



### 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 Enabla. The material forms as small, widely separated outcrops of residual, reddish brown, hard, sandy, plastic or massive lateritic crust 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 Enabla. A further 32 inactive gravel pits occur, mainly in the southern part of the area.

**Limesand**  
Series of long, well-sorted, and rounded sand dunes with broad deflation basins composed of pale greyish grey, fine to medium-grained quartz sand and shell debris are found along the coastline. These dunes are generally stable with foredunes and frontal dunes susceptible to wave and wind erosion although large areas of blowouts are evident along much of the coast. Thirteen 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 Leeman and Jurien Bay. For all deposits, the groundwater table is generally less than 10 m below the ground surface.

**Limestone**  
Low hills and rises of deflated 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 limited. A relatively thin, strong calcareous caprock overlies the limestone. Five active limestone pits are concentrated in the area 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 – Peel, Avon, and the Murrumbidgee. The alluvial sand and gravel is generally composed of fine to medium-grained sand and silt with varying degrees of sorting and grading. The floodplains and lower terraces comprise fine, red and reddish brown sands and silty sands grading to clay at depth. Upper terraces and fans comprise well-sorted, yellowish brown to grey brown silty sands and sandy clay. No active pits are known, but 27 inactive sand and gravel pits are present, mostly in the Enabla area. Thickness of material is generally less than 2 m. Groundwater is generally close to the ground surface.

**Colluvial sand and gravel**  
Colluvial material principally forms in two areas. North of Enabla the gently undulating slopes of the Kooragang region have a cover of green to greyish brown sand and over pale yellow sands and gravelly sands. Between Mingenew and Carnamah colluvial material consists of hardsetting reddish brown sand and gravelly sand, with some gravelly sand and gravelly sand and gravelly sand. The main source of the material is the Kooragang region. Most of the ten active and 30 inactive sand and gravel pits are situated between Dongara and Enabla, and a few inactive pits are located in the Three Springs - Carnamah area.

**Eolian sand**  
Discontinuous, level to gently undulating sandbars with low, sandy rises are located up to 20 km north, west and south of Enabla. This unit is a complex association of strandline, colluvial and alluvial deposits that has been significantly reworked by eolian activity. The material comprises thick, pale grey, leached quartz sand overlying yellow, fine to medium-grained sand on the floor, with more silty and gravelly material on the floor. Three inactive sand pits are situated 11 km northwest of Enabla. This unit is the main source of the material in the Kooragang area. No active pits are known, but 27 inactive sand and gravel pits are present, mostly in the Enabla area. Thickness of material is generally less than 2 m. Groundwater is generally close to the ground surface.

**Grey sand**  
Very low-lying dunes and intervening gently undulating plains are present east and southeast of Jurien Bay at the foot of the northern extension of the Grange Scarps. Poorly drained sandbars, swamps, depressions and poorly defined river channels occur between the dunes. The grey sand comprises leached, pale grey, silty sand with humic and iron-rich layers overlying pale yellow sands at variable depths. The small, intertidal active pits of no more than very local significance is 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 loose, iron-rich nodules and pebbles of fragments, commonly set in a clay-rich or sandy matrix on gently sloping colluvial hillslopes. The material on these slopes is relatively fine, 2-4 m Active gravel pits occur 14-22 km northwest of Dongara, 3 km southeast of Enabla and 15 km east of Green Head. A further 44 inactive sand and gravel pits occur widely throughout the area.

**Sandplain sand and gravel**  
Sandplain sand and gravel covers much of the eastern half of the area. The materials of the sandplain complex consist of pale yellowish brown, silty, quartz sand between 1-3 m in thickness overlying amorphous, sandy silty sand, which becomes cemented with depth. The gravel consists of weathered sandstone and shale 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, by surficial leaching and groundwater dissolution, of the underlying limestone. This is the main source of both specification 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 5 km west of Jurien Bay, while four inactive pits are present in the same area and 30 km north of Leeman.

### 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 unconsolidated, ranging from white to grey and red and brown. It is commonly laminated and brecciated. A small inactive sand pit is found 27 km north of Three Springs.

**Sandstone**  
Sandstone outcrops 20 km northeast 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 shaly and plastic, and is weathered by residual, thin sandy pits and gravel. Active sand pits, obtaining material from the weathered sandstone, are located 15 km east of Jurien Bay, and 15 km northeast and 40 km north-northeast of Enabla. 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 calcareous sandstone, pebbly sandstone, and conglomerate. Clasts in the pebbly beds are predominantly of volcanic origin. In places, well-laminated and massive sandstone 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 large operating quarry occurs 3.5 km southeast of Carnamah.

### Quarries and pits

Active  
Inactive  
Proposed  
Aggregate  
Clay  
Gravel  
Limestone  
Lime  
Sand

### Analyses

**Lime**  
CaCO<sub>3</sub>  
Acid insoluble residue  
Limestone  
CaCO<sub>3</sub>  
Acid insoluble residue  
Sand and Gravel  
Sand  
Gravel  
Fines

### 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 to groundwater, in metres  
Showing thickness of surficial material, in metres

### Legend

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

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

### Diagrammatic relationship of basic raw materials

Ferricrete  
Limesand  
Limestone  
Alluvial sand and gravel  
Colluvial sand and gravel  
Eolian sand  
Grey sand  
Lateritic gravel  
Sandplain sand and gravel  
Yellow sand  
Hardrock

### DATA SOURCES

Theme	Date/Version	Geological Survey of Western Australia, Department of Mines and Petroleum	Organisation
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 Tenement Division, Department of Mines and Petroleum	

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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.

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### SHEET INDEX

### WESTERN AUSTRALIA

### GOVERNMENT OF WESTERN AUSTRALIA

Department of Mines and Petroleum  
Geological Survey of Western Australia  
MINISTER FOR MINES AND PETROLEUM  
EXECUTIVE DIRECTOR

### ROYALTIES FOR REGIONS

ROYALTIES FOR REGIONS  
The Royalties for Regions Program is a contribution from the State Government of Western Australia to the Royalties for Regions Program.

### 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 Morawa. The project received a funding contribution from the State Government of Western Australia through the Royalties for Regions Program.

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