

### Surficial materials

**Ferricrete**  
 Ferricrete is ubiquitous in the southern part of the area, but is also found in isolated patches up to 50 km north of Eneabba. The material forms as small, widely separated outcrops of residual, reddish brown, hard, sandy, pebbly or massive lateritic crusts on all crusts and summit surfaces. It is generally up to 3 m in thickness. Five active gravel pits are situated up to 50 km south and one 30 km north of Eneabba. A further 32 inactive gravel pits occur, mostly in the southern part of the area.

**Particle size distribution**  
 Ferricrete

**Limesand**  
 Series of low, well-sorted, parallel and nested parabolic dunes with broad deflation basins composed of pale yellow-grey, fine to medium-grained quartz sand and shell debris are found along the whole coastline. These dunes are generally stable with freshwater and tidal dunes susceptible to wave and wind erosion although large areas of blowouts are evident along much of the coast. Three active and three inactive limesand pits are located in the area, which is an important area for the production of agricultural lime. Most pits are located within 20 km of Dongara and between Coorow and Jurien Bay. For all deposits, the groundwater table is generally less than 10 m below the ground surface.

**Limestone**  
 Low hills and areas of shallow transgressive barrier, parabolic and long-walled, parabolic dunes extend in a broadly continuous belt parallel to, and immediately inland of, the coast. The limestone is a pale yellowish-brown calcareous and calcareous sandstone containing quartz and shell debris and is variably lithified. A relatively thin, strong calcareous caprock overlies the limestone. Five active limestone pits are concentrated in the areas around Dongara and Jurien Bay. A further 32 inactive pits are located throughout the whole coastal belt.

**Sand and Gravel**  
**Alluvial sand and gravel**  
 Alluvial plains, floodplains and river terraces are subject to regular flooding from multiple watercourses of the major rivers - the Avon, the Swan and the Murchison - and from the many creeks in the Eneabba area. The floodplains and lower terraces comprise fine, red and reddish brown sands and silty sands grading to clay at depth. Upper terraces and flats comprise silt to fine-grained, reddish-brown to greyish brown silty sands over sandy clay. No active pits are known, but 27 inactive sand and gravel pits are present, mostly in the Eneabba area. Thicknesses of material are generally less than 2 m. Groundwater is generally close to the ground surface.

**Coluvial sand and gravel**  
 Cultural material principally forms in two areas. North of Eneabba the gently undulating slopes of the Mingenew region have a cover of red to green brown quartz sand over pale yellow sands and gravelly sands. Between Mingenew and Carnamah cultural material consists of heterogeneous reddish brown sands all grading to silty sands with lower to gravelly brown quartz sand over pale yellow sands and gravelly sands. Most of the ten active and 30 inactive sand and gravel pits are situated between Dongara and Eneabba, and a few inactive pits are located at the Three Springs - Carnamah area.

**Particle size distribution**  
 Coluvial sand and gravel

**Eolian sand**  
 Discontinuous, level to gently undulating sandplains with low, sandy dunes are located up to 20 km north, west and south of Eneabba. This is a complex association of sandstone, coluvial and alluvial deposits that has been significantly reworked by eolian activity. The material comprises thick, pale grey, washed quartz sand covering low, fine to medium-grained sand dunes, with more silty and gravelly material on the flats. Three inactive sand pits are situated 11 km north of Eneabba. This unit is the main resource of trans-dune iron concentration in the Coorow area. Non-ferrous sandstone resources could be a significant source of basic raw material. Groundwater is usually at depths greater than 15 m.

**Grey sand**  
 Very low-relief dunes and intervening gently undulating plains are present east and southeast of Jurien Bay at the foot of the northern extension of the Gageo Scarps. Poorly drained sandplains, swampy depressions and poorly defined dunes occur between the dunes. The grey sand comprises washed, pale grey, silty sand with humic and iron-rich layers overlying pale yellow sands at variable depths. The small, intermittent active pits of more than very local significance to 14 km northeast of Jurien Bay on a small, low degraded dune. There is little scope for significant sand resources from this unit.

**Lateritic gravel**  
 Lateritic gravel is ubiquitous throughout the central parts of the area between Mingenew and Carnamah as concentrations of blocks, inter- and sub-parallel and fragments, commonly set in a clay-rich or sandy matrix on gently sloping colluvial hillsides. The material on these slopes is relatively thin, 1-2 m. Active gravel pits occur 16-22 km north of Dongara, 3 km southwest of Mingenew and 15 km east of Green Head. A further 44 inactive sand and gravel pits occur widely throughout the area.

**Particle size distribution**  
 Lateritic gravel

**Sandplain sand and gravel**  
 Sandplain sand and gravel covers much of the eastern half of the area. The materials of the sandplain comprise coarse, pale yellowish-brown, silty, quartz sands between 1-3 m in thickness overlying homogeneous, sandy lateritic gravel, which becomes overlain with depth. The gravel overlies weathered sandstone and siltstone bedrock. Four active sand pits and 46 inactive sand and gravel pits are present throughout the eastern half of the area.

**Yellow sand**  
 Residual, pale yellowish-brown, medium- to coarse-grained quartz sand forms discontinuous units through the coastal belt. The yellow sand is the weathering product of surficial leaching and groundwater dissolution of the underlying limestone. This is the main resource of both sand and non-specification sand in the area, but is of variable quality. The more silty red sands are preferred for building pits, and these are commonly located close to the limestone. Four active sand and gravel pits are located 4 km east of Jurien Bay, while four inactive pits are present in the same area and 30 km north of Leeman.

**Particle size distribution**  
 Yellow sand

### Hard rocks

**Sedimentary rocks**  
**Chert**  
 Chert outcrops in an area 25 km north of Three Springs, around and south of Carnamah. It represents silicified dolomite, sandstone and other sedimentary rocks. Silicification took place soon after deposition. The chert is unbedded, ranging from white to grey and red and brown. It commonly laminated and brecciated. A small inactive sand pit is found 27 km north of Three Springs.

**Sandstone**  
 Sandstone outcrops 20 km northwest and east of Jurien Bay and in a north-trending belt in the central part of the area. In both areas the sandstone is variegated, fine to coarse grained and heterolithic, with some siltstone and shale, and is weathered by residual. Iron sands pits and gravel pits, obtaining material from the weathered sandstone, are located 15 km east of Jurien Bay, and 16 km northeast and 40 km north-northeast of Eneabba. Four inactive sand and gravel pits are present in the same areas.

**Sandstone, minor conglomerate**  
 Sandstone outcrops east of Mingenew and north of Three Springs. Lithologies include well-bedded and cross-laminated quartz and heterolithic sandstone, pebbly sandstone, and conglomerate. Cracks in the rock beds are predominantly of volcanic origin. In places, well-laminated and massive siltstone is common. This material has not been worked.

**Igneous and metamorphic rocks**  
**Granite**  
 Granite includes a range of rocks: porphyritic granite, granite and granite gneiss. They outcrop in the northeast part of the area as low hills and domes with boulder-strewn slopes and deeply dissected terrain. Granites are generally pink to grey, medium- to coarse-grained, equigranular rocks, although porphyritic, banded and other textures are common. A single open quarry occurs 3.5 km southeast of Carnamah.

### Quarries and pits

- Active
- Inactive
- Proposed
- Aggregate
- Cy
- City
- Gv
- Gravel
- Lad
- Limesand
- Lst
- Limestone
- Sd
- Sand

### Tenure for basic raw material

- Mining lease, live (Mining Act 1978)
- Prospecting Licence, live (Mining Act 1978)
- Extractive industry licence, live (Planning and Development Act 2005)
- Crown reserve for basic raw materials

### Boreholes

- Showing depth of surficial material, in metres
- Showing thickness of surficial material, in metres
- Homestead
- Highway, with national route marker
- Major road
- Minor road
- Railway, operating
- Townsite (Land Administration Act 1997)
- Class A National Park or Nature Reserve
- Local Government Authority boundary
- Drainage
- Contour, elevation in metres

### Analyses

**Limesand**

CaCO<sub>3</sub> Add insoluble residue

**Limestone**

CaCO<sub>3</sub> Acid insoluble residue

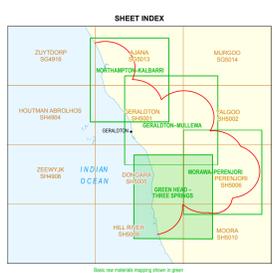
**Sand and Gravel**

Sand

Fines

Gravel

Basic raw materials on this map have been compiled from existing Geological Survey of Western Australia and Department of Agriculture and Food WA maps. Circled areas indicate unworked bedrock and surficial deposits not considered basic raw material resources.



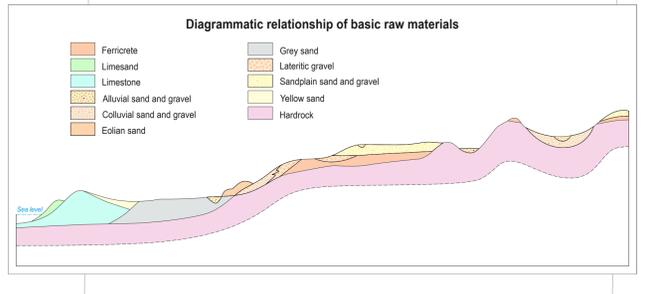
### DATA SOURCES

Theme	Date/Version	Organization
Basic raw materials	2014	Geological Survey of Western Australia, Department of Mines and Petroleum
Topography	2013	Landgate (Geoscience Australia)
Contours	2006	Geological Survey of Western Australia, Department of Mines and Petroleum
Mining tenements	2015	Mining Titles Division, Department of Mines and Petroleum

© WA State Government unless otherwise indicated

Compiled by Geological Survey of Western Australia 2015  
 Cartography by I. Leach  
 Edited by I. Leach and M. Greenberg  
 Published by the Geological Survey of Western Australia  
 Copyright are available from:  
 Department of Mines and Petroleum  
 100 Plain Street, East Perth WA 6004  
 Phone: +61 8 9223 3444  
 Website: www.dmp.wa.gov.au  
 Email: geosurvey@dmpp.wa.gov.au  
 The recommended reference for this map is:  
 Geological Survey of Western Australia 2015, Basic raw material resources, Green Head - Three Springs (1:200 000 scale), Geological Survey of Western Australia, Resource Potential for Land Use Planning.

**Disclaimer**  
 This product was produced using information from various sources. The Department of Mines and Petroleum (DMP) and the State Government of Western Australia (WA) do not warrant the accuracy, currency or completeness of the information. DMP and the State accept no responsibility and disclaim liability for any loss, damage or costs incurred as a result of any use of or reliance on whether wholly or in part upon the information provided in this publication or incorporated into it by reference.



## RESOURCE POTENTIAL FOR LAND USE PLANNING

### Basic Raw Material Resources

# GREEN HEAD - THREE SPRINGS

This mapping was produced to identify potential basic raw material resources within close proximity of settlements between Green Head, Northampton and Merredin. The project received a funding contribution from the State Government of Western Australia through the Royalties for Regions Program.

© Western Australia 2015