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FOREWORD

It is with great pleasure that I deliver, on behalf of the Regional Development Australia Pilbara Committee, the Pilbara State of the Environment Report 2013. The realisation of the report is the result of a combined funding partnership between Regional Development Australia Pilbara, the Shire of Ashburton, Town of Port Hedland and the Shire of Roebourne.

The Pilbara Regional Development Australia Committee, on which Pilbara Councils and community are represented, has a central role in strengthening the region through consultation and engagement with key stakeholders and the community on economic, social and environmental issues and in delivering solutions and defining priorities for informed regional planning.

The Pilbara is an enormously important resource recognised nationally and internationally for its mineral and hydrocarbon wealth, ancient landscapes and rock art, and Indigenous culture.

In 2012 stakeholders determined environmental sustainability as a key strategic planning priority for Regional Development Australia Pilbara, specifically, the delivery of a consistent regional approach to encourage, promote and support sustainable environmental practices.

At the same time, Pilbara local government authorities have acknowledged the environmental impacts of recent exponential growth recognising the need to ensure that future growth results in better sustainable outcomes and more livable communities. As a consequence, there has been an enhanced focus by local governments on holistic and proactive planning approaches that consider the broad assets of the region, including the natural and built environments, population, cultural and economic considerations. This has seen a greater focus on the incorporation of environmental sustainability strategies by Pilbara local government authorities in Community Strategic Plans.

While it is acknowledged that there has been considerable quality environmental research in the Pilbara, the absence of a unified regional policy position on environmental issues, interpretation of that information at the local level, and development of measures to monitor or track progress towards environmental indicators, are significant impediments to the identification and delivery of environmental sustainability outcomes.

The Pilbara State of the Environment Report 2013 addresses these issues through applying the same methodology as the as the Australian State of the Environment Report 2011 ensuring rigor in the approach to research, consultation, the identification of key pressures, issues and indicators, and the development of a framework for measurement and reporting.

The report provides sound information on the environmental resources of the Pilbara and indicators to facilitate a ‘whole of landscape’ view of development to provide for the strategic assessment of growth, development and management plans and to inform decision-making for the delivery of improved environmental outcomes. This approach is not intended to prevent development but rather to assist proponents and key decision-makers to deliver better environmental outcomes in the context of changing population and climate scenarios.

At a local government level key environmental themes and issues are prioritised and indicators proposed in the form of a report card to enable measurement and reporting to the community over time. While the report card includes key actions by each local government, the intention more broadly is for environmental impact to be considered by Council as part of its regular decision-making process. This approach involves a significant commitment by Pilbara Councils and one that is to be applauded.

On behalf of the Regional Development Australia Pilbara Committee I would like to thank the Shire of Ashburton, the Town of Port Hedland and the Shire of Roebourne for their financial contribution to the Report and key stakeholders for their active participation in related consultations.

As a final point of note, I also extend my thanks to Essential Environmental and the staff of Regional Development Australia Pilbara who have worked tirelessly over the last six months to deliver a quality report.

Collene Longmore
Chairperson,
Regional Development Australia Pilbara

Collene Longmore
Chairperson,
Regional Development Australia Pilbara
The Pilbara region is situated in the north of Western Australia between the Gascoyne, Mid-west and Kimberley regions (Figure 1). It comprises 507,896 km² of a vast array of landscapes, waterscapes and seascapes. From numerous offshore islands along the coastal plains of the Indian Ocean in the west of the region, to the largest mountain range in Western Australia, the Hamersley Ranges, through the middle and the desert plains across to the Northern Territory border in the east, the Pilbara is enormously rich in resources and natural beauty.

The rapid growth that is predicted to occur in the Pilbara region both presently and in the future is likely to impact on the remarkable environmental and cultural values of the Pilbara landscape. This State of the Environment Report summarises briefly the environmental resources of the Pilbara region, providing a clear picture of the drivers of change; the pressures or likely impacts on the environment; current management initiatives; and future outlooks. It aims to provide decision-makers with access to current and relevant information to improve understanding and facilitate effective management of important aspects of the Pilbara’s environmental and cultural systems.

1.1 PURPOSE

There is a significant amount of information currently available regarding the state of the environment in the Pilbara, however much of it is not readily accessible to support decision-making. Although it is noted that the quality of the Pilbara environment is currently generally healthy, it is considered that there are a number of issues that should be actively monitored to facilitate the identification of appropriate and potentially remedial action.

The Pilbara State of the Environment report will provide decision-makers with access to current and relevant information to improve understanding of future risks, and facilitate effective management of important aspects of the Pilbara’s environmental and cultural systems.

It contains indicators which are currently being measured and can be used to evaluate impacts on the environment that may result from future growth and development in the Pilbara region. Although these indicators may not provide the best representation of impacts, by monitoring changes over time, future adaptive management responses and/or mitigation actions can be identified to assist in the achievement of objectives and long term goals.

The Pilbara State of the Environment report provides a platform for community action by raising awareness and understanding of key environmental issues which will, in turn, help people and organisations make informed decisions regarding future management actions to reduce negative impacts on the environment.

1.2 REPORT PREPARATION

The State of the Environment Report for the Pilbara was developed using a similar process to that used for the Australia State of the Environment Report 2011. This included a desk top review of available information to describe the current state of environmental resources, consultation with stakeholders, identification of pressures, issues and indicators; and development of a framework for measurement and reporting. No additional investigations or technical work was undertaken to review or support the findings. Consultation with stakeholders included the following agencies:

• Local Governments (Shire of Ashburton, Shire of Roebourne and Town of Port Hedland).
• Department of Environment and Conservation.
• Department of Water.
• Department of Agriculture.
• Department of Fisheries.
• Department of Indigenous Affairs.
• Department of Mines and Petroleum.
• Department of Regional Development and Lands.
• Department of Transport.
• Department of Planning.
• Office of the Environmental Protection Authority.
• Pilbara Development Commission.
• Pastoral Lands Board.
• Rangelands NRM Co-ordinating Group.
• Native Title Representative Bodies and indigenous groups.
• CSIRO.
• Department of Sustainability, Environment, Water population and Communities.
• Water Corporation.

This report has been prepared for Regional Development Australia Pilbara on the basis of publically available information, as well as that supplied by key stakeholders as part of limited regional consultation. No action has been made to check the validity of this information. Because there are substantial parts of the region that have yet to be surveyed in detail, it is likely that additional environmental and natural resource values will be found. Accordingly, any decision-making should recognise the limitations of the data on which they are based and ensure that additional information is collected and analysed where necessary.
1.3 REPORT STRUCTURE

This report provides information on the state of the environment of the Pilbara region as a whole, highlighting key environmental assets and issues relevant to the environmental themes of air, water, land, biodiversity, coasts, marine environment, heritage and built environment (sections 4 to 11). It identifies fundamental drivers of change (section 3) and key pressures on each of these environmental themes. An objective has been proposed for each key pressure or environmental issue, supported by an indicator that aims to measure changes in environmental condition. The supporting text outlines the current activities or responses being undertaken to address the pressure and implications for the future. A suggested response is then proposed to guide future action.

Throughout the document, specific examples of current best practice with regards to environmental management are highlighted in boxes. These should be used to assist in the development of solutions for the future.

In order to make the information relevant to the Shires of Ashburton and Roebourne and the Town of Port Hedland, Section 2 interprets the information from the report at the local scale, identifying the most significant threats and environmental priorities for each local government, supported by locally relevant indicators delivered via a “scorecard” approach. This is intended to provide local government with a tool that can be readily updated to assess progress against objectives and identify areas of decline to guide management and decision-making.

Section 12 provides information on monitoring including information sources for indicators to facilitate easy reporting.
The Pilbara Region

FIGURE 1

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The Pilbara region is vitally important to Western Australia and the nation. It is enormously rich in natural resources – from the considerable mineral and hydrocarbon wealth to the ancient, sculptured landscapes, biodiversity and country. The region is home to one of the oldest continuous cultures, celebrated across a multitude of locations such as the magnificent rock art gallery on the Burrup Peninsula.

Growth in the Pilbara region has been dominated by the resource industry, which has influenced the timing, location, and form of towns and infrastructure, as well as the social and demographic profiles of the Pilbara community. The Pilbara local governments, which include the Shires of Ashburton, East Pilbara, and Roebourne, and the Town of Port Hedland, recognise the need to ensure that future growth results in better environmental outcomes and delivers more liveable communities. This will require a more holistic and proactive approach to planning that takes account of all assets in the region – the natural and built environments, population, cultural and economic considerations.

This report aims to provide better information on environmental attributes and indicators to facilitate a ‘whole of landscape’ view of future development. These broad indicators will provide a foundation for the strategic consideration of plans and decision-making, identifying how best to protect environmental values across the landscape, rather than the traditional piecemeal, project-by-project approach. The strategic consideration of future growth, development and management activities will deliver better environmental outcomes and provide clarity for proponents and other decision makers in the context of a changing population and climate.

It is recognised that the direct responsibility for the protection and management of many environmental values rests with agencies other than local government, as most decisions regarding the management of natural resources are outside their jurisdiction. This broadly includes decisions regarding the extraction of minerals and petroleum, pastoral land management, land clearing, water use, fishing and aquaculture, fire and air quality, and large scale infrastructure. This notwithstanding, local government has a direct responsibility for the planning and management of town sites and other areas that are vested in them for a particular management purpose. Local government is also the voice of the community, and this advocacy role is critical if better environmental outcomes and more liveable cities are to be achieved into the future.

The following sections provide a brief summary of some of the key environmental values in each local government area, highlighting key themes and issues that are considered by each local government to be a priority. Indicators are identified so that changes in each value can be monitored over time and outcomes can be reported to key stakeholders and the community. The priority issues are summarised in an individual local government report card for 2013.
# 2.1 SHIRE OF ASHBURTON

The Shire of Ashburton is the most southern of the Pilbara shires, comprising over 100,000 square kilometres. It stretches from the coastal beaches, rocky headlands, mudflats and mangroves around Onslow, across the Stewart Hills to Pannawonica and the Hamersley Ranges to Tom Price and Paraburdoo (Figure 2). Although these towns contain the majority of the Shire’s population of 10,000 residents, many aboriginal people reside in the communities of Bindi Bindi, Wakathuni, Bellary (Innawonga), Youngaleena and Ngurawaana.

The Shire is home to immense cattle stations which coexist with substantial mining operations. Its economy also comprises a sustainable fishing base and some tourism opportunities.

Growth in the Shire of Ashburton is currently being driven by the construction of two of the world’s largest LNG projects - Chevron’s Gorgon and Wheatstone LNG plants, which are being constructed on the western coast, as well as the inland expansion of iron ore mining including Rio Tinto’s operations which aim to increase inland expansion of iron ore mining including Pilbara’s natural environments, together with celebrating and valuing the Aboriginal and European history and heritage, with the aim of being a recognised leader in sustainability practices. These outcomes are to be delivered via a number of strategic directions that are outlined in the 10 Year Community Strategic Plan 2012 – 2022: Living Life under Goal 3: Unique Heritage and Environment, and Goal 4: Distinctive and well serviced places as follows.

<table>
<thead>
<tr>
<th>Objective</th>
<th>Strategic Direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goal 3: Unique Heritage and environment</td>
<td>Encourage Aboriginal participation in the management of natural assets.</td>
</tr>
<tr>
<td></td>
<td>Protect (manage) the diversity of the Shire’s natural environments.</td>
</tr>
<tr>
<td></td>
<td>Improve recreational access to natural environments with a focus on signage, access and safety.</td>
</tr>
<tr>
<td></td>
<td>Manage the industry/natural asset interface.</td>
</tr>
<tr>
<td>Leading regional sustainability</td>
<td>Build capacity to encourage protection of natural assets, good air quality and responsible use of electricity and water.</td>
</tr>
<tr>
<td></td>
<td>Implement waste minimisation strategies.</td>
</tr>
<tr>
<td>Celebration of history and heritage</td>
<td>Initiate programs and attract funding to celebrate the Aboriginal and European history and heritage of the Shire.</td>
</tr>
<tr>
<td>Goal 4: Distinctive and well serviced places</td>
<td>Plan appropriately for future housing and accommodation needs balancing State government growth targets, changing industry needs, community expectations and the need for timely and affordable release of land and housing.</td>
</tr>
<tr>
<td>Well planned towns</td>
<td>Ensure new developments are sensitive to the natural and built environments.</td>
</tr>
<tr>
<td></td>
<td>Ensure buildings and landscaping enhance the local character of towns and integrate with the natural environment, with a focus on beautification.</td>
</tr>
<tr>
<td></td>
<td>Incorporate social planning and ecological sustainable development principles in planning strategies and policies.</td>
</tr>
<tr>
<td></td>
<td>Ensure there is an effective interface between government and industry to ensure holistic planning and development.</td>
</tr>
<tr>
<td>Quality public infrastructure</td>
<td>Provide and maintain affordable infrastructure that serves the current and future needs of the community, environment, industry and business.</td>
</tr>
<tr>
<td></td>
<td>Develop plans for water conservation and water-wise use across the Shire.</td>
</tr>
</tbody>
</table>

Progress towards achieving the objectives of the Shire’s Community Strategic Plan is to be measured through community surveys and workshops, as well as through the delivery of community services, operational projects, asset management and infrastructure. This Report will also assist in the measurement of progress, through tracking changes and trends in the state of the environment.

## 2.1.1 State of the Environment in Ashburton

The Shire of Ashburton is rich in natural resources. These resources, which include clean air, substantial surface and groundwater systems, incredible coastal and marine environments, wide pastoral lands and significant mineral and petroleum resources, support a wide variety of biodiversity and cultural and heritage values.

The Shire contains 8 IBRA subregions:\(^1\) Cape Range, Ashburton, Hamersley, Chichester, Fortescue and Roebourne, with small portions of Augustus and Wooremal (Figure 3). Vegetation types in these regions are predominantly hummock grassland with scattered shrubs, with the remainder a mixture of low woodland and sparse shrubs, with small amounts of samphire, tidal mudflats and mangroves located in coastal region. A more detailed description of the bio sub-regions of the Pilbara is found in section 3.2 of the Pilbara Framework: Regional Profile (WAPC, 2009) and in the DEC’s Biodiversity Audit (DEC, 2003a).

Western Australia’s conservation reserve system plays a pivotal role in conserving WA’s biodiversity, which is both rich and exhibits a high degree of endemism (i.e. plants and animals occurring nowhere else (DEC, 2003b). The National Strategy for the Conservation of Australia’s Biological Diversity (1996) contains an objective to ‘establish and manage a

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\(^1\) IBRA regions are Interim Biogeographical Regions or bioregions and bio-subregions. This framework was developed by the Commonwealth and State governments to better understand the terrestrial and aquatic biodiversity.
Comprehensive, adequate and representative system or protected areas covering Australia’s biodiversity. Conservation reserves account for just under 15 per cent of land tenure in the Shire of Ashburton and include Barlee Range Nature Reserve, Cane River Conservation Park, Karajini National Park, Millstream-Chichester National Park, and Mungaroo Nature Reserve, as well as a number of offshore island nature reserves including Barrow Island and Thevenard Island (Figure 4). A new terrestrial conservation reserve has also been planned for the Shire of Ashburton, the proposed West Hamersley Range Conservation Park. A small portion of the proposed Mulgalands Conservation Park, most of which is situated in the Shire of East Pilbara, is also located in the very east of the Shire of Ashburton. The level of reservation of land for conservation purposes in the Shire of Ashburton is much greater than the rest of the Pilbara and equal to the internationally recognised standard of reservation of between 10 and 15% of each bioregion.

The Hamersley Ranges are a nationally recognised Biodiversity hotspot. They contain numerous endemic mammals, reptiles and plants, and their gorges have been described as ‘valuable refuge for plant species’, as their topographical location generally protects them from fire (Rangelands NRM, 2010).

A search of the DEC Threatened Species data base revealed 49 species of rare fauna, including the Dwarf Bearded Dragon, the Loggerhead, Flatback and Green turtles, the Northern Quoll and the Night Parrot, five specally protected fauna species (including the Dugong and Salt Water Crocodile), 37 Species protected under international agreements and 25 species of priority fauna which are known to occur in the Shire (Figure 4).

The DEC Threatened Species data base also contained three listings of declared rare flora (including Alota quadrata, Lepidium cataptycon, and Thryphtane witwteri) as well as 47 species of priority flora. The Shire of Ashburton contains nineteen Priority Ecological Communities and one Threatened Ecological Community, the Themeda grasslands of Pilbara Region (Grassland plains) which is dominated by the perennial Themeda (kangaroo grass) and many annual herbs and grasses) and exists to the north-west of Tom Price. In addition, Breadon Creek near Onslow and other coastal mudflat areas are likely to support mangrove and samphire communities which are of interest to the Environmental Protection Authority as benthic primary producer habitat as well as nursery, feeding and breeding grounds for marine fauna. See EPA Guidance Statement No. 1 – Tropical Arid Zone Mangroves along the Pilbara coastline, April 2001, for further information.

Significant water resources in the Shire include Millstream Pools, which are a proposed Ramsar site, as well as the nationally important wetlands of the Karajini Gorges, Weeli Wolli Spring, Eumouth Gulf East, Fortescue Marshes, Kookhabinna Gorge, Mt. Bruce coolibah-lignum flats and Yadjiyugga Claypan. Major surface water basins include the Port Hedland Coast, Onslow Coast, Fortescue River, and Ashburton River (Figure 5). The Ashburton River Catchment covers over 75,000 square kilometres and includes the Ashburton, Angelo, Hardey, Henry Rivers and Tunnel, Perry, Ethel, Turee, 7 Mile, Duck Creeks, flowing northwest to the ocean.

Similarly to the rest of the Pilbara, groundwater resources are particularly important to the Shire of Ashburton. The Shire contains a number of important aquifers, including Carnarvon – Birdrong, Hamersley – Millstream, Lower Robe alluval, Lower Cane alluvial and Lower Bungaroo Valley (Figure 6). It is within the Pilbara Groundwater Management Area which is proclaimed under the Rights in Water and Irrigation Act 1914. Public drinking water is supplied predominantly from groundwater and the Shire’s Public Drinking Water Source Areas include the Cane River Water Reserve, Millstream Water Reserve, and the Harding Dam Catchment Area.

The Water Corporation currently hold an allocation license for 15 GL from the Millstream aquifer. This is nearly three times the long-term sustainable yield of this resource which is estimated at 5.2 GL/year (DoW 2010). Although the licence conditions for Millstream and Harding Dam require the dam to be used as the primary water source for the West Pilbara water supply scheme, water supply issues in the dam have required the use of the Millstream aquifer to supplement supply during peak demand periods (DoW 2012).

The State Government has reached an agreement with Rio Tinto to develop a new long term groundwater source from the Bungaroo Valley. This water will be used to supplement the Water Corporation’s West Pilbara Water Supply Scheme and reduce the reliance on Millstream.

Pools and wetlands also have significant cultural value to the local Indigenous people. For instance, stories of ‘The Dreaming’ from the Millstream area provide the basis for the cultural practices of the Yindjibarndi and Ngarluma people (WAPC, 2009).

The local Traditional Owners in the Onslow area are the Thalanyji people. The Thalanyji cultural tradition is associated with the rainbow serpent Burra Balanyji that created underground tunnels in the area which link all of the water bodies around Onslow – the rivers, the creeks and all the fresh water soaks (Shire of Ashburton, 2010). There are a number of listed Aboriginal heritage sites within the Shire (Figure 7). These sites are protected under the Aboriginal Heritage Act 1972. Under this Act, activities in these areas will require permission through engagement and consultation with the region’s traditional owners.

The soils of the Shire are predominantly sandy along the coast, with a mixture of contrasting rocky, stony and clayey soils through the Hamersley Ranges and remainder of the Shire. Parts of Onslow are susceptible to Acid Sulphate Soils (Figure 8). These are naturally occurring soils, sediments or organic substances formed under waterlogged conditions that contain iron sulphide minerals. When exposed to air, the sulphides in the soil oxidise and release sulphuric acid and iron into the soil and groundwater, often in harmful quantities. This has implications for using the area for any built or landscaped development (Shire of Ashburton, 2011). A search of the Department of Environment and Conservation’s Contaminated Sites Database revealed a number of registered contaminated sites in the Pilbara, most notably the town of Wittenoom. Other registered sites include Thevenard and Varanus Islands.

The Shire of Ashburton contains a number of offshore islands that provide important marine habitat and marine resources including petroleum. Barrow Island is the second largest island in Western Australia with an area of 202 km². It is a Class A nature reserve designated for the “Conservation of Flora and Fauna” and is surrounded by the Barrow Island Marine Park and Barrow Island Marine Management Area (Figure 10). The Barrow Island nature reserve is considered one of the most important conservation reserves in the State due to its importance as a biological refuge. The island is home to 22 endemic species of mammal, reptile, bird and subterranean fauna (DEC, 2012), many of which are considered threatened fauna (20 taxa) because they are not found on the mainland (EPA, 2007). Both Barrow Island and Thevenard islands are subject to mining activity associated with Chevron’s Gorgon LNG project. Additional information on Barrow Island and Thevenard Island is contained within section 9.
2.1.2 Environmental priorities

The priority environmental themes for action in the Shire of Ashburton are air, water, coasts and built environments. As stated previously, it is recognised that direct responsibility for decision-making and management of the majority of environmental issues and impacts lies with many State Government agencies or land managers. Accordingly, this section will focus on the decisions and activities of local government that influence the protection and management of the environment. Advocacy opportunities (i.e. where local government’s main role is to provide a voice for the community and work in partnerships to deliver outcomes) will be highlighted where possible.

Air

Although air quality is generally good, dust is a significant issue across the Pilbara and can impact on the health of both humans and the environment. As no ports in the Shire of Ashburton currently export iron ore, the main sources of dust in the region is from fire. Not only do bushfires generate large volumes of particulate matter, but the fires also burn off the cryptograms holding the soil together and leave behind a fine friable powder that becomes airborne at very low wind speeds (BHP pers comm). Dust may also be generated from transport and industrial processing; however, impacts from these sources tend to be localised (Figure 9).

Another potentially significant air quality issue is associated with the Wittenoom Town site, Wittenoom Airfield, Wittenoom Gorge, Yampire Gorge and the Joffre Creek flood plain between the Wittenoom Townsite and the Fortescue River. This area is a registered contaminated site due to the known presence of free asbestos fibre contamination within soils at the site. Although waterborne migration of asbestos has been identified as the most significant method of migration, windborne migration has been considered more significant in terms of health risk associated with respirable fibres (GHD and PB, 2006). Wittenoom has been classified under the Contaminated Sites Act as “Contaminated - Remediation Required” and its status as a town has been formally removed; however, no action has yet been undertaken to clean up the site.

Further discussion on the issues and pressures associated with air quality in the Pilbara is contained in section 4.

The following objective for air quality has been proposed:

**Levels of particulates in the air meet the relevant standards in order to protect health, amenity and the environment.**

In order to meet this objective, the Shire of Ashburton should:

- Manage Shire waste disposal facilities to reduce offsite impacts including fires.
- Continue to work with the DEC regarding the management of bushfires.
- Advocacy: Work with State Government and industry to improve practices and extend the Port Hedland Air Quality Management Plan framework and governance structure across the whole of the Pilbara.

Progress towards the objective is proposed to be measured via the following indicator:

**Number of exceedances of particulate levels with State Government-agreed standards.**
Water

The availability of and access to water is a significant consideration for growth and development across the Shire. Drinking water is provided in Onslow by the Water Corporation, while Rio Tinto owns and operates schemes for Tom Price, Paraburdoo, and Pannawonica.

Water for Onslow is supplied from the Cane River bore field, from a Priority 1 public drinking water source area, located some 30 kilometres to the east of the town within the Carnarvon groundwater basin. Current infrastructure is considered to be at capacity and unreliable. The Water Corporation is investigating the feasibility of extracting additional water from the Cane River bore field and the Birdrong aquifer. Inadequate water supply is considered to be a significant issue, delaying applications for new houses (WAPC, 2011).

The Water Corporation commenced a water efficiency program in the Pilbara in 2010. This included a leak detection program, installation of smart meters in some towns and an education campaign. The Shire of Ashburton has also signed up to become a Waterwise Council to improve effective use of potable water within the Onslow townsite.

Rio Tinto Utilities own and operates the water supply schemes for Tom Price, Paraburdoo and Pannawonica. The company is licensed under the Water Services Licensing Act (1995) to supply potable and wastewater services to these towns, as well as Dampier in the Shire of Roebourne. Tom Price, Pannawonica and Paraburdoo are supplied with water from bore fields in shallow alluvial aquifers and supply is not currently considered to be at capacity. Groundwater management is administered by Rio Tinto through Groundwater Operating Strategies which are agreements between the Department of Water and Rio Tinto detailing abstraction and monitoring requirements and reporting by both parties. Drinking Water Source Protection Areas are currently being established by the Department of Water for both Tom Price and Paraburdoo and water quality is managed in accordance with the recently signed Memorandum of Understanding with the Department of Health for Drinking Water Quality (Rio Tinto Utilities, 2012).

Tom Price’s parks and reserves are irrigated using Shire bores located in the township. North Tom Price uses mains water for park and reserve irrigation.

Although wastewater treatment facilities are also operated in most towns, only limited reuse of treated wastewater occurs in the townsites. Rio Tinto has, however, commenced a sewer program whereby surplus water from below water table mining at Marandoo mine is used to grow Rhodes grass under a pivot irrigation system on Hamersley station, 45 km north east of Tom Price (Rio Tinto, 2012). Surplus water will also be reinjected to the Southern Fortescue borefield to replenish the aquifer which supplies the Tom Price township (DoW, 2011).

Rio Tinto recognises the importance of sustainable development and has made a commitment to optimise management of water resources and minimise disturbance of land and water bodies. Rio is also working with the State Government to reduce pressure on the Millstream aquifer by developing an additional drinking water supply source at Bungaroo Valley.

Further discussion on the issues and pressures associated with water resources in the Pilbara is contained in section 5.

The following objectives for water resources have been proposed:

- Provide for the water needs of the future community and environment and optimise efficient use of fit-for-purpose supplies.
- Sustainably manage the water resources of the Shire of Ashburton to maintain environmental, cultural and social values.
- Manage discharges to ground and surface waters to avoid contamination.

In order to meet these objectives, the Shire of Ashburton should:

- Develop a water conservation plan for water use across the Shire
- Educate the community regarding the need to use water wisely
- Maximise use of treated wastewater from the Onslow wastewater treatment plant for fit-for-purpose use including irrigation of playing fields and streetscapes
- Ensure that planning decision-making is consistent with the DoW’s Water Quality Protection Note: Land Use Compatibility within Public Drinking Water Source Areas in the vicinity of any drinking water borefields, including the requirements for well-head protection zones.
- Advocacy: Work with the Water Corporation and Rio Tinto to improve water use practices across the community and mining operations, and maximise fit-for-purpose use of recycled or dewatering water.

Progress towards the objectives is proposed to be measured via the following indicators:

- Water use per capita per annum.
- Water allocation within sustainable yield limits.
- Health of significant water-dependent environments.

Coasts

Onslow is one of the most cyclone affected towns on the Western Australian coastline, averaging one cyclone with wind gusts in excess of 90 km/h every two years. Between 1953 and 1963 Onslow suffered five severe cyclone impacts having wind gusts exceeding 170 km/h and a further three cyclones causing damage, some flood related (Shire of Ashburton, 2010a). Cyclones are generally associated with flooding and have the potential to increase storm surges in coastal areas.

The Shire of Ashburton has acknowledged that the cyclone activity around Onslow increases the risk of the town being affected by flooding and storm surge to the extent that they have identified the Onslow Coastal Hazard Special Control Area in their Town Planning Scheme No 7. This special control area provides for the Shire to require any planning application to be supported by an assessment, prepared to the satisfaction of council, of the impact of potential flood and storm surge events on the proposed development. The location of the special control area was determined on the basis of a storm surge study completed by Halpern Glick and Maunsell in 2000 based on modelling that was undertaken by Global Environmental Modelling Systems, to meet the criteria outlined in State Planning Policy 2.6: Coastal Planning Policy (2003). As this policy has been revised, further work was required to assess the impact of global climate change.

LandCorp commissioned M P Rogers & Associates to conduct a coastal vulnerability assessment of the Onslow townsite. This report recommended setbacks to allow for the action of physical coastal processes that range from 30 m (for the area protected by the seawall) up to 372 m for the land adjacent to 4 Mile Creek (M P Rogers & Associates, 2011). Modelling for coastal inundation showed that large areas of Onslow and its surrounds are vulnerable to
inundation and provided advice regarding design event water levels and finished floor levels. Any proposed development in Onslow should account for these levels and recommendations.

A further consideration at Onslow is the recent presence of moored vessels in Beadon Creek that provide floating accommodation for workers. Permission for the presence of these ‘floatels’ has been granted by Department of Transport, as the Shire of Ashburton has no jurisdiction over these waters. Mooring areas have been leased to Chevron for 2 years, ending in 2013. Plans for lease renewal or additional vessels are uncertain and depend on development of accommodation in Onslow. Concern has been expressed; however, by the Shire of Ashburton that additional ‘floatels’ will be established at this location, reducing local community access to the Creek for social and recreational activity.

There are currently no designated sites for coastal camping in the Shire of Ashburton; however some camping is known to currently occur at the mouth of the Ashburton River and along other areas of the coast. Impacts from recreational use of the coast are increasing, with greater numbers of people having access to the coast, seeking off-road experiences, camping, boating and fishing. Consideration must be given to improving the management of coastal recreation so that the environmental, recreational and cultural values of the coast can be maintained into the future. Further discussion on the issues and pressures associated with coastal areas in the Pilbara is contained in section 8.

The following objectives for the coast have been proposed:

• Ensure protection of assets and values in areas susceptible to coastal vulnerability.
• No further loss or degradation of coastal habitat.

In order to meet these objectives, the Shire of Ashburton should:

• Ensure that any development in Onslow addresses the requirements of the report on Onslow Townsite Planning: Coastal Setbacks & Development Levels (M P Rogers & Associates, 2011).
• Ensure that any substantial future development is supported by a current storm surge and flood inundation study consistent with the most current predictions for sea level rise and coastal processes.
• Undertake a strategic assessment of coastal recreation and access and develop a framework for the future management of coastal recreation, having consideration of signage, access and safety.
• Consider opportunities for joint management of the coasts with traditional owners.
• Work with the Department of Transport to manage impacts of the use of floatels and consider the opportunity to require planning approval.

Progress towards the objectives is proposed to be measured via the following indicators:

• Value of assets in areas vulnerable to sea level rise and storm surge.

Area of mangrove loss.

Built environments

The key built environments in the Shire of Ashburton are Onslow, Tom Price, Pannawonica and Paraburdoo. With the exception of Onslow, these townsites were established to support the exploration and mining of iron ore in the region. Whilst Tom Price and Paraburdoo have been normalised, with responsibility for municipal services being transferred from Hamersley Iron to local government, Pannawonica is still a “closed town”, with all services being provided by Rio Tinto.

The Shire also has a number of remote Aboriginal communities. These include Bindi Bindi, Wathuthuni, Bellary (Innawonga), Youngaleena, Ullawarra, Ngalakura, Yatharla and Nyugawana. Services in these communities are provided by a variety of agencies including Aboriginal Corporations, and the responsibility for management resides with a number of federal, State and Local Government agencies. Many remote communities are on pastoral stations, while others have been excised and the Crown Land is vested in the relevant Aboriginal Corporation. Community layout plans have been prepared for Wathuthuni, Innawonga, Youngaleena and Nyugawana by the Western Australian Planning Commission. These plans establish development requirements based on need and social/cultural, physical, environmental and economic opportunities and constraints. They provide a framework for decisions made by the Community on land use planning matters in the short to medium term. Further information is available on the Department of Planning website.

Power supply for Tom Price, Pannawonica and Paraburdoo is provided by Rio Tinto, from a gas-fired power plant in Dampier. Electricity in Onslow is provided via a 3.6 megawatt gas turbine power plant operated by Onslow Electric Power. The existing power supply is considered to be inadequate as the voltage is too low (200 volts) and the supply is operating at 25% below capacity (LandCorp, 2012). During summer peak loads, the Onslow power station requires support from temporary diesel generation. An increase in power load by Onslow Salt or new industrial expansion will require a review of Onslow’s energy generation strategy (WAPC, 2011).

The Shire of Ashburton is responsible for waste management and provides rubbish collection services in Onslow, Pannawonica and Paraburdoo. Limited recycling occurs, with the exception of steel/scrap metal, largely as a result of high contamination rates and transport costs. Currently, capacity at the Onslow tip site has been reached, and there is only about 12 months capacity in Paraburdoo, with Tom Price under pressure as well. Planning has commenced to identify an appropriate site for a landfill in Onslow and a transfer station in Paraburdoo. The Shire will also consider opportunities for increased reuse and recycling as part of the planning being undertaken.

In Tom Price and Paraburdoo, Rio Tinto Utilities is responsible for the provision of electricity, water and wastewater services, as well as maintenance of some community facilities. The Shire of Ashburton maintains the parks and stormwater system. Water for irrigation of parklands in Tom Price is provided by mains water, although some negotiation is occurring between the Shire and Rio regarding the opportunity to use treated wastewater. The stormwater systems in Tom Price and Paraburdoo are reaching the end of their construction lifespan and now require significant upgrades to maintain adequate levels of service.

As previously stated, Onslow’s water supply, provided by the Water Corporation through the Onslow Town Supply Scheme, is operating at capacity. Water supply has been identified as a significant impediment to future development (WAPC, 2011). Wastewater in Onslow is provided by the Water Corporation and the wastewater treatment plant is also operating at capacity. Expanding the plant is possible but odour from the plant could constrain development west of the town. In the longer term, the treatment plant might require relocation (LandCorp, 2012).

The Shire of Ashburton is committed to the delivery of distinctive and well-serviced places that are well planned, accessible and safe, with quality public infrastructure (Shire of Ashburton, 2012). Although planning control is provided by the Shire of Ashburton Local Planning Scheme
No.7, limited strategic planning has been undertaken across the Shire to guide growth, as the Shire is yet to complete their Local Planning Strategy. It is recognised; however, that a significant level of influence by RioTinto over both Tom Price and Paraburdoo provides a challenge for the implementation of a strategic vision for the Shire.

Local planning has been undertaken for the Onslow townsite and the Ashburton North Strategic Industrial Area. Additional guidance for built form in Onslow is provided within the Pilbara Vernacular Handbook, Part 5, which outlines advice on responding to climate; incorporating natural landscapes; building on the Pilbara character and identity; enhancing liveability; and mobilising for change (LandCorp, 2012).

Further discussion on the issues and pressures associated with built environments in the Pilbara is contained in section 11.

The following objectives for built environments have been proposed:

- **Ensure the management of stormwater addresses water quality as well as flooding.**
- **Improve the efficiency of energy use and optimise the use of renewable energy resources.**
- **Minimise waste and associated environmental impacts, while maximising re-use and recycling.**

In order to meet these objectives, the Shire of Ashburton should:

- Provide strategic guidance for the future planning and development of the Shire through completion of a Local Planning Strategy.
- Ensure proposed development is consistent with the principles and recommendations of LandCorp’s Pilbara Vernacular Handbook, noting specific recommendations for Onslow.
- Provide streetscapes, public places and spaces that enhance the local character of towns and integrate with the natural environment, optimising shade with locally native plants.
- Work with State Government and industry to ensure holistic planning and development occurs that is consistent with the strategic vision for the Shire.
- Develop stormwater management plans for Onslow, Paraburdoo and Tom Price that ensure appropriate levels of service will be maintained and water quality of stormwater is addressed.
- Work with RioTinto to optimise the use of treated wastewater from its wastewater treatment plants.
- Encourage the installation of water and energy efficient fittings and fixtures including photovoltaic panels, solar hot water systems, greywater systems and smart meters in private and public buildings.
- Ensure planning for future waste management facilities optimises opportunities for reuse and recycling of waste.

Progress towards the objective is proposed to be measured via the following indicators:

- Flooding in townsites.
- Energy consumption per dollar gross regional product.
- Amount of waste to landfill per capita.
- Proportion of waste recycled/reused.
FIGURE 2  Ashburton location

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Scale 1: 1,500,000

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FIGURE 3  Ashburton IBRA and vegetation types
FIGURE 4  Ashburton Biodiversity

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FIGURE 5  Ashburton surface water resources
FIGURE 6  Ashburton groundwater resources
FIGURE 7  Ashburton heritage

Aboriginal Heritage Sites (DHA) - status
- Insufficient Information - lodged & not assessed under Section 5 of the NHA
- Lodged with Registrar - not assessed
- Registered site
- Stored - lodged & does not meet terms of Section 5 of the NHA

Native Title - classification
- Applications determined by the Federal Court
- Applications lodged with the Federal Court
- Registered with the National Native Title Tribunal
- Indigenous Land Use Agreements within WA registered with the National Native Title Tribunal

Datasource: Landgate, Geoscience Australia. Created by H. Bruce Projection: MGA50 Zone50

Onslow: 1 historic site

Wittenoom: 1 historic site
FIGURE 8 Ashburton soils and contaminated sites
FIGURE 9  Ashburton air emissions

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Emissions point sources by Industry
- Copper Ore Mining
- Fertiliser Manufacturing
- Coal Seam Electricity Generation
- Gas Supply
- Gold Ore Mining
- Gravel and Sand Quarrying
- Industrial and Agricultural Chemical Product Wholesaling
- Industrial Gas Manufacturing
- Iron Ore Mining
- Oil and Gas Extraction
- Other Metal Ore Mining
- Other Non-Metallic Mineral Mining and Quarrying
- Other Petroleum and Coal Product Manufacturing
- Petroleum Product Wholesaling
- Petroleum Refining and Petroleum Fuel Manufacturing
- Pipeline Transport
- Port and Water Transport Terminal Operations
- Rail Freight Transport
- Railway Rolling Stock Manufacturing and Repair Services
- Vegetable and Drink Services
- Water Supply

Scale 1: 1,500,000
Figure 10: Ashburton coasts and marine

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Scale 1: 1,000,000

0 40 km
2.1.3 Individual report card
The following report card focuses on activities that are the direct responsibility of the Shire. It should be reviewed (remeasured and reported) annually to support the implementation of the Strategic Community Plan. Objectives and indicators are outlined in the preceding sections. Additional information on measurement and reporting is contained in section 12.

<table>
<thead>
<tr>
<th>THEME</th>
<th>STATE</th>
<th>PRESSURE</th>
<th>SHIRE RESPONSE</th>
<th>PROGRESS &amp; TREND</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air</td>
<td>Air quality generally good with localised occurrences of high levels of particulates.</td>
<td>Bushfires have potential to significantly impact on air quality.</td>
<td>Manage tip site fires and issue permits and infringements where required.</td>
<td>Amber (in decline)</td>
</tr>
</tbody>
</table>
| Water            | Water supply issues are delaying development in Onslow.              | Increasing population and climate variability is putting pressure on scarce water resources, as is mine dewatering and over abstraction. | • Work with the community to improve efficiency of use and with Rio Tinto to maximise reuse of fit-for-purpose water sources.  
• Develop a water conservation plan for water use across the Shire. | Red (improving) |
| Coasts           | Significant areas of coastline affected by uncontrolled access. Port areas impacted by dredging and shipping activities. Some assets under threat from coastal vulnerability. | Coastal areas under pressure from storm surge and sea level rise, recreational impacts and port activities including dredging. | • Undertake a strategic assessment of recreation impacts on the coast and develop a strategy to improve outcomes.  
• Develop a strategy to manage coastal vulnerability across the Shire. | Amber (in decline) |
| Built environments | Upgrades required to stormwater systems in townsites. Limited waste reuse or recycling. Lack of urban amenity and access to affordable housing. | High population growth rates, increasing cost of construction and land assembly issues. | • Prepare a Local Planning Strategy.  
• New development is consistent with Pilbara Vernacular Handbook.  
• Develop stormwater management plans for Onslow, Paraburdoo and Tom Price.  
• Install water and energy efficient fittings and fixtures in public buildings.  
• Planning for future waste management facilities will optimise opportunities for reuse and recycling of waste. | Amber (improving) |
2.2 TOWN OF PORT HEDLAND

The Town of Port Hedland comprises nearly 12,000 square kilometres between the Shires of Roebourne and East Pilbara (Figure 11). It has a large expanse of coastline and generally follows the catchments of the Yule and Turner Rivers.

Port Hedland is well known for its enormous iron ore and salt stockpiles, which are transported out of Australia’s largest bulk commodity port. Its population of just over 20,000 resides in two main centres, Port and South Hedland, as well as in a number of remote Aboriginal communities which include Jipininya, Marta Marta, Yandeyarra, Punju Njama, Strelley, Tkalka Boorda, Tkalka Wara and Woodstock.

Growth in Port Hedland is highly dependent on the resources industry and the world’s demand for steel. It has seen enormous growth pressure in the last ten years, evidenced by the State Government’s vision for Port and Hedland to become one of the Pilbara’s two regional cities, with an ultimate population of 50,000.

The Town of Port Hedland created a vision for the town that sits at the core of the Town of Port Hedland’s Strategic Plan 2010-2015. This vision sees Port Hedland as “A place of vast horizons, story and discovery, of people and possibility; where the profoundness of the past meets with the potency of the future.”

This vision will guide the transformation of the town into a regional city as it underpins the Town of Port Hedland’s strategic documents such as the Pilbara’s Port City Growth Plan and the Strategic Community Plan. The Port Hedland Strategic Community Plan (2012b), which represents the needs and aspirations of the community, sets out the vision for the next 10 years.

Strategic theme 3: environment, aims to deliver “A city in which we live in balance with our unique surrounds” by

Creating a vibrant and diverse place to live that is in balance with the natural elements of our surroundings and cultural heritage. A safe, modern and attractive city, Port Hedland is a community where generations of residents are proud to call home and establish themselves as a permanent fixture in the unique environment of Port Hedland.

It is supported by a number of identified actions for the Town of Port Hedland, including the need to:
- Address housing shortage and affordability through using Council held land, providing high quality modular construction, providing incentives and other forms of inducement to deliver housing by 2013.
- Provide safe and accessible community facilities, libraries, services and public open spaces that connect people and neighbours.
- Provide environmental protection and management and ensure that resources are used sustainably.
- Develop education, research and strategic investment opportunities for ‘clean technology’ industrial development.
- Provide environmental protection and management that ensures that natural resources are used sustainably.
- Maintain our natural and built resources to ensure their long term protection for the future.
- Facilitate industry and town growth, while preserving and celebrating the unique environmental assets, consistent with the town’s pro-development position.
- Achieve sustainable outcomes for the local community, while minimising negative impacts through the Town’s strong working relationships with the mining industry.

The Strategic Community Plan also contains a number of indicators that will be tracked and reported as the Corporate Business Plan is implemented. It will be reviewed by Council to ensure ongoing alignment to community needs.

The indicators in the Strategic Community Plan that are relevant to this report are:
- Improved housing affordability (within 25% of Perth prices).
- A clearly defined plan is implemented to meet water needs.
- Developed and implemented environmental protection and management plan.
- Reduced in dust and noise pollution levels.
- Increased facilities for sustainable use of power and water.
- Increased partnerships with industry and community to manage natural and built resources sustainably.
- Increased level of recycling initiatives in the Town of Port Hedland.

2.2.1 State of the Environment

The Port Hedland economy has grown 61% over the last three years (Town of Port Hedland, 2012a). This has resulted in enormous pressure for growth in an already heavily constrained environment which is being increasingly affected by climate variability. Port Hedland has seen an increase in temperature since 1970 and it also likely to see in increase in cyclones in the near future.

The Town of Port Hedland local government area contains significant water resource assets including the De Grey River, Eighty Mile Beach System and Leslie (Port Hedland) Saltfields System which are nationally important wetlands listed in the Directory of important Wetlands in Australia (Figure 12). Most surface water systems are seasonal, and the Town contains the Turner, Yule and Lyndon River catchments, and the mouth of the De Grey River. There are also a number of ephemeral creeks which provide key flowpaths for heavy rainfall events, particularly during the summer cyclonic episodes which occur every few years. Groundwater is used for almost all water supplies, with key aquifers near townsites fully allocated (Figure 13).

The Town of Port Hedland contains three IBRA subregions: Roebourne, Chichester and a small portion of Pindaniland. Vegetation types in these regions are predominantly hummock grassland with scattered shrubs, with the remainder a mixture of low woodland and sparse shrubs, with small amounts of samphire, tidal mudflats and mangroves located in coastal region (Figure 14). A more detailed description of the bio-system or protected areas covering Australia’s wildlife is given in Figure 15. The Town of Port Hedland contains one area of environmental significance, the Pilbara’s Conservation Reserve, Mungarooa Range Nature Reserve, as well as two offshore islands: Bedout Island and North Turtle Island. These areas account for just under six per cent of land tenure in the Town of Port Hedland. This level of reservation is less than that of the Pilbara; and is considerably less than the internationally recognised standard of reservation of between 10 and 15% of each bioregion.

IBRA regions are Interim Biogeographical Regions of bioregions and bio-subregions. This framework was developed by the Commonwealth and State governments to better understand the terrestrial and aquatic biodiversity.
A search of the DEC Threatened species data base revealed ten species of priority flora, as well as eighteen species of rare fauna, two specially protected fauna species, thirteen species of priority fauna and 37 fauna species protected under international agreements (Figure 15). These include the Green turtle, Flatback turtle, Northern Quoll, Crest-tailed Mulgara, Banded Hare-Wallaby and Bilby. These, and others such as the Dugong and Peregrine Falcon are also protected under the Environment Protection Biodiversity Conservation Act 1999.

Although most turtles use offshore islands for nesting purposes, there are two significant nesting sites in the Port Hedland area: Munda Beach and Cemetery Beach. The Munda Beach rookery is one of the largest nesting sites for the Flatback turtle in Western Australia.

One priority ecological community exists within the Town of Port Hedland - Four plant assemblages of the Wona Rookery is one of the largest nesting sites for the Wedgefield Industrial Estate. Most are associated with hydrocarbon pollution of the soil and groundwater.

The Town of Port Hedland contains significant mineral resources. Mining activity includes iron ore at Paroo, Poondano and Anson-Wodgina, with substantial salt operations in the Port Hedland townsite, and gEMS and semi-precious stones mined in the Ord Ranges.

Operations at the port result in a number of off-site impacts on the Port Hedland community and nearby environment including noise and dust (Figure 17). Dust and noise from the iron ore and port operations are currently being managed through a management program, which involves the application of water to prevent dispersal of dust particles.

There are over 1000 registered Aboriginal Heritage sites within the Town of Port Hedland (Figure 18). Much of the areas surrounding the town sites is also subject to Native Title, including a large area around Port Hedland in which the Ngarla People have been recognised as having Native Title rights over the land. A Native Title Agreement between the Kariyarra people and the State Government over the Hedland townsite has been established. In Port Hedland, Native Title negotiations between the Yamatji Marlija Aboriginal Corporation and the State Government are also being progressed to reach a similar agreement as that reached in South Hedland (Town of Port Hedland, 2012).

The coastal margins from Cape Preston to Cape Keraudren are recognised as having natural heritage significance as it is listed on the Register of the National Estate.

2.2.2 Environmental priorities

The priority environmental themes for action in the Town of Port Hedland are air, water, coasts and built environments. As stated previously, it is recognised that direct responsibility for decision-making and management of the majority of environmental issues and impacts lies with many State Government agencies or land managers. Accordingly, this section will focus on the decisions and activities of local government that influence the protection and management of the environment. Advocacy opportunities (i.e. where local government’s main role is to provide a voice for the community and work in partnerships to deliver outcomes) will be highlighted where possible.

Air

The significant level of activity at the Port Hedland port, which is expected to increase further in the next few years, results in high levels of particulate emissions which have the potential to impact on the health and amenity of the environment and Port Hedland residents. The particulate emissions, or dust, are comprised primarily of iron-oxide particles (93%) with measurable levels of sodium, magnesium, aluminium, calcium, manganese and copper. The importance of this issue has been recognised by Government, through the establishment of a taskforce with the objective of providing effective dust management strategies within Port Hedland. The Taskforce reported in March 2010 with the release of the Port Hedland Air Quality and Noise Management Plan.

The Port Hedland Air Quality and Noise Management Plan (Department of State Development, 2010), is a comprehensive plan for the ongoing management of air quality and noise in Port Hedland. The Dust Taskforce makes recommendations to manage both issues with regard to health risk assessment and analysis; land use planning; industry initiatives; and governance. These recommendations have been considered in the development of the Port City Growth Plan, which aims to achieve a greater balance between industry and the management of potential environmental health risks by changing the approach to planning and development in the West End of Port Hedland. Decisions on future land use in the West End will also be guided by health-risk studies which are still continuing.

The Taskforce also recommended the adoption of an interim air management criterion of 70 μg/m³ (24 hour average) with 10 exceedences per calendar year. This criterion is higher than current NEPM standards, as it is recognised that the dust composition in the Pilbara (Hedland aired) is very different from the dust composition of cities and farming land that the NEPM standard is based on. The Taskforce also notes that this criterion is part of a continuous improvement framework within which industry can work to reduce emissions over time (Department of State Development, 2010).

Particulate emissions are continually measured across Port Hedland by the Port Hedland Industries Council and this real-time information is available to the public on the Port Hedland Industries Council website (http://phimonitoring.com.au/monitor/rt/realtime. psp/HideId=371). This data is used by the Dust Taskforce to make broad level management decisions. It is interesting to note that all monitoring sites are influenced by high regional dust levels and many sites are recording dust from sources other than the export industry, including traffic movements and construction activities, as well as bushfires.

In order to address dust generated from port activities, the Port Hedland Port Authority has produced Dust Management Guidelines that were developed as a collaborative industry initiative by Port Hedland Industries Council members. The...
PHPA Dust Management Guidelines describe what is broadly considered to constitute leading practice for dust management in bulk materials handling processes, making recommendations for site specific application, taking into account a range of factors including local conditions and circumstances, available knowledge and technology, operational and maintenance aspects, safety and financial considerations (PHPA 2012).

Vegetated dust buffers are an effective management tool in the abatement of dust. This is evidenced in Kalgoorlie-Boulder where the Goldfields Dust Abatement Committee and Kalgoorlie-Boulder Urban Landcare Group planted a large “Green Belt” between the mining area of Kalgoorlie-Boulder and the city, which has noticeably reduced dust in the townsite. A small planted dust buffer exists in Port Hedland on the boundary of the port facilities and rest of the town. The buffer zone runs along the southern side of Wilson Street to protect the commercial and residential areas to the north from a proportion of the dust created by the port. Consideration should be given to increasing the area of the dust buffer within the port and in other areas of Port Hedland.

Although operational dust emissions from local sources are recognised as the main source of airborne dust loadings across Port Hedland (Department of State Development, 2010), a number of other sources including bushfires contribute to high environmental dust levels.

Further discussion on the issues and pressures associated with air quality in the Pilbara is contained in section 4.

The following objective for air quality has been proposed:

Levels of particulates in the air meet the relevant standards in order to protect health, amenity and the environment.

In order to meet this objective, the Town of Port Hedland should:

- Consider opportunities to enhance the planted dust buffer in and around the Port Hedland port.
- Manage Shire waste disposal facilities to reduce offsite impacts including fires.
- Continue to work with the DEC regarding the management of bushfires.
- Advocacy: Work with the Port Hedland industries council to improve practices and implement the recommendations and governance structure proposed in the Port Hedland Air Quality Management Plan.

Progress towards the objective is proposed to be measured via the following indicator:

Number of exceedances of particulate levels with State Government-agreed standards.

**Water**

Port Hedland relies on abstraction from alluvial sediments of the Yule and De Grey river valleys for its water supply, which is managed by the Department of Water and supplied by the Water Corporation through the Port Hedland Water Supply Scheme. The Yule River wellfield is located approximately 45 kilometres to the west of Port Hedland, while the De Grey River wellfield is approximately 60 kilometres to the east. Water is stored in tanks in South Hedland and then transferred to other bulk storage tanks in the Port area and on Finucane Island.

Pilbara port operations are large users of water, often with a vast majority of scheme water being used for dust suppression. The need for efficient water use in ports is critical, particularly as drinking water is essential to support the continued growth of Pilbara cities and towns, and this has been recognised by industry as part of the preparation of the Dust Management Guidelines: Leading practice (PHPA 2012). The Department of Water is also working with industry to produce water efficiency guidelines for port water use which will be used to assist the preparation of water efficiency plans.

In order to meet these objectives, the Town of Port Hedland should:

- Develop a water conservation plan for water use across the Town.
- Educate the community regarding the need to use water wisely.
- Continue to maximise use of treated wastewater from the South Hedland wastewater treatment plant for fit-for-purpose use including irrigation of playing fields and streetscapes.
- Optimise use of fit-for-purpose water and substitute alternative sources for drinking water where possible.
- Ensure that planning decision-making is consistent with the DoW’s Water Quality
Protection Note: Land Use Compatibility within Public Drinking Water Source Areas in the vicinity of any drinking water borefields, including the requirements for well-head protection zones.

- Advocacy: Work with State Government to develop a clear and implementable plan to meet the water needs of the future.
- Advocacy: Work with the Water Corporation and industry to improve water use practices across the community and mining operations, and maximise fit-for-purpose use of recycled or dewatering water.

Progress towards these objectives is proposed to be measured via the following indicators:

- Water use per capita per annum.
- Water allocation within sustainable yield limits.
- Health of significant water-dependent environments.

Coasts
The expansive Port Hedland coastline (Figure 19), which stretches for around 300km, contains a variety of mangroves, warm water reefs, rocky coastal outcrops and sandy beaches, which provide important habitat for terrestrial and marine ecosystems. The Port Hedland area is home to several species of mangrove, which are an integral part of coastal and marine processes. Mangroves act as nursery, feeding and breeding grounds, and as buffer zones against wave action, thereby reducing erosion and storm surge damage to coastal areas.

Port Hedland's beaches also provide important habitat for turtles. Concern surrounds the impact of lighting from industrial facilities and residential developments in the coastal area on turtle nesting activities. The EPA has responded with the release of an Environmental Assessment Guideline for protecting marine turtles from light impacts (EAG5), which specifically addresses approaches to proposal design and implementation to protect marine turtles from the adverse impacts of light.

Activities associated with the Port Hedland port have the potential to significantly impact on the important coastal and marine values of the region. This includes dredging activities, shipping and other activities associated with mining and port operations. Port Hedland is Australia's largest port, in terms of total annual tonnes of throughput, and supports mining activities in the whole region. In the next three years, the Port Hedland Port Authority has confirmed that this export will grow to more than double what is being currently shipped through both the inner and outer harbour (Town of Port Hedland 2012). This increase is likely to result in further impacts on the mangroves and marine environment, which may also result in a decline in recreational values.

Fishing, boating and water sports are popular recreational activities of the Port Hedland community and its visitors. Access to the coast in the Port Hedland area outside the townsite is primarily via pastoral stations, which include Mundabullangana and De Grey. Recent actions of campers, which include damage to fences, vandalism of equipment, uncontrolled fires, rubbish dumping and inappropriate access tracks, have led to the closure of both of these stations to the public. It is considered that the increase in the population of the region is resulting in similar impacts along the entire expanse of the Pilbara coastline.

The Pilbara coast is recognised as being one of the most cyclone-prone coasts in the world, averaging four cyclones a year between November and April. The growth of Port Hedland is constrained by the potential for flooding and storm surges, and the response to this issue has produced the town's existing pattern of segmented development.
Changes in climate are likely to lead to increased frequency and severity of storm events, resulting in an enhanced risk of storm surge and flooding. Key areas of risk include Pretty Pool, South West Creek and South Creek (adjacent to South Hedland). Land at the airport and the Wedgefield and Boodarie Industrial areas is also substantially affected by flooding, and the South Hedland wastewater treatment plant may also be at risk of inundation (Cardno, 2011).

Further discussion on the issues and pressures associated with coastal areas in the Pilbara is contained in section 8.

The following objectives for the coast have been proposed:

- Ensure protection of assets and values in areas susceptible to coastal vulnerability.
- No further loss or degradation of coastal habitat.

In order to meet these objectives, the Town of Port Hedland should:

- Ensure that any substantial future development is supported by a current storm surge and flood inundation study consistent with the most current predictions for sea level rise and coastal processes. Development in Port and South Hedland should be consistent with the Port Hedland Coastal Vulnerability Study (Cardno, 2011).
- Undertake a strategic assessment of coastal recreation and access and develop a framework for the future management of coastal recreation that actively protects dune, creek and mangrove ecosystems from degradation by off-road vehicles and other inappropriate uses.
- Consider opportunities for joint management of the coasts with traditional owners.
Advocacy: Work with the State Government and industry to ensure that any expansion of activities and/or infrastructure at the Port minimises impacts on the environment.

Progress towards the objectives is proposed to be measured via the following indicators:

- Value of assets in areas vulnerable to sea level rise and storm surge.
- Area of mangrove loss.

**Built environments**

The key built environments in the Town of Port Hedland are Port and South Hedland, both of which provide a range of community services including cultural, recreation and shopping facilities. The *Pilbara Planning and Infrastructure Framework* (WAPC, 2012) identifies that the role of this Pilbara city is to act as a gateway and service centre for the East Pilbara.

The future vision for the growth of this regional city is comprehensively outlined in the *Pilbara Port City Growth Plan* which was released in 2012 by the Town of Port Hedland together with the Department of Planning, Pilbara Cities Office (Pilbara Development Commission), and LandCorp. The Plan incorporates all land within the municipality of Port Hedland, with primary focus on the settlement areas of South and Port Hedland. It provides a high level strategic blueprint to facilitate the sustained growth of Port Hedland into Pilbara’s Port City, including how it will relate to its landscape, protect natural environmental assets and respond to the challenges of climate change including infrastructure requirements. Additional guidance for built form in Port and South Hedland is provided within the Pilbara Vernacular Handbook, Part 4, which outlines advice on responding to climate; incorporating natural landscapes; building on the Pilbara character and identity; enhancing liveability; and mobilising for change (Land Corp, 2012).

Power is supplied in Port and South Hedland by Horizon Power as part of the North West Interconnected Grid. Although there is some potential to upgrade the substations in these centres to cope with future development, additional land can be identified in Port Hedland, it is recognised that additional generation capacity is required to enable the delivery of the Pilbara Cities vision.

As stated previously, water supply for Port and South Hedland is provided by the Water Corporation from the De Grey River and Yule River Borefields. This system is at capacity and the Water Corporation is investigating a new water source area approximately 200km east of Port Hedland (West Canning Basin), which may present a long term solution for the Town of Port Hedland's water demands. Until then, innovative solutions will be required to meet the immediate and short term demand for water (Town of Port Hedland, 2012).

Waste management is a significant issue in the Town of Port Hedland. The Town currently operates a landfill facility in South Hedland and an incinerator in the Wedgefield Industrial area. Although the landfill facility is not nearing capacity, the Town is considering the closure and rehabilitation of this site in the medium term, largely in response to land use and buffer issues.

The Town has no official waste recycling programs, although it is working with the community and contractors to divert glass and plastic from landfill during special events. Uncommingled steel is also diverted and reused where possible. The Town of Port Hedland is also working with the local CARE group to deliver “Cash for Rubbish” which is a rubbish clean up incentive scheme, designed to encourage residents to care for their surroundings and the Town, while supporting fundraising opportunities for local community organisations, sporting groups and schools.

A recent approval by the Environmental Protection Authority has paved the way for Australia's first waste to energy plant to be built in Boodarie near Port Hedland. The $180 million plant, planned to be constructed by New Energy Corporation, will process as much as 100,000 tonnes of rubbish a year. The plant will process commercial and industrial waste and may take as much as 50% to 80% of household municipal waste from Port Hedland, converting gas from decomposing material into heat and power via a process of gasification. The energy produced, which could power more than 20,000 homes every year, is anticipated to be put into the grid, and may alleviate some of Port Hedland's energy issues.

Further discussion on the issues and pressures associated with built environments in the Pilbara is contained in section 11.

The following objectives have been proposed for the built environment:

- Ensure the management of stormwater addresses water quality as well as flooding.
- Improve the efficiency of energy use and optimise the use of renewable energy resources.
- Minimise waste and associated environmental impacts, while maximising re-use and recycling.

In order to meet these objectives, the Town of Port Hedland should:

- Implement the Pilbara Port City Growth Plan.
- Ensure proposed development is consistent with the principles and recommendations of LandCorp's Pilbara Vernacular Handbook, noting specific recommendations for Port and South Hedland.
- Provide streetscapes, public places and spaces that enhance the local character of towns and integrate with the natural environment, optimising shade with locally native plants.
- Develop stormwater management plans for Port and South Hedland that ensure appropriate levels of service will be maintained and water quality of stormwater is addressed.
- Continue to work with the Water Corporation to optimise the use of treated wastewater from its wastewater treatment plants, substituting fit-for-purpose water for drinking water where possible.
- Encourage the installation of water and energy efficient fittings and fixtures including photovoltaic panels, solar hot water systems, greywater systems and smart meters in private and public buildings, particularly in Council-managed areas.
- Ensure planning for future waste management facilities optimises opportunities for reuse and recycling of waste.
- Consider establishment of a domestic recycling service.

Progress towards the objectives is proposed to be measured via the following indicators:

- Flooding in townsites.
- Energy consumption per dollar gross regional product.
- Amount of waste to landfill per capita.
- Proportion of waste recycled/reused.
FIGURE 11  Town of Port Hedland

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FIGURE 14  Town of Port Hedland IBRA and vegetation types

Scale 1:750,000

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FIGURE 15  Town of Port Hedland Biodiversity

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FIGURE 16  Town of Port Hedland soils and contaminated sites
FIGURE 17  Town of Port Hedland heritage

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FIGURE 19  Town of Port Hedland coasts and marine environments

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2.2.3 Individual report card

The following report card focuses on activities that are the direct responsibility of the Town of Port Hedland. It should be reviewed (remeasured and reported) annually to support the implementation of the Strategic Community Plan. Objectives and indicators are outlined in the preceding sections. Additional information on measurement and reporting is contained in section 12.

<table>
<thead>
<tr>
<th>THEME</th>
<th>STATE</th>
<th>PRESSURE</th>
<th>SHIRE RESPONSE</th>
<th>PROGRESS &amp; TREND</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Air</strong></td>
<td>Air quality generally good with localised occurrences of high levels of particulates.</td>
<td>Port operations and construction activities have potential to significantly impact on air quality.</td>
<td>• Consider opportunities to enhance the planted dust buffer in and around the Port Hedland port.</td>
<td><strong>Amber</strong></td>
</tr>
<tr>
<td><strong>Water</strong></td>
<td>Water supply issues are an impediment to future development.</td>
<td>Increasing population, climate variability is putting pressure on scarce water resources, as is mine dewatering and over abstraction.</td>
<td>• Work with the community to improve efficiency of use and with Water Corp to maximise reuse of fit-for-purpose water sources.</td>
<td><strong>Red</strong></td>
</tr>
<tr>
<td><strong>Coasts</strong></td>
<td>Significant areas of coastline affected by uncontrolled access. Port areas impacted by dredging and shipping activities. Some assets under threat from coastal vulnerability.</td>
<td>Coastal areas under pressure from storm surge and sea level rise, recreational impacts and port activities including dredging.</td>
<td>• Undertake a strategic assessment of recreation impacts on the coast and develop a strategy to improve outcomes.</td>
<td><strong>Amber</strong></td>
</tr>
<tr>
<td><strong>Built environments</strong></td>
<td>Lack of urban amenity and access to affordable housing. Upgrades required to stormwater systems in townships. Limited waste reuse or recycling.</td>
<td>High population growth rates, increasing cost of construction and land assembly issues.</td>
<td>• Implement the Pilbara Port City Growth Plan.</td>
<td><strong>Amber</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• New development is consistent with Pilbara Vernacular Handbook.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Develop stormwater management plans for Port and South Hedland.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Install water and energy efficient fittings and fixtures in public buildings.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Planning for future waste management facilities will optimise opportunities for reuse and recycling of waste.</td>
<td></td>
</tr>
</tbody>
</table>
2.3 SHIRE OF ROEBOURNE

The Shire of Roebourne forms the central coastal part of the Pilbara region. With an area just over 15,000 square kilometres, it is bounded by the Indian Ocean in the north and west, the Town of Port Hedland in the east, and the Shire of Ashburton in the south (Figure 20). Settlement is largely confined to a string of towns along the coastal strip and the North West Coastal Highway.

The Shire has a rapidly growing population, largely due to natural resource projects in the region which include the mining of iron ore and other minerals, and oil and gas operations. Continuing expansion of these operations, new projects and investment in infrastructure are expected to drive further population growth in the Shire.

The potential for growth in the Shire has been recognised by the State Government, and it forms a key component of the Government’s Pilbara Cities Vision. Under this vision, the State Government aims to deliver sustainable regional centres by ‘normalising’ land and housing supply, improving infrastructure and community facilities, while supporting the health and well-being of the resident population (Government of Western Australia, 2010).

The Karratha City of the North Plan (Shire of Roebourne, 2010) offers a ‘roadmap’ for the transformation of Karratha from a resource town into a regional city of the north. It outlines principles, objectives and strategies for the integrated delivery of projects and outcomes, and provides specific guidance in terms of responsibilities, time and costs to ensure coordinated delivery and monitoring of outcomes.

The community’s aspirations for the Shire have been recently outlined in the Shire of Roebourne Strategic Community Plan 2012 – 2022. The plan outlines the outcomes that the Council will be achieving through strategies provided in the Corporate Business Plan over the next five years. The Strategic Community Plan also incorporates state and regional plans including the Pilbara Planning and Infrastructure Framework 2012, Karratha - City of The North Plan and the Pilbara Regional Council Strategic Plan 2012-2014. These linkages help position the Shire’s planning within a much broader context, allowing the consideration of current and emerging community needs and the identification of key stakeholders and interdependencies which may affect delivery of appropriate services to the community over time.

Shire of Roebourne Strategic Community Plan strategic theme 3: Our Natural and Built Environment – Thriving and Sustainable, has an associated goal to “strive to ensure our community lives sustainably in a thriving natural environment”. The Shire of Roebourne is dedicated to achieving the following outcomes as part of their own activities:

- An environmentally responsible and sustainable organisation – through the protection and enhancement of the natural environment, open spaces, beaches and waterways.
- A sustainable and thriving natural environment – by exploring options to reduce, reuse or recycle our waste and minimize our carbon footprint.
- Environment that promotes healthy lifestyle – by providing shading in meeting places.

The Shire of Roebourne will report on the progress of the Strategic Community Plan annually as part of the Annual Report and will monitor progress internally against the projects and services outlined in the accompanying Operational Plan. The quarterly reviews of the Operational Plan will be available through the council website.

2.3.1 State of the Environment

The Shire of Roebourne is well known for its considerable natural, cultural and heritage values. From the historic towns of Cossack and Roebourne, across the wide expanses of the pastoral stations across the Chichester plateau and back to the Burrup Peninsula, which contains the world’s oldest and largest collection of rock art engravings, the Shire is rich in natural resources.

The Ngarluma/Yindjibarndi people are recognised as having Native Title rights over a significant portion of the Shire of Roebourne and the Jaburara (or Yaburara) Aboriginal language group are recognised as the original inhabitants of the Burrup Peninsula and Dampier Archipelago. The Dampier Archipelago contains one of the densest concentrations of rock engravings in Australia with some sites containing thousands or tens of thousands of images. It is listed on the Register of the National Estate and is protected by the Environment Protection and Biodiversity Conservation Act as a Matter of National Environmental Significance.

The terrestrial areas of the Dampier Archipelago also support a diversity of flora from the Pilbara region. Approximately 32% of the flowering plant species known from the Pilbara region occur on the islands (OSEWPnSC website, 2013). Over one hundred species of birds have been

<table>
<thead>
<tr>
<th>OUTCOMES</th>
<th>STRATEGIC INDICATORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Community Volunteer Groups</td>
<td>Number of active voluntary groups working for clean beaches.</td>
</tr>
<tr>
<td>New Cycle ways and Cycling Trails Developed</td>
<td>Developing and implementing a water savings plan.</td>
</tr>
<tr>
<td>Initiatives on Recycling</td>
<td>Number of new initiatives for developing partnerships with recycling agencies.</td>
</tr>
</tbody>
</table>
recorded in the Dampier Archipelago region, including both terrestrial species and sea and shore birds, some of which are migratory. Many reptiles occur in the place with thirty-two species known from the Burrup Peninsula and forty-one species known from the islands of the Dampier Archipelago (DSEWPaC website, 2013).

According to the DEC’s Threatened Species Database, six Priority flora species are recorded within the Shire of Roebourne, as well as 22 species of fauna that are rare or likely to become extinct, two species of specially protected fauna, 35 species that are protected under international agreements and thirteen species of priority fauna. These include the Flatback turtle, Northern quoll, Pilbara Olive Python, Dougong and Perigrine Falcon.

Although there are no Threatened Ecological Communities in the Shire, five Priority Ecological Communities have been identified. These include Roebourne Plains gilgai grasslands; Roebourne chenopod association; Wona Land System; Burrup Peninsula rock pile communities and the Hoseflat Land System (Figure 21).

The marine waters adjacent to Karratha fall within the Northwest Shelf Province of the Northwest Marine region, an area that supports a complex range of habitats including rocky coastlines, sandy substrates with mangroves and seagrass, and a number of islands and associated reefs. These habitats support a high diversity of marine species, including significant population of protected marine mammal, reptile and shark species (Government of WA, 2010). Key protected areas include the Montebello Commonwealth Marine Reserve, the Dampier Commonwealth Marine Reserve and the Montebello Islands Marine Park (Figure 22). Additional information on the values of the Shire’s marine environment is provided in section 9.

There are few places in the world where mangroves occur in arid conditions and as such the mangroves along the Karratha coastline are considered regionally significant and zone mangroves (Government of WA, 2010). The waters off Karratha are also subject to substantial recreational fishing pressures due to the use of the town by fly-in fly-out workers as well as tourists during the winter months.

The Shire contains significant water resource assets including the Fortescue River and other significant surface water systems including a large proportion of the Harding Dam catchment area (Figure 23). Due to a number of issues regarding the ability of surface water systems to supply water in the Pilbara, groundwater is used for almost all water supplies, with a large proportion of this for mining use including dewatering. The key groundwater aquifers are the Hamersley fractured rock aquifer, Pilbara fractured rock aquifer and Pilbara coastal saline aquifer (Figure 24).

The soils within the Shire of Roebourne are predominantly alluvial sand in coastal areas, with silt and clay deposited on floodplains, with clay soils surrounding the rocky and stony soils of the Karratha hills. A search of the DEC’s contaminated sites database revealed nine registered contaminated sites in the Shire, most of which are in relation to hydrocarbon contamination (Figure 25). Although current information suggests the presence of soils with high to moderate risk of acid sulphate soils occurring along the coastline and mudflat areas of the Shire, site investigations have yet to encounter any actual acid sulphate soils.

Although there are only two active mining operations in the Shire of Roebourne - Sino Cape Preston Iron and Dampier Salt, Karratha provides administrative and service support to a substantial part of the booming resources industry in the Pilbara including Woodside’s North West Shelf gas fields, with Cape Lambert and Dampier providing the port infrastructure for the iron ore operations of Rio Tinto.

Over two thousand indigenous heritage sites have been identified in the Shire and are protected under the Aboriginal Heritage Act 1972 (Figure 26). The Shire of Roebourne also has a municipal heritage register which has recently been revised to incorporate additional information about the acknowledged heritage sites in the municipality. The Shire of Roebourne is well known for the historic town of Cossack as well as many important heritage buildings and sites in the town of Roebourne. It is noted; however that the Municipal Heritage Inventory does not address heritage sites prior to European occupation.

2.3.2 Environmental priorities

The priority environmental themes for action in the Shire of Roebourne are air, water, biodiversity, coasts and built environments. As stated previously, it is recognised that direct responsibility for decision-making and management of the majority of environmental issues and impacts lies with many State Government agencies or land managers. Accordingly, this section will focus on the decisions and activities of local government that influence the protection and management of the environment. Advocacy opportunities (i.e. where local government’s main role is to provide a voice for the community and work in partnerships to deliver outcomes) will be highlighted where possible.

Air

While the air quality in the majority of the Shire of Roebourne is considered generally to be good, there are a variety of industrial activities in the coastal centres of Karratha, Dampier and Cape Lambert which may impact on air quality (Figure 27). Port facilities, particularly those for iron ore shipment, are recognised as having the potential to impact on ambient air quality, as a result of particulates (dust) and emissions from ships.

Significant sources of emissions to air on the Burrup Peninsula include the North West Shelf Joint Venture; Rio Tinto’s iron ore export facility; and Burrup Fertilisers ammonia plant. Other contributing sources include shipping activity in the Port of Dampier and urban emissions from the towns of Karratha and Dampier (Burrup Rock Art Monitoring Management Committee, 2009). In response to concerns expressed about possible adverse impacts on the rock art by industrial emissions to air, the Western Australian Government established the Burrup Rock Art Monitoring Management Committee in 2002. This Committee commissioned a number of environmental investigations to establish whether industrial emissions are having adverse impacts on the rock art on the Burrup Peninsula. Having reviewed all the evidence of the reports and the comments from an international peer review panel, the Committee reached the conclusion that at March 2009 there was no scientific evidence to indicate that there is any measurable impact of emissions on the rate of deterioration of the Aboriginal rock art in the Burrup (Burrup Rock Art Monitoring Management Committee, 2009).

The Pilbara Air Quality Study 2004 identified particulate levels in Dampier that exceed NEPM criteria. It found that industry was the single largest contributor to emissions in the airshed in Karratha, contributing 95% of the volatile organic compounds, 82.3% of the oxides of nitrogen and 19.6% of the carbon monoxide (DEC, 2004). No further monitoring has been made available regarding the quality of the Karratha and Dampier airsheds since this work,
as industry is focussed on the impacts that currently exist in Port Hedland. It is hoped that the findings of the Port Hedland Dust Taskforce are translated appropriately into the Shire of Roebourne in the near future.

Further discussion on the issues and pressures associated with air quality in the Pilbara is contained in section 4.

The following objective has been proposed for air quality:

**Levels of particulates in the air meet the relevant standards in order to protect health, amenity and the environment.**

In order to meet this objective, the Shire of Roebourne should:

- Manage Shire waste disposal facilities to reduce offsite impacts including fires.
- Continue to work with the DEC regarding the management of bushfires.
- Advocacy: Work with State Government and industry to improve practices and extend the Port Hedland Air Quality Management Plan framework and governance structure across the whole of the Pilbara.

Progress towards the objective is proposed to be measured via the following indicator:

**Number of exceedances of particulate levels with State Government-agreed standards.**

**Water**

All waterways in the Shire of Roebourne are highly variable, flowing for only part of the year in response to larger, generally cyclonic, rainfall events. The only surface water source that is used as a major water supply in the Pilbara is the Harding Dam; however, due to evaporation losses and high levels of sediment, this source is not overly reliable, and the Harding Dam is only able to supply water at current levels of demand for approximately two years without a large recharge event (DoW, 2010b).

Because of the variability in rainfall and high evaporation rate in the Pilbara, groundwater is a very important water resource in the Shire. Groundwater occurs throughout the region but is most easily located and accessed near surface water drainage lines (alluvial channels). The aquifers on the coast, such as the Pilbara coastal aquifer (Figure 24), are relatively small, typically receiving an annual recharge of less than 10 GL/yr. They also play an important role during periods of low or no recharge, in sustaining permanent pools – which in turn support ecosystems in an otherwise arid environment (DoW, 2010b).

The Shire of Roebourne also contains the Hamersley fractured rock aquifer and Pilbara fractured rock aquifer. These fractured rock aquifers occur in the inland areas of the Shire. They are harder to locate than the coastal aquifers and the amount of water available from them is difficult to predict. Water supplies in the inland areas can, therefore, be problematic both in quantity and quality (DoW, 2010b). The water abstracted from these aquifers is mainly for mine use and mine dewatering purposes.

The West Pilbara water supply scheme supplies most of the coastal towns and port facilities of Karratha, Dampier, Roebourne, Wickham, Point Sampson and Cape Lambert (DoW, 2010b).
While groundwater is the primary water source for the majority of the Pilbara region, water for the West Pilbara scheme comes mainly from the Harding Dam with the Millstream borefield being used when water is not available from the dam (DoW, 2010). This scheme is currently operating at capacity and the Water Corporation is relying on water from the Millstream borefield. The Department of Water will ensure the enforcement of the water abstraction rules to minimise impacts on the ecosystem, which include substantial monitored of the groundwater and ecosystems.

An extra 10 GL/year source from the Rio Tinto owned and operated Bungaroo Creek borefield will be delivered to the West Pilbara water supply scheme by mid-2014 through an ongoing project which includes construction of a new nine million litre water tank and upgrade of several pump stations (Water Corporation 2013). The next major source of water for the West Pilbara water supply scheme was originally expected to be obtained from a desalination plant on the Burrup Peninsula. However, the Bungaroo Creek borefield agreement between Rio Tinto and the State Government, along with heavy rainfall in the 2010 - 2011 cyclone season, has meant the desalination project has been deferred (Government of Western Australia, 2011).

The use of water within the Shire of Roebourne is substantially above the average for Perth, and also above the average in the Pilbara. It is considered that this may be a result of a lack of community awareness of the need to conserve or use water efficiently. Although a behavioural change program, including retrofitting of water-saving showerheads, taps and toilets for residential and small non-residential customers and a leak detection and repair program in the Karratha, Dampier, Wickham, and Point Sampson communities has been implemented in the past, the short-term nature of a large proportion of the Shire’s community may require more frequent implementation of water efficiency education activities.

The Water Corporation provides sewerage services in Karratha and Roebourne, while wastewater services in Dampier and Wickham are provided by Rio Tinto. Point Samson currently has no sewerage service, utilising on-lot septic systems and alternative treatment units. Upgrades are currently occurring to the Karratha wastewater treatment plants. The Dampier wastewater treatment plant is at the end of its design life and in need of decommissioning to enable further development of the town.

Treated wastewater is currently used by the Shire of Roebourne to irrigate large recreation areas. The current upgrades to the Karratha Wastewater Treatment Plant may increase the level of recycling and reuse by providing an opportunity for the implementation of a dual-reticulated system (third pipe), that provides a source of non-drinking water for irrigation and fit-for-purpose uses.

Opportunities exist to optimise the use of water technologies to address water shortages across the Shire. The Dampier Port Authority currently utilises small desalination plants which provide a cost effective option for sourcing good quality water for operations. Although this provides a local solution to water scarcity in the region, there is a lack of coordinated management of the impacts of the desalination plants, as the current regulations do not require environmental approval of plants that produce under a million litres per annum.

Further discussion on the issues and pressures associated with water resources in the Pilbara is contained in section 5.

The following objectives have been proposed for water resources:

- Provide for the water needs of the future community and environment and optimise efficient use of fit-for-purpose supplies.
- Sustainably manage the water resources of the Pilbara to maintain environmental, cultural and social values.
- Manage discharges to ground and surface waters to avoid contamination.

In order to meet these objectives, the Shire of Roebourne should:

- Develop a water conservation plan for water use across the Shire.
- Educate the community regarding the need to use water wisely.
- Optimise use of fit-for-purpose water and substitute alternative sources for drinking water where possible.
- Maximise use of treated wastewater from all wastewater treatment plants for fit-for-purpose use including dual reticulation networks, and irrigation of playing fields and streetscapes.
- Ensure that planning decision-making is consistent with the DoW’s Water Quality Protection Note: Land Use Compatibility within Public Drinking Water Source Areas in the vicinity of any drinking water borefields, including the requirements for well-head protection zones.
- Advocacy: Work with the Water Corporation and Rio Tinto to improve water use practices across the community and mining operations, and maximise fit-for-purpose use of recycled or dewatering water.

Progress towards the objectives is proposed to be measured via the following indicators:

- Water use per capita per annum.
- Water allocation within sustainable yield limits.
- Health of significant water-dependent environments.
- Water quality in Harding Dam meets required standards.
**Biodiversity**

The Shire of Roebourne contains parts of only two IBRA subregions: Roebourne and Chichester (Figure 28). The Chichester subregion comprises the northern section of the Pilbara Craton. Undulating Archaean granite and basalt plains include significant areas of basaltic ranges. Plains support a shrub steppe characterised by *Acacia inaequalitiera* over *Triodia wiseana* (formerly *Triodia pungens*) hummock grasslands, while *Eucalyptus leucophloia* tree steppes occur on ranges (DEC, 2003).

Vegetation types in the Roebourne subregion of the Pilbara bioregion, are described as grass savannah of mixed bunch and hummock grasses, and dwarf shrub steppe of *Acacia stellaticeps* or *A. pynfolia* and *A. inaequalitiera* on the coastal and sub-coastal plains. Uplands are dominated by *Triodia* hummock grasslands. Ephemeral drainage lines support *Eucalyptus victoriae* or *Corymbia hammersleyana* woodlands. Samphire, *Sporobolus* and mangal occur on marine alluvial flats and river deltas (DEC, 2003). A more detailed description of the bio sub-regions of the Pilbara is found in section 3.2 of the Pilbara Framework: Regional Profile (WAPC, 2009) and in the DEC’s Biodiversity Audit (DEC, 2003).

The Burrup Peninsula has significant conservation and environmental values. The peninsula is home to a diverse range of flora and fauna, and provides an undisturbed habitat for many species endemic to the Pilbara. Much of the peninsula remains in a relatively untouched state. The area is also rich in aboriginal heritage sites and cultural values. The Burrup Peninsula contains the world’s richest known concentration of rock art and as such, is a conservation resource of international significance. The Burrup Peninsula is also home to a large industrial estate in the southern portion with multiple heavy industrial developments and ports.

Offshore islands also provide significant habitat for terrestrial and marine wildlife. Significant islands in the Shire of Roebourne include the Dampier Archipelago and Montebello Islands (Figure 22). The Dampier Archipelago comprises 42 islands, islets and rocks that range from less than 2ha to 3,290ha in size and covers an area of approximately 400 km². The mangrove systems in the sandy embayments of Nickol Bay are important marine habitats and are also recognised habitat for the Dugong and Flattback Turtle. Turtle nesting areas include both the Burrup Peninsula and islands of the Dampier Archipelago. Additional information on the significant marine fauna around the Karatha area can be found in the Dampier Archipelago/Regnard Marine Reserve Indicative Management Plan.

The Montebello Islands, protected by the 58,000 hectare Montebello Islands Marine Park, include more than 250 low-lying islands and islets. The complex system of reefs, lagoons and channels and the convoluted island coastlines provide an exceptionally diverse range of habitats for marine plants and animals. The area supports at least 150 species of hard coral, more than 450 species of fish, more than 630 species of molluscs and 170 known species of sea stars, urchins and other echinoderms (DEC and Department of Fisheries, 2009). Further studies are likely to reveal new species.

Six species of mangroves occur in the Montebello Islands Marine Park, usually in narrow strips fringing bays. The mangroves are scientifically very important, as it is unusual to find mangroves growing within lagoons on oceanic islands. These spectacular coastal forests provide valuable nursery areas for juvenile fish and crustaceans and are stopover areas for rare and protected migratory wading birds (DEC and Department of Fisheries, 2009).

The National Strategy for the Conservation of Australia’s Biological Diversity (1996) contains an objective to ‘establish and manage a comprehensive, adequate and representative system or protected areas covering Australia’s biodiversity’. There is only one terrestrial conservation reserve, the recently declared Murujuga National Park, although 3 areas of the Mardie, Karatha, and Pyramid pastoral stations are proposed to be incorporated into the conservation estate in 2015. The Murujuga National Park accounts for less than one per cent of land tenure in the Shire of Roebourne. This level of reservation is critically low compared with the internationally recognised standard of reservation of between 10 and 15% of each bioregion; however, it is recognised that parts of each IBRA subregion are reserved within the Shire of Ashburton.

Major threats to biodiversity arise from the clearing of land for development including infrastructure. The construction of substantial linear infrastructure such as railways and roads poses additional threats to biodiversity resulting from fragmentation of land and creating barriers and risks to fauna movements.

Altered fire regimes have the ability to significantly impact on the land and biodiversity values of the Shire. Fires, which may be started accidentally by visitors or from lightning strikes, have the ability to cause widespread damage, particularly when they occur in the hotter months of the year. Additional information on the impacts of fire are contained in section 7.

Further loss of vegetation and biodiversity including fauna occurs as a result of the introduction of weeds, pests and feral animals, both accidentally or commercially introduced, which compete for food, water, soil and land. Introduced animals of concern in the Shire include the mouse, black rat, domestic cattle and cats. Environmental weeds also require a substantial management effort to control.

Further discussion on the issues and pressures associated with biodiversity resources in the Pilbara is contained in section 7.

The following objectives have been proposed for biodiversity:

- **Appropriate use and control of fire to maintain biodiversity.**
- **Minimise the loss or degradation of native vegetation in order to maintain or enhance biodiversity.**
- **Manage and control introduced animals, pests and weeds to maintain biodiversity and land productivity.**

In order to meet these objectives, the Shire of Roebourne should:

- Identify areas of locally significant bushland and habitat and provide appropriate protection and management.
- Consider the appropriate location of cultural and environmental corridors as part of development of the local planning strategy to provide connectivity between environments.
- Manage weeds, pests and introduced animals on Shire land.
- Continue to work with the DEC in the management of fires.
- Advocacy: Work with the Department of Agriculture and Food and the Department of Environment and Conservation in the management of weeds, pests, feral animals and introduced species.
- Advocacy: Work with the DEC to extend the conservation estate to protect under-represented areas of vegetation and habitat.
Progress towards the objectives is proposed to be measured via the following indicators:

- Fire frequency and extent.
- Percentage of native vegetation remaining per local government area.
- Percentage of vegetation association protected in secure conservation reserves.
- Area of land granted for clearing.
- Number of organisms listed under the Biosecurity and Agriculture Management Act 2007 that require active management.

Coasts
The mainland coastline of the Shire of Roebourne stretches for approximately 350 km, with the Shire of Ashburton to the south and the Town of Port Hedland to the north east. The Shire’s coastline contains a diverse range of ecosystems including marine environments with intertidal rocky reefs, deep-water coral reefs, limestone reefs, mangroves, riverine estuaries, extensive mud-flats, seagrass beds and headlands, hills and dunes.

Coastal influences vary seasonally, and high water during storm surge events can proceed as far inland as fifteen kilometres beyond the normal average tide (Landvision, 2011). Six pastoral leases abut the coast, the largest being Mardie Station, which lies adjacent to around thirty per cent of the Shire’s coastline.

The Roebourne coastline is used for recreational and cultural activities and has a number of sites of historical significance. In waters adjacent to the Dampier Townsite and those of the Dampier Archipelago, boat-based fishing is popular, occurring in both deeper offshore waters as well as in tidal estuaries and mangroves near Dampier (Rangelands NRM, 2009).

Swimming, snorkelling, yachting, diving and nature appreciation is popular at a number of the Archipelago islands (including Barrow Island and the Montebello Islands), as well as at Point Samson and the historical town of Cossack. Some shacks provide basic accommodation for visitors on the archipelago islands and are managed by the Department of Environment and Conservation (Rangelands NRM, 2009).

Camping activity is popular at the designated camp grounds at Cleaverville, Forty Mile (Gnoorea) and Balla Balla, although the community has raised some concerns about the level of activity and resultant impacts on fragile ecosystems and fish stocks. Areas around these campsites and along other stretches of the Shire’s coastline have been impacted by uncontrolled access from 4WD and off-road vehicles.

The Shire of Roebourne is one of the major locations in the state for the exploration, extraction, processing and export of iron ore, salt and natural gas. It contains a number of deepwater ports and onshore processing and export support facilities. Additional facilities are also planned at Anketell (near Wickham) and many existing operations are planned for expansion. Port operations and the installation
of infrastructure along the sea bed generally require significant dredging of marine environments. Over 100 million cubic metres of material is proposed to be dredged in the Dampier port, resulting in significant impacts on nearby marine habitats and ecosystems.

The Shire of Roebourne coastline is also subject to coastal vulnerability. The Karratha Coastal Vulnerability Study (JDA Consultant Hydrologists 2011) and the Dampier Coastal Vulnerability Study (JDA Consultant Hydrologists 2012) were undertaken to assess the effects of future climate change, including flooding from storm surge, on development in Karratha and Dampier. The Karratha study found that development in the townsite is not generally impacted by flooding with most of the existing town, Gap Ridge and Baynton West in the west, and the Karratha Light Industrial Area above the 100yr ARI flood level. Correspondingly, within the Dampier Townsite, the 100 year ARI flood extent indicates that a significant proportion of the townsite is subject to some degree of inundation. Flooding is generally restricted to the roads, reserves and creek lines, with only minor, localised flooding of residential and commercial lots; however.

Further discussion on the issues and pressures associated with coastal areas in the Pilbara is contained in section 8.

The following objectives have been proposed for the coast:

- **Ensure protection of assets and values in areas susceptible to coastal vulnerability.**
- **No further loss or degradation of coastal habitat.**

In order to meet these objectives, the Shire of Roebourne should:

- **Ensure that any development in Karratha and Dampier addresses the requirements of relevant coastal vulnerability studies and that any substantial future development is supported by appropriate current storm surge and flood inundation information consistent with the most current predictions for sea level rise and coastal processes.**
- ** Undertake a strategic assessment of coastal recreation and access and develop a framework for the future management of coastal recreation, having consideration of signage, access and safety**
- **Consider opportunities for joint management of the coasts with traditional owners**
- **Advocacy: Work with the State Government and industry to ensure that any expansion of activities and/or infrastructure at the Port minimises impacts on the environment.**

Progress towards the objectives are proposed to be measured via the following indicators:

- **Value of assets in areas vulnerable to sea level rise and storm surge.**
- **Area of mangrove loss.**

**Built environments**

The Shire of Roebourne contains a number of settlements. The key regional city of Karratha provides service support for the other centres of Dampier, Roebourne, Wickham, Cossack and Point Samson. There are also three Aboriginal communities in the Shire: Cheedilha, which is based close to the town of Roebourne, and Weymul and Mingullatharndo, which are more remote. The history of development of the Shire underpins the pattern of settlement.

The townships of Roebourne and Cossack (formerly Tien Tsin) were initially settled as pastoral settlements in the 1860s. Cossack grew in response to the pearling industry, and Point Samson was established as a port for Roebourne. Growth across the Shire was low until the discovery of iron ore deposits and offshore natural gas fields in the 1960s.

The response to the growth of the mining industry saw Dampier established as a port in 1963 by Hammersley Iron. Karratha was then settled in 1968 to supplement Dampier’s urban capacity in a joint State Government/Hammersley Iron project. This was followed in 1970 by Wickham, which was constructed by Cliffs Robe River Iron Ore in 1970 to provide accommodation for the Cape Lambert iron ore processing and shipment facility. In 1975, the Shire’s administration office was transferred from Roebourne to Karratha (Shire of Roebourne website, 2013).

Power for Roebourne is provided by Horizon Power, as part of their Northwest Interconnected System. The current capacity of the system is stretched and it is recognised that it will not be sufficient to cater for the projected growth in the Pilbara region. It is noted that some additional power generation may be available as a result of the Chevron Wheatstone LNG project.

Water and wastewater in Dampier and Wickham are provided by Rio Tinto Utilities. The Water Corporation provides both water and wastewater services to Karratha and Roebourne; however Point Samson is unsewered, with only water provided by the Water Corporation through their West Pilbara Water Supply Scheme. The West Pilbara Water Supply Scheme sources its water from a combination of the Harding Dam Catchment Area and Millstream aquifer. As outlined in above, a recent state agreement with Rio Tinto will see this scheme augmented with 10GL of water from the Bunagroo Valley. Further discussion on water resources is provided in section 5.

Upgrades are currently occurring to the wastewater treatment plants in Karratha and the output will produce high quality recycled water. It is proposed that the recycled water be used to irrigate the Shire’s parks and could also provide a fit-for-purpose source of non-drinking water via a reticulated network within the proposed Mulataga development.

Waste collections services are provided by the Shire in the townsites. The Shire operates the 7 Mile Waste Facility which is approximately 10km from Karratha as well as the Roebourne/Wickham Waste Transfer Station which is located on the Roebourne-Point Samson Road. Limited recycling occurs, with the exception of scrap metal, car batteries and oil.

The Weymul Aboriginal Corporation was established in 1999 to represent the Ngarluma people who are the traditional owners of the Ngarluma region of the Pilbara. Weymul (Cherrata) Community exists on a freehold lot within the Mt Welcome Pastoral Station. Services are provided by the Weymul Aboriginal Corporation in a manner consistent with remote communities. Water is supplied from a bore, wastewater is via septic tanks and power.
is provided by a diesel generator. Waste is disposed of in an area that has the potential to contaminate the bore; however a community layout plan has been established which designates an area for a waste transfer station that aims to protect the well-head zone (Plexus Town Planning, 2007a).

The Mingullatharndo Community is located approximately 10km east of Roebourne, 1km south of the highway in an area which is prone to flooding. Power is provided by a temporary generator. An unfenced waste disposal area is located approximately 300 metres south west of the Community in the form of a two metre pit which is filled in over time. It has been recognised that this is not adequate and it is intended that a system of waste transfer to Roebourne will eventually be implemented.

Groundwater in the area is contaminated by naturally occurring arsenic and is not fit for consumption. Families at the Community are responsible for obtaining and storing their own water supplies. Currently no water is delivered however it is proposed that in future the water supply will be provided by tanker from Roebourne (Plexus Town Planning, 2007b).

The Karratha City of the North Plan (Shire of Roebourne, 2010) recognised that there were significant issues associated with the built environments in Karratha and across the Shire. It noted that:

“current practices are not sustainable because they are not leading to the development of sustainable local communities. The dominance of major industries, difficulties in attracting labour, high costs of living, inadequate infrastructure, and poor quality of amenity has led to a vicious cycle that needs to be broken.”

This acknowledgement underpins the City Wide Growth Plan and its Implementation Plan, which recognise the need to change conventional practice and traditional methods of delivery. It proposes an integrated approach that will bring together the economic, social, environmental and built form responses that are needed at several spatial and non-spatial levels simultaneously, to deliver vibrant towns, with a good quality of life that is affordable for all to enjoy.

Implementation of the Karratha City of the North Plan is continuing, with State and local government working together to achieve the Pilbara Cities Vision. Greater strategic guidance is required to direct growth and development outside Karratha, so that the community as a whole prospers. This has been recognised by the Shire, and work has commenced to develop a local planning strategy.

The built form is slowly changing to recognise the cultural and climatic characteristics of the region, and this is guided by the Pilbara Vernacular Handbook, which outlines advice on responding to climate; incorporating natural landscapes; building on the Pilbara character and identity; enhancing liveability; and mobilising for change (LandCorp, 2012).

Further discussion on the issues and pressures associated with built environments in the Pilbara is contained in section 11.

The following objectives have been proposed for the built environment:

- Ensure the management of stormwater addresses water quality as well as flooding.
- Improve the efficiency of energy use and optimise the use of renewable energy resources.
- Minimise waste and associated environmental impacts, while maximising re-use and recycling.

In order to meet these objectives, the Shire of Roebourne should:

- Provide strategic guidance for the future planning and development of the Shire through completion of a Local Planning Strategy.
- Ensure proposed development is consistent with the principles and recommendations of LandCorp’s Pilbara Vernacular Handbook.
- Provide streetscapes, public places and spaces that enhance the local character of towns and integrate with the natural environment, optimising shade with locally native plants.
- Work with State Government and industry to ensure holistic planning and development occurs that is consistent with the strategic vision for the Shire.
- Work with RioTinto and the Water Corporation to optimise the use of treated wastewater from wastewater treatment plants.
- Encourage the installation of water and energy efficient fittings and fixtures including photovoltaic panels, solar hot water systems, greywater systems and smart meters in private and public buildings.

- Ensure planning for future waste management facilities optimises opportunities for reuse and recycling of waste.
- Consider establishment of a domestic recycling service.

Progress towards the objective is proposed to be measured via the following indicators:

- Flooding in townsites.
- Energy consumption per dollar gross regional product.
- Amount of waste to landfill per capita.
- Proportion of waste recycled/ reused.
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FIGURE 22 Shire of Roebourne marine and coasts

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Scale 1: 750,000
FIGURE 23  Shire of Roebourne surface water

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Scale 1: 750,000

Legend
- Shire of Roebourne
- Principal towns
- Major rivers
- Major roads

Pilbara surface water catchments
- Peter Creek
- Roeb River
- Fortescue River
- Harding River
- Pravah River
- Sherlock River
- George River
- Mallard River

N

0 30
FIGURE 24 Shire of Roebourne groundwater

Legend
- Shire of Roebourne
- Principal towns
- Major rivers
- Major roads

Groundwater management areas
- Pilbara
- Key groundwater aquifers
- Carnarvon - Birdwing
- Pilbara - Coastal Saline
- Pilbara - Fractured Rock
- Hamersley - Fractured Rock
- Lower Pinnacles Aquifer

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Scale 1: 750,000
Figure 25: Shire of Roebourne soils and contaminated sites

Legend:
- Shire of Roebourne
- Principal towns
- Major towns
- Major roads

Acid Sulfate Soils - probability
- High probability of occurrence (>75% chance in mapping unit)
- Low probability of occurrence (6-75% chance in mapping unit)
- Extremely low probability of occurrence (1-6% chance in mapping unit)
- Contaminated site (remediation required, restricted use or remediated for restricted use)
FIGURE 26  Shire of Roebourne heritage

National Heritage List: Dampier Archipelago / Burrup Peninsula
Karratha: 1 historic site
Cossack: 10 historic sites
Roebourne: 13 historic sites

Aboriginal Heritage Sites (DIA) - status:
- Insufficient information - lodged & not assessed under Section 5 of the AHA
- Lodge with Registrar - not assessed
- Registered site
- Exempt - lodged & does not meet terms of Section 5 of the AHA

Register of National Estate - class:
- Historic
- Indigenous
- Natural
- National Heritage List

Native Title - classification:
- Applications determined by the Federal Court
- Applications lodged with the Federal Court
- Indigenous Land Use Agreements within WA registered with the National Native Title

Legend
- Shire of Roebourne
- Principal towns
- Major rivers
- Major roads

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Scale 1: 750,000

FIGURE 26  Shire of Roebourne heritage
FIGURE 27  Shire of Roebourne air emissions
Figure 28: Shire of Roebourne IBRA and vegetation types
2.3.3 Individual report card

The following report card focuses on activities that are the direct responsibility of the Shire. It should be reviewed (remeasured and reported) annually to support the implementation of the Strategic Community Plan. Objectives and indicators are outlines in the preceding sections. Additional information on measurement and reporting is contained in section 12.

<table>
<thead>
<tr>
<th>THEME</th>
<th>STATE</th>
<th>PRESSURE</th>
<th>SHIRE RESPONSE</th>
<th>PROGRESS &amp; TREND</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air</td>
<td>Air quality generally good with localised occurrences of high levels of particulates.</td>
<td>Bushfires have potential to significantly impact on air quality.</td>
<td>• Manage tip site fires and issue permits and infringements where required.</td>
<td>Amber (improving)</td>
</tr>
<tr>
<td>Water</td>
<td>Water supply issues are an impediment to future development.</td>
<td>Increasing population and climate variability is putting pressure on scarce water resources, as is mine dewatering and over abstraction.</td>
<td>• Work with the community to improve efficiency of use and with Rio Tinto to maximise reuse of fit-for-purpose water sources. • Develop a water conservation plan for water use across the Shire.</td>
<td>Red (but improving)</td>
</tr>
<tr>
<td>Biodiversity</td>
<td>Under 15% of IBRA regions are contained in secure conservation reserves.</td>
<td>Remnant vegetation threatened by weeds, over grazing and other impacts.</td>
<td>• Develop a local biodiversity strategy including location of cultural and environmental corridors. • Manage weeds, pests and introduced animals on Shire land.</td>
<td>Amber (in decline)</td>
</tr>
<tr>
<td>Coasts</td>
<td>Significant areas of coastline affected by uncontrolled access. Port areas impacted by dredging and shipping activities. Some assets under treat from coastal vulnerability.</td>
<td>Coastal areas under pressure from storm surge and sea level rise, recreational impacts and port activities including dredging.</td>
<td>• Undertake a strategic assessment of recreation impacts on the coast and develop a strategy to improve outcomes. • Develop a strategy to manage coastal vulnerability across the Shire.</td>
<td>Amber (in decline)</td>
</tr>
<tr>
<td>Built environments</td>
<td>Lack of urban amenity and access to affordable housing. Upgrades required to stormwater systems in some townsites. Limited waste reuse or recycling.</td>
<td>High population growth rates, increasing cost of construction and land assembly issues.</td>
<td>• Prepare a Local Planning Strategy. • New development is consistent with Pilbara Vernacular Handbook. • Develop stormwater management plans for aging or sub-standard infrastructure. • Install water and energy efficient fittings and fixtures in public buildings. • Planning for future waste management facilities will optimise opportunities for reuse and recycling of waste.</td>
<td>Amber (improving)</td>
</tr>
</tbody>
</table>
The Pilbara environment is subject to fundamental pressures which result in changes to the environment. The primary drivers of change in this region are population growth; consumption of natural resources; and climate variability. These pressures are driven by the often conflicting collective and individual behaviours, attitudes and values of communities locally, nationally and internationally.

3.1 POPULATION GROWTH
Population growth is a driver of environmental change at the local, state and national level. As local populations increase, their demand for resources such as water, energy, food and materials, as well as their need for space and infrastructure also increases. This results in a direct impact on the environment and local landscape, as well as flow-on effects in other regions and even countries.

The Pilbara has experienced considerable population growth, largely associated with the development of mining projects in the region. Nearly 60,000 people lived in the Pilbara in 2011 (ABS, 2012), an increase from a population of 41,000 in 2006. This nearly fifty per cent increase in five years has resulted in a high demand for housing, health, education and recreation facilities, transportation and waste infrastructure, local business and tourism development.

The 46% rise in population experienced between 2006 and 2011 was markedly greater than in any other five year period over the last 25 years, and in fact, follows a period of population decline in the Shires of Ashburton and East Pilbara and the Town of Port Hedland (as shown in Chart 1 and Chart 2).

In comparison, the national average population growth was only eight per cent over the same five years (ABS, 2012), demonstrating the magnitude of recent population growth in this region.

The number of visitors in the Pilbara region at the time of the 2011 census totalled approximately 24,500, over forty per cent of the permanent population. While it is not possible to determine the exact number of visitors who were in the region for work purposes (i.e. ‘fly-in fly-out’ workers), it may be inferred that the majority of visiting people were in the Pilbara for work purposes, with only a small proportion actual visitors. This is on the basis that ‘fly-in fly-out’ employees comprise over fifty per cent of the mining sector workforce in Western Australia (Morris, 2012).
There are a number of different predictions for population growth in the Pilbara region, WA. Tomorrow (WAPC, 2012) population forecasts predict the population of the Pilbara to reach 59,500 by 2026. This population figure has already been surpassed. The Chamber of Minerals and Energy (CME, 2012) believes that the population of the Pilbara will reach 72,600 by 2020, based on 2011 census figures and regional project schedules. Population forecasts undertaken independently by the Shire of Roebourne and the Pilbara Development Commission predict population increases greater than those predicted by the Chamber of Minerals and Energy, at growth rates of 2.8 per cent (approximately 76,800 by 2020) and 2.5 per cent (approximately 75,800), respectively.

In contrast to the above predictions, the Government of Western Australia’s Pilbara Cities Vision is built on the foundation of doubling the overall residential population of the Pilbara to more than 140,000 by 2035. This includes the transformation of Karratha and Port Hedland to ‘Pilbara Cities’, each with populations of approximately 50,000. Other Pilbara towns including Newman, Tom Price and Onslow are also predicted to grow to become larger towns and communities.

The Chamber of Minerals and Energy predicts that the major towns of Port Hedland, Karratha, Newman and Onslow will grow. This predicted growth is largely attributed to new residential employees of mining companies and their families, as well as indirect employment generated by economic growth resulting from additional residential and ‘fly-in fly-out’ employment in the area (CME, 2012). It should be noted that the level of population growth is substantially linked to the growth of the mining sector and hiring policies of mining companies. Any decline in mining activity or changes to operations has the ability to impact substantially on the populations of the Pilbara.

Supply constraints may also slow the growth of the population in the Pilbara relative to the growth in demand. The most critical supply constraint is a shortage of residential housing coupled with housing costs (both purchase price and rental rates) being significantly higher than those in other areas of Australia. This is compounded by the attitude of many new Pilbara residents who often see their time in the Pilbara as temporary. This leads to a desire to rent rather than own properties and an attitude that does not support long term growth. In combination these factors may lead to a future “minimal growth” scenario in the Pilbara.

A summary of environmental pressures resulting from population growth in the Pilbara is provided in Box 1.

Box 1: Environmental pressures relating to population growth in the Pilbara

Critical environmental pressures

- Changes in land use to accommodate permanent and/or temporary increases in residential and transient populations and associated services.
- Increased transport demand to service population.
- Increased consumption of natural resources including water and basic raw materials sourced locally.

3.2 CONSUMPTION OF NATURAL RESOURCES

Human activity in the Pilbara has a major influence on the environment due to the consumption of natural resources including water, energy, food, as well as activities associated with mining and pastoralism.

The Pilbara region’s mineral and petroleum sectors are major drivers of the state’s and Australia’s economy and a substantial increase in the export of minerals from the region, particularly of iron ore, has occurred in recent years. Iron ore production in the Pilbara is expected to increase even further over the next 10 years.

The Pilbara region contributed over $32 billion dollars to Western Australia’s economy and made up nearly 14% of Western Australia’s Gross State Product and three percent of Australia’s Gross Domestic Product in 2010-2011 (ABS, 2013). This is an impressive amount considering the region contains only 0.3% of the country’s population.

The communities of the Pilbara region are significantly influenced by the mining industry, as this is the main form of employment for around 35% of the Pilbara population. The Pilbara workforce also contains a number of ‘fly-in fly-out’ workers who commute from around the country and overseas (possibly as many as 24,000 in the Pilbara at any one time could be inferred from 2011 census data – see section 3.1). Although there are many people who are long term residents of the Pilbara, anecdotal evidence suggests that a large proportion of the workforce sees their residency in the Pilbara as a temporary or short-term event that will bring them substantial materialistic gains. This attitude results in a culture of consumption and is generally not supportive of building a community that invests in the protection of the Pilbara environment and life-style into the long term.

Chart 3: Australia’s ecological footprint (Source: WWF, 2012)
Australia’s ecological footprint in the Living Planet Report 2012 was 6.68 global hectares (gha) per person. This is 2.47 times the average global footprint (2.70 gha). The most significant factor contributing to the Australian ecological footprint is carbon emissions from fossil fuels which accounts for approximately 40% of the total footprint as shown in Chart 3.

According to the Australian National Greenhouse Accounts 2009-10 (Commonwealth of Australia 2012) Western Australian carbon emissions account for approximately 13% of the national total (Chart 4) whilst Western Australia contains approximately 11% of the national population. These emissions stem largely from the energy sector (as seen in Chart 5).

It is not currently possible to refine this information by region or local government area. The National Greenhouse Information System reports only at by state and by industry and the Western Australian Government does not require constitutional corporations to report under the National Greenhouse and Energy Reporting Act 2007 or to report under any alternative greenhouse gas reporting scheme.

A summary of environmental pressures resulting from the consumption of natural resources in the Pilbara is provided in Box 2.

### Box 2: Environmental pressures resulting from the consumption of natural resources in the Pilbara

#### Critical environmental pressures
- Worldwide demand for mineral resources, driving ongoing development of industry.
- Removal of non-renewable resources from the region.
- Increasing ecological footprint of settlements.
- Declining availability and increasing cost of critical resources including water, energy, food and shelter.
- Ongoing and legacy environmental damage from temporary workforce.
3.3 CLIMATE VARIABILITY

In 2007 the Intergovernmental Panel on Climate Change (IPCC) released their fourth assessment report, concluding that:

- Warming of the climate system is unequivocal.
- Humans are very likely to be causing most of the warming that has been experienced since 1950.
- It is very likely that changes in the global climate system will continue well into the future, and that they will be larger than those seen in the recent past.

These changes have the potential to have a major impact on human and natural systems throughout the world including Australia.

3.3.1 The Pilbara climate

The Pilbara region is characterised by high temperatures, particularly during the summer months and variable rainfall patterns interspersed with long dry periods. The Bureau of Meteorology (BoM) defines the wet season for the Pilbara as the period extending from December to the end of March. Tropical cyclones often bring intense rainfall and resulting flooding. Some areas of the Pilbara have the highest average annual evaporation rate in Australia (Van Vreeswyk et al., 2004). The annual evaporation rate throughout the Pilbara is considerably higher than the average rainfall. The climate of the Pilbara region can be broadly described by two climate categories: tropical along the coastal areas and arid through the central and eastern parts of the region. Regional variations in rainfall occur, with coastal areas and western inland areas located in the path of tropical cyclones often receiving higher rainfall. The arid desert areas in the central east of the region are characterised by higher temperatures and significantly lower rainfall.

During most of the cooler times of the year, winds tend to be easterly or south-easterly over most of the Pilbara, influenced by the passage of winter high pressure systems that move east across the mainland. In spring prevailing winds weaken as a semi-permanent heat low develops over the land. In coastal areas the wind direction becomes more variable, particularly in the warmer months, when the wind direction often reverses in the afternoon and sea breezes from the north and north-west dominate (Van Vreeswyk et al., 2004).

Maximum temperatures in the Pilbara (Chart 6) are generally higher in the north and inland, particularly through the summer months of October to March. Marble Bar, located in the central north, is famous for maintaining the highest maximums for almost the entire year.

Average minimum temperatures (Chart 7) across the region are significantly lower in winter, particularly in inland areas (Newman and Paraburdoo) which reach approximately 6 to 10°C in June-August. Coastal and northern areas (Karratha and Marble Bar) maintain significantly higher average minimum temperatures, reaching above 26°C in summer between December and February.

Average annual rainfall in the region is typically around 300 mm, generally increasing to the north, and in some western inland areas where summer cyclones typically pass through (Figure 29). Marble Bar, located approximately 150 km from the coast, maintains the highest average annual rainfall (341 mm). Port Hedland, located on the coast, west and south of Marble Bar also maintains a high average annual rainfall (324 mm); however, Karratha, also located on the coast west of Marble Bar, holds the lowest average annual rainfall of 286 mm. This shows the variability of rainfall patterns across the Pilbara (Figure 29 and Chart 8).
The timing of rainfall events is also variable across the region. Most areas are affected by summer (“wet season”) rains, with Onslow and surrounding areas also subject to winter frontal systems.

Tropical cyclones

The Pilbara coast is located in one of the most cyclone-prone areas of the world (Van Weeswyk et al., 2004). BoM records dating back to 1910 indicate that 235 cyclones crossed the coast up to 2004, while another 160 passed close by but stayed out to sea. In three different years (1965, 1981 and 1984), six cyclones, the highest number in a year, crossed the Pilbara coast.

The severe and unpredictable nature of cyclones in the region has historically caused significant widespread damage to infrastructure and domestic livestock and even human death. Damage is often caused as a result of destructive winds and flooding from rain and storm surge. Destructive winds in a category 5 cyclone can reach up to 300 km/h (BoM, 2012a). Some of the strongest cyclones to affect the Pilbara include Cyclone Joan (December 1975), Cyclone Olivia (April 1996), and Cyclone George (March 2007), the last of which resulted in the death of three people.

Cyclones that affect the Pilbara typically originate over the warm northern waters in the Timor Sea and travel in a west to south-west direction roughly parallel to the Western Australian coast. While opposite the Pilbara coastline, some cyclones change their path to a south-easterly direction and cross the coast to eventually become spent in the central desert region, while others continue along the coastline or move further west and degrade (Van Weeswyk, 2004). Cyclones that do cross the Pilbara coast are usually more severe than those crossing the Kimberley coastline due to the extra time in which the cyclone develops.

Notwithstanding the severe destruction caused by cyclones, they are also critical for supplying up to 50% of average annual rainfall (Van Weeswyk, 2004). However, the high intensity of cyclonic events, particularly after long periods of dry weather, often results in minimal retention of rainfall within the landscape due to high velocity run-off and dry, hydrophobic soils.
3.3.2 Climate change – IPCC scenarios

The IPCC reports provide limited detail on Australian climate change, particularly when it comes to regional climate change projections. For this reason the Australian Greenhouse Office, through the Australian Climate Change Science Programme, engaged CSIRO and the Bureau of Meteorology to develop climate change projections for Australia. Climate change in Australia (CSIRO, 2007) is based upon international climate change research including conclusions from the IPCC’s fourth assessment report. It also builds on a large body of climate research that has been undertaken for the Australian region in recent years.

Figure 30 and Figure 31 below are taken from Climate Change in Australia (CSIRO, 2007) and provide an overview of projected temperature and rainfall change in Western Australia under various scenarios. Projections are given relative to the period 1980-1999 (referred to as the 1990 baseline for convenience). The projections give an estimate of the average climate around 2030 and 2070, taking into account consistency among climate models. Individual years will show variation from this average. The 50th percentile (the mid-point of the spread of model results) provides a best estimate result. The 10th and 90th percentiles (lowest 10% and highest 10% of the spread of model results) provide a range of uncertainty. Emissions scenarios are from the IPCC Special Report on Emission Scenarios; “low emissions” is the B1 scenario, “medium emissions” is A1B and “high emissions” is A1FI.

Figure 30: Western Australia annual temperature change 2030 (left) and 2070 (right) (Source: CSIRO, 2007)
The CSIRO 50th percentile scenarios presented above predict temperature increases in the Pilbara of 0.6 to 3.0 °C at the coast and 1.0 to 4.0 °C inland. Rainfall is predicted to decline by between 2 and 40% at the coast and between 2 and 20% inland. However, the spread of rainfall predictions is such that there is significant potential for increased rainfall, especially in the north east of the region.

In addition to the predicted overall decline in annual average rainfall, the CSIRO modelling also predicts increasing rainfall intensity and number of dry days, meaning that rainfall events are likely to be more intense but separated by longer dry periods in between. Extreme intensity events (highest 1%) are predicted to increase in the north.

Recent work by the CSIRO and the Climate Commission (Steffen, 2011) suggests that temperature, rainfall and storm event patterns have significantly changed in Western Australia in recent decades, which has seen impacts on biodiversity, water resources and coastal infrastructure. More specifically, that average temperatures have increased, rainfall patterns have become more variable with a drying climate trend, and storm events have become more frequent and intense.

### 3.3.3 Climate change – regional trends

State-wide changes in average temperature and rainfall since 1970 have been mapped by the Bureau of Meteorology and are presented in Figure 32 and Figure 33 below. Since 1970 the Pilbara has experienced increasing temperatures and changing rainfall patterns, with declining rainfall in coastal areas and increasing rainfall inland, in particular around Newman and Marble Bar.
Figure 32: Western Australian trend in average temperature 1970-2011 (°C/10 years)
(Source: BoM, 2012b)

Figure 33: Western Australian trend in total annual rainfall 1970-2011 (mm/10 years)
(Source: BoM, 2012b)
This contradictory rainfall pattern may be because the rainfall penetrating inland is predominantly associated with major storm events which have been more prevalent, despite the general downward trend in annual rainfall. Figure 34 represents the decadal trend in a count of the number of cyclones for a given area and clearly identifies an increase in the number of cyclones passing through the Pilbara since 1970. This trend may continue as predicted by the CSIRO modelling discussed previously but is predicted to be overridden by the decline in average annual rainfall at some point before 2030.

A review of local data from a selection of Pilbara towns shows that at the coast in Port Hedland the 30 year average maximum temperature is observed to have increased by approximately 0.4 °C since 1977 (Chart 9) whilst the 30 year average annual rainfall (Chart 10) has remained consistent since 1971.
Chart 11: Onslow climate trend – temperature

Chart 12: Onslow climate trend – rainfall

Chart 13: Newman climate trend - temperature

Chart 14: Newman climate trend - rainfall

Annual Average Maximum Temperature (°C)

30 Year Moving Average


Annual Average Rainfall (mm)

30 Year Moving Average

Further south along the coast in Onslow the average maximum temperature (Chart 11) has also increased 0.2 °C since 1972, with average annual rainfall (Chart 12) remaining relatively consistent since 1969.

Inland at Newman there is limited historic data available and so a 5 year average has been presented for average maximum temperature (Chart 13). There is a visible increase of approximately 1.2 °C since 2001 but this increase may not be representative of longer term trends. Average annual rainfall records were used to measure a 10 year average in Newman (Chart 14).

At Redmont, further north and inland and approximately 70 km south west of Marble Bar, there is also limited historic data available and so a 10 year average has been presented (Chart 15) with consistent temperatures visible.

Average annual rainfall (Chart 16) at Redmont has remained relatively consistent since 1978 with slight fluctuations in the 10 year average of less than 10 mm.

Although the data can be somewhat sparse for some localities, the general trend is indicative of gradually increasing temperatures, which supports modelled scenarios. The trend in rainfall does not indicate an obvious decline or increase in coastal areas, while the inland rainfall trend may suggest an increase in some of these areas. This contrasts heavily with the south-west of Western Australia where average rainfall reductions of over 100 mm have been observed for long term averages in the last 30 years.

The potential increase in rainfall in inland areas supports modelled scenarios. However, more significant than the annual rainfall amount, is the change in distribution of events. There is a clear trend in recent rainfall records towards less frequent, more significant events which is also in agreement with CSIRO model scenarios and may have significant implications for the Pilbara.
3.3.4 Sea levels

The Pilbara coast is potentially vulnerable to changing ocean levels including; astronomical tidal ranges, storm surges, wave set-up, sea level rise and tsunami. The major towns of the Pilbara with a vision of becoming cities (WAPC, 2012), Karratha and Port Hedland, are located on the coast, and therefore sea level rise is a significant issue that may affect the vast majority of the Pilbara’s population.

Storm surge is also an issue that requires consideration in the Pilbara and other coastal areas in Australia. Storm surge is an offshore rise of water associated with a low pressure weather system (typically a tropical cyclone). Storm surge is caused primarily by high winds pushing on the ocean’s surface. The wind causes the water to pile up higher than the ordinary sea level. Low pressure at the centre of a weather system also has a small secondary effect, as can the bathymetry of the body of water. It is this combined effect of low pressure and persistent wind over a shallow water body which is the most common cause of storm surge flooding problems.

A study was undertaken by the Department of Climate Change in 2009 to investigate aspects of coastal vulnerability to climate change, using the Pilbara coastline as a case study (Sheridan Coakes Consulting, 2009). This study presented climate change scenario modelling undertaken by Sinclair Knight Merz for the broader Pilbara region including the impacts of rising sea levels.

The study found that:

- **Temperature** – Whilst people working in the Pilbara are able to cope with extreme heat conditions the anticipated ongoing increase in heat and potential increase in number of hot days was estimated to reduce labour productivity in the region by 0.41 percent, over the course of an average year. This loss of productivity has an equivalent annual cost of $3.78 million.

- **Rainfall change** – Industry and local government authorities recognised that there may be some increase in flooding but were not particularly concerned. Reduced rainfall may lead to increased need for seawater desalination because of reduced yields from surface and groundwater drinking water sources.

- **Sea level change** – Rising sea levels are expected to increase maintenance costs for Port Authorities and industries. The increase in maintenance cost is estimated to be $8 million per year.

- **Extreme weather** – The projected increase in the annual average number of severe storms was estimated to cost up to $6.7 million in damage to residential dwellings, $59 million in disruption to oil and gas tanker schedules, and $34.7 million in disruption to exploration and production rigs.

- **Fire and emergency services** – Increased demands on FESA services were estimated to increase operating costs by up to $540,000 per year.

- **Other impacts** – Coastal infrastructure and shipping channels are often aligned to prevailing wind and wave direction and so changes could have potential impacts and cost implications.

A summary of environmental pressure relating to climate change in the Pilbara is provided in Box 3.

**Box 3: Environmental pressures resulting from the changing climate in the Pilbara**

<table>
<thead>
<tr>
<th>Critical environmental pressures</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Temperature</strong> increases predicted to occur due to global climate change.</td>
</tr>
<tr>
<td><strong>Increasing frequency of significant rainfall events separated by more “dry-days”.</strong></td>
</tr>
<tr>
<td><strong>Increased erosion caused by more extreme wet/dry variability.</strong></td>
</tr>
<tr>
<td><strong>New rainfall and temperature patterns enable weeds and other more suited vegetation types to become established</strong></td>
</tr>
<tr>
<td><strong>Potential for desertification from rapid loss of native vegetation and topsoil.</strong></td>
</tr>
<tr>
<td><strong>Sea level rise of up to 0.9 m by 2110.</strong></td>
</tr>
<tr>
<td><strong>Increased impacts from storm surge due to increased frequency of significant weather systems.</strong></td>
</tr>
</tbody>
</table>
This chapter on air in the Pilbara will only focus on regional issues relating to ambient (outdoor) air quality. Information on national and global issues such as climate change, stratospheric ozone depletion and greenhouse gas emissions are addressed in both the State of the Environment Report: Western Australia 2007 (EPA, 2007) and the Australia State of the Environment 2011 report (State of the Environment Committee, 2011).

4.1 CURRENT STATE

Air quality can be affected by bushfires, mining, agriculture and industry. Key pollutants are dust from industrial and construction activities and particulates (measured as PM$_{10}$ and PM$_{2.5}$) from bushfires. Other pollutants of interest are oxides of nitrogen, ozone, lead, sulphur dioxide, and carbon monoxide. Local air quality in built environments may also be affected from fires occurring at rubbish tips. Pollutants are predominantly driven by wind patterns and topography and have the ability to effect the environment and landscape as well as human health in the region.

Industry is the primary cause of change in ambient air quality in the Pilbara, particularly around ports and mining operations in coastal areas. Dispersion of air pollutants is strongly influenced by wind patterns and topography, particularly along the Pilbara’s complex coastline.

Areas which are known to be affected by air quality impacts include:

- the ports of Dampier, Cape Lambert and Port Hedland which are affected by dust from iron ore shipment and emissions from ships.
- Port Hedland – affected by dust and noise as a result of nearby iron ore processing.
- Burrup Peninsula – emissions of nitrogen oxides from the combustion and processing of liquified natural gas and iron ore.
- Dampier power station and the gas turbines in Port Hedland – emissions of oxides of nitrogen from the burning of natural gas.

A Pilbara air quality study was published by Department of Environment in 2004 and presented pollutant concentrations from industry monitoring data compared with the National Environment Protection Measures (NEPM) for Ambient Air Quality in the coastal towns of Dampier, Karratha, Boodarie and King Bay, as shown in Table 1. Since 2004 there has been no further review of industry collected data compared with NEPM standards.

Results presented in the Pilbara air quality study (DoE, 2004) show that particulate levels in the Pilbara regularly exceed health standards.

Concern still exists regarding air quality implications from Wittenoom, infamous for its legacy of asbestos contamination resulting from crocidolite mining in the 1940s - 1960s. A study undertaken in 2006 examining the recent management of asbestos contamination in Wittenoom indicates that windborne transport of asbestos is dependent on disturbance through activities such as vehicle traffic and cattle mustering, as well as activities that result in loss of vegetation and increase the potential for erosion by wind and/or water (GHD Pty Ltd and PB, 2006). The assessment indicated that priority should be given to the stabilisation of the Colonial mine site, as well as to reducing the risk to human health by isolation or remediation of areas with high concentrations of asbestos that is in a form which can be subject to release to air.

### Table 1: Air pollutant concentrations measured in the Pilbara for the Pilbara air quality study (DoE, 2004)

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>NEPM Max concentration</th>
<th>Averaging period</th>
<th>Max allowable exceedances</th>
<th>Max observed levels</th>
<th>% of NEPM</th>
<th>Sites measured</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon Monoxide</td>
<td>9 ppm</td>
<td>8 hours</td>
<td>1 day a year</td>
<td>0.328 ppm</td>
<td>&lt;4%</td>
<td>Dampier</td>
</tr>
<tr>
<td>Ozone</td>
<td>0.10 ppm</td>
<td>1 hour</td>
<td>1 day a year</td>
<td>0.064 ppm</td>
<td>64%</td>
<td>Karratha</td>
</tr>
<tr>
<td></td>
<td>0.08 ppm</td>
<td>4 hours</td>
<td>1 day a year</td>
<td>0.062 ppm</td>
<td>78%</td>
<td>Boodarie Dampier</td>
</tr>
<tr>
<td>Nitrogen Dioxide</td>
<td>0.12 ppm</td>
<td>1 hour</td>
<td>1 day a year</td>
<td>0.062 ppm</td>
<td>52%</td>
<td>Karratha</td>
</tr>
<tr>
<td></td>
<td>0.03 ppm</td>
<td>1 year</td>
<td>None</td>
<td>-</td>
<td>-</td>
<td>Dampier</td>
</tr>
<tr>
<td>Sulphur Dioxide</td>
<td>0.20 ppm</td>
<td>1 hour</td>
<td>1 day a year</td>
<td>0.134 ppm</td>
<td>67%</td>
<td>Karratha</td>
</tr>
<tr>
<td></td>
<td>0.08 ppm</td>
<td>1 day</td>
<td>1 day a year</td>
<td>-</td>
<td>-</td>
<td>Boodarie</td>
</tr>
<tr>
<td></td>
<td>0.02 ppm</td>
<td>1 year</td>
<td>None</td>
<td>-</td>
<td>-</td>
<td>King Bay</td>
</tr>
<tr>
<td>PM$_{10}$</td>
<td>50 mg/m$^3$</td>
<td>1 day</td>
<td>5 days a year</td>
<td>Max allowable exceedances not met over 5 year study period</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>PM$_{2.5}$</td>
<td>25 mg/m$^3$</td>
<td>1 day</td>
<td>None specified</td>
<td>41.1 mg/m$^3$</td>
<td>164.4%</td>
<td>Boodarie</td>
</tr>
<tr>
<td></td>
<td>8 mg/m$^3$</td>
<td>1 year</td>
<td>None specified</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
Overall condition

Air quality in the Pilbara is generally good, with some localised issues associated with dust and particulates from industrial processes and transportation; benzene and bushfires. Potential air quality issues may also exist in Wittenoom relating to previous asbestos contamination.

Other air quality pollutants are not generally considered to be an issue in the region.
FIGURE 35  Point sources of emissions to air
4.2 PARTICULATES FROM INDUSTRIAL PROCESSES AND TRANSPORTATION

Objective: Levels of particulates in the air meet the relevant standards in order to protect health, amenity and the environment.

Indicator: Number of exceedances of particulate levels with Government-agreed standards.

Most air pollutants result from combustion and in the Pilbara the processing, transportation and shipment of iron ore and natural gas have been identified as the major combustive processes impacting on ambient air quality in the region (State of the Environment Committee, 2011). Dust associated with construction works, processing (including blasting, drilling, crushing, screening and stockpiling) and commercial transportation is a major source of particulates while motor vehicles and electricity generation are major sources of nitrogen oxides, sulphur oxides and air toxics such as benzene.

In 2004 NEPM particulate standards were exceeded in Boodarie and Dampier as reported in Pilbara air quality study (DoE 2004). No other sites in the Pilbara were measured and there has been no further reporting against NEPM standards since.

The Burrup Peninsula, or Murujuga, has the largest concentration of prehistoric indigenous rock art “petroglyphs” in the world and was included on the Australian Government’s National Heritage List in 2007 (DOIR, 2007). Increased emissions from nearby industry on the Burrup have been suspected of leading to possible disintegration of the rock art surfaces, and thus may result in the loss of irreplaceable history of the Jaburara People, traditional owners of the Burrup Peninsula (Karratha Visitor Centre, 2012).

4.2.1 Current response

The Environmental Protection Act 1986 includes a number of different mechanisms which can be applied to air quality management, including the environmental impact assessment of proposals that are likely to result in a significant impact on the environment. The Western Australian Government also has agreement with the National Environment Protection Measures, and has been a signatory to the Ambient Air Quality Environment Protection Measure since June 1998 and the Air Toxics National Environment Protection Measure since December 2004.

A draft State Environmental (Ambient Air) Policy 2009 has also been developed. The purpose of this policy is to establish the basis on which ambient air quality is to be protected, abate pollutants and restrict activities that diminish the environmental value of ambient air; and establish a framework and programme to protect and enhance environmental quality to support the environmental value of ambient air in Western Australia.

National Environmental Protection Measures (NEPM) standards have been set for a number of air pollutants, including particulates (both PM10 and PM2.5 under the Ambient Air Quality NEPM) and benzene (under the Air Toxics NEPM). NEPMs are broad framework-setting statutory instruments defined in the National Environment Protection Council Act 1994 (NEPC Act). They outline agreed national objectives for protecting or managing particular aspects of the environment and are similar to environmental protection policies. NEPMs may consist of any combination of goals, standards, protocols, and guidelines. The NEPM standard or ‘monitoring investigation level’, if exceeded, requires some form of further investigation by the relevant jurisdiction of the cause of the exceedance if appropriate.

While the Department of Environment and Conservation operates a number of air pollution monitoring stations in Perth, the southwest and Midwest of Western Australia, no monitoring station for regular monitoring of regional air quality is located in the Pilbara.

The only air quality monitoring that has been undertaken by the State Government since the 2004 study is a one-off Wedgefield Air Toxics Study undertaken at Port Hedland (Wedgefield) in 2006, measuring Volatile Organic Compounds. The monitoring program is currently under review.

Monitoring is, however, undertaken by facilities as required by the NEPM and the National Pollutant Inventory publishes annual air emission data from reporting by facilities (http://www.npi.gov.au/data/search.html). Published monitoring data is currently limited to total annual loads (kg), as shown in Chart 17, and therefore cannot be used to determine the number of exceedances of NEPM standards. In future, data could be extracted from individual existing sites for comparison to NEPM standards, as was done to develop the 2004 report.

In response to the concerns and issues surrounding air quality within Port Hedland, the Government of Western Australia established a taskforce in May 2009 with the objective of providing effective dust management strategies within Port Hedland (PHHP, 2012a). Port Hedland Dust Management Taskforce representatives were drawn from industry, State and Local Government. The Taskforce released the Port Hedland Air Quality and Noise Management Plan report in March 2010 (DSO, 2010).

In 2009 key users of Port Hedland Port also came together to establish the Port Hedland Industries Council (PHIC) as part of their commitment to the local community in managing the environment of Port Hedland. Its eleven foundation members are representatives of different companies with operations or activities in Port Hedland.

The Port Hedland Industries Council contributes to the control of dust and noise emissions from their activities by monitoring air quality. The PHIC monitors air quality at eleven sites around South Hedland and Port Hedland. PM10 is monitored at all eleven sites. In addition, PM2.5, NOx, SO2, and a breakdown of dust into Chromium, Copper,
Manganese, Sodium, Magnesium and Iron species are also monitored at selected sites. Real-time air quality data can be accessed by the public on the Town of Port Hedland website and is updated every 20 seconds (http://phicmonitoring.com.au/monitor/rt/ realtime.jsp?siteid=371).

$\text{PM}_{10}$ results collected by the PHIC are used to determine when dust events which may be hazardous to human health have occurred. This is considered by the Port Hedland Dust Taskforce to occur when $\text{PM}_{10}$ is greater than 70 µg/m$^3$/24 hour (DSO, 2010). This exceedance level is a departure from the National Environment Protection Measure for Ambient Air Quality for particulate matter, which recognises 50 µg/m$^3$. The Port Hedland Dust Management Taskforce determined that on current evidence, there is no justification for Air NEPM for $\text{PM}_{10}$ (50 µg/m$^3$) to be unconditionally applied in Port Hedland because it was developed for a different (urban) environment (DSO, 2010). Dust in Port Hedland is largely composed of coarse particles rich in iron oxides generated from mining related activities, while dust found in urban centres is largely composed of fine and ultra fine particles rich in combustion products. In addition, no direct evidence was found to prove that iron oxide in air poses a significant health hazard.

Results collected by the PHIC over the July 2012 – February 2013 period showed that 14 dust events occurred, where $\text{PM}_{10}$ levels exceed 70 µg/m$^3$ in 24 hours (PHIC, 2013).

The Town of Port Hedland has also established an Air Quality Control Working Group to specifically investigate air quality in the Town of Port Hedland. The Air Quality Control Working Group was established in response to community concerns regarding air and noise emissions in the region (Town of Port Hedland, 2013).

The Burrup Rock Art Monitoring Management Committee was established in 2002 to determine whether industrial emissions could affect the ancient rock art (DOIR, 2007). Air quality monitoring on the Burrup Peninsula was completed by Commonwealth Scientific and Industrial Research Organisation (CSIRO) Marine and Atmospheric Research in 2004 - 2005 and 2007 – 2008 (Gillet, 2008). Results from the air quality monitoring program showed that concentrations of nitrogen dioxide, sulphur dioxide, ammonia, nitric acid, particulates and air toxics (benzene and BTEX gas) were all low over this period, and little evidence of a gradient between background concentrations and that in industrial areas on the Burrup Peninsula was found. Regular monitoring of colour change and spectral mineralogy of the Burrup Rock Art has also been undertaken since 2004 by CSIRO Materials Science and Engineering (Lau et al., 2011). No consistent perceptible increase in colour change was observed over the 2004-2010 period (Lau et al., 2011).

The Department of Environment and Conservation has prepared A guideline for managing the impacts of dust and associated contaminants from land development sites, contaminated sites remediation and other related activities (2011). The guideline provides guidance on preparing a plan for the management of dust and associated contaminants arising from various activities such as land clearing for development, remediation of contaminated sites, mining and quarrying, bulk materials handling and storage and demolition works. The document also contains information relevant to the environmental impact assessment process.

4.2.2 Implications

As industrial activity is predicted to increase to meet economic demands (Pilbara Regional Planning Committee, 2012), air quality in the Pilbara region may be further affected. These activities may result in declining air quality, thus leading to pollution of adjacent land and waters, and adversely impacting on human health, regional biodiversity and heritage listed rock art on the Burrup Peninsula.

4.2.3 Suggested response

The State Government and industry should consider extending the Port Hedland Air Quality Management Plan framework and governance structure across the whole of the Pilbara.

Furthermore, measures such as those established in Kalgoorlie-Boulder are an example of an innovative and effective method of managing dust in mining areas and could be investigated by Pilbara local government.

The Goldfields Dust Abatement Committee was formed in the 1970s in response to dust issues in Kalgoorlie-Boulder. The committee successfully established zones around the townsite to be fenced off and dust levels within these areas to be continuously monitored (KGGM, 2009). In 1994 the Kalgoorlie-Boulder Landcare Group (KBULG) continued similar work and Kalgoorlie Consolidated Gold Mines (KGGM) formed a team of Environmental officers to monitor dust levels to ensure that ambient air quality in Kalgoorlie-Boulder met DEC and NEPM requirements. In addition, KBULG and KGGM completed extensive rehabilitation work within these zones, forming a “Green Belt” of approximately 730 hectares, including 210,000 trees, between the mining area and the townsite (KGGM, 2009).
4.3 BENZENE FROM INDUSTRIAL PROCESSES AND TRANSPORTATION

Objective: Levels of Benzene in the air meet the relevant standards in order to protect health, amenity and the environment.

Indicator: Benzene emissions above NEMP standards.

Benzene emissions are another potential air pollution issue in the Pilbara. Benzene concentrations in regional airsheds are expected to be below urban levels because the majority of emissions originate from motor vehicles, whose numbers are small in regional regions. Benzene emissions in the Pilbara were found to be equivalent to almost 10% of all motor vehicle emissions for Australia in 2003-04 (2006 Australian State of the Environment Committee, 2006). It is thought that natural gas processing operations in the region were the source of these emissions (DoE, 2004).

4.3.1 Current response

The Department of Environment and Conservation has not undertaken any further monitoring of benzene (BTEX) since 2004 except for the Wedgefield Air Toxics Study undertaken at Port Hedland (Wedgefield) in 2006. The annual average concentration of benzene in Wedgefield was found to be 10.4 μg/m³ (0.00326 ppm) based on NEPC reporting requirements. The NEPM monitoring investigation level for benzene is 0.003 ppm, therefore the annual average concentration of benzene at Wedgefield just exceeded the NEPM standard in 2006.

4.3.2 Implications

The decrease in benzene emissions since 2004/05 suggests that the issue is either being managed appropriately or it is naturally declining.

4.3.3 Suggested response

Monitor levels of benzene in the Pilbara and act as necessary.

4.4 BUSHFIRES

Burning vegetation and wildfires have also been identified as major sources of particulates (State of the Environment Committee, 2011). Smoke from bushfires consists of fine particles (measured as PM₁₀ and PM₂.₅) which can severely affect human health, in particular, the respiratory systems of people. If bushfires become more common place in the Pilbara, a possibility because of more extreme climatic conditions leading to longer dry periods (see Section 3.3), then further planning and management responses will need to be implemented to ensure that air quality in the Pilbara is not adversely impacted.

Bushfires are addressed in more detail in section 7.2.