcated in the plan there will be additional circulation for secondary level access, such as walking trails and footpaths for passive recreation. More detail on the overall movement strategy for the activity centre is previously set out in Chapter 4.

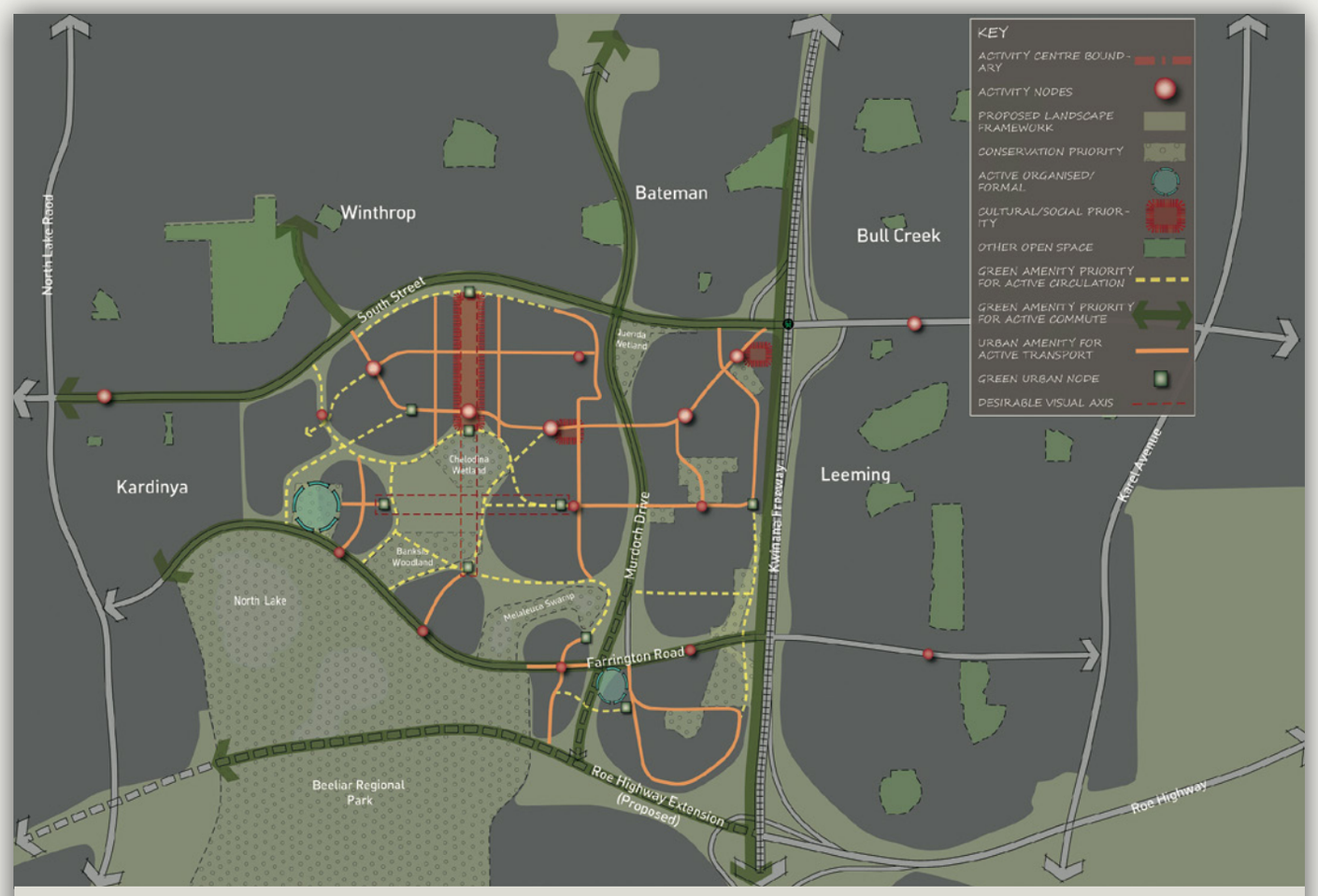

Figure 6.12: Strategic open space and circulation structure

Circulation

There are three circulations and connection categories, as follows.

- **Green amenity priority for active commuting:**

  This is associated with the main roads such as Murdoch Drive. These routes will include dedicated cycle and pedestrian paths with high quality visual amenity from significant planting and revegetation. The active transport would be dominated by commuter cycling to surrounding suburbs and the train station.

- **Green amenity priority for active circulation:**

  These are circulation (predominantly non-vehicular) routes through the centre associated with, or directly connected to, the open space areas. They include incursion of linear green open space or greener streetscapes into the developed area and are an extension of the urban amenity for active transport routes.

- **Urban amenity for active transport:**

  This category of circulation centres on attractive streetscapes with pedestrian and cycling priority or shared priority, for example, the proposed urban greenway/transit spine.

The built and natural environs of the activity centre will need to be supported by a suitable management and maintenance regime to control the impacts of increased pedestrian accessibility and foot traffic, as in any major urban centre

Green urban nodes

The demarcation between transitions or intersections of the urban amenity and green amenity for active transport routes occurs on a green urban node at key locations. A green urban node could be a small square, a pocket park or a small planted space which will provide both amenity facilities and visual legibility and orientation within the active transport network. These occur predominantly in, or at the edge of, urban built environments. These nodes do not need to be significant or dominant landmarks to provide the desirable legibility and orientation cues. Low key contrasts to the adjacent built form character can successfully function as orientation cues, especially if associated with activity and amenity.

There is an existing network of smaller pocket spaces and pedestrian paths throughout the core University campus. These provide for good connections, recreation stops and incidental spaces and will serve the growth of this part of the activity centre well. New development should seek to link into this established pattern. To the east, in the hospitals precinct, a number of courtyard gardens are being developed within the building framework of the Fiona Stanley Hospital site, and more significant open space relief is available within remnant conservation areas.

Open space priorities

The strategic open space plan outlines landscape/functional priorities for a significant proportion of the open space. The structure plan proposes the priorities to avoid the notion of zoning or separation of open space functions or facilities into, for example, organised sports or ecological preservation only. Provision of a diversity of attractive activities or facilities is important to encourage use and to achieve the optimum mental and physical health benefits that are associated with successful open space design. By demarcation of priorities the structure plan encourages innovation and diversity throughout the open space network for any potential complementary amenity, function or outdoor facility with that priority.

The open space that is not given a priority would include active and passive functions and facilities, and will provide a green setting for adjacent urban development or the priority open spaces. This open space includes the landscaped grounds within St John of God Hospital but will not include large developments such as recreation centres or community halls. The open space categories are as follows.

- Conservation priority: will be dedicated to preserving ecological and hydrological functions. Planting will be limited to local species. Complementary facilities could include water-sensitive urban design infrastructure, walking and exercise trails.

- Active organised/formal: will be primarily sports fields and courts with associated club houses and social facilities required for organised sport. Complementary facilities include treed walkways to the perimeter of fields for passive recreation, windbreaks and casual exercise, playgrounds associated with the social facilities or near residential development.
- Cultural and social priority: is for the campus spine of courts and quadrangles and includes the proposed town square, civic spaces or urban parks within the urban core. The character of the new spaces will primarily be urban and may include significant hard landscaping. These open spaces may include exotic planting, such as deciduous trees to provide access to winter sun and provide summer shade.

6.9 Embellishing cultural heritage

The Murdoch area does not contain any buildings or structures of European heritage value and there are no urban sites registered on the local or State heritage Inventories. However, a number of sites of indigenous cultural value exist around the Murdoch area, reflecting the extent and characteristics of the natural landscape and connections to the Beeliar wetlands (Figure 6.13).

The majority of identified camp sites are situated on the perimeters of the University campus and follow the pattern of swamps and wetlands. The significance of the wetlands extending south to Mandurah to the indigenous Nyungar is evidenced through local oral histories provided by Nyungar informants, early colonial diaries and archaeological evidence. The chain of lakes was a key transport route and Bibra Lake was also a major camp location due to a plentiful food supply.

The structure plan has a key role to play in ensuring that these sites are appropriately protected or respected in the context of the proposed urban development structure. The landscape framework conceived for the study area provides for the full retention and conservation of formal wetland areas.

Permanent camp sites are identified on the Department of Indigenous Affairs Heritage Register. There is a camp site at the Discovery Way/Murdoch Drive intersection which is located with the proposed urban core of the activity centre. It was previously a nominated site but has not been included in the permanent register. The Department has advised that the site was either too disturbed to keep as a registered site or did not meet the criteria to be on the permanent register. Consequently, development in this area is not restricted but could include references to the cultural links (for example, interpretive signage or public art).

Figure 6.13: Beeliar Lake system

In order to inform subsequent precinct or detailed area planning for other identified sites across the centre, consultations with the Department of Indigenous Affairs will help to identify the features and sensitivities of the camp locations and enable discussions about an appropriate design response. The general approach across the activity centre should be to seek to maintain and enhance cultural heritage links as these create distinctiveness and add value to the overall urban environment.

6.10 Further investigations

Various studies and investigations are recommended for the subsequent planning stages so that resource conservation objectives for Murdoch are achieved early in the planning process, significant impacts on relevant environmental factors are avoided (where possible), and the costs of mitigation and environmental management are reduced.

Considering the area and its environmental value, the following strategic studies are recommended to inform preparation of local structure plans. Some of the studies may be required at later stages in the development process. The studies that are most important to the area and/or are normally conducted at the planning stages include:

- district water management strategy;
- Carnaby's and Forest red-tailed black cockatoos survey (foraging, roosting and nesting habitat);
- Graceful sun-moth surveys (conduct in March);
- wetland delineation and buffer studies;
- level 2 vegetation/flora survey that identifies remnant vegetation areas of habitat for conservation significant orchid species as well as other potential conservation significant flora species (conduct in Spring);
- ecological linkages study;
- preliminary site investigation to assess the risk of soil and groundwater contamination; and
- a district energy strategy to address the potential of using renewable energy sources, shared energy systems and other power efficiencies.

Some of the above studies can be conducted in conjunction with others (e.g. cockatoo forage habitat with level 2 vegetation surveys). The requirement for flora and vegetation surveys is generally based on the size of the area to be identified for particular land uses and/or development, and the known significance of the vegetation on site. On this basis, flora and vegetation surveys are unlikely to be required for areas that have previously been cleared or are proposed to be redeveloped.

The level 2 survey should be carried out in accordance with Environmental Protection Authority and Department of Environment Regulation guidelines.

An ecological linkages study should be undertaken as part of the next planning stage due to the compatible spatial associations and connection at the landscape scale.

Figure 6.14: Quenda Wetland, Murdoch