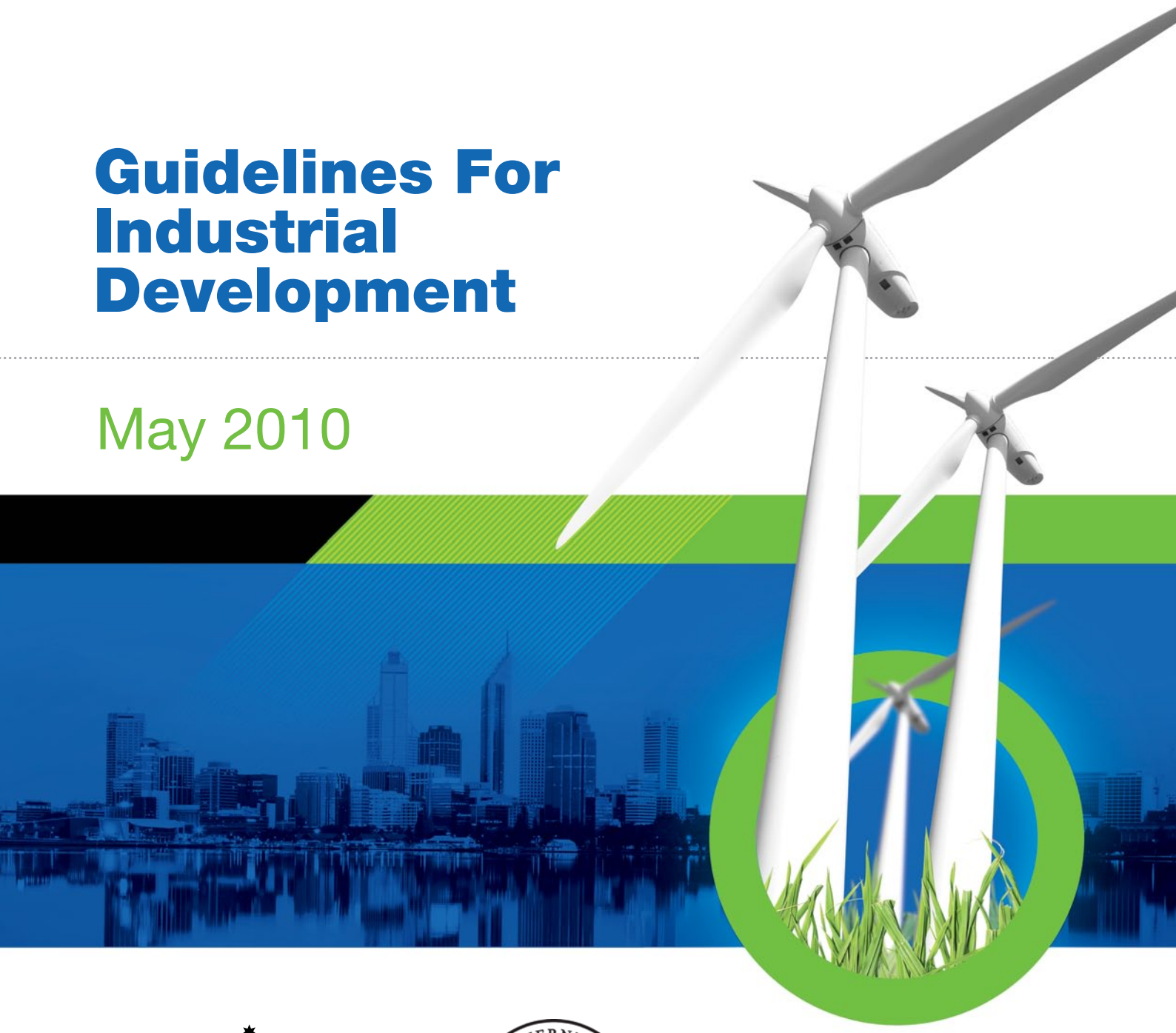
Perth Region NRM

Guidelines For Industrial Development

May 2010



Australian Government

THE GOVERNMENT OF WESTERN AUSTRALIA

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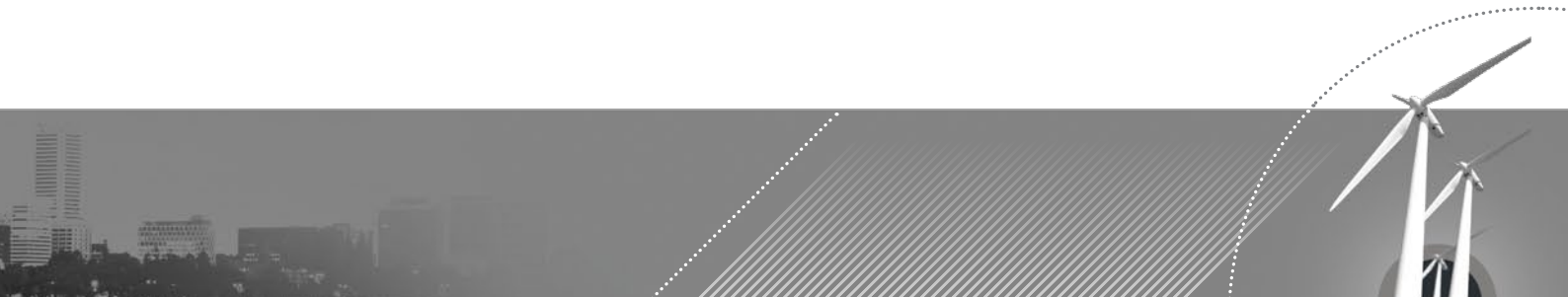


Chapter 1:
Introduction

There is an increased awareness within Australia and the community that our cities and towns including the areas which support them such as industrial and commercial areas, need to be more sustainable. A substantial amount of information is now available to improve the way new development considers and uses our natural resources; however, this has focussed largely on urban and residential uses. These Guidelines aim to raise awareness of issues and actions that can be taken to improve the environmental, economic and social sustainability of new industrial areas as part of the planning and development process.

Businesses in industrial and commercial areas are constantly striving for more economically sustainable ways of operating through the creation of synergies and partnerships and the adoption of new technologies. Recent global awareness of the potential impact of climate change and uncontrolled emissions has led to a greater recognition that traditional methods of managing waste with end-of-pipe solutions are no longer environmentally or economically viable. Bioregional development is increasingly favoured, where resources and materials are sourced from local areas, minimising transport and packaging requirements. Greater consideration is given to the health and safety of resident workers, building a sense of place through community networks and providing opportunities for sharing systems and resources.

The diverse nature of industrial and commercial operations requires specific solutions to achieve more efficient and effective use of the available environmental, economic and social resources. These Guidelines consider the operational aspects of industrial developments, providing generic strategies and solutions which may achieve sustainable industrial development.

1.1 Industrial development

Industrial and commercial development, together with its supporting infrastructure, needs to be designed to be resilient and adaptable, now and into the future. Resilience, adaptability and environmentally, economically and socially-responsive outcomes can be achieved through the creation of industrial developments which add value to businesses and communities by optimising the use of energy, materials and community resources.

The concept of industrial ecology is able to be applied in industrial areas by minimising the use and maximising the reuse of resources. The concept of industrial ecology is based on the recognition that no waste is produced in natural systems, as waste from one organism is utilised by the next in an unending chain. Industrial areas which have been specifically planned, designed and constructed to achieve environmental, social and economic goals are more likely to be able to optimise the transfer and use of waste and materials.

Although there are often perceived constraints to the development of industrial areas which achieve environmental, social and economic goals, such as increased up-front costs and extended time-frames for planning and development, there are many recognised benefits. These include long-term operational benefits which can be demonstrated via shortened pay-back periods.

1.2 Policy basis

The State framework for sustainability is provided by the *Western Australian State Sustainability Strategy* (Government of WA 2003) which contains the principles, visions and goals for conscious action towards meeting the needs of current and future generations through integration of environmental protection, social advancement and economic prosperity. This vision notes the importance of governance and the concept of global contribution in the achievement of better outcomes for natural resources, settlements, businesses and the community. This framework reflects national agreements such as the *National Strategy for Ecologically Sustainable Development* (1992) and the draft *Australia's Biodiversity Conservation Strategy 2010–2020* (2009).

The key principles for the integration of ecological, economic and social considerations into planning decision making are set out in *State Planning Policy 2: Environment and Natural Resources* (2003). It notes the need to, amongst other objectives:

[A] Actively seek opportunities for improved environmental outcomes including support for development which provides for environmental restoration or enhancement;

[B] Protect significant natural, indigenous and cultural features, including sites and features significant as habitats and for their floral, cultural, built, archaeological, ethnographic, geological, geomorphological, visual or wilderness values;

[C] Take into account the potential for economic, environmental and social (including cultural) effects on natural resources; and

[D] Take account of the potential for on-site and off-site impacts of land use on the environment, natural resources and natural systems.

Other guidance is provided by *State Planning Policy 3: Urban Growth and Settlement* (WAPC 2006a) which aims to manage growth and development of urban areas in response to the social and economic needs of the community and in recognition of relevant climatic, environmental, heritage and community values and constraints.

The draft *State Planning Policy: Network City* (WAPC 2006b) also provides clarity around the principles for planning decision-making in the Perth and Peel regions. It identifies the need to:

- Enhance efficiency of urban land use and infrastructure;
- Protect and rehabilitate the environment and improve resource efficiency and energy use; and
- Enhance community vitality and cohesiveness.

Proposals which have the potential to significantly impact on the environment may also be subject to formal environmental impact assessment under Part IV of the *Environmental Protection Act 1986*. Part V of the Act regulates discharges to land, air and water as well as disposal of certain waste products.

The Environmental Protection Act 1986 also contains a number of Regulations for the management of pollution including, the *Environmental Protection (Controlled Waste) Regulations 2004* and the *Environmental Protection (Unauthorised Discharge) Regulations 2004*. These Regulations are discussed in chapter 5 of these Guidelines.

Other legislation, policy and guidance documents which have relevance for industrial development include:

- *Commonwealth Environmental Protection and Conservation Act 1999*
- *Aboriginal Heritage Act 1972*
- *Wildlife Conservation Act 1950*
- *Rights in Water and Irrigation Act 1914*
- *Waterways Conservation Act 1976*
- *Metropolitan Water, Supply and Drainage Act 1909*
- *Metropolitan Water Authority Act 1982*
- *Contaminated Sites Act 2003*
- EPA Guidance Statement No.33 Environmental Guidance for Planning and Development, particularly Section B, C and D
- State Planning Policy 3.4: Natural Hazards and Disasters 2006
- State Planning Policy 4.1: State Industrial Buffer Policy (1997, draft 2004)
- WAPC Development Control Policy 4.1 – Industrial Subdivision
- Planning for Bushfire Protection (FESA & WAPC 2004)
- Stormwater Management Manual for WA (DoW 2004-2007)

1.3 Using the guidelines

These Guidelines are intended to be used and applied by a variety of stakeholders with an interest in industrial development in Western Australia. These stakeholders may include but are not limited to town planners, environmental scientists, engineers, architects, urban designers, land developers, local government and State government. Additionally, industrial operators, natural resource management and community groups may also benefit from the information contained within these Guidelines.

These Guidelines aim to facilitate better industrial development in Western Australia. They are structured to provide guidance regarding the implementation of sustainability principles in the planning, design, construction and operational phases of industrial development.

These Guidelines have been prepared with the best available information at the time. Innovation and technological advancement will lead to improvements in best practice. All opportunities for improved outcomes should be explored when planning for industrial development, including those which are beyond the current level of understanding.

1.3.1 Applying the guidelines

These Guidelines contain objectives for each of the key elements which should be met at each phase of the planning and development process (see section 1.3.2). The objectives may be achieved through the implementation of a range of strategies which are also identified for each planning and development phase. It is recognised that not all of the strategies may be able to be implemented for each industrial area and the degree of implementation will depend on site-specific factors and development circumstances. The application of the Guidelines is depicted in figure 1.

The objectives and strategies in these Guidelines have been developed to be practical, flexible and robust as well as to encourage innovation. It is not anticipated that any single industrial development would incorporate all of the recommendations within these Guidelines, but rather that they use those which would be applicable and achievable within the context of the particular industrial project.

It should also be noted that while these Guidelines have generally been developed with a focus on the development of new industrial developments, the Guidelines are robust enough to be applied during the redevelopment, expansion, upgrade or retrofit of existing industrial areas.

Each chapter of these Guidelines addresses one phase of the industrial development process, providing information on all the elements of industrial development. This is to facilitate ease of use, so that practitioners can focus on the information and requirements which are relevant to a particular stage in the planning and development process. It is useful to also consider the requirements of future stages, so that these can be planned and budgeted accordingly.

1.3.2 Phases of the planning and development of industrial areas

For the purposes of this document, the phases of industrial development are described as:

[1] Site selection and assessment;
[2] Structure planning and subdivision;
[3] Lot development; and
[4] Operational occupancy.

Phase 1: (Chapter 2) Site selection and assessment
Site selection and assessment requires the consideration of location and site features to identify the optimal position for a new industrial area. Chapter 2 of the Guidelines contains strategies and actions which should be considered when selecting and assessing locations for industrial developments, including site opportunities and constraints and required technical investigations.

The planning stage at which site selection and assessment occurs may vary depending on the size of the proposed industrial area, however the considerations outlined in Chapter 2 should be completed as part of strategic planning at the sub-regional or district level, or as part of the statutory rezoning of the land for industrial development purposes. The achievement of good industrial development at this stage will largely be achieved via the comparative assessment of locations and broad concept for the industrial area. Implementation mechanisms are explored further in section 1.5.

Phase 2: (Chapter 3) Structure planning and subdivision
The second phase of the development of industrial areas should determine the optimal form of the development. This may occur via development of a local structure plan or as part of the process of subdivision.

Local structure plans contain objectives and requirements for the future subdivision and development of the area to which they apply. Local structure plans provide a framework for the provision of infrastructure as well as a structure for the form of the development which outlines matters such as transport corridors, street and block layout, natural features to be retained and water management measures.

A local structure plan may be required to be approved prior to the subdivision of the land under the provisions of the zone. This is likely where an area is zoned for “Industrial Development”, as the structure plan provides necessary information to support the future subdivision and development of the area.

This also provides an opportunity for the preparation of precinct design guidelines which outline requirements for lot development and built form. The preparation and implementation of precinct design guidelines ensures the industrial development meets identified environmental, social and economic outcomes and agreed levels of performance.

In some instances a structure plan may not be required and therefore subdivision may occur subsequent to rezoning. This is generally in areas which have been rezoned for a long period of time or in which there are only a few lots.

The process of subdivision requires an application to be made to the Western Australian Planning Commission, which may be approved with or without conditions. Where an approved structure plan exists, subdivision should generally be in accordance with the structure plan.

This phase also includes the construction of the subdivision, which generally involves bulk earthworks, the construction of roads and the installation of services and infrastructure.

Actions are required at each of these stages in the design and development of industrial areas to achieve improved outcomes for the environment, economy and community. These are outlined in Chapter 3.

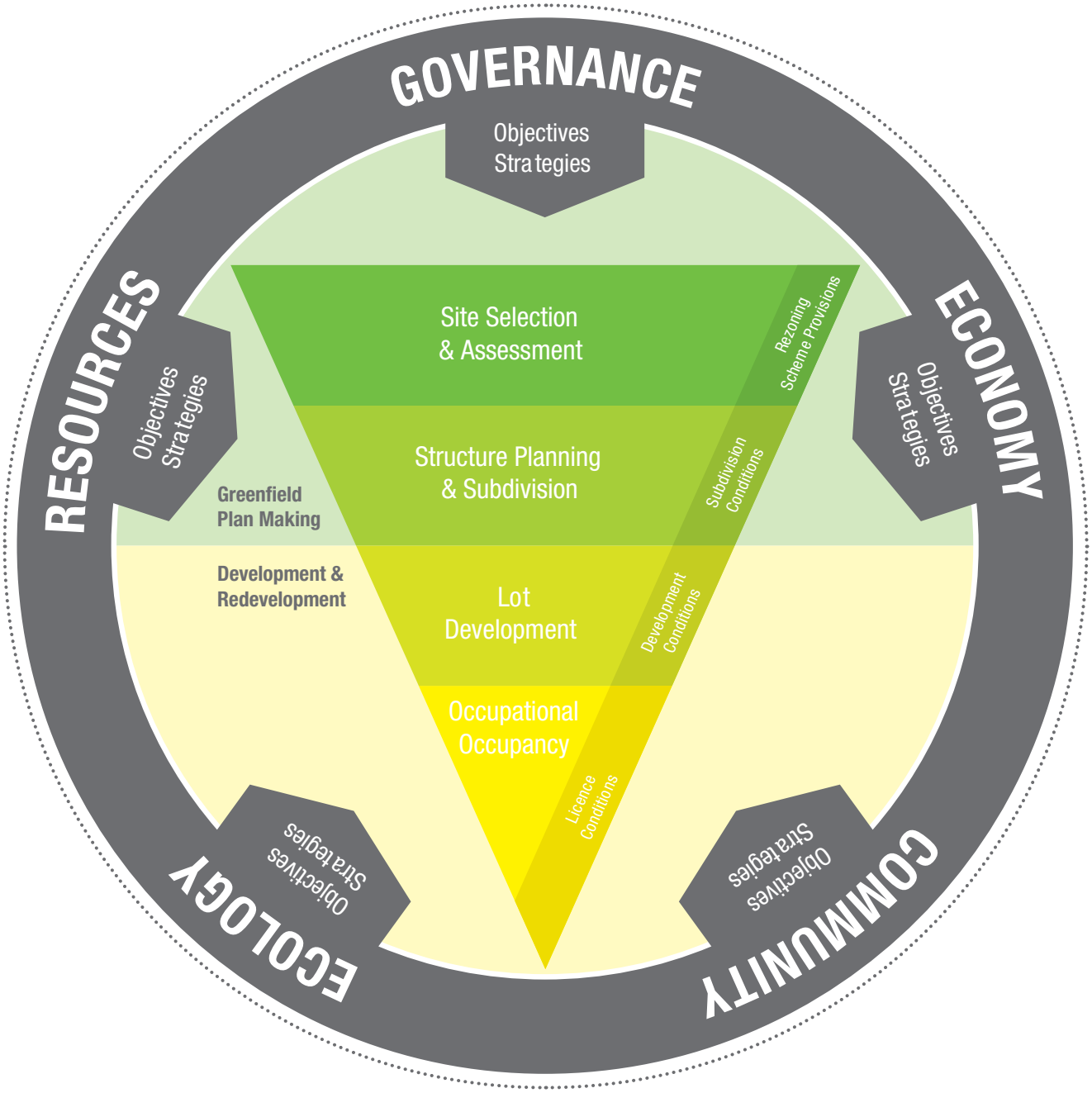


Figure 1: Implementation framework for the Guidelines.

Phase 3: (Chapter 4) Lot development

Lot development involves the design and construction of the building and associated infrastructure within the boundary of the lot. Consideration is generally given to site planning and orientation, built form, water and energy requirements and landscaping.

In most industrial areas, the construction of a building or premises requires development approval and/or a building licence. Guidance for lot development may be provided by the local government or precinct design guidelines.

Actions and strategies which should be considered during the planning and construction of the building and premises are outlined in Chapter 4.

Phase 4: (Chapter 5) Operational occupancy
The chapter on operational occupancy, Chapter 5, provides guidance for strategies and actions which can be implemented to improve the operation of individual premises and the development as a whole.

The operational phase is the longest of an industrial development. It is during this phase that resource efficiencies, economic and social benefits and reduced emissions are realised. These benefits are often identified as part of the business plan or environmental management plan/system for the premises.

The importance of establishing a centralised management body for the industrial development is highlighted during the operational phase, particularly through the opportunities for management and coordination in areas such as recruitment, marketing, shared infrastructure and capacity building. Options for a centralised management body are explored in Section 1.4.

There are many drivers for increasing the efficiency of industrial operations, most notably cost. Significant savings can be achieved by reducing the amount of resources used and waste generated as well as addressing social and employment issues. Some broad strategies addressing these issues are provided in Chapter 5.

1.4 Elements of industrial development

These Guidelines propose that more sustainable industrial development may be achieved at each phase of the planning and development process by addressing five key areas or elements:

- Governance
- Ecology
- Resources
- Economy
- Community

Each element is addressed by a series of objectives and strategies which, when implemented, can reduce the environmental impacts and increase the economic prosperity and social benefits of new industrial developments. The objectives and strategies within this guide will also act to identify and encourage opportunities for excellence and innovation in urban design, built form, land use and functionality within new industrial developments.

1.4.1 Governance

The importance of governance structures and the critical role they play in achieving sustainable development cannot be underestimated. Achieving sustainable industrial development requires the integration and coordination of traditional planning and development practices so that a multidisciplinary approach can be achieved at each stage of the process. An appropriate centralised management body should be identified to suit the development and may be different for each phase of planning, development and operation.

To date, the role of the centralised management body in Western Australia has largely been played by local and State governments, particularly during the planning and development phases. Experience nationally and internationally has shown that to successfully apply the principles of industrial ecology and enhance the future viability of a development, a centralised management body is required, particularly during the operational phase.

The most suitable structure and membership of this management body will vary, depending upon the requirements and phase of development. It may be necessary to start with one structure and move to another as the development progresses. However, consideration should be given to the benefits of continuity and adaptability with regards to management structures, as well as the opportunities for alliances and partnerships. Possible structures for the centralised management body include;

- A property management body, which can be a partnership between the developer and government with a focus on attracting occupants, maximising synergies and maintaining shared services, which would be most suited to the site selection and structure planning phase;
- An industrial development officer or team, housed by the local government (this option may be suited to smaller industrial areas or local governments who could pool resources with adjacent local governments). Local government industry officers may also fulfil an enforcement role as part of their management duties; or
- An incorporated business association, whose members are drawn from the businesses occupying the development or a local chamber of commerce and industry. This self-management system would be more applicable for the operational phase as it focuses on the long-term viability of the development including by-product exchanges, self-regulation, capacity building and/or community interactions.

The often lengthy development timeline of industrial developments necessitates an adaptive management approach to their planning and construction. Provision should be made for the monitoring, evaluation and review of the objectives and requirements of structure plans or guidelines, with clear roles and responsibilities for any necessary responses/actions.

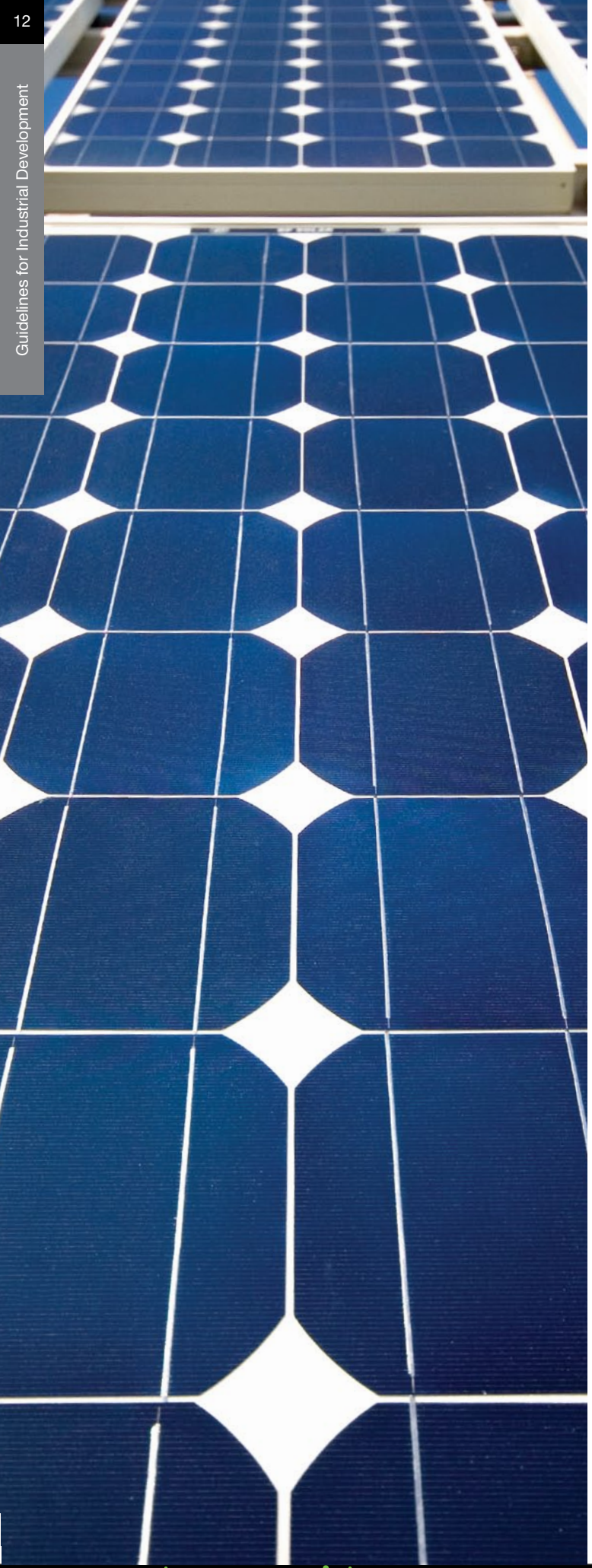
Another important objective is to ensure that measurable targets are developed alongside specific development recommendations in order to more definitively quantify and track the benefits of industrial development. Generally, this requires pre-and post-development monitoring or the comparison of indicators between an older industrial area and a recently constructed industrial development. While not all recommendations can be measured in a quantifiable way, having a range of measurable information across the environmental, social and economic sectors will enable some conclusions on the 'success' of the industrial development to be made and allow for future amendments for the Guidelines so that they may better deliver their intended objectives.

To guide the implementation of these targets, it is important to develop a broad concept plan for the initial planning phases of the development, which will later translate into the development of precinct design guidelines.

The broad concept plan should be developed after the site has been selected and should include the vision and objectives of the development. The objectives will be site dependent but should focus on the elements presented throughout these Guidelines. The concept plan should then inform the precinct design guidelines, which can specifically list requirements for lot development, built form and operation.

The development of industrial estates should include community involvement and awareness during the design, establishment and operation of the estate to facilitate greater positive social impacts and awareness. Improved community involvement will require a new approach to consultation over and above the minimum advertising of development proposals required under current town planning and environmental planning approval processes. Active, genuine and continual community involvement facilitated through workshops, committees and public forums will not only allow community views to be more fully understood, but will also allow local communities to develop a sense of ownership of their local industrial centres and facilitate stronger communities.

Although the governance structures of regulatory agencies are also important in the delivery of sustainable industrial development, they are not addressed by these Guidelines.



1.4.2 Ecology

The consideration of ecology as part of industrial development is a cornerstone of eco-industrial development. It requires the identification of existing environmental conditions together with strategies to protect significant assets and manage any impact on land, water or air resources. Matters to be considered include landform, landscape, soil and land, bushland and vegetation, wetlands, waterways, groundwater and buffers to and from proposed development.

Actions are required to address ecological matters at each phase of the planning and development cycle and these are discussed in each chapter of the guideline.

1.4.3 Resources

For the purpose of this guideline the term “Resources” applies to land, water, energy, waste and materials used or consumed during industrial development and operation. Strategies for the supply and use of resources as part of the planning, design, construction and operation of industrial areas should promote innovation and efficiency, consider opportunities for the use of renewable resources and the reuse and recycling of all resources.

The use of resources also has the ability to impact on the ecology of an area, primarily as a result of pollution or emissions. Measures to prevent pollution from the use of resources or disposal of waste are required to be implemented at phases 2, 3 and 4, as part of construction of the subdivision, lot development and operation of the industry. Consideration must also be given to the potential for the industrial area to produce off-site emissions such as gaseous emissions, noise, dust, odour and light. Appropriate management options, including siting and buffers, should be considered at each phase.

A significant contributor to the greenhouse gas emissions generated by an industrial area is that of transport. The provision of efficient transport networks, including freight, road, rail, cycling and pedestrian routes and access can reduce travel distances and facilitate the use of less greenhouse gas intensive modes of transport. Transport is discussed in the section on energy.

1.4.4 Economy

The economic success of a development depends on a variety of factors. These include the location of the development and its connectedness to freight and other transport networks as well as to critical suppliers and product markets. Other factors include the availability of services and infrastructure; the diversity and complimentarily of uses; and the ability to react flexibly and adaptively to future economic, social or environmental changes.

An economically successful development will offer employment opportunities on various levels for the local and regional market as well as ensure its compatibility and acceptance by surrounding land users. The reputation of a development is important to attract future businesses and hence the planning and preparation of safe, healthy and attractive industrial developments and workplaces is essential for future economic success.

By creating a sustainable work environment, workplaces and businesses will attract people - a significant factor in the economic success of any business. Hence places fit for business also need to be places fit for people.

While there are a number of measures within these Guidelines to facilitate an economically successful industrial estate, the ultimate determination of a successful industrial estate will be its ability to attract, support and retain successful businesses. Retaining the centralised management body throughout the operational phase to coordinate marketing and promotion, maintain alliances and partnerships and seek innovations to keep ahead of the market is critical to enhance economic viability.

1.4.5 Community

Industrial development should address potential social impacts and develop strategies and designs to maximise the benefits to the community from employment, services and infrastructure. This approach needs to commence at the site selection phase for sustainable industrial development and carry through to the ongoing operational phase.

Industrial developments should result in places of employment that are more than merely functional. They should provide safe opportunities for recreation and social interaction in spaces that are designed at the human scale not just at the mechanised industrial scale. These can be places where people are proud to work in, and proud to live nearby.

1.5 Implementation through the Western Australian land use planning system

The key mechanism for application of the Guidelines is through the land use planning system. Although current planning policy supports the need for more sustainable industrial development, there is limited guidance as to how to achieve this. These Guidelines recommend strategies and actions at various stages of the planning and development process which should be implemented to improve the way industrial areas achieve environmental, and social objectives, as well as being economically feasible.

Although improved outcomes can be achieved through voluntary implementation of the recommendations in these Guidelines, it may be desirable to strengthen the requirements by reference in strategic documents or require certain outcomes through statutory mechanisms. These mechanisms are discussed further below.

The layers of the WA planning system have been described in various documents (WAPC 2008; DPI 2009). There are many strategic and statutory tools in the WA land use planning system which can be used to deliver more sustainable industrial development. These are summarised in Table 1.

The key tools considered to have the most relevance in the development of industrial areas include local planning strategies, rezoning of region and local planning schemes, local structure plans, as well as subdivision and development approvals.

The local planning strategy provides the vision for the future growth and development of a local government area. It provides the rationale for future land use change, which is reflected in the local planning scheme. The local planning strategy will identify future areas for industrial development and may include a commitment to ensure that the area(s) are developed to achieve the social, environmental and economic objectives and principles. The location of future industrial areas should be justified in the local planning strategy or as part of a sub-regional or district structure plan.

The rezoning of land to allow for industrial development is an important stage which should be utilised to ensure specific objectives will be achieved. The rezoning of land should be supported by information which demonstrates that the land is capable of supporting the proposed use and development. This may be in the form of an amendment report, guided by the local planning strategy or district structure plan.

(Source: LandCorp)

Table 1. Layers, planning tools and control mechanisms in the WA planning system

Planning stage	Strategic planning & design tool	Statutory tool *(planning control mechanism)*
Regional and sub-regional planning	Regional/ sub-regional strategy Regional/ sub-regional structure plan	Region scheme
District planning	District structure plan Development guide plan Local planning strategy	Region scheme amendment (provisions) Local planning scheme
Local planning	Local structure plan/ outline development plan	Local planning scheme amendment (provisions) Local structure plan/ outline development plan
Subdivision	Detailed area plan	Subdivision application with conditions Detailed area plan (Clearance of conditions)
Development		Development application Building licence Developer covenant Local planning policy Local laws

It is recommended that the provisions of the zone require the preparation of a local structure plan or outline development plan prior to subdivision. This provides a comprehensive and orderly approach to planning for industrial areas that is able to give integrated consideration to a broad range of environmental, community and economic issues. Specific provisions may also be included to ensure particular development outcomes such as water management or levels of resource efficiency.

Some pre-model scheme text Schemes are restricted to specific industrial zones that relate directly to the type of industrial use such as a Light Industry Zone, General Industry Zone, Extractive Industry Zone and so on. When a rezoning occurs, it is recommended that the scheme is modified to include an "industrial development" zone, which requires the preparation and approval of a local structure plan to guide the future subdivision of the land.

The broad intent of the Industrial Development Zone allows the accommodation of any type of industrial use. Land use permissibility under such a zone is controlled through the applicable local structure plan. A local structure plan can provide an additional layer of 'zones' that separates potentially incompatible land uses but still provides for a variety of industrial uses that maximises opportunities for synergies within an individual development, in particular the use of resources. For example, the Neerabup Industrial Area whilst being zoned Industrial Development under the *City of Wanneroo District Planning Scheme No. 2*, has a structure plan for the area that provides for a number of "internal" zones including the General Industrial Zone, Service Industrial Zone and the Meridian Park Wanneroo Enterprise Zone. The various zones and their location are a reflection of the overall objectives for the development, particularly in terms of the types of industrial uses being accommodated. The land use permissibility within local structure plan zones is in accordance with the corresponding zone in the Scheme unless otherwise provided for in the structure plan.

A local structure plan also provides an opportunity to develop precinct design guidelines which, when adopted together with the local structure plan, are then required to be followed in the future subdivision and construction phases of the development. Precinct design guidelines generally focus on the built form of development, but can be expanded to require initiatives and actions at other stages of the design, construction and operation of eco-industrial developments. These Guidelines for Industrial Development provide substantial information which should be used in the development of specific precinct design guidelines.

Subdivision in Western Australia is controlled by the Western Australian Planning Commission. Where an approved structure plan exists, the subdivision of land should be generally in accordance with the approved structure plan. Conditions of subdivision may be imposed to require specific elements of the subdivision to be constructed or to comply with particular guidelines.

Subdivision may also be guided by Detailed Area Plans, which may also include more detailed guidelines for lot development. Detailed Area Plans would normally be prepared by the development subdivider or developer and then assessed and endorsed by the local government. Endorsement by the Western Australian Planning Commission is not usually required at this level of planning.

A development application is generally required to construct a premises in an industrial area. The relevant local government is responsible for ensuring that the requirements of any structure plan or design guidelines are implemented and enforced at the development and building application stages. Conditions on the development approval may also be imposed by the local government.

Another mechanism for improving industrial development is through the adoption of a local planning policy. Such a policy may provide general guidance on the matters to be addressed by structure plans, subdivision and development in industrial areas, or it may provide specific guidance for a particular industrial development.

The phases of industrial development proposed in this guideline can be easily aligned with the broad stages of the WA planning and development system (Table 2), as well as the planning systems in other States and Territories.

The phases of industrial development can be linked with the WA planning system as outlined in Table 2.

Table 2. Linking the phases of industrial development with the WA planning system and key mechanisms for achieving better outcomes

Industrial development phase	**Strategic planning tool**	**Statutory planning tool** ***(Implementation mechanism)***	***Key delivery mechanism***
1. Site selection and assessment	Sub-regional or district strategy or structure plan	Region scheme rezoning or local scheme rezoning (Scheme provisions)	• Comparative assessment of options • Concept plan
2. Structure planning and subdivision	Local structure plan	Subdivision application and approval (Subdivision conditions)	• Structure plan
3. Lot development	Building plan Development guidelines	Development application and approval Building licence (Development conditions)	• Precinct design guidelines
4. Operational occupancy	EMS or management plan	Operating Licence where required under the Environmental Protection Act (licence conditions)	• Business plan • Environmental management plan/system • Centralised management body

Detailed information on the matters which should be addressed at each stage of the planning, development and operation of industrial areas is contained in the following chapters.

Chapter 2:
Site Selection & Assessment

The location of an industrial area will ultimately influence its environmental, economic and social performance. The assessment and choice of location needs to extend beyond compliance and involve a more rigorous investigation of opportunities for resource efficiencies, waste product exchanges, as well as ecological, economic and social opportunities and constraints.

(Source: LandCorp)

The consideration of the location of industrial areas should occur as part of the strategic planning process, during the development of relevant sub-regional planning strategies, local planning strategies, district structure plans and rezonings. The comparative assessment of locations as part of these strategic planning processes is critical to optimise the location of the desired industrial area.

Key implementation tools which may be used to achieve improved industrial development outcomes at this stage include recommendations in these strategic plans and provisions to be included in local schemes. Often, the broad intent is outlined in a Concept Plan which will help to guide the next stage of planning. Scheme provisions may also require specific outcomes or refer to the need for future structure plans.

This chapter provides guidance to aid the identification of appropriate locations for future industrial areas. A comparative assessment must be made of possible options for locating the new industrial area, which should address the objectives, elements and strategies outlined in this chapter.

2.1 Objectives

Site selection should aim to:

[1] Avoid environmentally sensitive areas and protect and enhance natural areas and natural processes;

[2] Maximise resource efficiencies, including utilisation of renewable resources, proximity of existing infrastructure including transport and waste networks, energy supplies and water services;

[3] Ensure the efficient use of land, including brownfield and infill sites;

[4] Provide adequate buffers which manage offsite impacts;

[5] Maximise opportunities for synergies including by-product reuse and co-location with existing land uses; and

[6] Ensure the development considers economic and social issues including employment, safety, heritage and identity.

2.2 Strategies

The following strategies should be implemented when undertaking site selection for industrial areas.

2.2.1 Element: Governance

Management structure

Industrial developments rely on fostering partnerships and synergies between stakeholders and occupying industries, which is most successful when coordinated by a centralised management body. Options for a centralised management body are discussed in Chapter 1. The following strategies provide guidance on the role of the management body during the site selection phase.

[A1] Establish a centralised management body for the industrial development. Responsibilities of such a management body during this phase should include;

- » A comparative assessment of location options;
- » Development of a broad concept plan for the selected site;
- » Coordination of relevant planning and regulatory approvals;
- » Coordination of consultation with the community and stakeholders; and
- » Securing finance and undertaking a risk analysis.

Stakeholder and community consultation

For new industrial developments to be sustainable, they must include new technologies, concepts and social interactions. Therefore, site selection and assessment requires input from stakeholders and the local community, through early and well coordinated engagement.

An important aspect of community engagement is the concept that local communities can and should be considered an asset to an industrial development. Local populations are likely to provide the employment base for businesses, including local ownership. Local communities may also be potential customers or users of industrial by-products and products produced in an industrial development. Therefore, industrial developments should aim to integrate into local communities rather than be segregated from them. The following strategy is recommended.

[A2] Initiate consultation with the local community and stakeholders as part of the site selection process.

2.2.2 Element: Ecology

The Western Australian land use planning policy framework includes principles for ecological protection, which are outlined in Chapter 1. Historically, inappropriate site selection and poor emission controls have led to the degradation of the local environment at some industrial sites. Therefore, future industrial developments should aim to maintain, protect and enhance natural environments and ecological systems, as recommended by the following strategies.

[A3] Undertake an analysis of the ecological, hydrological and physical features of the site, which may include various technical site investigations to determine whether the area is capable of sustaining industrial uses. The Environmental Protection Authority (EPA) of Western Australia provides detailed advice on the key environmental factors that should be considered in *Guidance Statement 33: Environmental Guidance for Planning and Development* (EPA, 2008). These key environmental factors are likely to be different for each site, and as defined by the EPA, include biophysical (i.e. biodiversity, hydrology, topography), pollution management and social issues. Proponents should ensure proposals consider all relevant factors listed in the EPA's checklist (Table A3) of the statement (http://www.epa.wa.gov.au/GS33.asp);

[A4] Identify significant environments which will need to be protected, including landforms;

[A5] Provide adequate buffers to protect significant natural features and create ecological corridors; and

[A6] Consider the natural elements which may combine to form natural hazards, including floods, cyclones and severe storms, storm surges, bushfires, coastal erosion, landslides and earthquakes. *State Planning Policy 3.4: Natural hazards and disasters* (WAPC 2006) outlines policy objectives and measures to consider and manage such events during the planning process, such as setbacks and appropriate controls. Consideration should also be given to the predicted increases in sea levels, cyclonic activity, storm surges and high fire danger weather in Australia as a result of climate change.

The design should retain suitable buffers and areas of remnant vegetation

2.2.3 Element: Resources

Land

Land for industrial use is often in short supply due to land use constraints and the potential for land use conflicts between industrial activities and sensitive land uses. Considerable economic, social and environmental benefits arise from locating industrial developments in close proximity existing infrastructure and services. The following strategies are recommended.

[A7] Identify opportunities for co-location and synergies with existing industrial sites;

[A8] Consider sites which require minimal change in landform (i.e. small gradients);

[A9] Locate developments in brownfield, infill, abandoned and contaminated sites in preference to greenfield sites. These sites have social and economic advantages in terms of proximity to existing transport networks, existing infrastructure and services and a skilled workforce. The reuse of these sites also reduces greenhouse gas emissions associated with the construction and operational phases of the development. The reuse of this land protects ecologically valuable land such as remnant bushland, wetlands and prime horticultural and agricultural land.

[A10] Undertake a detailed land use assessment which incorporates appropriate separation distances between significant environmental features, sensitive land uses and industrial activities. Separation distances do not replace the need for industries to control emissions and minimise off site impacts. However, they can aid in protecting environmental features and reducing the community's exposure to emissions from industrial activities including noise, odour, vibrations, dust and particulates. *Guidance Statement No. 3 Separation distances between industrial and sensitive land uses* (EPA 2005) and *draft State Planning Policy No. 4.1 State Industrial Buffers* (WAPC 2004) are complementary State Government policies providing guidance on buffer distances. Although Guidance Statement No. 3 provides generic separation distances for a range of industry types, it highlights the need for site specific technical studies to ensure adequate separation is included in the design to avoid land use conflicts. Consideration should also be given to buffers required to protect the community from the emissions from transport networks servicing the industrial development.

Water

An increasing demand for water in a drying climate means that Australians need to source and manage water resources more wisely. Australians need to reduce their reliance on potable water supplies and utilise alternative options that are fit-for-purpose, particularly in areas subject to declining rainfall.

There are many factors which dictate the availability of cost-effective, suitable alternative water supplies including the types of industries likely to be located within the development. Water supply options require thorough investigation at the earliest stages of planning. This may also influence the viability of some developments.

The use of recycled water for industrial operations is a preferred option. The provision of recycled water may be from decentralised (i.e. networking between businesses) sources or centralised (i.e. nearby wastewater treatment plant) sources.

In Western Australia, the provision of recycled water for industrial use has been highlighted as a priority in the *State Water Recycling Strategy* (DoW 2008). The Kwinana Water Recycling Plant provides fit-for-purpose recycled water to local industries. The Water Corporation are proposing to expand this plant to its maximum capacity by 2010. Elsewhere, new wastewater treatment plants are proposed to meet the needs of urban expansion. There is the potential to locate these plants close to existing or planned industrial developments to provide fit-for-purpose supply and reduce the demand on potable water.

The following strategies provide guidance when considering water use and reuse.

[A11] Consider access to alternative water sources including recycled water from wastewater treatment plants, sewer mining, groundwater and stormwater harvesting;

[A12] Consider the proximity to existing infrastructure, including sewer; and

[A13] Identify constraints to the provision of infrastructure required for alternative water supplies.

Alternative water sources at a lot scale including rainwater tanks, greywater reuse systems and groundwater abstraction are discussed in Chapters 4 and 5.

Energy

Energy requirements of industrial areas are substantial and may include both peak and off peak usage. Reducing energy use in industrial areas requires efficient design and construction practices, including greater utilisation of renewable resources, improved energy efficiencies and offsetting unavoidable emissions. Reductions can be achieved through legislative controls and voluntary changes.

Due to the energy requirements of industrial processes, it is not always physically or economically viable to utilise renewable sources for primary supply. Nevertheless, Australia has a number of locations where renewable sources including solar, wind, geothermal, hydro, landfill gas and biomass are suitable and these should be explored as a secondary supply.

The following strategies are recommended to improve the consideration of renewable energy resources and energy efficiencies as part of the site selection process.

[A14] Scope opportunities for production of a local renewable source of energy;

[A15] Investigate opportunities for funding the adoption of renewable and efficient technologies through the Office of Energy in Western Australia and Federal Department of Climate Change and Energy Efficiency, and Department of Environment Water, Heritage and the Arts;

[A16] Minimise distance to existing energy supply infrastructure to maximise energy transmission efficiency; and

[A17] Consider the accessibility of public transport networks such as bus services and passenger rail services. Shared passenger and freight rail services not only provide more efficient alternatives for the transfer of goods and materials but also more energy efficient transport options to employees, reducing the need for car parking and increasing the amount of land available for industrial use or shared services (i.e. resource recovery plants).

Wind turbines provide a local renewable source of energy

2.2.4 Element: Economy

Location and co-location

The need for sustainable development in all sectors is apparent. Industrial and commercial developments provide significant economic activity but it is important that these activities are appropriately located to minimise offsite and environmental impacts and footprints. The location of existing infrastructure, particularly transport and the co-location of industries close to or within the development can influence the economic success of an industrial development.

The following strategies are recommended.

[A18] Undertake an analysis of constraints and opportunities to achieving sustainable development outcomes, including planning approvals and timelines for investigations and assessments;

[A19] Locate industrial developments close to existing infrastructure and services such as water, electricity, waste reuse and recycling facilities, transport routes (see below), service providers, existing markets and local labour markets;

[A20] Ensure the development is compatible with existing or proposed neighbouring land uses, incorporates adequate buffer distances and utilises natural landforms; and

[A21] Locate industrial developments adjacent to an established transport network to reduce greenhouse gas emissions and improve industrial freight efficiency. The type of transport infrastructure required will be dependent upon the types of operations that will occupy the development but may include port, rail, air or road.

2.2.5 Element: Community

Heritage and identity

Sustainable industrial developments are unlike traditional industrial areas and apply concepts which may be new to many communities. It is important that developers and planning authorities engage communities early in the planning process to communicate how the community will benefit from the development and to generate trust and support for the proposed outcomes. These benefits will be specific to each development but may include:

- creation of new jobs and business opportunities;
- improved amenities;
- comfortable, healthy indoor and outdoor work environments;
- reduced transport costs and lower greenhouse gas emissions due to more local employment opportunities;
- enhanced marketability and promotional edge;
- improved property values; and
- community enhancement programs, which could be offered through a partnership between developers and regulatory authorities.

Communities, whether they are existing or new, rural or metropolitan, each have their own identity or ‘sense of place’. To gain an appreciation of local heritage and identity the following strategies are recommended.

[A22] Investigate the indigenous values of the area, particularly where there are mythological sites, artefacts sites and sites where there is evidence of indigenous structures and work with the indigenous community to protect these values. Advice and enquiries concerning the *Aboriginal Heritage Act 1972* should be directed to the Department of Indigenous Affairs, for assistance regarding the protection of sites or consultation with the Aboriginal Community contact the South West Aboriginal Land and Sea Council, and for specific guidance on the development of Aboriginal site management plans contact Perth Region NRM’s Indigenous Heritage unit. See chapter 2 references for details on Perth Region NRM’s Aboriginal Cultural Heritage Management Plan Template;

[A23] Engage with local communities as part of the stakeholder consultation process to identify their needs and opportunities throughout the various phases of the development, including opportunities for training, development and future employment; and

[A24] Ensure effective and genuine community consultation is undertaken early in the planning process to gain an understanding of the local and cultural identity of an area and identify potential social impacts and issues.

Amenity

Historically, industrial developments have not considered amenity. However, there is an increasing demand from purchasers, tenants and employees for workplaces to provide a higher quality of work life. The following strategies aim to improve the amenity during the site selection phase.

[A25] Identify natural landforms and features to be retained, including established trees, drainage lines and bushland to enhance visual amenity; and

[A26] Scope local access to services including schools, child care, lunch bars, shopping centres, playgrounds, public open space and postal facilities. These services can be maximised by establishing developments close to existing services or attracting such services to the development through a marketing strategy.

Drainage and creek lines such as this should be retained and incorporated to enhance visual amenity

Industrial developments should be well serviced by existing or new facilities

Case Study: Site Selection

Cockburn Commercial Park

Bushland conservation is an important feature of Cockburn Commercial Park *(Source: LandCorp)*

Site description

Cockburn Commercial Park is located 23 km south west of the Perth CBD, within the City of Cockburn. It is located beside North Lake Road, Bibra Lake and close to existing major transport networks and other industrial estates. The estate offers a variety of lot sizes, making it suitable for many business types, including bulky goods retail, light industrial and commercial.

Cockburn Commercial Park is also located adjacent to South Lake, which is part of the Beeliar Regional Park. The Beeliar Regional Park has a high nature conservation value due to its rich diversity and complexity of ecosystems. Beeliar Regional Park is also socially important, as it provides cultural, recreational, landscape and aesthetic values.

LandCorp, in partnership with the City of Cockburn designed Cockburn Commercial Park with sustainability principles in mind. Whilst the development is located close to existing infrastructure, services and labour markets, it has been designed so that it is sensitive to the important ecological and social values of the adjacent Beeliar Regional Park.

Design principles incorporated

Due to the level of community interest in this development, LandCorp released a Public Environmental Review for the proposal, which included a community consultation program. Consequently, the proposal was amended to incorporate additional design elements that conserved the ecological and cultural features of the site.

The most significant feature of the estate is a 22 hectare conservation area, incorporated into the eastern edge of the development. This area provides a significant buffer to South Lake and the Beeliar Regional Park.

This conservation area was rehabilitated as part of a native vegetation regeneration program, designed to enhance any degraded areas and improve habitat diversity. The conservation area is now managed by the Department of Environment and Conservation and forms part of the Beeliar Regional Park.

As part of the community consultation program, local Noongar Elders were consulted. As a result, culturally significant ‘scar trees’ were identified and relocated to an old aboriginal campsite located in the conservation reserve. This old campsite has been developed into an interpretive centre for the recognition and advancement of aboriginal culture.

To reduce impacts on native fauna, subdivision of the estate was staged to enable fauna to move from areas being disturbed into areas of remnant vegetation or areas that had been rehabilitated. In addition, all lots are/will be landscaped with local native species, providing corridors for native fauna to move through the estate.

Development of this site involved clearing some native Jarrah-Banksia woodland. To reduce the potential of importing fungal diseases and weeds to the site, topsoil was stockpiled and used during landscaping. Cleared vegetation was also mulched and stockpiled and large logs were retained and stockpiled so that they could be incorporated into native gardens, providing habitat for native fauna.

To ensure these measures were adopted throughout the development, LandCorp prepared the following guidelines;

- Cockburn Commercial Park design guidelines
- Native garden and fauna habitat creation guidelines
- Landscaping and streetscaping plan

Further information

Further information on this estate, including the Cockburn Commercial Park design guidelines can be obtained online at http://www.landcorp.com.au/project/cockburncommercialpark/ or by contacting LandCorp on (08) 9482 7499.

(Information sourced from *Cockburn Commercial Park design guidelines*, LandCorp 2006 and *Cockburn Commercial Park Landscape Protection and Management Plan*, Strategen 2004)

Chapter 3:
Structure Planning & Subdivision

Once an appropriate location has been identified for an industrial development, it is necessary to determine the form and layout of the area. This may be achieved via a local structure plan and/or the subdivision of the area (see section 1.5).

The structure planning and subdivision phase involves two distinct stages; (1) structure planning and subdivision design and layout and (2) construction of the subdivision. This chapter provides separate guidance for both of these stages.

(Source: LandCorp)


Flinders
Cafe

Designing the Layout of the Industrial Area
(structure planning and subdivision design)

The creation of a local structure plan, which provides guidance on the design and layout of an industrial subdivision, is a significant opportunity to improve the environmental, social and economic sustainability of an industrial area. The form of the subdivision has a substantial impact on key aspects of the development, such as:

- the character and nature of the development;
- the efficiency of the transport network;
- opportunities for mixed use and locally based business and employment;
- access to and attractiveness of public transport, cycling and walking;
- management of stormwater;
- protection of key natural areas;
- provision of facilities and services;
- resource re-use opportunities; and
- the ability to optimise the on-going and efficient use of the land and other resources.

Although in some industrial areas, the development of a structure plan may not be required prior to subdivision, the Western Australian Planning Commission encourages the use of structure plans to provide the planning framework for an area, particularly in greenfield locations. This is because the development of a structure plan facilitates the integrated and site-based consideration of issues to achieve optimal outcomes.

The achievement of optimal outcomes can be enhanced through the establishment of design criteria or targets which need to be met as part of the design and construction of the industrial area. The use of design criteria is strongly recommended, as it provides effective but prescriptive guidance on how various policy and regulatory requirements as well as the objectives of the industrial development are to be met.

Design criteria may be incorporated into the structure plan directly or may be included in precinct design guidelines which may be prepared to support the structure plan but implemented at the next phase of development. Requirements for lot construction including built form to be included in precinct design guidelines are contained in Chapter four.

Achievement of design objectives for all aspects of the industrial development (as outlined in the structure plan) should be demonstrated via detailed design drawings.

3.1 Objectives

In developing the layout and form of an industrial development, there are several objectives which should be considered. These are as follows:

[1] Integrate the area into the local environment through site-responsive design which recognises, protects and where possible rehabilitates important landscapes, landform, natural areas and hydrological systems;

[2] Minimise energy use and greenhouse gas emissions by reducing the need for bulk earthworks, maximising transport networks, optimising block orientation and retaining shade trees and vegetation;

[3] Maximise opportunities for efficient use, reuse and recycling of water resources and ensure appropriate management of stormwater quality and quantity;

[4] Promote use of renewable resources for energy generation and construction of infrastructure;

[5] Maximise opportunities for efficient storage, reuse and recycling of waste;

[6] Incorporate technological capability, efficiency and pollution prevention into the provision of services and infrastructure; and

[7] Develop strategies to build relationships between the industrial area and the surrounding community including product and by-product demand and supply chains as well as social and employment networks.

3.2 Strategies

The above objectives can be achieved by implementing strategies which address the key elements of industrial development. The strategies outlined in the following sections should be considered as part of the development of any local structure plan, or where one is not required, as part of the design of the subdivision. Additional strategies to be considered as part of construction of the subdivision (prior to lot development) are outlined in Section 3.4.

3.2.1 Element: Governance

An appropriate governance framework is required to ensure the structure and layout of the industrial development is properly designed. This can be achieved by the following strategies.

[B1] Establish a centralised management body or continue to administer the existing body to ensure multi disciplinary input and the coordinated consideration of the objectives for this phase of development. Responsibilities of this management body during this phase would include;

- Preparation of precinct design guidelines for the development, including the vision and objectives of the development and how these will be implemented during the various phases of development, from design through to operation (which may have been addressed in the broad concept plan);
- Developing alliances and partnerships with key stakeholders and the community to increase local and regional support for the objectives of the development;

- » Coordination of a pre-development analysis of potential by-product exchanges to attract the businesses that would maximise synergies;
- » Preparation of an effective marketing plan to attract the appropriate mix of businesses to maximise synergies. This may include fostering a champion or anchor business that will attract other 'feeder' businesses;
- » Coordination of professional services to undertake pre and post development management plans to maintain and protect natural resources, which may include pre-development monitoring programs; and
- » Development of a strategy for the monitoring, evaluation and review of the design and layout, particularly where subdivision is proposed to be staged.

[B2] Consult and engage the community, including indigenous communities, regarding the layout of the development and retain and protect areas of community and ethnographic significance; and

[B3] Seek comments and input from local communities on the precinct design guidelines. During the design phase input should be sought regarding the interface between the development and adjacent areas; the design of traffic and transport infrastructure and services; and the design of facilities or business types that might attract local communities to use the facilities provided in the development. This may be achieved via community forums, workshops or community representation during the decision making process.

3.2.2 Element: Ecology

The design and layout of the industrial development should respond to the opportunities and constraints of the site to protect and retain sensitive environmental assets and minimise the longer term impacts on the surrounding environment. Industrial development should embrace the idea of reconnecting places of work with the environment by providing areas of public open space to enhance amenity and recreation opportunities, as well as to achieve improved outcomes for water and waste management and energy efficiency (i.e. minimising the heat island effect).

The following strategies are recommended.

[B4] Provide site information including current and adjacent land uses, topography and soils including acid sulfate soils (Planning Bulletin 64);

[B5] Undertake a site investigation to identify significant environments such as important landforms, wetlands (include types and classification), waterways, Bush Forever sites, regionally and locally significant flora and fauna and areas with cultural significance;

[B6] Adequately describe the pre-development environment to provide base-line data for the monitoring of future impacts. This includes quality and levels of both surface water and groundwater, the quality of the airshed, particularly if the development is located in proximity to an existing industrial area, as well as the nature, extent and condition of any remnant vegetation. Information should be obtained at a local scale and it is likely that this will require on-site investigations. Where the presence of any contamination is identified, the procedures outlined in the DEC's Contaminated Sites Management Series should be followed. (http://www.dec.wa.gov.au/pollution-prevention/contaminated-sites/index.html) ;

[B7] Ensure protection of significant environments and land scapes by providing adequate buffers from development and/or incorporating them into public open space or infrastructure corridors as appropriate. Create natural linkages and fauna corridors where possible. Certain species of vegetation, such as Declared Rare Flora and Fauna, Threatened Ecological Communities and Priority Flora or Fauna are required to be protected under State Government and Commonwealth legislation or policy. Various approvals may be required from the Environmental Protection Authority (EPA)(www.epa.wa.gov.au), Department of Environment and Conservation (www.dec.wa.gov.au) or the Australian Government Department of the Environment, Heritage, Water and the Arts (www.environment.gov.au). Further information on environmental approvals is contained in *Guidance Statement 33: Environmental Guidance for Planning and Development* (EPA, 2008).

[B8] Restore natural environmental features such as bushland, waterways and wetlands where possible. These areas can provide water quality and quantity management functions by filtering sediments, pollutants and reducing peak flows as well as having environmental and biodiversity values. The environmental values should be maintained or enhanced by ensuring that the current hydrological regime of the systems are maintained i.e. the volume and quality of water discharged into any existing system should ideally be the same as the volume and quality of water which would naturally flow into the system from the land to be developed. Structures such as gross pollutant traps, bioretention systems, hydrocarbon separators or open swales should be employed within the stormwater system prior to the discharge into the natural waterway.

[B9] Develop a local water management strategy to support the local structure plan and an urban water management plan for the subdivision. Water management including stormwater management should be planned and designed consistent with *State Planning Policy 2.9: Water Resources* (WAPC 2006), *Better Urban Water Management* (WAPC 2008); *Interim: Developing a Local Water Management Strategy* (DoW 2008a); *Urban water management plans: Guidelines for preparing plans and for complying with subdivision conditions* (DoW 2008b) and *the Stormwater Management Manual for Western Australia* (DoW 2004 – 2007).

[B10] Prepare relevant environmental management plans outlining commitments associated with the long-term protection of key environmental features. Through *Guidance Statement 33: Environmental Guidance for Planning and Development* (EPA 2008), the EPA outlines the main components of an environmental management plan, which is based on the AS/NZS ISO 14000 series;

- Description of project, status of the environmental feature/s and legislative requirements;
- Potential impacts from the development;
- Environmental objectives and performance indicators (i.e. criteria, standards);
- Management actions for each stage of the project (i.e. design, construction), responsibilities, schedules and management actions;
- Required monitoring plan to ensure the objectives and criteria are met;
- Contingency actions;
- Reporting of monitoring results;
- Level of stakeholder consultation; and
- Review and updating the management plan.

[B11] Retain topography and landscape where possible to maintain a “sense of place”, reduce visual impacts of development and reduce the need for cut and fill. Guidance on how to address landscapes is contained in the *Visual Landscape Planning in Western Australia: A manual for evaluation, assessment, siting and design* (WAPC 2007).

[B12] Consider potential impacts of climate change, particularly in coastal areas and flood-prone areas, as well as bushfire risk and changes in soil characteristics resulting from changing rainfall patterns.

3.2.3 Element: Resources

Sustainable industrial developments use resources more efficiently, focusing on the preferential use of recycled and renewable resources. This section aims to facilitate better use of resources as an outcome of the planning and design of the industrial development. Section 3.4 deals with resource use as part of construction of the subdivision.

The design of an industrial development is able to optimise the co-location of industries and encourage synergies; develop infrastructure for the supply of renewable resources; and ensure all resources are used efficiently including shared infrastructure where possible.

Land

Land available for industrial use in towns and cities is an important resource. The following strategies are recommended to assist in maximising the efficient use of this resource.

[B13] Identify buffers required to protect sensitive land uses in adjacent areas. Guidance on buffer distances is provided in *EPA Guidance Statement No 3 Separation distances between industrial and sensitive land uses* (EPA 2005). The EPA is also currently in the process of developing an Environmental Protection Policy for ambient air quality to implement the National Environment Protection Measure. Buffers may include areas of bushland, provided there is no impact on the bushland from the adjacent industrial uses;

STAGE 1
MERIDIAN PARK, NEERABUP

Meridian Park offers a variety of lot sizes to encourage a diversity of business types. *(Source: LandCorp)*

[B14] Locate potentially noxious industrial activities closer to the core of the area or within a separate industrial area altogether. Less intensive uses could be used to form part of an 'informal' buffer zone. *EPA Guidance Statement No.3 Separation distances between industrial and sensitive land uses* (EPA 2005) provides advice on this issue in order to avoid or minimise the potential for land use conflict.

[B15] Consider 'micro-zoning' to designate specific areas for certain types of industries to encourage synergies and sharing of resources;

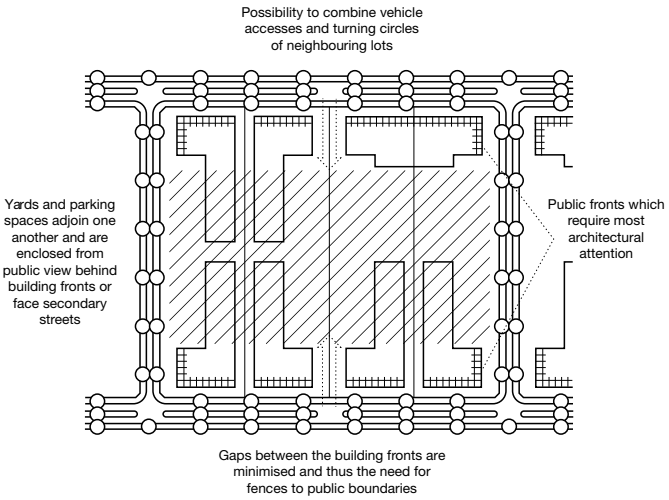
[B16] Ensure a variety of lot sizes to maximise the efficient use of the land and encourage diversity of uses (which may provide an opportunity for synergies and partnerships);

[B17] Consider opportunities for integrating service corridors and infrastructure such as telecommunications, water and wastewater services; power and gas supplies;

[B18] Identify where the estate layout can integrate any developed areas. This includes integrating driveways, crossovers, landscaping and parking areas;

[B19] Identify opportunities for shared facilities and services and locate these facilities in a central, easily accessible location. Individual business may not be able to provide these facilities and a shared facility can provide benefits to multiple businesses. Ensure arrangements have been agreed for the management of these facilities. Examples of shared facilities and infrastructure include:

- Wastewater treatment systems – can generate a reliable source of non-potable water for fit-for-purpose supply and reduce costs and energy requirements for treatment at large treatment plants;
- Loading / unloading areas –can reduce parking and hard-stand areas, providing additional industrial land for other uses. If large vehicles can use a centralised point for pick-ups and drop-offs, these shared areas may also reduce vehicle emissions;
- Parking – shared parking areas can reduce hard-stand areas, providing additional land for other uses. Verge parking provided by the developer can also reduce the amount of on-site parking. Reducing the availability of parking may encourage alternative forms of transport (e.g. car pooling);
- Common storage space – can maximise the use of available land, reduce operational costs associated with running a half-filled storage area and enable the use of sophisticated logistic management systems, which would otherwise be unaffordable to many smaller businesses;
- Turning circles and access ways – the strategic placement of crossover locations can maximise the efficient use of land. Where necessary, agreements can be established for shared use of an access way, including rights of access, maintenance and repair and insurance;
- Cycling facilities – can increase the uptake of cycling as an alternative mode of transport;
- Recycling facilities and waste disposal areas – can reduce waste and recycling costs for small businesses as well as facilitating improved exchange and recycling of resources in general;
- Wash down facilities - can be a manual operation or an automatic cleaning of industrial equipment. They can reduce costs for individual businesses and facilitate the management of waste water;
- Recreation and community areas – can provide social benefits to the industrial development; and
- Management and corporate services – including meeting rooms; telecommunications tools, and administrative and/or clerical services.



Perimeter blocks allow for a more efficient use of space and screens work and storage areas from public view *(Source: Cardno)*

Water

The management of water is a critical issue in industrial areas. This includes water supplied to the area for use in the development, the production and disposal of wastewater and the management of stormwater and rainfall. *State Planning Policy 2.9: Water resources* (WAPC 2006) requires new development to employ a total water cycle approach to the consideration of water resources including the achievement of water sensitive urban design outcomes. Consideration must also be given to environmental water, as outlined under the Ecology element above.

Additional information on the process and requirements at both local structure plan and subdivision stages is contained within *Better Urban Water Management* (WAPC 2008).

Minor rainfall events should be infiltrated at close to the source as possible.

Strategies to improve the management of water resources include:

[B20] Investigate fit for purpose water supply options for the development;

[B21] Infiltrate minor rainfall events as close to source as possible i.e. install soakage systems in road reserves and verges (check with the relevant local government for critical event criteria);

[B22] Treat stormwater flows prior to them entering the receiving environments via bioretention systems incorporated into road reserves and verges. It is recommended that the area of bioretention is equal to 2% of the directly connected impervious surfaces. The installation and on-going maintenance of treatment systems used to remove hydrocarbons and other industrial pollutants must be considered if stormwater has potential to be contaminated;

[B23] Manage flooding and waterlogging appropriately;

[B24] Minimise impervious areas by using pervious paving and direct stormwater from pervious areas to vegetated garden areas. Where it is difficult to minimise impervious areas ensure that runoff is directed to retention basins for storage and reuse;

[B25] Install rainwater tanks and collection systems to supply water for non-potable uses. Rainwater tanks can also be incorporated as part of rainwater detention needs;

[B26] Undertake a water balance to identify the likely water demand of the development and investigate the viability of using recycled water to assist in meeting the demand, particularly for toilet flushing, external uses and suitable industrial processes.

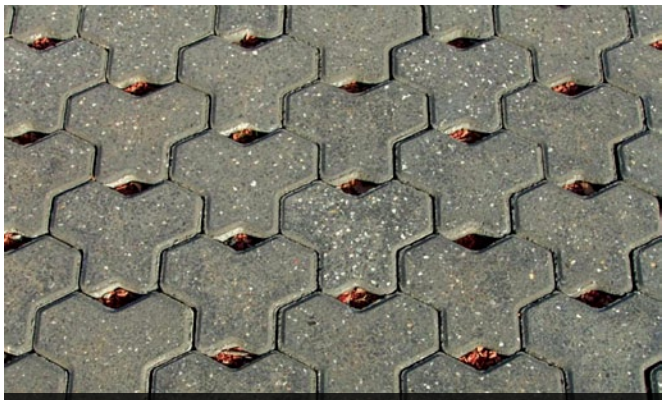
[B27] Consider the proximity of available alternative sources (i.e. wastewater treatment plants), available infrastructure (i.e. third pipe networks) and availability of other sources (i.e. groundwater). Consideration should also be given to water requirements for other nearby land uses and the recycling opportunities they provide (i.e. residential providing recycled water for industry);

[B28] Seek opportunities to provide recycled water from sources within the industrial development, through industrial networking. Co-locate industry types that are able to supply and use recycled water.

[B29] Establish water efficient landscaping in public areas and promote the use of drought resistant, local vegetation;

[B30] Ensure connection of work areas including washdown bays, to deep sewerage and identify wastes permitted to be discharged to the system. Where sewerage is not available, appropriate wastewater management systems must be installed which are capable of treating all types of pollutants likely to be present. Preference should also be given to systems which can recycle the wastewater for fit-for-purpose reuse; and

[B31] Identify monitoring requirements for the assessment of water use (supply) and any impact of the industrial development on the water resources of the area (ground and surface water including any wetlands and drainage).



The use of pervious paving in hardstand areas will provide additional areas for infiltration *(Source: www.wsud.org)*

Energy

Similarly to the management of water, industrial developments require strategies to reduce the amount of energy used; to improve the efficiency of use; and to increase the use of renewable sources.

The Council of Australian Governments recently adopted a Renewable Energy Targets of 20 per cent by 2020 and agreed to stronger energy efficiency standards for commercial buildings. For further information, see the Australian Building Codes Board website (www.abcb.gov.au).

Strategies to improve the management and use of energy resources include:

[B32] Retention of landform as far as practicable to minimise cut to fill (earthmoving) needs and the transport and supply of fill;

[B33] Ensure appropriate layout and orientation of blocks so that premises can maximise passive solar lighting, thermal conditions and cross ventilation. Lot layouts and building envelopes should allow for maximum solar efficiency by responding to seasonal patterns of sunlight, prevailing local breezes, shading and humidity fluctuations. At least 75% of lots should be oriented appropriately. Consider the use of building envelopes for larger lots to encourage the orientation of buildings to maximise solar efficiency;

[B34] Establish a renewable source of energy (consider a system of decentralised power generation such as cogeneration) or provide infrastructure to facilitate connection of the development to a renewable power generation and distribution system;

[B35] Investigate opportunities for energy recovery through industrial networking within the estate (i.e. capture steam from industrial processes and reticulate the resultant thermal energy around the park via a co-generation plant. This can result in significant cost savings to occupying industries, which can be highlighted during marketing);

[B36] Design a safe, equitable and feasible road layout with a clearly defined access hierarchy to facilitate the traffic flow of heavy goods delivery vehicles as well as commuter and visitor traffic. Maximise any linkages with existing rail networks. Ensure road reserves are an appropriate width incorporating on-street parking where possible; consider the angle of curves; and avoid cul-de-sacs; and

[B37] Develop a traffic management strategy which addresses access to industrial developments including noise management and parking needs and encourages increased public transport use, walking and cycling to maximise the use of land and minimise emissions from transport sources.

Recovery of resources such as scrap metal should be coordinated throughout the estate

Waste

The generation and management of waste from an industrial estate is often overlooked during the planning and design phase. However significant outcomes can be facilitated through an appropriately designed industrial development that provides options for individual and coordinated waste management strategies.

[B38] Ensure access to recycling facilities by incorporating a resource recovery facility or recycling facility within the development to reduce waste outputs. Resources that could be recovered or recycled include organics, glass, plastic, metal, paper/cardboard, timber and e-waste. Operational and management arrangements for these facilities or any other communal waste services should be coordinated by the centralised management body; and

[B39] Identify and categorise areas for the stockpiling or storage of wastes to achieve optimal exchange of products and by-products.

3.2.4 Element: Economy

Businesses have always searched for ways to reduce costs and achieve strong and sustained economic growth. Strategies usually revolve around process or operational efficiencies including technology advancement. An increasing awareness of the impact of the location and layout of industrial developments has led to the understanding that significant economic advantages can be achieved through good design and shared infrastructure and services, particularly where guided by a centralised management body. Benefits include the ability for co-location, synergies and partnerships as well as innovation and a reduction in operational risks.

Strategies to facilitate economic sustainability as part of the design of the development layout include:

[B40] Undertake a resource flow analysis to identify the types of businesses required to maximise the capture and reuse of by-products, including water, energy and waste. Successful industrial developments are founded on networks of suppliers and distributors who depend upon local material, water and energy flows. Industrial developments are more sustainable where there is a large supply of waste material, water or energy flows that can be re-used by clustered industries;

[B41] Prepare a precinct clustering strategy for the development. Synergies between businesses, such as by-product reuse and shared use of infrastructure are more likely to occur if businesses are located in suitable clusters;

[B42] Prepare a detailed finance and risk management strategy. The strategy should refer to the key design elements of the development, as outlined in the relevant precinct design guidelines. These may include defined objectives for renewable energy, water efficiency, transport, local amenity or synergies such as a centralised warehouse facility. The strategy should involve a thorough risk management analysis of the establishment costs, payback periods and operational savings of applying each of the objectives. The environmental and social benefits should also be taken into account, for example, reduced emissions and clean up costs and reduced crime due to improved social amenity. The risk management analysis should also consider the demographics of the local labour force and existing local markets. Where synergies and by-product exchanges are planned, there should be sufficient research into the resource flows and business types required to maximise these efficiencies;

[B43] Ensure effective freight, road, rail (where available), pedestrian and cycle access to and from the surrounding transport networks and within the estate area;

[B44] Assess the sufficiency of public transport and ensure the development can be adequately serviced when development commences;

[B45] Locate any new transport networks that are required to service the development away from residential or environmentally sensitive areas;

[B46] Ensure staging and installation of service infrastructure is undertaken in an orderly fashion which facilitates optimal lot development;

[B47] Understand the nature of local markets and sources of materials so that these opportunities can be marketed and maximised at later stages of development;

[B48] Encourage a diversity of business types to include activities that make use of the industrial area outside of normal business hours, such as gymnasiums, community halls or playing fields and sporting clubs, when the area is underutilised; and

[B49] Develop a marketing strategy which highlights the economic, environmental and social benefits of the development to attract suitable businesses. If a risk management analysis (Strategy B41) has been prepared for the development, then key findings should be included in the marketing strategy. Economic, environmental and social benefits can be demonstrated through case studies which focus on the economic and socio-economic advantages of the development. Branding of the development should reflect its nature and ability to address sustainability principles and foster partnerships and innovation.

3.2.5 Element: Community

Limited consideration is usually given to the achievement of community or social outcomes as part of the design of an industrial development. Increasing awareness of the need for social sustainability has led to improved understandings of the significant benefits which can be achieved from addressing heritage, amenity, social needs and wellbeing, community access and facilities, safety and security as part of the design of an industrial development. These social and community benefits can lead to a more productive workforce, a greater ability to attract and retain staff, higher land values, less vandalism and anti-social behaviour and improved integration and tolerance from adjacent non-industrial land uses.

The following strategies are recommended:

[B50] Provide areas of public open space within reasonable proximity to all lots. This should include passive and active areas, to allow employees to connect with their environment (protect significant environmental areas and landscapes) and engage in passive and active recreational activities during break times to facilitate a healthier and more productive workforce. These areas also help to address microclimate issues (such as the heat island effect); can be used to integrate stormwater management; provide a buffer for adjacent sensitive land uses; and develop local identity. Plan to include appropriate facilities such as tables and chairs, exercise equipment, skate ramps and shelter/shading;

Provide sheltered rest areas for employees

[B51] Locate and plan public transport routes, as well as safe and connected dual-use pathways, footpaths (which should be included on all local roads) and bicycle facilities (including end-of-trip facilities);

[B52] Minimise negative visual impacts in areas of high amenity or high landscape quality and ensure high amenity of the development through requirements for landscape, parking, fencing, signage and built form. Information on planning to manage visual impacts is contained in the WAPC's *Visual Landscape Planning in Western Australia: a manual for elevation, assessment, siting and design* (WAPC 2007);

[B53] Plan for passive surveillance of the public domain to address the safety of users. This includes legible street networks (no cul-de-sacs); well designed and efficient street lighting including lighting of environmental features such as trees and public art and the use of sensor lights or indirect lighting; and coordinated closed circuit television cameras; and

[B54] Clearly differentiate between areas of private and public domain, including shared facilities, and ensure appropriate landscaping and management of both.

Ensure high amenity of the streetscape

Construction of the Subdivision

Although the construction of the subdivision or development occurs at a different stage to the design, the strategies to improve construction practices of the subdivision are largely determined as part of the design phase. Clear guidance is therefore required to be incorporated into the design report (local structure plan) which can be implemented at each future stage of the development.

The construction of the development largely involves bulk earthworks, the construction of roads and other transport networks and the installation of services such as power, water, gas, telecommunications and sewer. These activities have the potential to impact the environment and adjacent land uses. Management strategies are therefore required to control access, clearing of vegetation, noise, light, dust, erosion and sediment, dewatering, litter, weeds and pests (including dieback in some areas), and protection of existing sensitive environments. The efficient use of appropriate construction materials must also be considered.

There are various statutory mechanisms for controlling off-site impacts during construction. These include subdivision conditions and conditions of Works Approval.

3.3 Objective

The construction phase of an industrial development should aim to:

[1] Minimise the impact of earthworks and construction on the environment and adjacent land uses.

[2] Identify and use the most efficient construction materials available

3.4 Strategies

Strategies to achieve the above objective associated with the construction of the development or subdivision are as follows.

[B55] Undertake a risk assessment of all possible impacts which may result from the construction of the estate/subdivision. Impacts and issues which may need to be considered include:

- » protection of existing sensitive environments including fauna and their habitats;
- » soil or groundwater contamination;
- » acid sulphate soils;
- » access to the site by construction equipment and contractors;
- » clearing of vegetation and topsoil;
- » weeds and pests (including dieback);
- » noise;
- » light;
- » dust;
- » erosion and sediment;
- » dewatering; and
- » litter and illegal dumping.

[B56] Develop a construction management plan which outlines the necessary actions to mitigate and manage the potential impacts identified through the risk assessment. Clear guidance is necessary where the construction is proposed to be staged to ensure appropriate temporary structures and solutions, and efficient implementation of infrastructure;

[B57] Materials used in the construction of the subdivision should be sourced using sustainable procurement practices which give consideration to lifecycle emissions and maximise recycled components;

[B58] Control clearing of native vegetation by marking and fencing areas to be retained (with temporary structures). Sediment fencing should be erected around environmentally sensitive areas to manage sediment, litter and weed transfer. The *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* provide for the requirements related to clearing;

[B59] Stage the clearing of vegetation to provide native fauna with an opportunity to move into areas of remnant vegetation;

[B60] Relocate grass trees, large tree logs (for fauna habitat) and other suitable plants from areas to be cleared into landscaped or revegetation areas, preferably within the industrial development, or elsewhere;

[B61] Stockpile both topsoil and cleared vegetation (as mulch) onsite, to be used in landscaping or revegetation works;

[B62] Identify the risk of fungal diseases, including dieback (Phytophthora) and ensure appropriate management measures are implemented (refer to *Managing Phytophthora Dieback Guidelines for Local government* by the Dieback Working Group 2000);

[B63] Cut and fill earthworks should be minimised as far as possible during site preparation including the preservation of existing landscapes;

[B64] Opportunities should be sought to reuse spoil materials such as low grade limestone, or granite, or other rocks into the built form or landscaping within the development;

[B65] Construction work should adhere to stormwater management procedures in accordance with the *Stormwater Management Manual for Western Australia* (Department of Water 2004-2007). This includes temporary bunding of stormwater infrastructure; designation of wash-down areas located as far as practicable from stormwater systems or natural water bodies; treatment of stormwater prior to infiltration; use of recycled or fit-for-purpose water supplies for dust suppression; and management of silt and erosion.

[B66] Manage acid sulfate soils consistent with Department of Environment and Conservation guidelines (including dewatering) and any applicable Acid Sulfate Soils Management Plan;

[B67] Where dewatering is required, approval will be required from the Department of Water. Developers may be required to obtain a groundwater well licence from the department under Section 5C of the *Rights in Water and Irrigation Act* (1914). Applicants will be required to demonstrate limited adverse impacts on the environment, other groundwater users and the public;

[B68] Employ contractors with recycling capabilities and provide separate on-site bins for waste materials;

[B69] Ensure noise, dust and sand-drift management measures are consistent with relevant local government requirements;

[B70] Develop and conduct induction training for contractors to inform them of specific requirements for site management as outlined in the construction management plan; and

[B71] Ensure the construction management plan is implemented and includes a requirement for review and monitoring, particularly where the construction is planned to be staged.

Case Study: Structure Planning
Flinders Precinct, Latitude 32

Entry statement for the Flinders Precinct, Latitude 32 Industry Zone *(Source: LandCorp)*

Project description

The Flinders Precinct is the first stage in the development of the Latitude 32 Industry Zone (formerly known as the Hope Valley Wattleup Redevelopment Project) which is situated approximately 30km from the Perth CBD, 20km from Fremantle and 2km from the Kwinana Heavy Industrial Area.

The Flinders Precinct is located within the south western corner of the Latitude 32 project area, close to major roads such as Anketell Road, rail and the nearby bulk cargo port. It comprises approximately 157 hectares, of which around 80 hectares is developable industrial land. The Flinders Precinct forms 11% of the 1,426 hectare Latitude 32 Industry Zone.

The overall intent for Latitude 32 is to establish a new benchmark in environmental, social and economic sustainability and the Flinders Precinct will incorporate the highest standard in sustainable practices, including cleaner technologies, recycling and design.

Design principles incorporated

A set of consolidated sustainability benchmarks have been developed for Latitude 32 to guide the future planning and development of the area including development of local structure plans. There are two categories of benchmarks, which note the need to address the key areas of sustainable design (including construction and operation) and regional synergies (such as the facilitation of service, utility, supply chain, and by-product synergies). These principles have been applied as part of the design and development of the Flinders, demonstrating more sustainable outcomes in the following areas:

Governance

- Development of Precinct Design Guidelines which contain mandatory and recommended best practice requirements; and
- Community engagement and consultation.

Ecology

- Over 15% of the area is allocated to open space including conservation and water management; and
- Retention and rehabilitation of wetlands and their buffers supported with management plans and development of ecological linkages via transport corridors.

Water

- Compliance with water sensitive design principles including the Department of Water's *Stormwater Management Manual* via development of an urban water management plan prior to subdivision.

Energy

- The proximity of Flinders to freight connections (including a proposed intermodal container handling area) within Latitude 32 ensures transport connections and efficiencies are optimized.

Economy

- Provision of a wide range of lot sizes (2000sqm to 4ha+) to support a wide variety of industry types; and
- A "town centre" activity node provides a focal point and promotes the development of support service related facilities such as a lunch bar/convenience store and community facilities to cater for the new employment base.

Community

- Over 80% of lots are within 400 meters of a park or recreational area.

Implementation issues

The Flinders Structure Plan was prepared around three years before the district structure plan (DSP) for the wider Latitude 32 area. A key aspect of the DSP has been preparation of sustainability benchmarks to guide the overall design process and provide an implementation framework to encourage and provide for world's best sustainability practices throughout Latitude 32.

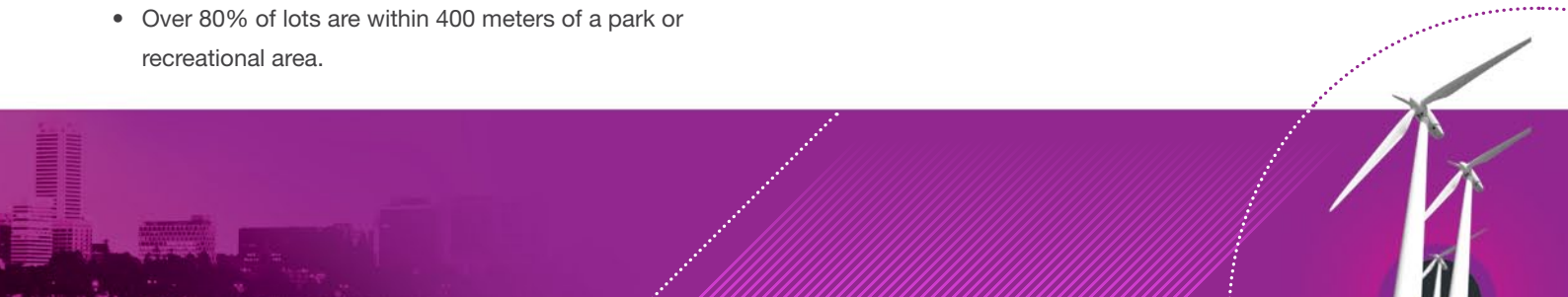
The Flinders Precinct Structure Plan was retrospectively reviewed against the benchmarks and compares favourably against a large proportion of the sustainable design benchmarks (Flinders meets about 80% of design benchmarks fully or partly/possibly) but compares less favourably against the regional synergy benchmarks (50% of synergy benchmarks are partly met, none are fully met due to the economies of scale of Flinders being developed in advance of the wider Latitude 32).

Recommendations to improve the level of sustainability have been made and can be incorporated as part of future planning for the area and for Latitude 32 as a whole. They address the areas of alternative water sources, waste management, earthworks, industry clustering, employee and community facilities, public art and theming and telecommunications.

Further information

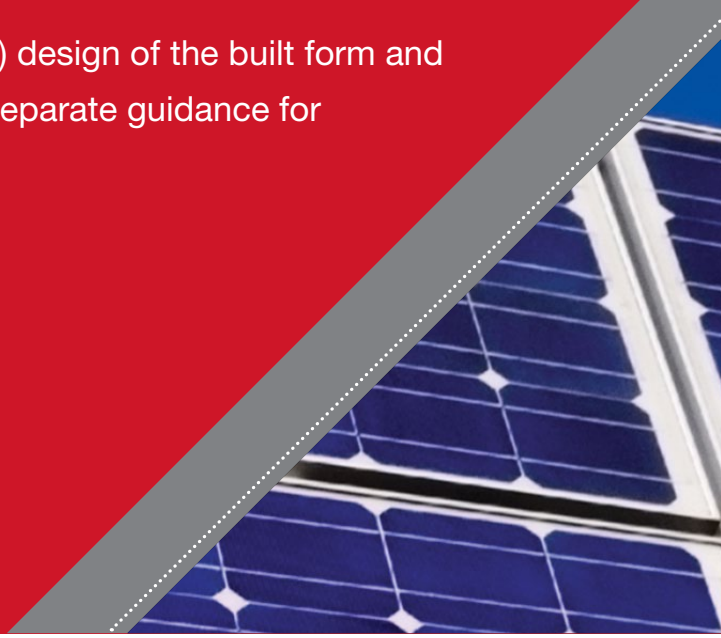
Further information on this estate, including the *Flinders Precinct Design Guidelines* can be obtained online at http://www.flindersprecinct.com.au/ or by contacting LandCorp on (08) 9482 7499. Details on the planning for the wider Latitude 32 area can be obtained at http://www.latitude32planning.com.au.

(Information sourced from *Flinders Precinct Design Guidelines*, LandCorp 2008 and *Report for Latitude 32, Review Flinders Precinct Structure Plan against Sustainability Benchmarks*, GHD 2009)



Chapter 4:
Lot Development

Lot development contains two distinct stages; (1) design of the built form and (2) building construction. This chapter provides separate guidance for both stages.



Built Form

The application of sustainable built form has multiple benefits including;

- Developments that are more attractive to investors and tenants, potentially resulting in higher purchase prices and quicker sales timeframes;
- Demonstrated risk management, particularly in regards to resource shortages and climate change, which is useful when seeking insurance or investment; and
- Increased industry and community recognition, which would provide marketing benefits;
- Efficient use of resources, reduced operational costs and reduced impacts on the natural environment.

Building design generally requires development approval and/or building approval from the relevant local government. Applications are assessed for compliance with the *Building Code of Australia* (BCA), local policies and by-laws, and any modifications made by the State. The BCA covers requirements for buildings such as warehouses, offices, showrooms, storerooms and laboratories which often exist in light or general industrial areas.

Sustainability provisions in the BCA are currently limited to energy efficiency, health and amenity. Therefore, building applications associated industrial development should strive beyond compliance with the BCA to include water efficiency, thermal efficiency, water reuse, waste reduction, waste recovery and socio-economic initiatives.

Precinct design guidelines should guide and inform this stage of development. The precinct design guidelines should include minimum requirements for built form that must be complied with by all developers within the estate. This chapter provides a list of possible requirements that may be included in the precinct design guidelines.

Additional information can be obtained from the Green Building Council of Australia, which is developing an Industrial Pilot Tool. Although in a trial phase, the tool provides comprehensive design criteria for energy, water, waste, transport, indoor environmental quality, materials, emissions, ecology and innovation. The tool is available online at http://www.gbca.org.au/green-star/rating-tools/green-star-industrial-pilot/1761.htm

4.1 Objectives

Industrial development should be cognisant of the need to provide buildings that are responsive to climate; have minimal impacts on the surrounding environment; maximise the efficient use of resources; provide improved work environments; and are adaptable. Lot development in industrial estates should:

[1] Ensure built form maximises the efficient use of resources and land and is responsive to local and regional climates;

[2] Reduce on-going operational costs to improve economic sustainability of the development through the adoption of resource efficiencies and adaptable building design;

[3] Ensure the development reflects local heritage and identity and provides a safe and accessible environment; and

[4] Ensure the development adopts best practice measures to minimise impacts on the surrounding environment, particularly in areas of pollution control.

4.2 Strategies

The following strategies should be implemented as part of the design and construction of the industrial premises. They should also be incorporated into precinct design guidelines where possible.

4.2.1 Element: Governance

Holistic management of an industrial estate should continue throughout the lot development phase through the continuation of an appropriate governance framework, namely the centralised management body.

The centralised management body should ensure the implementation of precinct design guidelines, including application of sustainability criteria at the lot level.

To maximise the implementation of efficiencies and sustainable initiatives during this phase the following strategies are recommended.

[C1] Maintain a centralised management body to aid in the development and implementation of various guidelines and management plans and provide support and assistance to purchasers, tenants, developers and builders;

[C2] Implement lot level design criteria contained within precinct design guidelines. Guidance for developing lot level design criteria can be obtained by addressing the strategies within this Guideline, as well as from reviewing the following;

- *Meridian Park Design Requirements and Guidelines* (LandCorp, 2009);
- *Industrial pilot tool* developed by the Green Building Council of Australia (GBCA 2009).The tool is available online at http://www.gbca.org.au/green-star/rating-tools/green-star-industrial-pilot/1761.htm;
- *EnviroDevelopment* which is an independent incentive-based system developed by the Urban Development Institute of Australia (Queensland), which sets criteria for key elements that extend beyond compliance. A copy of the EnviroDevelopment Standards (UDIA (Qld), 2006) can be accessed online at http://www.envirodevelopment.com.au/_dbase_upl/EnviroStandards_23Oct06.pdf ;

[C3] Implement financing and risk management strategies for the design and construction of the premises. These strategies can be used to evaluate several options for built form and refine the design process to ensure the most cost effective and sustainable option is selected. Financing this stage may be aided by the centralised management body forming a partnership arrangement between the public and private sectors, which would also reduce the risks of investment and potentially streamline regulatory processes; and

4.2.2 Element: Ecology

Adequate structural controls should be incorporated into the design that prevent impacts on the natural environment from future industrial activities. The use of non-structural controls are addressed in Chapter 5. The following strategies are recommended.

[C4] Implement the appropriate features of the approved urban water management plan (as required by *Better Urban Water Management* (WAPC, 2008)). Lot scale design features will be site specific but may include;

- » hydrocarbon traps;
- » lot scale bioretention systems (rain gardens and tree pits);
- » soil amendment for landscaped and garden areas;
- » rainwater tanks;
- » greywater systems;
- » soakwells;
- » permeable paving; and
- » swales incorporated into car parks.

[C5] Minimise removal of existing trees by utilising them for shade and screening;

[C6] Use local native species or those that are water-wise and/or nutrient-wise within landscaped areas. Ensure planting densities are sufficient to prevent weeds, promote high survival rates and improve aesthetics. Species lists could be provided in the precinct design guidelines;

[C7] Ensure no invasive plant species are used in landscaping;

[C8] Implement measures to ensure stormwater is not contaminated by on-site activities. Provide adequately designed servicing and storage facilities that prevent the intrusion of stormwater in areas where chemicals and substances will be stored or used (i.e. vehicle servicing, food manufacture, hazardous chemical storage). Such areas should be weather proofed and bunded to prevent any chemicals discharging to the environment via car parks, soakwells or drainage networks. Mechanical servicing and mixing of chemicals should occur where the floor consists of a durable, low permeable material (i.e. reinforced concrete) which has been finished and graded to contain any spilt material or wash down water. Ramps or speed bumps should be installed to allow wheeled traffic cross bunded access ways (DoE 2005); and

[C9] Consider the inclusion of additional water quality and quantity design features that extend beyond those specified in the urban water management plan. The *Stormwater Manual for WA* (DoW 2004-2007) provides advice for lot scale stormwater management.

Incorporate swales into car parks to promote infiltration and improve water quality. *(Source: www.wsud.org)*

4.2.3 Element: Resources

Water

Water sources

A reduction in potable water use is possible through improved efficiencies and greater utilisation of alternative water sources. The latter should be considered thoroughly during the structure planning and subdivision phase, particularly if options requiring large scale or buried infrastructure are to be used (e.g. third pipe, separate outflow piping of different grade wastewater).

Alternative water source options that can be applied at the lot scale are summarised in Table 3. The following strategies provide guidance when considering these alternative sources.

[C10] Require suitably sized rainwater tanks to be installed on all lots to reduce potable water use. The use of rainwater should be consistent with the *Draft Guidelines for the Use of Recycled Water in Western Australia* (Department of Health, 2009). Appropriately designed and placed rainwater tanks can also provide thermal insulation to buildings and reduce the need for on-site soakage. Ensure rainwater tank overflow is directed to designated landscaped areas;

[C11] Investigate the viability of decentralised sources that are suited to industrial uses;

Table 3. Summary of alternative water sources and possible reuse options in industrial developments (Adapted from South East Water, Victoria)

Water	Source	Quality	Treatment required	Potential uses
Rainwater tanks	Roof runoff during rain events	Moderate and variable quality, dependent upon location	Sedimentation can occur inside tank, some filtration may be required	Toilet flushing, irrigation, cooling tower/boiler, dust suppression, some industrial processes
Groundwater	On-site extraction of groundwater that may require a licence from the Department of Water	Dependent on aquifer	Dependent upon quality. Mineral levels and salt content would require testing	Toilet flushing, irrigation, cooling tower/boiler, some industrial processes
Stormwater harvesting	Runoff from hardstand areas	Moderate and variable quality, consideration must be given to likely contaminants	Reasonable level of treatment to remove litter and reduce pollutant loading	Toilet flushing, irrigation, cooling tower/boiler, some industrial processes
Greywater	Laundry water, bathroom basins, some industrial processes	Low quality, potential for organic loading depending on how water was initially used	High level of treatment	Toilet flushing, irrigation, cooling tower/boiler, some industrial processes
Process water	Production processes, evaporative cooling, irrigation, some industrial processes	Variable – depending on the process where the water was initially used	Dependent upon quality	Variable – dependent upon process and quality of water needed
Condensate	Evaporative cooling, boiler blowdown, sterilisers, auto claves, cooling loops and defrost systems	Variable – depending on the process where the water was initially used	Dependent upon quality	Toilet flushing, irrigation and cooling tower make-up water

Water use efficiency

Water sustainability initiatives should be demonstrated as part of the urban water management plan approved for the development, and adopted accordingly into the built form. The following strategies focus on reducing water use through the integration of efficient appliances, equipment and innovations which should be outlined in the urban water management plan.

[C12] Install water efficient appliances, including WELS (Water Efficiency Labelling and Standards) rated flow controllers, toilets, taps and urinals;

[C13] Install water efficient industrial equipment and seek innovative designs that can be integrated into the built form. This will be dependent upon the processes used within each business but may include automatic shutoff controls, fogging nozzles for cooling or high pressure-low volume nozzles;

[C14] Ensure cooling towers are designed to return steam condensate to the boiler where possible;

[C15] Ensure landscaping incorporates the use of waterwise gardens (including mulch, amended soils), rain gardens and/or tree pits, which have the potential to significantly reduce water use; and

[C16] Where irrigation is required, water should be sourced from non-potable, recycled water sources. Irrigation systems should be installed sub-surface to reduce evaporation and should be fitted with timers and moisture sensor control overrides to reduce water use.

Install rainwater tanks to reduce potable water use. *(Source: www.wsud.org)*

Waterwise gardens and tree pits will reduce water use and improve landscape amenity. *(Source: www.wsud.org)*

Energy

Renewable energy resources

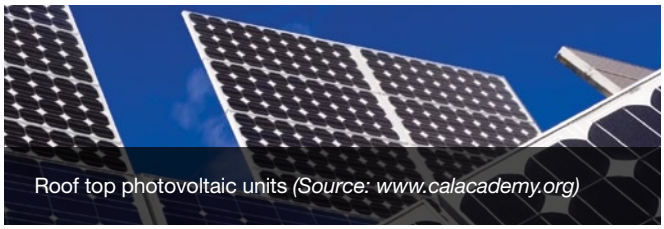
Building design plays a significant role in reducing energy requirements and resultant greenhouse gas emissions. On-site generation of energy from renewable resources has the potential to further reduce carbon emissions, reduce operating costs and improve property values. The payback periods of installing solar and wind technologies are also reducing, due to improved technology, government rebates, the increasing costs of energy prices, lower installation costs and research and development in this sector. The following strategies are recommended to improve the adoption of renewable energy sources at the individual lot scale.

[C17] Design roof profiles to maximise the use of renewable energy sources, such as solar photovoltaic (PV) panels or wind turbines;

[C18] Incorporate the wiring (i.e. Smart meters) and structural capacity for future placement of these structures on rooftops to save on retrofitting costs;

[C19] Incorporate the use of on-site renewable energy sources including:

- » solar powered exterior lighting;
- » solar hot water systems; and
- » lot-scale PV panels or wind turbines, which can be used to supplement the primary energy source.



Roof top photovoltaic units *(Source: www.calacademy.org)*

Energy efficient design

Energy efficient design can reduce overall energy use and associated operating costs, improve thermal comfort of occupants, improve property values and improve the marketability of a business.

The principles of energy efficient design should be incorporated into the built form of an industrial development, through the development or building approval process. The application of energy efficient principles will vary for each lot due to differences in topography, drainage requirements, outlook from buildings, security requirements and streetscapes. It is therefore important to acquire the services of an appropriately qualified architect to determine the most energy efficient design for the site.

The following strategies are recommended to improve the energy efficiency of industrial buildings.

[C20] Engage an appropriately qualified architect to design the most energy efficient design for the lot and likely industrial use/s;

[C21] Ensure building orientation maximises thermal comfort and energy efficiency. Individual site constraints such as topography, prevailing breezes and environmental features should be considered at the structure planning phase;

[C22] Maximise the use of natural lighting to the floor level through the incorporation of strategically placed windows, skylights (Figure 2), internal and external solar shades, clerestory windows, light shelves, light wells and awning reflectors;

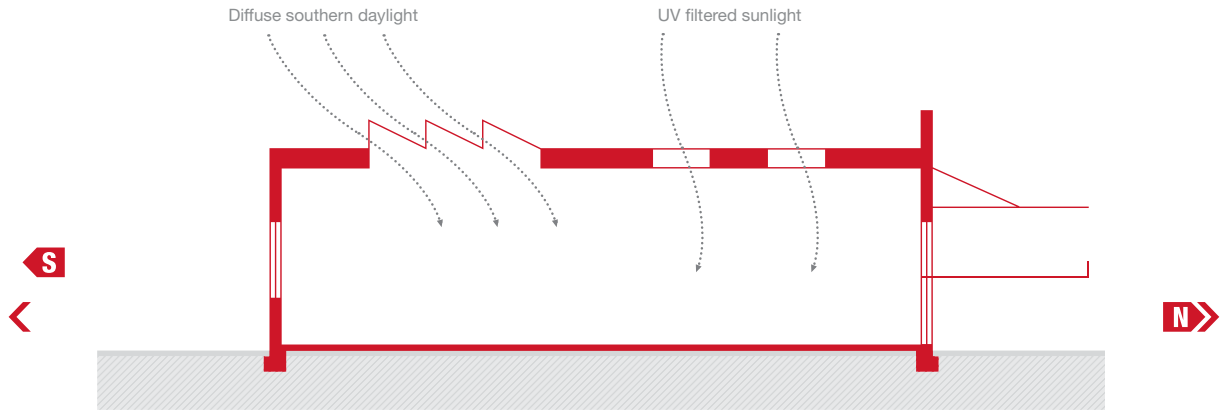


Figure 2: Examples of skylights and saw tooth roof skylights to maximise natural light (Maddington Kenwick Strategic Employment Area Sustainability Action Plan, City of Gosnells 2008 draft)

[C23] Incorporate external shading devices including overhangs (Figure 3), shutters, awnings and directional louvers to all north, west and east facing openings;

[C24] Maximise cross ventilation through the use of natural prevailing breezes (Figure 4), to improve thermal comfort, reduce artificial heating and cooling requirements and counteract the build up of indoor air pollutants. *Australian Standard 1668.2* provides requirements for minimum fresh air rates;

[C25] Reduce solar gain through the utilisation of pale coloured roof and wall materials with a minimum Solar Reflective Index (SRI) of 50;

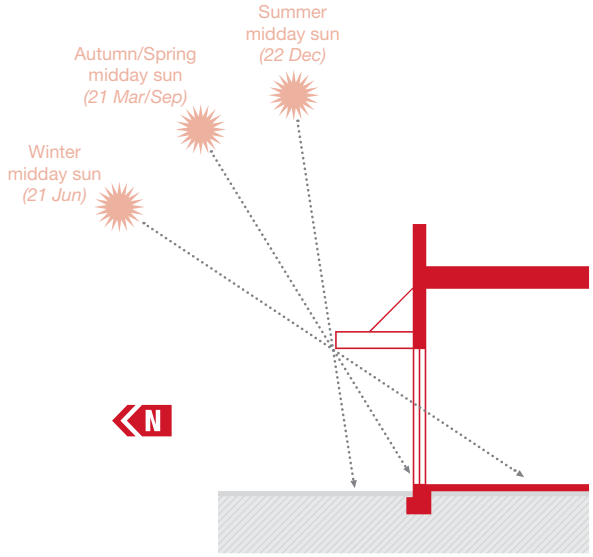


Figure 3: Example of shading to eliminate summer sun on north facing windows, while allowing solar access to winter sun (Maddington Kenwick Strategic Employment Area Sustainability Action Plan, City of Gosnells 2008 draft)

[C26] Consider the use of roof or vertical (wall) gardens that reduce heat gain and improve amenity. More information on roof gardens (or green roofs) can be found at www.growingup.org.au (*The blue-print to green-roof Melbourne*, Melbourne Water, 2009);

[C27] Install sub-meters for high energy use areas (i.e. greater than 100kVa) that facilitate on-going management of energy consumption;

[C28] Install suitable wall and ceiling insulation;

[C29] Ensure ceiling voids are ventilated to remove excess heat;

[C30] Install ceiling fans that have a 'winter mode' to circulate warm air during cooler months;

[C31] Install energy efficient lighting, including compact fluorescent lamps (CFLs), LEDs;

[C32] Install light zoning that is individually switched and appropriately sized; and

[C33] Ensure that lighting is automated with occupant detection and daylight adjustment (i.e. photo-cell sensors).

Green roof gardens will reduce heat gain and improve amenity. *(Source: www.wsud.org)*

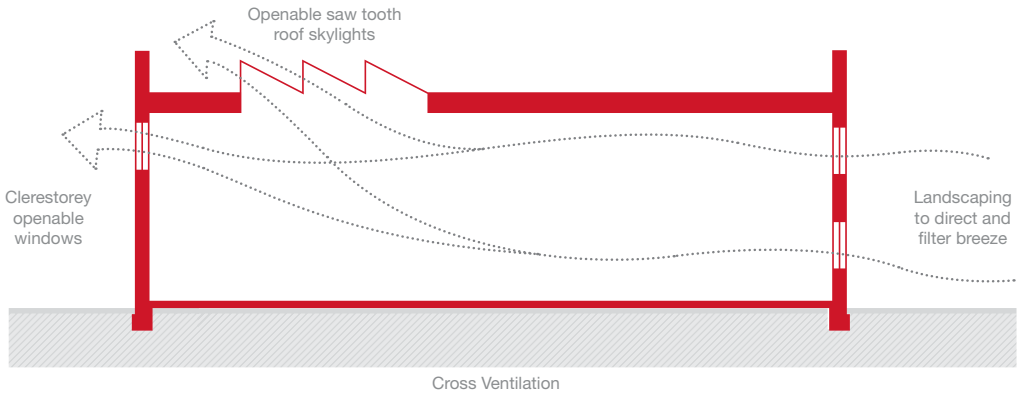


Figure 4: Cross ventilation achieved by operable clerestory and saw tooth roof skylights (Meridian Park Draft Design Requirements and Guidelines, LandCorp, 2009)

Maximise the use of natural lighting through the use of skylights

Utilise external solar shading devices to reduce solar gain

Dramatic entrance canopies such as this enhance the visual amenity of the area and provide effective solar shading

Transport

Providing facilities that encourage the use of energy efficient transport options is possible through built form. The following strategies are recommended.

[C34] Provide bicycle parking, showering and personal storage facilities in industrial buildings;

[C35] Provide accessible, safe and attractive pathways that link the development to adjacent services and transport networks; and

[C36] Limit available car parking spaces to encourage the use of alternative forms of transport; and

[C37] Designate easily accessible car parking for disabled access, car pool vehicles, hybrid vehicles or small fuel efficient vehicles and ensure bays are clearly signposted.

Waste and materials

Waste minimisation and rates of recycling can be influenced by appropriate design, through implementation of the following strategy.

[C38] Incorporate lot-scale recycling areas that support estate-scale resource recovery facilities. Lot-scale recycling areas should be designed so they are separate from, but adjacent to, general waste disposal areas. Recycling areas should be clearly signposted and accessible to employees and recycling trucks;

Provide lot-scale recycling areas

4.2.4 Element: Economy

Resource efficiency

Industrial developments that are well managed, adopt resource efficient design and have an attractive public realm are likely to facilitate greater economic activity. The additional costs which may be incurred through implementing efficiency strategies at the lot development phase, as outlined in the above Element (4.2.3), will provide ongoing and long lasting cost savings throughout the operational life of the development.

To maximise on-going cost savings throughout the operational phase, the built form of industrial buildings needs also to focus on resource efficiency. The incorporation of alternative resources (i.e. recycled water, solar power), improved resource efficiency and reuse of materials provides independence and enhanced security of resource availability when compared with sole reliance on conventional sources or methods of operation. This independence will result in greater profitability as the cost of resources escalates in the future.

Ideally, centralised facilities that aid in resource recovery and reuse of by-products should be planned for during the structure planning and subdivision phase (See Chapter 3). If this is not possible, provision should be made for resource recovery at the lot scale, which may be particularly useful for units and strata title lots. The facilities required for lot-scale resource recovery are largely dependent on the site and occupying businesses. The following strategies are recommended.

[C39] Integrate resource efficient design and use of renewable resources and materials into the built form to reduce on-going operational costs; and

[C40] Include areas for resource recovery and stockpiling. These areas need to be appropriately located away from the public realm and adequately covered and/or bunded to ensure they do not pose a risk to the natural environment or public amenity.

Adaptable design

Adaptable building design allows an industrial development to evolve as market conditions change over time. Adaptable design will reduce potential requirements for retrofitting buildings at a later stage due to changes of use or tenants and other factors including carbon pollution reduction requirements.

Adaptable design should also consider the social elements of built form that aim to improve workspaces for employees such as indoor air quality, natural lighting, break-out spaces and visual access to landscaped areas.

Adaptable and resource efficient design and the use of quality materials can also enhance an industrial development by providing an attractive public realm. If industrial developments are attractive places to work and visit, this enhances the reputation and image of the area, attracting investors, occupants and customers and leading to greater economic success. To ensure industrial buildings are adaptable for future changes in use, the following strategies are recommended.

[C41] Provide open plan buildings that have the majority of structural fittings on the outer shell of the building, which can facilitate future refits. Division of the internal space with columns or beams should be avoided, leaving floor space as free as possible for a flexible internal layout to suit current and future tenants;

[C42] Incorporate the use of quality building materials to reduce maintenance and repair costs. This should include the use of good quality recycled materials, which can be incorporated as a feature, for example recycled timber for customer service counters; and

[C43] Incorporate the use of innovative designs, including iconic and landmark buildings which have the ability to enhance the identity of the development.

Crime prevention

Traditional industrial developments are generally not populated outside operational hours due to their low amenity, lack of public facilities and lack of diversity in land use. This may result in high levels of vandalism and theft, with businesses having to spend considerable sums of money to improve security. To reduce crime and the associated costs the following strategies are recommended.

[C44] Apply crime prevention through environmental design (CPTED) principles, as outlined in D*esigning Out Crime Planning Guidelines* (WAPC, 2006) available online http://www.planning.wa.gov.au/Plans+and+policies/Publications/896.aspx ;

[C45] Allow a suitable mixture of industrial operations that have a varied range of operational hours. Inclusion of recreational facilities would encourage visitors outside of normal business hours at weekends, improving passive surveillance;

[C46] Building façades should create the frontage of a lot. Where fencing is required between industrial lots and public areas it should provide permanent, effective screening to industrial service yards, storage areas, and car parks. Materials used for fencing should be of similar quality as the building façades and be strategically placed to be integrated with the building;

[C47] Incorporate the use of appropriate fencing throughout the development to provide sufficient security while contributing to the general amenity of the streetscape. Low quality fencing and steel chain link fencing should be avoided as they can imply that an area is subject to criminal and antisocial behaviour. In turn, this could adversely impact upon the general appearance and economic success of the development. Also, businesses threatened by crime often employ other security measures such as guard dogs and powerful lighting, which can discourage people to occupy these areas, which reduces passive surveillance;

[C48] Incorporate detailed façade treatments, anti-graffiti coatings and prickly / thorny shrubbery planted against blank walls to prevent graffiti;

[C49] Construct buildings from materials and fixtures that are resistant to vandalism and require minimal maintenance, including solid core doors, steel door frames, laminated glass, sturdy locks and hardware;

[C50] Ensure glazed areas on the ground floor and adjacent to the public realm have a visible-light transmittance of at least 50% (when measured through the glazing and possible film together) and a visible-light reflectance of no more than 10%. Covering out these glazed areas with signage or otherwise should not be permitted;

[C51] Ensure roller shutters or similar devices provided to openings on the ground floor and adjacent to the public realm are visually permeable;

[C52] Support the use of security patrols during the operational phase in preference to physical measures that detract from public areas;

[C53] Avoid the use of high security fencing adjacent to the main street frontage;

[C54] Incorporate artworks or approach local community groups or schools to decorate blank walls with murals or artwork; and

[C55] Consider the use of historical or cultural names for roads and open spaces and the use of public art and theming in activity nodes.

4.2.5 Element: Community

Heritage and identity

The built form of an industrial development should adopt a common visual scheme or concept which is applied throughout the development. The form should be functional but should also compliment the character of the existing local neighbourhood and sympathetically reflect the site's history and sense of place.

The design of street frontages influences the amenity of an industrial development. In many existing industrial areas, private spaces are routinely exposed to public view and result in a streetscape of yards, storage areas, car parks and fences which detract from the visual amenity of the area. The following strategies outline ways to achieve a more attractive streetscape in industrial areas.

[C56] Design perimeter blocks, which allow buildings to connect to form a continuous line along a street or block, so that private space is contained within backyards or courtyards. This also allows signage to be posted on the façade, removing the need for free standing signs on the street verge;

[C57] Ensure that buildings on individual lots are harmonious and compatible in terms of scale, building materials and architectural structure in order to create an integrated built form. Allowance should also be made for buildings to positively contrast against each other to provide variety and interest;

[C58] Ensure that secondary street facing façades are of similar architectural quality as the primary street façade;

[C59] Contain ancillary uses (i.e. storage) in the same built form envelope as the predominant industrial use;

[C60] Avoid long 'blind' (windowless) façades particularly if they are designed to face a street, car parking area or public open space;

[C61] Provide effective, long-term screening of storage areas from public viewpoints. Conditions to limit the height of stacked or stored materials should be imposed as part of planning approvals for industrial developments; and

[C62] Present the design concept to the local community, and encourage their input into the final design.

Safe and accessible buildings

Efforts should be made to ensure that industrial buildings are comfortable, accessible, safe and appropriate for a variety of people. Indoor air quality is particularly relevant, considering the variety of chemicals and products used in various industrial operations. The following strategies are recommended to provide safe and accessible industrial buildings that also provide a productive work environment.

[C63] Maximise natural ventilation of outside air to counteract the build up of indoor air pollutants. *Australian Standard 1668.2-2002* (Standards Australia 2002) provides advice and specifies criteria for ventilation rates.

[C64] Incorporate measures to ensure building occupants are not exposed to high levels of outdoor air pollutants. This may include regular monitoring of indoor air quality to ensure optimal ventilation rates for occupants. Ventilation rates will be site specific depending on the location, prevailing winds and topography of the site.

[C65] Ensure that buildings are designed to provide safe access for all individuals. Requirements for disabled access are stipulated under the Commonwealth *Disability Discrimination Act 1992* and *AS 1428-1992 Design for access and mobility* (Standards Australia 2003). However, building design should extend beyond compliance and include the following measures;

- Clear and safe pedestrian access into businesses from the road and any car parks, including disabled access;
- Clear demarcation of how buildings should be accessed, such as an obvious entrance;
- Avoid very heavy swinging doors or narrow doorways; and
- Minimise the use of steps or sudden level changes to access buildings
- Avoid the use of alternative access points or facilities for disabled people. Instead, main facilities should be designed so that they are convenient and safe for all users. This not only improves the experience of all users of that space, as well as offering potential efficiencies from avoiding duplicate facilities, but it also avoids the segregation of social groups.

[C66] Building design should protect pedestrians from the elements and improve the comfort of outdoor spaces designed for people through the use of awnings and other shade structures, footpaths with safe and reliable access;

[C67] Provide adequate shared facilities for employees that promote an enjoyable, safe and productive work environment. These may include the following facilities;

- on-site break out areas that could be shared with adjacent lots and may include barbeques, fixed seating and waterwise landscaping; and
- car parking spaces behind the front of the building that encourage fuel efficiency (i.e. closer bays for car pool, hybrid and fuel efficient vehicles) and ensure employee security.

Building Construction

Building construction involves a considerable use of resources including materials, energy and water and often produces vast amounts of recyclable waste that is generally directed to landfill. It is also a complex phase that involves a number of trades and contractors and has significant potential to cause a range of pollution related issues. This stage of development provides many opportunities to improve resource efficiencies, recycling and implement effective pollution control measures and should be carefully managed by the centralised management body.

4.3 Objectives

Ensure that the building construction phase implements strategies to:

[1] Prevent pollution of and impacts on the natural environment;
[2] Improve resource efficiencies; and
[3] Minimise the generation of construction waste.

Silt fencing should be used during construction to minimise sediment damaging infrastructure and entering the environment

4.4 Strategies

The following strategies provide recommendations for sustainable construction of buildings in industrial developments.

4.4.1 Element: Ecology

Management of natural features

Although the majority of site works would have occurred prior to this phase, there may be larger lots in the development which have retained significant vegetation or areas which have been set aside containing natural features for ecological, water management, separation or aesthetic purposes. To minimise impacts on any natural features the following strategies are recommended.

[C68] Where a building envelope exists, ensure all construction activities and impacts are contained within the envelope; and
[C69] Identify and protect significant vegetation, trees or water features (wetlands and waterways/drains) to be retained by fencing or flagging.

Pollution Management

Lot development involves minor earthworks and the use of heavy machinery to prepare the floor pad and various lot scale infrastructure. This localised disturbance has the potential to contribute to soil erosion and sedimentation if not carefully managed.

Building construction activities also have the potential to compromise water quality and impact on the surrounding environment due to a range of processes, products and chemicals used during this phase. Table 4 outlines potential forms of construction pollution, where it may occur and options to prevent impacts on the environment, which should be incorporated into the building construction management plan.

Table 4. Potential construction pollution

Building construction material	Control options
Cleaning solvents	• Vehicle/machinery wash down is only permitted in dedicated and contained wash down bays
Concrete	• Wash down of trucks, chutes and pumps should not occur on site • Mixing should occur in designated contained areas • Temporary bunds should be used where concrete has the ability to be spilt and wash into adjacent stormwater systems
Fertiliser	• Use amended soils, slow release and phosphorus free fertiliser
Glue, adhesives	• Use products with no or low volatile organic compounds • Clean up should occur in designated wash down bays
Paints	• Use products with no or low volatile organic compounds • Paints and wash waters should be disposed of to sewer or a contained area on-site and must not be discharged to stormwater systems • Oil based wash water should be contained on-site and removed to a licensed waste depot
Pesticides	• Physical barriers (i.e. mesh) should be used in preference to chemical control
Plastering	• Plaster waste and wash waters must not be discharged to stormwater systems Residues and wastes should be allowed to dry in a designated containment area and then removed off site to a licensed waste depot
Sediment	• Develop a sediment control plan that includes structural and non-structural controls
Wood preservatives	• Use products with no or low volatile organic compounds

To minimise pollution from building construction, the following strategies are recommended.

[C70] Develop a building construction management plan which requires all contractors to be properly trained regarding management of construction pollution and associated management procedures. The plan should specify;

- » the types of construction materials to be used, including those with no or low volatile organic compounds and methods of control (Table 4);
- » appropriate methods of vehicle and equipment wash down to be used by contractors;
- » spill management procedures;
- » targets for recycled content;
- » specifications for high quality and durable building materials;
- » considerations for lifecycle assessment of building materials; and
- » waste minimisation targets, which could be linked to the waste minimisation plan (See Section 4.4.2);
- » noise management procedures
- » dust control measures; and
- » sand drift/sediment control measures.

[C71] Ensure that building construction activities are compliant with the requirements of the approved urban water management plan, which outlines how the proponent will manage construction activities. Although this applies primarily to subdivision construction, erosion control measures should remain throughout the lot development phase.

4.4.2 Element: Resources

Water

Water efficiency

As lots are developed, the landowner or developer will need to demonstrate compliance with the urban water management plan adopted for the development. There is a requirement for urban water management plans to address how construction works will be managed. During building construction, builders and contractors can improve their water use efficiency by maximising the use of recycled water and adopting changes to conventional practices. The following strategies should be employed to improve water use efficiency during building construction.

[C72] Ensure compliance with the relevant urban water management plan;

[C73] Substitute potable water with alternative fit-for-purpose sources or adopt waterless options. This could include;

- » Use of recycled water from adjacent land uses for building construction and/or dust supression;
- » Capture or reuse of water in the testing of services, which could be held in temporary storage tanks for reuse in wash down water (i.e. paint or plaster wash down); and
- » Use of dry clean up methods, such as shovels or scrapers rather than hoses.

[C74] Require building or development applications to demonstrate water conservation measures to be employed during the building construction phase of each lot.

Energy, waste and materials

Total lifecycle energy

The building construction phase involves a considerable use of energy, from the processing and manufacture of building materials to the transport of materials and on-site construction. The embodied energy or total lifecycle energy of building materials needs to be considered during this phase so that appropriate low energy materials can be utilised.

The following strategy is recommended.

[C75] Determine total lifecycle energy requirements of construction materials and methods and select products with the lowest energy requirements. Total lifecycle energy requirements should include an estimation of;

- » the energy required in production of the material;
- » the energy required for transport of the material; and
- » the longevity of the material compared to alternative products.

Efficient building materials

The selection and use of higher quality building materials will improve the life span of a building and make it more cost effective and resource efficient in the long term. The follow strategies are recommended.

[C76] Utilise high quality and durable building materials, with consideration for the lifecycle assessment of materials chosen. A number of interactive web tools are available to assist with selecting environmentally preferable building materials. Examples of eco-selectors can be found on the VicUrban website www.cfd.rmit.edu.au/content/download/334/3204/.../Score_Card.pdf and the EnviroDevelopment website http://www.envirodevelopment.com.au/01_cms/details.asp?ID=35 under 'Materials'.

Waste minimisation and recycling

Minimising and recycling waste during building construction provides an opportunity to reduce waste going to landfill, reduce transportation costs and improve profitability. Common recyclable materials include concrete, tiles, sand, bricks, timber, glass, metals, plasterboard, plastics, cardboard and fittings. These materials can be reused on site in other buildings, landscaping or road construction, or collected and transported to resource recovery facilities where they may be reprocessed (i.e. plasterboard). To achieve this, the following strategies are recommended.

Provide temporary on-site recycling bins to recover reusable materials such as metal from the waste stream

[C77] Develop a waste minimisation plan to minimise waste and maximise recycling and recovery opportunities. The waste minimisation plan should consider;

- » Waste minimisation and recycling targets for building construction, to be adopted by all contractors;
- » How contractors and building site personnel will be informed and trained to minimise waste;
- » Purchasing policies that encourage procurement of construction materials that support waste avoidance, have recycled content and/or use sustainable, renewable resources (i.e. plantation timber, recycled steel and concrete);
- » Purchasing policies that encourage procurement of non-toxic materials used during construction including paints, floor coverings, sealants, adhesives, poly vinyl chloride (PVC) products and furnishings;
- » Provision of temporary on-site recycling facilities during construction including separate bins to recover glass, timber, metal, concrete and plaster from the waste stream; and
- » Monitoring requirements to ensure targets are met.

4.4.3 Element: Economy

Construction costs

The use of innovative construction techniques, alternative and recycled materials can reduce construction costs and times. Sourcing labour locally and materials from local suppliers and in bulk quantities can reduce costs and greenhouse gas emissions through minimising transport requirements. The following strategies recommend ways to maximise profitability during the building construction phase.

[C78] Maximise cost efficiencies by constructing multiple buildings simultaneously. For example, sharing heavy or specialised machinery such as cranes or bitumen surfacers (road plants). Also consider economies of scale through bulk purchases of materials or services when multiple businesses are seeking similar services or products. Economies of scale could apply to the procurement of common building materials such as concrete, cement or sand, or to the provision of services such as electrical, plumbing, landscaping or signage.

[C79] Consider linking bulk purchases of construction materials and services to the sale of industrial lots by offering discounts and marketing opportunities where suppliers are promoted through the branding of an entire industrial development. To gain these kinds of cost savings the timing of construction phases across the development needs to be well understood by a single coordinating entity, such as the centralised management body.

4.4.4 Element: Community

It is generally accepted that poor air quality can result in health problems, which may carry a substantial cost burden to businesses. Indoor air quality is influenced by ventilation rates and the sources of emissions within and outside the building. Outdoor air quality is influenced by industrial emissions and can impact on nearby communities. The following strategies are recommended to minimise health impacts on local communities and contractors during construction and post construction and throughout the operational phase of the development.

[C80] Ensure the use of non-toxic materials and methods during building construction including;

- » Water-based paints with low or no low volatile organic compounds;
- » Non-carpet floors with low or no low volatile organic compounds;
- » Where carpets are required, ensure they are mechanically fixed and contain low levels of low volatile organic compounds;
- » Non composite wood products, or where composite wood products are required use those with low formaldehyde emissions;
- » Natural staining of wood products, for example beeswax or linseed oil; and
- » Limiting the use of glues and adhesives, or where they are required use low volatile organic compound products.

[C81] Adopt management procedures to minimise noise, dust and odour impacts on nearby communities. The centralised management body should implement and advertise a community hotline to manage community relationships during the construction phase.

Case Study: Lot Development

Meridian Park Enterprise Zone

Meridian Park Enterprise Zone
(Source: LandCorp)

Site description

The Meridian Park Enterprise Zone comprises approximately 400 hectares of industrial land to be jointly developed by LandCorp and the City of Wanneroo. Meridian Park is situated off Flynn Drive within the 1000 hectare Neerabup Industrial Area, north of Wanneroo.

The Meridian Park development is expected to meet the industrial land needs of Perth's rapidly growing North West Corridor for the next 15 years. The development is promoting leading practice in industrial park design through comprehensive design criteria which will positively influence resource efficiency, maintain and enhance the environment and promote quality urban spaces within Meridian Park.

Design principles incorporated

LandCorp and the City of Wanneroo have developed the *Meridian Park design requirements and guidelines*. These guidelines provide direction and advice on sustainability and built form design objectives for the first five stages of the estate.

To ensure the *Meridian Park design requirements and guidelines* are adopted, LandCorp has appointed an Estate Architect, who is required to approve all development applications prior to lodgement with the City of Wanneroo. Purchasers are encouraged to attend a planning and design workshop coordinated by the Estate Architect, designed to assist them in preparing their development and building applications. Purchasers are also able to contact the Estate Architect for advice when preparing their applications.

The *Meridian Park design requirements and guidelines* have a strong focus on resource efficiency and visual amenity. The guidelines contain mandatory and best practice design requirements. In summary, these include;

Water

- All developments are to install onsite rainwater tanks plumbed into toilets and landscape irrigation. A minimum storage ratio of 90 kL/ha is required, but may vary depending on employee numbers;
- All developments are to install water efficient fixtures and fittings; and
- All developments are to use drought tolerant plants within soft and dry landscaping treatments.

Energy

- All developments are to meet passive solar design principles, including building orientation, shading, natural lighting and cross flow ventilation;
- All developments are to optimise wind and natural light for cooling and lighting purposes;
- Developments requiring hot water facilities are to provide solar hot water systems or 5 star gas or heat pumps; and
- All developments are to install energy efficient fixtures and fittings.

Waste and materials

- All developments are to prepare waste minimisation plans; and
- All developments are to recycle low-grade limestone for feature building purposes.

Land

- All developments are to optimise shared access and parking areas to promote efficient land use;
- LandCorp shall provide verge parking embayment to reduce onsite parking; and
- LandCorp shall provide dual-use pedestrian and bike pathways.

Built form and amenity

- Building designs are to be flexible and adaptable for multiple uses;
- Building designs shall activate street edges;
- Building layout is to optimise the use of developable land;
- Developments are to provide an onsite break-out area for employees; and
- LandCorp shall provide active public open space for employee recreation

Purchasers must demonstrate how they have applied the design requirements when submitting their applications.

Implementation issues

LandCorp engaged Worley Parsons to review the design guidelines in 2009. The review found that nearly all of the requirements focus on good building/landscape design which translates into social and environmental benefits, while energy and water efficiency are increasingly subject to regulation and increased pricing.

The review found that around three quarters of all the provisions could be implemented for little or no additional cost, and most of the remainder could be implemented relatively cheaply when incorporated into the initial design process. The zero/low cost energy efficiency items were considered the most beneficial as they incorporate rapid payback and increasing financial benefits for the owner or tenant, closely followed by the water related provisions. Spending on water saving elements is currently less attractive financially but is a regulatory requirement and is part of future-proofing against risk. Both energy and water elements will become increasingly more financially beneficial as energy and water pricing rises in Western Australia.

Further information

A complete list of the *Meridian Park design requirements and guidelines* may be obtained online at http://www.meridianpark.com.au/_document/Meridian-Park-Design-Guidelines.pdf

Additional information on Meridian Park can be found at http://www.meridianpark.com.au/ or by phoning LandCorp on (08) 9482 7499

(Information sourced from *Meridian Park design requirements and guidelines*, LandCorp 2009 and *Sustainability Review and Cost Benefit Analysis, Worley Parsons 2009*)

Chapter 5:
Operational Occupancy

The operational phase is the longest phase of an industrial development. Resource consumption and social and economic activities all peak within this phase. Traditional management of industrial developments is often fragmented, with little cooperation between businesses to enable synergies and the efficient use and reuse of resources

(Source: Kwinana Industries Council)

Industrial developments should focus on collaboration between occupying businesses with the aim of contributing to a sustainable economy. The operational phase of an industrial development should be overseen by a centralised management body that can seek out opportunities for maximising resource efficiencies and providing ongoing management and support to occupying businesses.

Additional strategies and objectives are usually achieved via their incorporation into an business plan or environmental management plan/system for the business. An environmental management plan/system is a tool used to manage the environmental impacts of an organisation's activities. It provides a structured approach to planning and implementing environmental protection measures, which is incorporated into the daily and long term operations of a business.

This chapter provides guidance to improve the sustainability of newly developed industrial developments and can also be applied retrospectively to existing developments.

5.1 Objectives

The operational phase of an industrial development should aim to:

[1] Ensure the development is sensitive to the natural environment by incorporating appropriate environmental management and pollution prevention practices into daily operations;

[2] Encourage water use efficiency and reuse opportunities in the ongoing management of individual premises and the development as a whole;

[3] Maximise the energy efficiency and use of renewable energy in the development and contribute to Australia's targets for reducing greenhouse emissions;

[4] Promote appropriate waste management practices by encouraging occupying businesses to reduce, recycle and recover waste prior to disposal;

[5] Improve the economic success of the development by providing an ongoing governance framework that manages tenancies, marketing, training and communications.

These objectives can be achieved by implementing the strategies provided in the following sections.

5.2 Strategies

5.2.1 Element: Governance

Successful international and national industrial developments have on-going management and support provided by a centralised management body. The centralised management body provides multiple benefits to occupying businesses, authorities and the community due to their intimate knowledge of the businesses and operations in the estate. The centralised management body has the ability to adopt a holistic view of the development, apply economies of scale and identify synergies between operators. The following strategies are recommended to ensure ongoing success of future industrial developments in Western Australia.

[D1] Maintain a centralised management body throughout all stages of the development and continue its presence throughout the operational phase. Responsibilities of the management body should include;

- Recruiting businesses to ensure the area is fully tenanted and to maintain the mix of companies which maximise the use of by-products;
- Establishing a Product, Waste and Resource Register to facilitate industrial networking and by-product synergies;
- Assisting businesses in developing and implementing Environmental Management Systems/Plans that cover their own operations;
- Coordinating networking links to local businesses and service providers, marketing and promotion for the development;
- Providing information and training on new and emerging technologies;
- Coordinating resource audits of businesses, particularly energy, water and waste, to improve efficiencies and identify synergies;
- Coordinating monitoring of security, energy and water use for shared services;
- Setting targets and strategies for local employment, resource reduction and recycling;
- Providing a mediation role for conflicts between industrial operators;
- Coordinating flexible tenancy agreements to allow for multiple uses of common areas (i.e. storage space, training and conference facilities);
- Managing shared facilities including resource recovery, business development and recreation (A full list of possible shared facilities is provided in strategy b19, Section 3.2) ; and
- Facilitating education and capacity building programs with the aim of assisting business operators to improve their financial and environmental performance.

5.2.2 Element: Ecology

Management of natural areas

If significant natural features (such as areas of bushland) are located within the industrial development, ongoing protection and maintenance of these features is required throughout the operational phase. A management plan should identify the potential threats to the natural feature/s including weed invasion, illegal dumping of waste, bushfires and dieback. The management plan should also outline how these will be managed and who will be responsible for undertaking and financing ongoing management. To ensure the ongoing protection of natural features the following strategies are recommended.

[D2] Prepare and implement management plans to maintain, protect and enhance significant natural features.

[D3] Determine responsibility and funding for ongoing maintenance of natural areas. Consideration should be given to funding interested non-government organisations to implement on-ground works, such as local advocacy groups. Involvement of local businesses and the community is also encouraged, through tree planting or cleanup days for team building activities.

Discharge and emissions

The management of discharges and emissions from industrial developments requires careful monitoring and management. The Department of Environment and Conservation is responsible for administering the *Environmental Protection Act 1986* and *Environmental Protection Regulations 1987* (as amended). Premises listed in Schedule 1 of the Regulations are subject to a Works Approval, licensing or registration, which may involve monitoring requirements as a condition of licence.

Industrial operations not included in the Schedule are regulated by the *Environmental Protection (Unauthorised Discharges) Regulations 2004* and *Environmental Protection (Controlled Waste) Regulations 2004*.

The *Unauthorised Discharges Regulations 2004* apply to minor pollution offences including the discharge of substances to surface or groundwater such as hydrocarbons, solvents, degreaser, detergents, coolants, food waste, laundry waste, pesticides, paint, acids and alkalis. Businesses can receive on-the-spot infringement fines, which increase if the matter goes to court.

Industries producing liquid wastes that cannot be disposed of in a class I, II or III landfill must ensure that wastes are transferred to an approved disposal facility by a licensed waste carrier. The *Controlled Waste Regulations 2004* are designed to ensure the safe transportation of such waste and ensure it is not unlawfully disposed of into the environment. These regulations also provide an even and competitive system for companies in the waste management industry.

To ensure protection of the environment from unauthorised discharges and emissions the following strategy is recommended;

[D4] Businesses should be aware of their environmental obligations regarding the transport, storage use and disposal of materials and substances used on-site including the need for regulatory approvals from the Water Corporation, Department of Environment and Conservation and Local government for their operations.

5.2.3 Element: Resources

Water

Supply and alternative sources

Determining an appropriate water source is critical in the early stages of planning any development. Infrastructure requirements associated with some alternative water sources (i.e. third pipe, stormwater harvesting) are more economically viable when installed during construction of the subdivision. Nevertheless, there are opportunities for installing and utilising alternative water sources post-development as suggested by the following strategy.

Water sub-metre

[D5] Investigate the suitability and cost effectiveness of alternative, fit-for-purpose water supplies. Potential supplies could include rainwater tanks, groundwater and on-site recycling systems. Consider the;

- » Purpose of supply (i.e. industrial processes, toilet flushing, landscape irrigation);
- » Volume of water required;
- » Required water quality; and
- » Requirement for any approvals to utilise the source (i.e. Groundwater Licence with the Department of Water)

Water use efficiency

Industrial developments usually contain a diversity of business types with varying water requirements. A number of industrial processes require high quality water and rely heavily on scheme supply, whereas others are able to utilise alternative sources.

Those businesses that rely heavily on the scheme supply (greater than 20,000kL/yr) are required to join the Water Corporation's Waterwise Business Program. This involves undertaking an annual water management assessment and developing a water efficiency management plan. Assistance is provided by the Water Corporation free of charge to those businesses participating in the Waterwise Business Program.

Regardless of the source, opportunities exist to reduce, reuse and recycle water during the operational phase of development. The following strategies recommend ways to improve operational water use efficiency during this phase.

Waterwise landscaping treatments will reduce water consumption

[D6] If appliances and equipment require replacement or upgrading, ensure they are water efficient. Many common domestic appliances (i.e. flow controllers, dishwashers, toilets) are rated for their water efficiency under the Water Efficiency Labelling and Standards (WELS) scheme www.waterrating.gov.au ;

[D7] Encourage the adoption of water efficient initiatives and behaviours in all operations. Although these initiatives would vary for each premise, suggestions include;

- » Installing high pressure, low volume nozzles on sprayers;
- » Using solenoid valves to stop water flow when production stops;
- » Using air cooling wherever possible;
- » Ensuring hot water systems are located close to the site that the hot water will be used and ensure hot water pipes are properly insulated;
- » Using shovels or scrapers to remove solid material from equipment or floors, rather than hoses;
- » Educating workers in wise water use techniques and strategies;
- » Maintaining systems and appliances to reduce leaks;
- » Conducting routine tests for leaks; and
- » Reusing condensate where possible.

[D8] High water use industries should consider the installation of sub-meters for major water use areas within their lot (i.e. wash-down areas, heat rejection systems, irrigation systems and bathrooms). Sub-meters allow occupants to track process water, detect leaks and accurately monitor water consumption against reduction targets;

[D9] Utilise waterwise landscaping treatments. Landscape design should maximise the use of waterwise local native plants, incorporate soil conditioner into planted areas, utilise mulch to reduce evaporation and install efficient irrigation systems regulated by moisture sensors and flow meters; and

[D10] Seek support from eco-efficiency programs aimed at the industry-sector level, such as Green Stamp (motor trades, cleaning and printing industries) and the Centre of Excellence in Cleaner Production.

Water reuse and recycling

Recycled water presents an opportunity to improve security of water supply by conserving high quality water for consumptive use and using a fit-for-purpose quality of water where possible.

The *State Water Recycling Strategy* (DoW 2008) acknowledges the importance of recycled water use in industrial areas and sets a strategy direction requiring all new industrial areas to investigate the installation of a third pipe system to distribute recycled water. Post-development options for water reuse and recycling at the lot scale should be considered on a case-by-case basis as indicated by the following strategy.

[D11] Consider post development recycling options suitable for the business. Consideration should be given to the reliability and quality of the supply, treatment required prior to reuse and potential uses within the operation. Options which may apply to many industries include the reuse of uncontaminated wastewater (i.e. condensate) for toilet flushing and the irrigation of gardens, greywater reuse or custom designed wastewater recycling technologies.

Energy

Carbon Pollution Reduction Scheme

The Australian Government's Carbon Pollution Reduction Scheme is set to be introduced in 2011. It is the Australian Government's primary policy tool to drive a reduction in the emission of greenhouse gases listed under the Kyoto Protocol (carbon dioxide, methane, nitrous oxide, sulphur hexafluoride, hydroflurocarbons, perflurocarbons).

The Scheme will cover emissions from stationary energy, industrial processes, waste and fugitive emissions from gas and oil production. The Scheme will require mandatory obligations from around 1,000 entities across Australia (Australian Government 2008).

Occupancy sensors can reduce energy consumption in industrial and commercial buildings. Source: http://www.thinkspace.com

Although the vast majority of the 7.6 million registered businesses across Australia will not face new regulatory obligations as part of the Scheme, the Scheme does propose significant economic reform, which will affect the pricing of goods and services. Emissions intensive goods and services will be more expensive than those that are less emissions intensive. This will provide incentives for industries to seek and/or supply low emissions goods and services. To help prepare for the transition to the Scheme the following strategies are recommended.

[D12] Undertake an emissions assessment or carbon footprint analysis, which includes a life cycle assessment of materials and processes. Support is available through various carbon management consultants, some of which also offer businesses an emissions certification scheme; and

[D13] Seek support to aid in the transition to a low carbon economy, available utilisation of funding from the Australian Government's Climate Change Action Fund. The fund provides for small business capital allowances and grants for innovation in climate change actions including the adoption of low emission equipment and technologies. Additional information can be found at http://www.climatechange.gov.au.

Renewable sources

The use of renewable sources as either a primary source of energy (i.e. GreenPower) or a secondary source (i.e. onsite technologies) contributes to the increased use of clean sources of energy. This can avoid the depletion of natural resources for future generations and can provide an improved market image for participating businesses. To incorporate the use of renewable resources during the operational phase of an industrial development the following strategies are recommended.

[D14] Incorporate the use of decentralised renewable energy technologies where possible, including the use of solar photovoltaic systems and/or wind turbines, which are backed up by the main electricity grid or remote area power supply systems (i.e. generators); and

[D15] Where on site renewable sources are not feasible, supplies should be provided from GreenPower sources, offered as part of the National GreenPower Accreditation Program. Businesses can apply to use the GreenPower logo on promotional material, to help demonstrate commitment to the environment and provide a marketing edge.

Energy efficiency

Introduction of the Carbon Pollution Reduction Scheme in 2011 will highlight the importance of energy efficiency. Industry will be driven by market forces to produce and purchase low carbon emitting goods and services, requiring the installation of energy efficient equipment and appliances and the adoption of energy conserving behaviours. Experience in Australia and overseas indicates that the adoption of energy efficient practices by businesses can reduce energy use by 15-25 per cent. This is achievable through actions which range from simple low cost housekeeping changes through to investment in energy saving equipment, systems or designs, which often have a relatively quick payback period (SEDO 2009). To reduce energy use during the operational phase the following strategies are recommended.

[D16] Install energy efficient lighting, equipment and appliances in all industrial buildings. Energy ratings for some appliances used in businesses are provided on the website www.energyrating.gov.au including;

- Air-conditioners;
- Refrigerators / Freezers; and
- Energy efficient machinery and tools.

[D17] Encourage energy efficient initiatives and behaviours for all operations. Although these initiatives would vary for each premise, suggestions may include;

- Sub-metering, which allows businesses to accurately monitor consumption of substantial energy use areas or equipment (i.e. air conditioning, pumps, chillers, ventilation, car park lighting). This enables operators to fine tune operational procedures to minimise consumption, detect operational problems and reduce energy wastage;
- Insulation;
- Automated lighting with occupant detection and daylight adjustment;
- Individually zoned lighting areas, particularly enclosed spaces such as lunch rooms, bathrooms and office space;
- Limiting non essential lighting such as large promotional signage and up lighting onto buildings;
- Installing motion sensors on security lighting, which also reduces light pollution; and
- Natural ventilation of car park areas or ventilation by variable speed drivers.

[D18] Seek support and assistance on how to improve energy efficiency in daily operations, available through the;

- Office of Energy, which provides subsided professional energy audits, sustainable energy seminars and grants to small businesses throughout Western Australia. SEDO has also developed an online Energy Smart Directory, which lists suppliers of energy efficient goods and services (http://www.energysmartdirectory.com/);
- Perth Region NRM's Light Industry Program, which provides specialised energy audits and sustainability assessments to enable and encourage small to medium-sized businesses adopt more efficient practices;
- Green Stamp, which offers support and assistance for businesses belonging to the motor trades, cleaning and printing industry associations;
- Centre for Excellence in Cleaner Production, which provides training and an online business manual;
- Carbon pollution reduction consultancies, which offer personalised training services and emissions certification schemes;
- Commonwealth funding;
- Regional NRM groups; and
- Industry and business association initiatives.

Transport

Transport costs associated with the operational phase of an industrial development are largely governed by its proximity to rail, arterial roads, airports, population base and public transport. Although an established development cannot influence its proximity to transport networks, options still exist for businesses and employees to reduce transport costs and greenhouse gas emissions, via the following strategies.

[D19] Implement a Workplace Travel Plan for individual businesses or for the development. TravelSmart is a national program aimed at reducing reliance on vehicles and utilising alternatives such as public transport, shuttle buses, walking, cycling, car pooling and teleworking. Business can encourage the uptake of alternative options by developing a Workplace Travel Plan, with assistance from TravelSmart officers (http://www.transport.wa.gov.au/travelsmart/14890.asp) or the centralised management body;

[D20] Develop a Product, Waste and Resource Register for the development that enables businesses to identify where by-products can be utilised by another residing business, eliminating disposal costs. The register can also be used to coordinate the delivery of goods and services used by multiple businesses, reducing delivery costs and possibly receiving discounts for bulk purchase which may not normally be possible for smaller businesses.

Waste and materials

Waste avoidance and reuse

Australia is rapidly running out of accessible, cost-effective landfill space and waste management is highlighted as a significant community responsibility. Recent changes to Western Australian legislation include the passing of the *Waste Avoidance and Resource Recovery Act 2007* (WARR Act 2007).

Changes under the WARR Act 2007 include the establishment of the Waste Authority, future development of a State Waste Strategy, power to require local government's to prepare Waste Plans and extended producer responsibility schemes, which may have implications for business.

At a national level, the Federal government is currently developing a National Waste Policy that aims to reduce waste and improve resource recovery. At the time of preparing these guidelines the Federal government was seeking community input to draft the policy. The Carbon Pollution Reduction Scheme will impact on the waste sector, particularly in relation to methane emissions from landfill which will be regulated under the Scheme.

Packaging is a priority waste for the Federal Government. The National Packaging Covenant is a voluntary initiative by Government and industry, to reduce the environmental effects of packaging on the environment. It is designed to minimise the environmental impacts arising from the disposal of used packaging, conserve resources through better design and production processes and facilitate the re-use and recycling of used packaging materials (National Packaging Covenant, 2009). Businesses that do not involve themselves voluntarily in the initiative may be subject to regulation under the National Environmental Protection Measure's for Used Packaging Materials applicable in that State (in Western Australia this is the *Environmental Protection (NEPM-UPM) Regulations 2007)*.

Common industrial wastes include concrete, asphalt, rubble, sand, paper, cardboard, office equipment, timber, metals, plastics, glass, organics and hazardous wastes. Minimising the generation of these wastes through avoidance and reuse has the potential to reduce costs to businesses and the community by reducing the use of raw materials used and reducing the amount of waste directed to landfill. This can be achieved by the following strategies.

[D21] Seek opportunities to avoid waste and increase reuse in daily operating procedures. Professional assistance may aid in identifying such opportunities and in Western Australia it is available from the following initiatives and programs;

- The Strategic Waste Initiatives Scheme (SWIS), which encourages businesses, local government, community groups and individuals to apply for financial support. Funding will be provided for initiatives which are consistent with the *Statement of Strategic Direction for Waste Management in Western Australia* (DoE 2004) and the Waste Authority's 'Priority Areas for Funding';
- The Recycle at Work program is an initiative of Amcor Recycling and is aimed at assisting and supporting small to medium sized businesses recycle waste (http://www.recycleatwork.com.au/); and
- The Green Stamp Program which assists small to medium-sized businesses to incorporate processes that avoid, reduce, reuse, recycle and dispose of waste in an environmentally friendly manner.

[D22] Seek innovative products and processes that are more durable, energy efficient, avoid the use of toxic materials and are easy to recycle. Utilising a life cycle approach has economic and environmental benefits.

Seek opportunities to avoid waste and increase reuse of materials

Resource recovery

Resource recovery involves recycling of used products and the recovery of embodied energy from waste. Recycling services, infrastructure and markets in Australia are expected to grow in the future. For industrial developments to efficiently recover resources and maximise on associated cost savings the following strategies are recommended.

[D23] Establish a Product, Waste and Resource Register to enable viable recycling activities within the development. The Register should be coordinated by the centralised management body. The Register would enable identification of useable by-products and synergies between occupants and initiate recycling of some products that are only viable when produced in large quantities;

[D24] Reuse organic and green waste within the development; and

[D25] Prepare a recycling strategy that clearly demonstrates a commitment to recycling. Identify the types and volumes of waste produced, methods of separating and storing recyclables, measures to ensure wastes are recycled and targets for recycling including cost benefits.

Material storage and use

Material storage and use during the operational phase should focus on good housekeeping practices. No substances should be allowed to escape to the environment through stormwater runoff, air emissions or to the soil, as recommended by the following strategies.

[D26] Materials and chemicals with the potential for polluting the environment should be appropriately stored and used within containment compounds. Compounds should be built using low permeability materials and should have the capacity to store at least 100 percent of the volume of the largest contained fluid storage vessel, plus 25 per cent of the volume of all other containers. If stored outside, the compound should be covered and the volume of the compound should allow for any captured stormwater (DoW 2006). Storage of fuels, solvents, explosives and dangerous goods are controlled via the *Explosive and Dangerous Goods Act 1961* and *Australian Standard 2715: the storage and handling of hazardous chemical materials*;

[D27] Develop an emergency response plan for any industries that store or handle chemicals or substances that could potentially harm the environment. The plan should cover the concepts of spill prevention, preparedness, response and recovery. More information to assist in developing an emergency response plan can be obtained at http://portal.environment.wa.gov.au/pls/portal/docs/PAGE/DOE_ADMIN/GUIDELINE_REPOSITORY/CHEMICAL%20SPILLS%20EMERGENCY%20RESPONSE.PDF; and

[D28] Industries using refrigerants should aim to install or replace systems with those that have an Ozone Depleting Potential (ODP) of zero. Large systems should also be equipped with a leak detection and recovery system.

1.2.4 Element: Economy

Although the planning and construction phases of sustainable industrial developments may involve greater up-front costs, it is during the operational phase where the economic benefits to occupants and the community are realised.

These economic benefits include:

- Increased local employment,
- Reduced travel costs for employees;
- Higher workplace productivity;
- Reduced operating costs due to energy and water efficiencies, waste avoidance, building design and reuse;
- Improved economies of scale due to shared infrastructure and services
- Reduced costs for disposal to landfill;
- Potential income from the sale of by-products;
- Enhanced market image; and
- Reduced environmental liability and cleanup costs.

To maximise these benefits, the following strategies are recommended.

[D29] Retain the centralised management body throughout the operational phase to ensure the development is economically competitive. Successful industrial developments rely on recruiting and retaining a suitable mixture of businesses to keep the development fully leased/occupied and maximise synergies. During the operational phase the centralised management body should;

- » Identify innovations, seek incentives, coordinate marketing networking/mentoring/information exchanges efforts and encourage private/public partnerships to provide greater economic stability when market conditions fluctuate;
- » Develop a 'buy local' policy for the development. The Product, Waste and Resource Register should include a register of goods and services supplied by local businesses, which could be maintained by the centralised management body;
- » Continue implementation of the marketing and promotion strategy for the development throughout the operational phase to attract and retain a sustainable mix of profitable businesses to maximise synergies; and
- » Seek financial incentives such rebates, reduced energy and water costs or reduced rates for applying innovative technologies that focus on the sustainable use of resources.

1.2.5 Element: Community

An improved sense of community within the development and with adjacent communities provides a more productive work environment, more cohesive communities, improved relationships with neighbours and an improved corporate image. The following strategies are recommended.

[D30] Businesses should make themselves familiar with the requirements of the Occupational Health and Safety (OH&S) legislation applicable to their State or Territory. Safe Work Australia provides guidance on OH&S and has developed a series of national standards codes of practice and related guidance notes to inform businesses of their requirements. These cover topics such as atmospheric pollutants, construction work, dangerous goods, hazardous substances, noise, treated timber and integrating OH&S into industry training packages. A full list is available at http://www.safeworkaustralia.gov.au/swa/HealthSafety/OHSstandards/

[D31] Ensure the centralised management body facilitates open interaction between operators and owners so that knowledge transfer, partnerships and innovation is maximised.

[D32] Develop a communications strategy for the development that encourages interaction between employees of occupying businesses, fostering a sense of community within the development and improving the quality of work life. Interactions may be enhanced through organised activities such as social functions, shared training sessions or regular newsletters. The provision of well-designed public open space, communal areas, shuttle bus services, small businesses development centres and lunchbars would also encourage a sense of community within the development;

[D33] Encourage business champions to provide a mentoring role to other operators within the development;

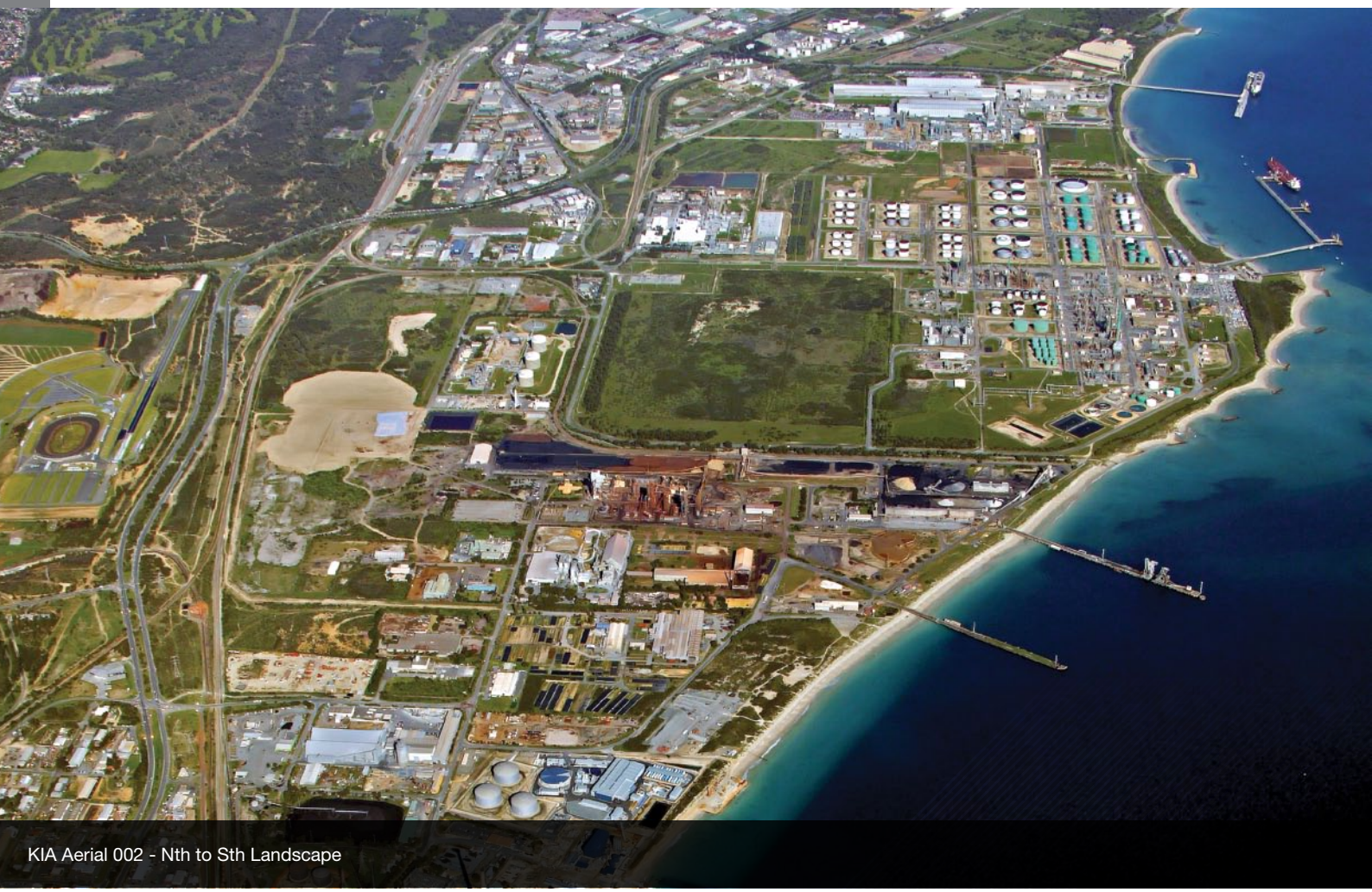
[D34] Encourage a sense of community with adjacent land uses with the aim of reducing land use conflicts. Greater interactions with adjacent communities may also encourage the use of local goods and services, improve knowledge of local industry practices and stimulate local employment opportunities. Mechanisms for developing this wider sense of community could include the distribution of newsletters or financial support of community events or clubs.

[D35] Establish a 'local employment program', in cooperation with the local government, which aims to provide employment opportunities for residents and access for businesses to the local employment market. A local employment program can create opportunities for local residents, addressing persons with special needs, qualifications or within certain age groups. Local authorities should consider providing direct or indirect subsidies to participating businesses.

[D36] Develop ongoing training and capacity building programs for employees that provide specialist advice on resource efficiency. Due to the vast range of business types within an industrial development, training programs should be tailored to suit the requirements of individual businesses or specific industry sectors. This may involve in-house training using qualified staff or working with an independent body that is able to organise the training, such as an industry association or the centralised management body.

[D37] Complement training programs with signage, information in emails or newsletters and presentations at staff meetings which aim to reinforce the information provided in training sessions.

Case Study: Operational Occupancy
Kwinana Industries Council



KIA Aerial 002 - Nth to Sth Landscape

Project description

The Kwinana Industries Council is an incorporated business association with membership drawn from the Kwinana industrial area. The Kwinana Industries Council was established in 1991 and provides a centralised support network to its members, focusing on the long-term viability of the industrial area. It is a beneficial self-governance framework that focuses on by-product exchanges, two-way community interactions, workplace health and safety and research into leading edge technology.

The majority of the Kwinana Industries Council's work is carried out by six committees (Eco-Efficiency, Environment and Planning, Workforce and Education, Community Health, Public Safety, and Public Affairs and Communications Advisory) where members work voluntary to improve industry operating practices. The Kwinana Industries Council's mission is to promote and contribute to the sustainable co-existence of Kwinana industry, the community and the environment.

Design principles incorporated

The Kwinana industrial area is well positioned to be a world leader in industrial symbiosis, where industries work with each other to make better use of waste or by-products. Over 45 regional synergies already exist in the Kwinana industrial area, which include by-product synergies and shared use of utility infrastructure.

The benefits of these synergies have resulted in:

- water savings of 8,200 GL/year
- energy savings of 3,750 TJ/year
- waste reductions of 421,600 tonnes/year
- gas emission reductions of more than 134,000 metric tonnes per year
- carbon dioxide emission reductions equivalent to removing 73,000 cars from the road

Some of the examples of the synergies that currently exist in the Kwinana industrial area include:

- A chemical plant (CSBP) provides CO_2 to a gas provider (Air Liquide), who purifies and compresses the gas to a standard that can be used as food grade CO_2 for soft drinks and beer. Previously, the CO_2 was vented to the atmosphere as waste gas;
- The Kwinana wastewater treatment plant (WWTP) infiltrates treated wastewater into groundwater upstream of Alcoa's groundwater extraction bores. This process enables Alcoa to reuse the treated wastewater for their process water circuit for the Kwinana alumina refinery. Thus the discharge from Kwinana WWTP is indirectly reused by Alcoa and is estimated at 1.1 GL per annum. Without this synergy Alcoa would need to use scheme water; and
- The Kwinana cogeneration plant (116MW capacity) supplies all the steam for the BP Kwinana refinery and at the same time generates electricity for BP as well as for the grid. The cogeneration plant is fired with excess refinery gas and natural gas. This synergy allowed BP to decommission its inefficient boilers, saving BP in the vicinity of A$15 million in capital expenditure while ensuring a cost competitive reliable source of steam and electricity for their refinery. This is estimated to have reduced carbon dioxide emissions by 170,000 tonnes per annum which would otherwise have been emitted on a continuing basis.

To identify, develop and implement additional synergies the Kwinana Industries Council is working in partnership with the Centre for Sustainable Resource Processing on a number of projects. Through this partnership more than 120 new potential synergy opportunities have been identified through targeted workshops with industry employees, industry discussions, review of existing information and compilation of a database of company inputs and outputs. These synergies are being evaluated and prioritised for future implementation.

Implementation issues

In the Kwinana industrial area there are a few barriers preventing some synergies from being realised. These include;

- Relatively low price for utility resources – the low cost of utilities reduces the economic viability of adopting some synergies. This is expected to change as the cost of utilities rise in the future;
- Core business focus - The emphasis of site personnel is to devote their efforts to core business activities resulting in potential missed synergy opportunities unless there is an overwhelming commercial benefit;
- Distances between companies – although the Kwinana industrial area is relatively compact, the distances still pose a challenge with regard to the recovery and reuse of byproducts, water and energy; and
- Environmental regulations as a synergy barrier - Some Kwinana companies are experiencing obstacles in getting governmental approvals for the use of alternative fuels and raw materials. Although some by-product synergies appear technologically and economically feasible, their practical implementation has been halted by uncertainties in the legislative framework. In particular, the final responsibility for approved reuse options and community concern is a major obstacle.

Further information

Further information on the Kwinana Industries Synergies Project can be obtained online at http://www.kic.org.au/Synergies.asp or http://cleanerproduction.curtin.edu.au/research/publications/2008/3b1_2008_status_report.pdf Alternatively, contact the Kwinana Industries Council on (08) 9419 1855 or the Centre for Sustainable Resource Processing on (08) 6436 8702

(Information sourced from *Capturing Regional Synergies in the Kwinana Industrial Area: 2008 Status Report*, Van Beers D. Centre for Sustainable Resources Processing, 2008 and *Industry's Environmental Synergies*, Kwinana Industries Council, 2008)

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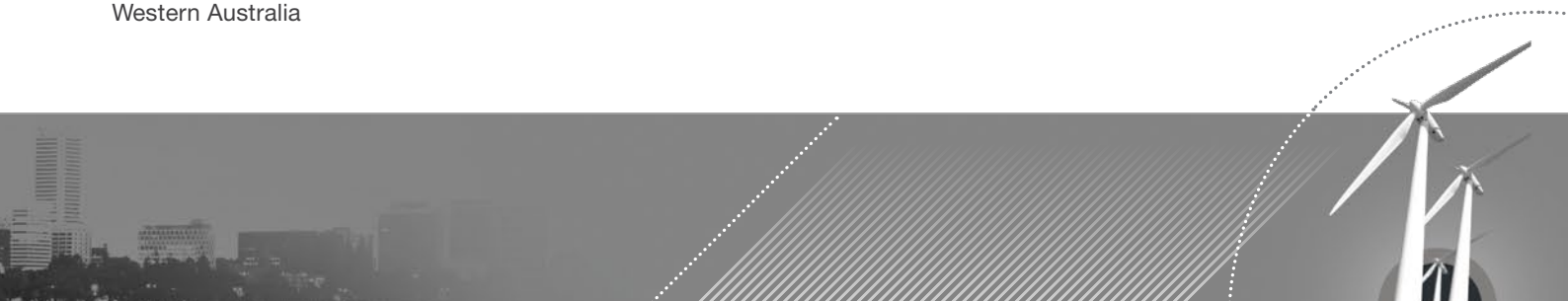

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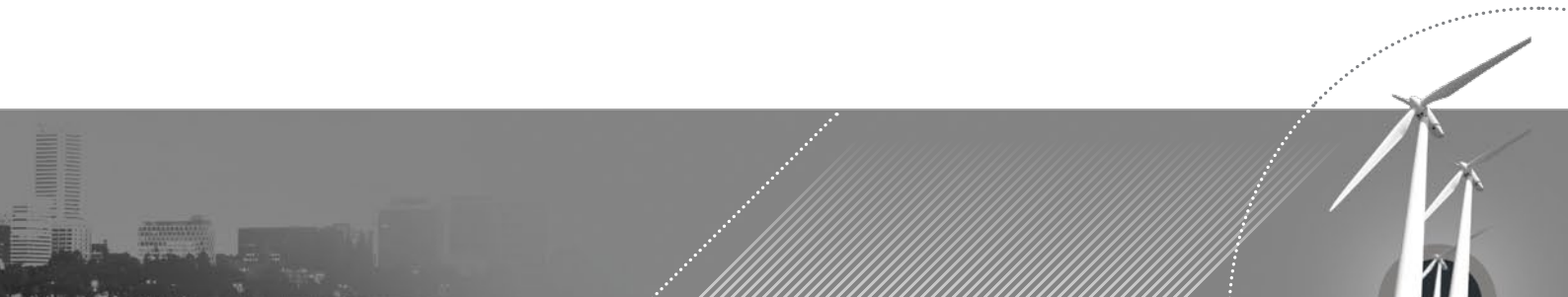


Assessment checklists

These checklists provide a summarised process for the delivery of better industrial development. The checklists identify actions to be completed and elements to be considered at each stage, making reference to the relevant strategies contained in these Guidelines. Please refer to the relevant chapter for more information on how the individual strategies may be achieved.

The following checklists are provided.

Checklist 1: Phase 1: Site selection and assessment

Checklist 1A: Comparative assessment

Checklist 3 - Phase 3: Lot development

Checklist 3A: Built form

Checklist 3B: Building construction

Checklist 2: Phase 2: Structure planning and subdivision

Checklist 2A: Subdivision design

Checklist 2B: Construction of the subdivision

Checklist 4 - Phase 4: Operational occupancy

Checklist 4A: Estate management

Checklist 4B: Operations management

Checklist 1

Phase 1: Site selection and assessment

The following activities are recommended to be completed as part of site selection as assessment.

Action	Completed	Comment
Comparative assessment of locations (see checklist 1A)		
Broad concept plan (A1)		
Identification of planning process and timeline for approvals (A18)		
Community consultation (A23, A24)		
Risk analysis/preliminary feasibility (A1)		
Consideration of financing (A1)		
Establishment of centralised management body (A1)		
Local renewable energy and alternative water sources considered (A11, A13-15)		

Checklist 1A: Comparative assessment checklist

When undertaking the comparative assessment of each option/site, the following elements should be addressed.

Element	Option 1	Option 2
Ecological, hydrological and physical features of the site (A3)		
Significant environments including buffers (A4, A5, A20, A25)		
Assessment of natural hazards (A6)		
Location maximises the use of land (A7 – A10)		
Access to water infrastructure including alternative sources (A11 – A14, A19)		
Maximise energy and transport efficiencies and urban linkages (A16, A17, A19, A21, A26)		
Heritage assessment (A22)		

Checklist 2

Phase 2: Structure planning and subdivision

The following activities are recommended to be completed as part of structure planning and subdivision.

Action	Completed	Comment
Establishment of centralised management body (B1)		
Community consultation (B2, B3)		
Development of structure plan, detailed area plan or subdivision design (see checklist 2A)		
Precinct design guidelines (see chapter 4)		
Subdivision construction plan (see checklist 2B)		
Financial and risk management strategy (B42)		
Market analysis and marketing strategy (B47-49)		
Approved local water management strategy/urban water management plan (B8)		

Checklist 2A: Subdivision design

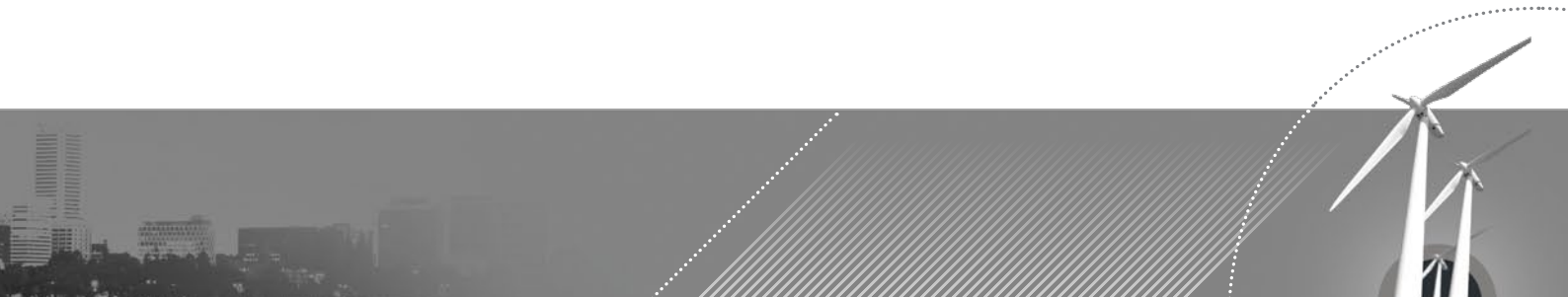
When designing the estate layout, the following elements should be addressed.

Element	Comment
Site assessment of land use, soils, topography, hydrogeology, natural environment and landform (B4-6)	
Design to enhance the natural environment while providing a functional landscape (B7, B8, B10-13, B32, B50, B52)	
Optimise lot design and servicing including transport systems (B14-19, B33, B36, B37, B43-46, B51, B53, B54)	
Stormwater management strategy (B9, B21-25)	
Maximise use of water including alternative water sources (B9, B25-31)	
Renewable energy use (B34, B35)	
Effective waste management (B38, B39)	
Resource flow analysis (B40)	

Checklist 2B: Construction of the subdivision

When developing the construction management plan (B56), the following elements should be addressed.

Element	Comment
Lifecycle costing of products (B57)	
Best-practice site preparation techniques (B56-62)	
Manage and inform contractors appropriately (B66, B68, B69)	
Compliance with criteria (B63 -65, B67)	



Checklist 3

Phase 3: Lot development

The following activities are recommended to be completed as part of lot development.

Action	Completed	Comment
Maintenance of centralised management body (C1)		
Design criteria and/or precinct design guidelines (see checklist 3A)		
Building construction management plan (see checklist 3B) (C70)		
Financial and risk management strategy (C3)		
Market analysis and marketing strategy		

Checklist 3A: Built form

The following activities are recommended to be completed as when designing the development/built form.

Element	Comment
Environmentally-conscious landscaping and retention of vegetation (C5-7, C15, C46)	
Best practice water sensitive urban design (including water efficiency and water reuse) measures (C4, C8-16)	
Maximise renewable energy and resource use (C17, C19, C39)	
Efficient use of energy (C18, C20, C21, C27, C30-33)	
Minimise energy needs (C22-26, C28, C29)	
Reduce transport emissions (C34-37)	
Waste and material recycling (C38, C40)	
Best practice urban design principles including adaptability and crime-prevention(C41-C53)	
Appropriate industrial character (C54-60)	
Access and amenity (C61-67)	

Checklist 3B: Building construction

When developing the building construction management plan (C70), the following elements should be addressed.

Element	Comment
Building footprint and area of disturbance (C68, C69)	
Compliance with criteria (C71, C72, C81)	
Water conservation and efficiency (C73-74)	
Lifecycle analysis of material and methods including procurement and staging (C75, C76, C78-80)	
Waste management (C77)	

Checklist 4

Phase 4: Operational occupancy

The following activities are recommended to be completed as part of the operational phase of industrial development.

Action	Completed	Comment
Maintenance of centralised management body (D1, D29, D31)		
Estate management responsibilities (see checklist 4A)		
Operational/business plan (see checklist 4B)		

Checklist 4A: Estate management

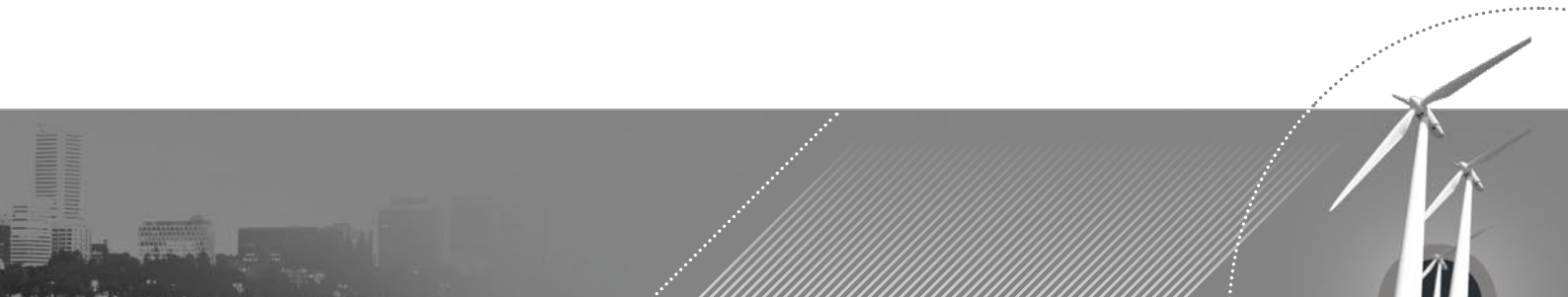
The following matters need to be considered as part of the operation of the estate as a whole.

Element	Comment
Management of natural environments and features (D2, D3)	
Management of waste and materials (D4, D20, D23, D24)	
Water supply (D5)	
Carbon emissions and energy (D13, D14, D19)	
Communications (D32)	
Community, training and safety responsibilities (D27, D30, D33-37)	

Checklist 4B: Operations management

The following matters should be addressed as part of the management and operation of the premises.

Element	Comment
Water conservation and efficiency (D6-11)	
Footprint analysis (D12, D22)	
Energy efficiency (D15-18)	
Waste and materials management (D21, D25, D26, D28)	



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