AN INTRODUCTION TO TOPOGRAPHIC MAPS

Gary B Lewis

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AUSTRALIAN GEOLOGICAL SURVEY ORGANISATION

Geoscience Education

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An introduction to topographic maps

Topographic maps provide us with a two dimensional representation of our three dimensional world. They provide us with information about the landscape including the hills and valleys, the courses of creeks and rivers, the nature of coastlines, the types and styles of vegetation and those features humans have added to the natural world such as roads, railways and towns.

With topographic maps we can discover places we cannot visit, plan the use of land, design nature trails, study natural vegetation and animals distribution, plan camping, hiking and bushwalking trips and many other important, interesting and fun activities.

This kit introduces you to the language of topographic maps through hands-on activities based on real maps. Once you have completed these activities, you will be well on the way to getting the most out of topographic maps of other areas.

This book is set out with background information about the skills needed to read topographic maps followed by 16 activities based on the two topographic maps found in the back pouch. The suggested answers to the activities can be found at the back of the book.

The activity symbol (on the right) is shown in the notes when an activity exists based on the material covered in the text. This symbol refers to activities which use the Rockhampton Map and cover basic concepts covered in the text.

This activity symbol (on the right) is shown in the notes when a more advanced (complex) activity exists which is based on the Jacobs River Map .

Map Cards

To help you measure distances, bearings and read grid references there is a map card included in the back pouch. This see-through card has a line scale in kilometres marked along the left-hand edge, a grid reference guide and a compass rose and bearing guide. All the 1:100,000 scale items are in black. The blue distance scale and blue grid reference guide is for 1:250,000 scale maps. The map card is a useful tool for reading all 1:100,000 and 1:250,000 scale maps.

Reading maps

For a topographic map to be read and its information used correctly the following simple principles need to be understood :

What is the scale (or how big is big and how long is long)?
Where is north (or which way is up)?
What do the symbols represent (legend)?
How is the ground's surface represented (contours)?

There are many excellent texts which explain all of these principles in detail — a list of suggested books can be found at the back of this book. This kit explains the basics then lets you try them out on real maps. So let's start at the very beginning . . . . . .

Scale

The topographic maps in this kit are at a scale of 1:100,000. This means that 1 cm on the map is equivalent to 100,000 cm (or 1 km) on the ground. Not all maps are of this scale. Other common scales are:

1:5,000 (one cm on the map equates to 50 m on the ground)
1:10,000 (one cm on the map equates to 100 m on the ground)
1:250,000 (one cm on the map equates to 2.5 km on the ground)
1:1,000,000 (one cm on the map equates to 10 km on the ground)

The scale of a map is marked in two ways — a ratio, such as 1:100,000 and as a line scale. The line scale allows distances to be measured on the map face. Current maps show the line scale in kilometres.

SCALE 1 : 100 000

Some maps have line scales which show distances in kilometres, miles and nautical miles.

Distances

To measure the distance between two points (in a direct line), use a straight-edged piece of paper and mark the distance between the two points. Hold the marks on this piece of paper against the line scale to convert to kilometres. Likewise, you can measure the distance using a centimetre ruler then convert to kilometres — one cm equates to one km. The map card has a kilometre scale for both 1:100,000 (in black) and 1:250,000 scaled maps (in blue).

ACTIVITY

To measure the distance along a road or river or any curved route on the map, use a piece of string. Mark on the string where you start and then place the string along the route until you reach the final destination and mark the string again. Now measure the string between the two marks and convert to km as before. **(Activity : As the crow flies)**

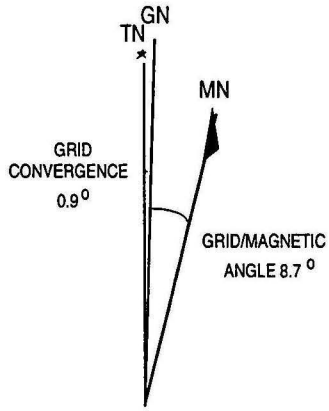
Likewise, you can build a simple opisometer (a miniature trundle wheel) to measure distances that are not in a straight line. The plan for making this device is in the activity section. **(Activity : Opisometer it!)**

Advanced Activity — State Boundaries
This activity involves measuring the length of a state boundary. The boundary on this map follows a river as well as a straight line between two points.

Directions

North Points

The direction to north from the centre of the map face is shown by the north points on the side of the map. Three north points, true (TN), grid (GN) and magnetic (MN), are shown.



True north, grid north and magnetic north are shown diagramatically for the centre of the map. Magnetic north is correct for 1983 and moves easterly by 0.1° in about three years.

topo/northpoint

True North is the direction to the north geographic pole — that point around which the earth rotates.

Grid North is the direction along which the grid reference lines are drawn (see Grid References) — this is 0.9° to the east of true north.

Magnetic North is the direction the compass needle points due to the earth's magnetic field — Magnetic North is not a fixed point as the Earth's magnetic field moves slightly from

year to year. The variability in the position of magnetic north relative to true north is known and is given as a rate of 0.1° to the east per three years.

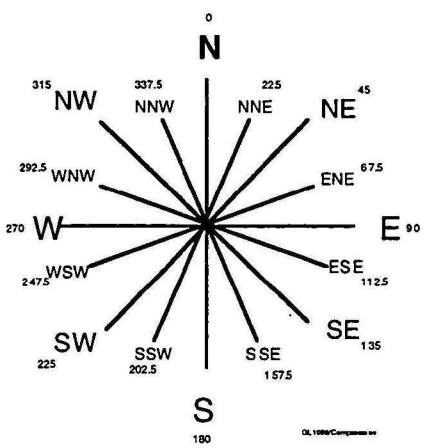
If you were going to use the Rockhampton 1:100,000 map for navigation using a magnetic compass, you would need to set the magnetic compass to reflect the changed position of magnetic north. (The map's magnetic north point was true for 1983). Some compasses have a small wheel or dial to allow you to set this angle — most require you to add/subtract the angle from the reading manually.

For most purposes, the top of the map along the grid lines can be considered as north (grid north). Other compass directions can then be determined from grid north. The map card has a compass rose which will help you calculate compass directions.

Bearings

As well as using compass points, directions can be given as a bearing. Bearings are the angle, in degrees, from north. As the bearing can be any angle within a full circle, bearings range from 0° at north through to 360° (which is also north). For example, the direction east is at a bearing 90° (sometimes written as 090).

The diagram below shows the compass points and their corresponding bearings. The map card included in this kit has the same compass rose and a circular bearings guide.



The fundamentals of navigation requires the skills of reading bearings and measuring distances. **(Activities : Land the aircraft, Periscope up!)**

Map Projections

The surface of the Earth is curved. This means that a flat map will misrepresent the exact curved surface. To minimise the distortion, map makers (cartographers) use map projections to portray all, or part of the round Earth as accurately as possible on a flat

surface. There are many different types of map projections. The cartographer chooses one best suited to the use of the map and/or area of the earth's surface being mapped.

Most maps, including the ones in this kit, have been drawn using the Transverse Mercator projection.

Latitude and Longitude

Latitude and longitude is a grid system used to locate any point on the surface of the Earth.

Latitude — is the distance north or south of the equator and is measured in degrees, minutes and seconds. The Equator is at latitude zero degrees and the South Pole is at latitude 90°S (the North Pole is at 90°N).

Each degree is divided into 60 minutes and each minute is divided into 60 seconds. With the use of computers, it is more common now to give these coordinates in a "digital style" where minutes are given as a decimal rather than in 60ths.

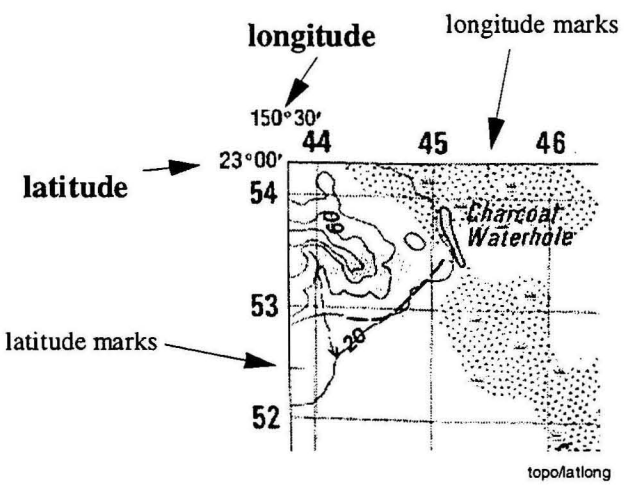
The following symbols are used to represent degrees (°), minutes (') and seconds (").

The Rockhampton Topographic Map covers the area between 23°00'S (23 degrees and 00 minutes south of the equator) and 23°30'S (23 degrees and 30 minutes south of the equator).

Longitude — is the distance east or west from an imaginary line which runs from the North Pole, through the London suburb of Greenwich in England and down to the South Pole. This is often known as the Greenwich line. Why Greenwich? This is the location of the Royal Observatory and all maps drawn by the British during the early development of maps used this line as 0° longitude line. Today, all maps use the Greenwich line for 0° longitude. Like latitude, longitude is measured in degrees, minutes and seconds.

The Rockhampton Topographic Map covers the area between 150°30'E and 151°00'E.

Latitude and longitude coordinates are given at each corner of the map face. The upper left corner, for example, is at latitude 23°00'S and longitude 150°30'E. (You will notice that the S and E have been left off.)



ACTIVITY

As well as the corner coordinates being shown, latitude marks and longitude marks occur along the edges of the map. Each mark represents one minute. The tenth mark is slightly longer. These can be used to locate places on the map using latitude and longitude coordinates. **(Activity : Latitude-Longitude)**

When using this method of finding a location, the latitude is always given first followed by the longitude.

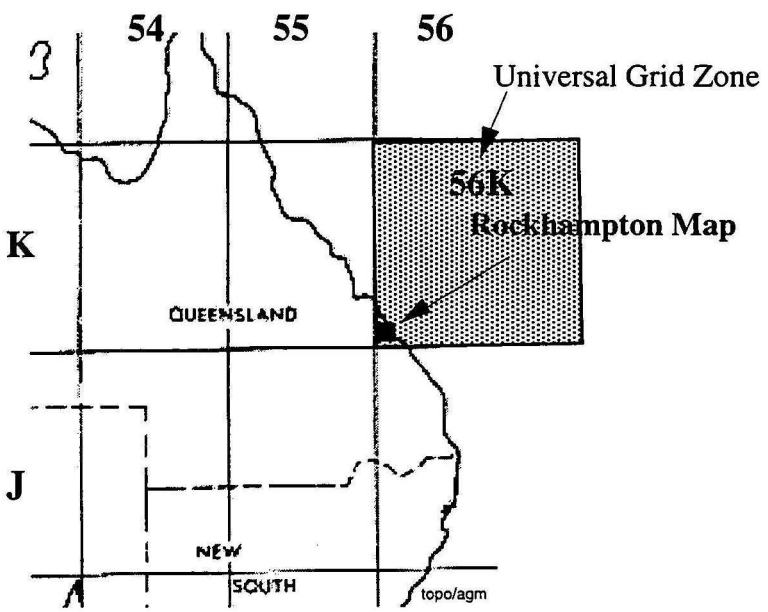
So, when reading latitude the first number refers to the whole number of degrees, and the next number after the point refers to the number of minutes towards the next latitude line or, more simply, the number of 60ths towards the next latitude line. The same applies to the longitude numbers. If the second number is 00, this means that the location is exactly on the latitude or longitude line.

Australian Map Grid

A much simpler method of finding locations is to use a grid system which is based on lines 1000m apart. This is known as the Universal Grid Reference System and uses decimals rather than 60ths as in the latitude/longitude system.
In Australia we use the Australian Map Grid (AMG) which is part of the Universal Grid System. This system is divided into zones, 100 km squares then, for 1:100,000 scale topographic maps, six figure grid references.

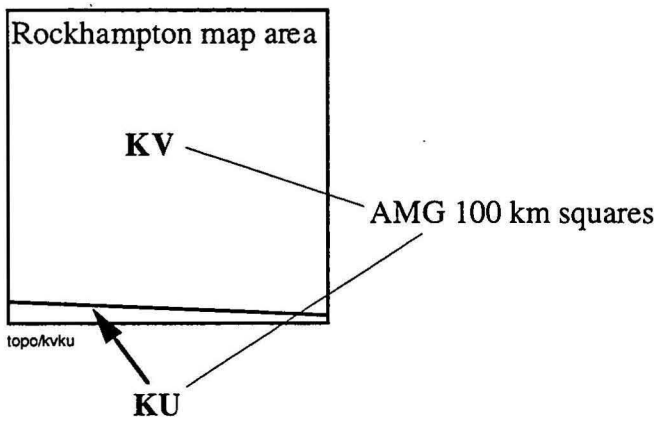
Zones

The AMG covers 9 "longitude" zones of the Universal Grid System — zone 49 to zone 57 and five "latitude" zones — zone G to zone L. The Universal Grid System zone covering the Rockhampton Map is zone 56K.



100 km Squares (100,000m squares)

Each zone is divided by the AMG into 100 kilometre squares, each square identified by two letters. In the case of the Rockhampton Map, the majority of the map area falls into the KV square with a slither of the KU square at the bottom of the map.



Grid References

Grid references are a sequence of numbers describing the location of any point on the map surface. Combined with zone and 100 km square information, we can give the coordinates of any place on earth.
Grid references for a 1:100,000 scvale map are divided into two sequences of three numbers — making up the 6 figures. The first three numbers refer to the vertical lines (eastings) and the second three numbers to the horizontal lines (northings). Each easting line is given two numbers and these are marked on the top and bottom of the map. Likewise, each northing line is given two numbers which are marked on the sides of the map. Each line is 1000m or 1 km from the other lines. Combined together on 1:100,000 scale maps, the eastings lines and the northing lines produce a grid over the map surface with each grid box being 1 km square.

Each Map Card contains a Grid Reference Guide to assist you in reading grid references. This guide is designed to place over a grid box, with each fine line representing 1 grid division.

In this booklet and in many other texts, the letters "GR" are used to signify that the sequence of numbers refer to a **G**rid **R**eference.

Reading Grid References on 1:100,000 scale maps

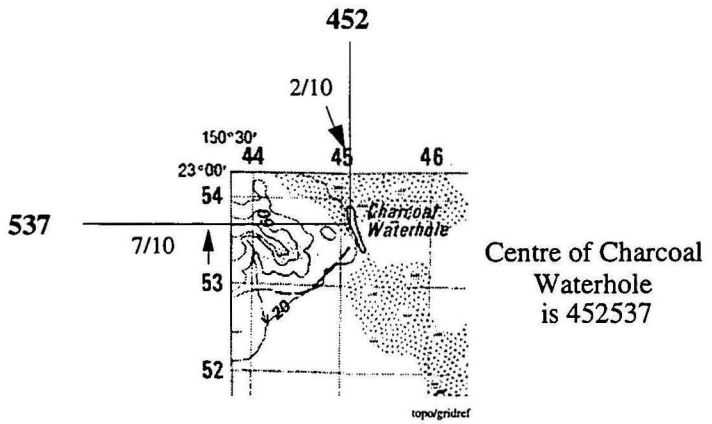
ACTIVITY

To read a grid reference (ABCXYZ) for a given place, first find the easting line (the vertical line) immediately to the left of the place and write down its two numbers (AB). Now estimate the distance the place falls between this easting line and the next easting line to the right as a decimal (1-9). You can use the Grid Reference Guide on the Map Card (or use a ruler) to be exact — each grid square is exactly 10 mm across. The number (1-9) you get will be number C. This gives you the third easting number. If the place falls on an easting line then the third easting number is 0.

To get the three northing numbers, first find the northing (horizontal) line directly below the place and write the two numbers of this line down (XY). As with the eastings, calculate the distance (1-9) between the northing line and the next line above the place. Using the black Map Card Guide is most accurate. This is the third northing number and the final number of the six figure grid reference (Z). **(Activity : Find it! Grid it!)**

For example, what is the grid reference for the center of Charcoal Waterhole in the upper left-hand corner of the map?

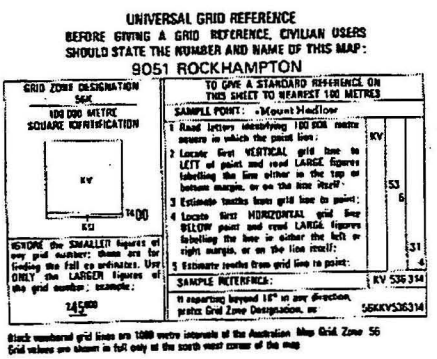
The closest easting line to the left of the waterhole is 45. The distance from this easting to the next easting is 2/10. So the easting coordinates for the center of the waterhole is 452. The northing directly below the waterhole is 53. The distance from this northing to the center of the waterhole is 7/10 the distance towards the next northing line so the northing coordinates are 537. Put them together and the six figure grid reference is GR 452537.



Due to the scale of the map, this grid reference is accurate to the nearest 100m.

This six figure grid reference is unique for this map. If we wanted to give the full AMG reference for this waterhole we would combine the zone, 100 km square and grid reference data together to give the following full reference 56KKV452537. Normally however, we would give only the map name and sheet number and the six figure grid reference — Rockhampton 9051 GR 452537.

Topographic maps have this information all summarised in a Universal Grid Reference Box located on the side of the map :—



Index to Adjoining Sheets

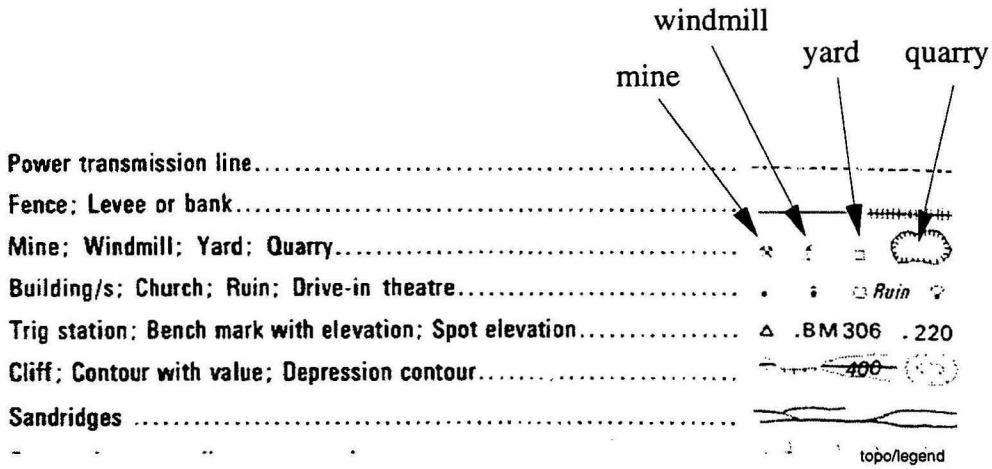
It is often the case when using maps that you require information which occurs on the next map above, below or along side. The Index to Adjoining Maps diagram enables you to quickly see the name and number of these maps.

Legend

The legend on a topographic map is the key to the use of colour and symbols on the map face. The cartographer (the scientists who develop and draw maps) uses a set of standard colours and symbols to depict roads, railway lines, buildings, vegetation rivers and other features.

ACTIVITY

The legend is easy to understand. Each feature is listed with its corresponding symbol or colour. Some features are grouped with each object listed in the same order as the depicted symbol. **(Activity : The key to it all)**



Advanced Activity — Vegetation trail

This activity involves you reading vegetation types from the legend. It also requires you to use grid references and draw conclusions about topography-vegetation relationships.

ACTIVITY

Contours

Over the history of map making, one of the most difficult pieces of information to record accurately on a map has been elevation. A variety of methods have been used, including shading, hachuring — using short or long lines, colour and spot heights. By far the most accurate and most common now is the use of contours.

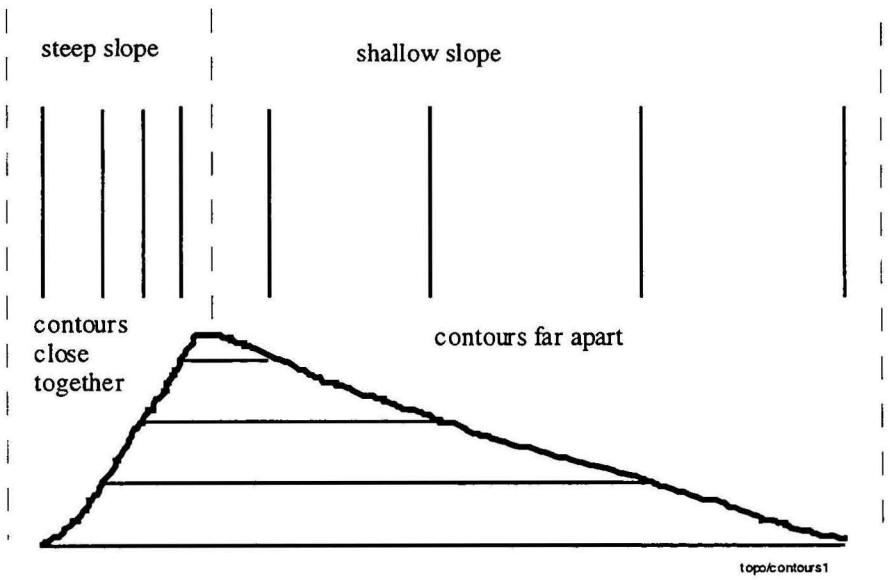
A contour is a line which joins places of equal height on a map. Adjacent contour lines are separated by a known height — the contour interval — which can vary from map to map. The contour interval on the Rockhampton map is 20 metres. This means that each contour line is separated by 20 metres in elevation. **(Activities: Mt Lizard Grapes, Mobile Phone Towers)**

The contour lines representing 100's of metres (known as index contours) are thicker than the other contour lines and are marked with their value ie. 100m, 200m and so on. Contours which show localised "depressions" are sometimes marked with small cross-marks (see legend).

Advanced Activity — Hydro Power
This activity involves you in estimating distances and heights using scale and contours. It also requires you to use grid references.

Approximate contour lines can be drawn from a grid of known heights (spot heights). **(Activity : Join the elevation dots)**

Contours not only show heights, but the arrangement of the lines show slope gradients. Contour lines that are close together represent steep slopes. Contours lines which are far apart represent shallow slopes.



In some places the slope can become so steep, such as at a cliff line, that the contour lines appear to join or overlap. This can make reading contour values difficult.

After some practice, it is possible to look at contours on a map and "see" the topography in three dimensions. For most people, however, this is not possible, and drawing a cross section is the fastest and most accurate way at looking at the topography.

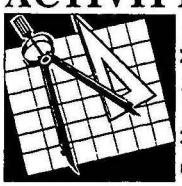
Drawing a cross-section

Cross-sections are not difficult to draw if the contour lines are clear and not too close together. The first step is to decided between which two points a cross-section will be drawn. The section is in a direct line between these two points. Take a piece of paper with a straight edge and hold it between the two points. Mark on the paper the two points and label them (A, B). Starting at one point (A), move along the paper marking where it cuts a contour line until you reach the second point (B). Label the value of each of these contour marks — you may have to follow them around on the map until you can find a value, or by counting up or down from a labelled index contour (ie 100's).

Draw, on a piece of graph paper, a box which is the same width as the distance between the two points (A-B). Using the same scale (1 cm = 1000 m), mark the vertical scale in metres above sea level making sure it covers the lowest height and maximum height!

Using this piece of paper, transfer the contour height information on to the graph paper by sliding the straight edge up and down to the corresponding heights on the graph. Place a dot on the graph paper at each point the contour was marked on the piece of paper making sure that the starting point (A) stays on the side of the graph ie you have not slid the piece of paper horizontally. When you have placed a dot for each of the contour values, draw a curved line through the points to show the approximate shape of the topography. **(Activity : Mt Atherton section)**

ACTIVITY



Rockhampton Map

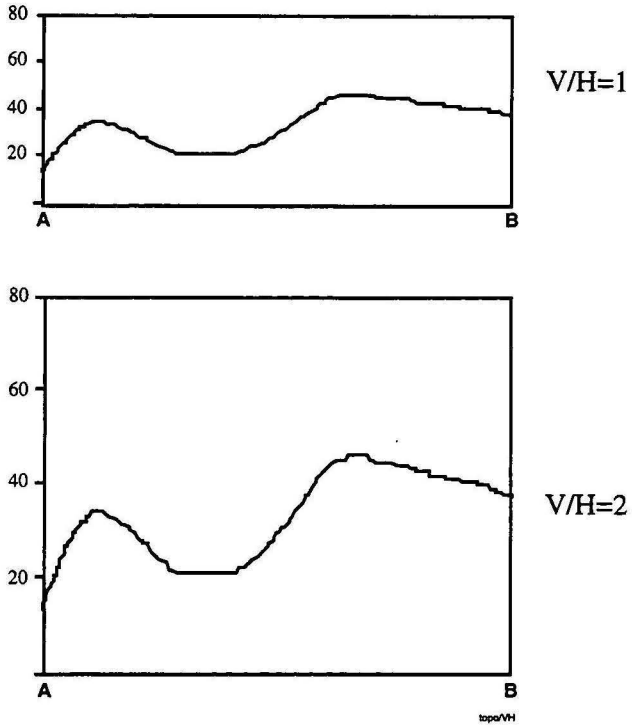
Vertical exaggeration

Because you have used the same scale horizontally as vertically, this cross-section has no vertical exaggeration — the shape of the topography is true and has not been made "bigger". This is referred to as having a vertical exaggeration of 1 — that is 1m across is the same scale as 1m up.

Sometimes, especially in flat lying areas, a vertical exaggeration of 1 will not show up subtle changes in slope and the vertical height scale is changed to give an exaggerated topography in the section. A vertical exaggeration of 2 would be, for example, that each metre of elevation would be twice the scale of a metre across the ground (see diagram on the next page).

Vertical exaggeration can be calculated by dividing the value of 1 cm of the vertical height scale by 1 cm of the horizontal distance scale. If they are the same then V/H=1.

$$VE = \frac{VS}{HS} = \frac{\frac{1}{10,000}}{\frac{1}{100,000}} = \frac{1}{10,000} \times \frac{100,000}{1} = 10$$



Because water naturally only flows downhill, contour information can be used to find out the direction a stream or river is flowing. The stream or river along its path on the map will cross contour lines. The distance between these "crossing" may be far apart if the stream is slow flowing and meandering or close together if the stream is tumbling over cliffs, waterfalls or rapids. To work out the flow direction, find two places on the map where the stream crosses contour lines and then find the value of these lines. The stream is flowing in the direction from the higher contour line value to the lower contour line value that it crosses.
(Activity : Ride the rapids)

ACTIVITY

ACTIVITY

Advanced activity — Chairlift ride
This activity requires you to draw a cross-section using a VE=2. You will be required to use grid references.

Geological Maps

A geological map provides another dimension to the information stored on topographic maps. Geological maps show the rock types, the boundaries between them and their relative ages. Geological maps may also show the position of mines, both past and present, and mineral deposits discovered but not worked.

Geological maps are available from the Australian Geological Survey Organisation (AGSO) or your state geological survey office.

Australian Surveying & Land Information Group

The Australian Surveying and Land Information Group (AUSLIG) is the Australian Government's civilian surveying, mapping and land information agency. AUSLIG was established in 1987 from the amalgamation of the Australian Survey Office and the Division of National Mapping. Its responsibilities include the production and maintenance of national and regional spatial datasets in both digital and graphical form, and the reception and processing of remotely sensed satellite imagery of the Australian continent. A major part of this task involves the provision of topographic mapping information at the national scales of 1:100 000, 1:250 000 and smaller.

AUSLIG

Topographic Map Sales

Why not obtain the topographic map of your own area? For copies of your map visit your local map retailer or contact AUSLIG:

AUSLIG Map Sales
PO Box 2
BELCONNEN ACT 2616
Free call : 1 800 800 173
Fax : 06 201 4381
WWW : http://www.auslig.gov.au
Email : mapsales@auslig.gov.au

Australian Geological Survey Organisation

The Australian Geological Survey Organisation (AGSO) was established in 1946 (as the Bureau of Mineral Resources) to provide a national geological survey focus during the post-war boom period. Since this time the Organisation has been instrumental in the discovery of numerous mineral and petroleum deposits and continues to provide the very best survey data and geological advice to government, industry and research institutions. The research which AGSO undertakes covers almost all areas of geoscience, including mineral exploration, onshore and offshore petroleum exploration, environmental and groundwater geoscience, and geological hazards. Associated with this research is the storage and manipulation of geological and geophysical data and the production of cartographic and geographic information system (GIS) products.

Geological Map Sales

Why not obtain the geological map of your own area? Information on the current availability and prices of geological maps can be obtained from:

AGSO Sales Centre
Constitution Avenue
Parkes, ACT 2600
ph (06) 249 9519 or (06) 249 9642
fax (06) 249 9982
Email : sales@agso.gov.au
WWW: http://www.agso.gov.au

or

Reply Paid Service 538
AGSO Sales Centre
GPO Box 378
Canberra ACT 2601
(no stamp required)

Some suggested Australian topographic map reading resources

Beginning map skills by John and Patty Carratello, illustrated by Paula Spence and Keith Vasconcelles, Hawker Brownlow Education, c1995.

Reading maps : reading and interpreting by George Moore, illustrated by Cliff Derksen, R.I.C. Publications, 1992.

"On track" map reading and compass use resource by Geoffrey Archer & Raymond Williams, Australian Navigation Skills & Accessory Services, 1996 (Available from Australian Navigation Skills & Accessory Services, PO Box 675, Cheltenham Vic 3192.)

Heinemann atlas geography skills, Editor: Raymond Pask, Rigby Heinemann, 1996

APE : atlas puzzles & exercises by Gregory J. Reid, Longman Cheshire, 1994.

Topographic mapping skills for secondary students by Grant Kleeman, Hodder Headline, 1995.

Map skills by William H. Maurer and artist, Suzanne Gillespie, Hawker Brownlow Education, 1988.

Maps & Atlases

TOPOGRAPHIC MAPS

Topographic maps can be used to study mapping and map use or to discover more about the shape of the earth on which we live.

AUSLIG produces topographic maps covering the whole of Australia at 1:250 000 scale and the bulk of populated areas at 1:100 000 scale.

These maps show natural and man made features including land surface (represented by contours and spot elevations). Many maps are supplemented by relief shading to help readers visualise the landscape.

GENERAL REFERENCE MAPS

For a broader view of Australia, AUSLIG's range of general reference maps provide students with an overall picture of the Australian Continent.

In a range of sizes to suit just about every use, this group consists of:
Australia - Wall Map (comprising 4 sheets)
Australia - General Reference Map (1:5 million)
Australia - Compact Reference (1:9 million)
Australia - Folio Map (A3)
Australia - Report Map (A4)

AUSLIG's Asia Pacific Map is also a key reference tool, providing students with an overall picture of the Asia Pacific region as well as detailed insets on 15 major countries.

See your local AUSLIG Retailer to purchase any of these products

THEMATIC MAPS

For specific social, environmental or geographic studies, AUSLIG's thematic map range consists of:

Aboriginal Land and Population
Dams and Storages
Forestry Reserves
Fuels
Geology
Land Use
Land Tenure
Minerals Other Than Fuels
Nature Conservation Reserves
Official Australian Postcode Map
Natural Vegetation (1788)
Present Vegetation (1988)
Public Lands
Railways Systems
Soil Resources

These large coloured single sheet maps of Australia are ideal as wall displays as well as being key reference material.

MAPS OF EXTERNAL TERRITORIES

Australia's seven external territories include the Antarctic Territory, the Cocos (Keeling) Islands, Heard and McDonald Islands, Norfolk Island and others. AUSLIG produces a range of maps and satellite images at different scales for anyone interested in these important area. These maps provide students with an insight into the landscape and features of these territories and will aid understanding of their uniqueness and significance.

TOURIST MAPS

To discover more about Australia's most prominent natural and cultural sites, AUSLIG's tourist maps provide an excellent starting point.
From the broad view of the Australia Tourist Map and Northern Australia Tourist Map, down to an intimate view through the Uluru, Kakadu, Norfolk Island, Canberra and Australian Alps Tourist Maps.

ATLASES

AUSLIG's AUSMAP Atlas of Australia, presents a comprehensive view of our continent. This atlas includes more than 200 maps, 40 satellite images and aerial photographs as well as other diagrams and descriptive text.
AUSLIG also produces detailed atlases on Australian Agriculture, Climate, Geology and Minerals and Vegetation.

AUSTRALIA UNFOLDED

Australia Unfolded is an atlas of Australia's natural and man made features on CD-ROM. Unlike other atlases, you choose the information you want to see. Australia Unfolded provides an easy and enjoyable way to view and create your own maps.

To make your own map, select the area, the map features and add your own information using the drawing tools provided. Maps can be used in school assignment or reports via the clipboard function. They can also be printed directly or saved for another time.

Australia Unfolded can be used as a classroom tool for mapping areas of interest in Science, Geography and History. Three detailed tutorials are included and can be used for program familiarisation and reinforcement of geographic and mapping skills.

For more information, price lists or to purchase any of these products, contact:

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AUSLIG

An introduction to topographic maps

Activities

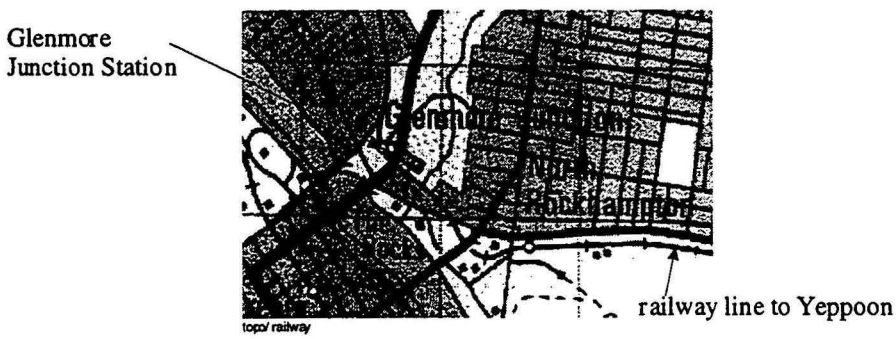
ACTIVITY

Rockhampton Map

As the crow flies

The shortest distance between two points is a straight line. But we can not always travel between two places "as the crow flies" and are forced to follow roads, rivers or railway lines. This can make us travel much greater distances, such as between Rockhampton and Yeppoon which are on the Rockhampton 1:100,000 Topographic Map.

1. Find the railway station at Glenmore Station in Rockhampton. Railway lines are shown as black crossed lines and railway stations are shown as dots on the railway lines.



2. Find the railway station at Yeppoon.

3. Using a straight piece of paper, measure the direct distance between Glenmore Station and Yeppoon Station. Remember that one centimetre on this map equals one kilometre on the ground.

The direct distance between Glenmore Station and Yeppoon Station is _____km.

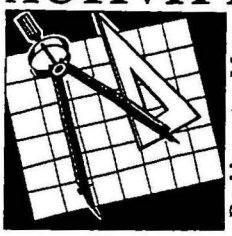
4. Using a piece of string, measure the distance between the two stations along the railway line. Mark a dot on the string with a pen at Glenmore station then hold the string on the path of the railway line following each curve of the track all the way to Yeppoon station. Mark the string again. Measure the length of the string between the two marks and convert the measurement into kilometres.

The distance between Glenmore Station and Yeppoon Station by rail is _____km.

5. Using a piece of string again, measure the most direct route between the two stations by road. Roads are marked as red lines on the map

The distance between Glenmore Station and Yeppoon Station by road is _____km.

ACTIVITY



Rockhampton Map

Opisometer it!

An opisometer is a device that enables you to measure distances which are not in a straight line. It works like a trundle wheel — a scaled wheel which you roll along the map surface between two points.

Attached is a template for a model Opisometer. The wheel needs to be glued onto some stiff card-board then cut out. Also cut out the handle section. The handle needs to be folded long-ways where marked and then folded in half. The wheel is then placed in the handle and a split pin or a bent paper clip placed through the wheel's centre. The wheel needs to be able to move freely when it is run along the map.

Your opisometer will now look like the picture on the template.

Calibration

To use you opisometer you need to calibrate the wheel. To do this place the arrow on the wheel so it points down. Place the wheel next to a centimetre ruler so that the arrow is exactly against the 0 mark. Slowly roll the wheel the opisometer along till the wheel is exactly at the 1cm mark. Using a pencil, make a mark on the wheel at this point and label it as 1km. Roll the wheel to the 2cm spot on the ruler and mark the wheel again, but this time 2km (remember that each centimetre on the map equates to one kilometre on the ground).

Continue calibrating your opisometer until you come back to the arrow. You should be able to get around 25 marks (25 km) on the wheel but every wheel will be slightly different!

Using the opisometer

To measure the distance between two places, start with the arrow on the wheel touching the paper and slowly move the wheel until you reach the final destination. Before lifting the wheel, read your distance off the wheel. If you are between marks you will have to make an estimate of the fraction (decimal) of a kilometre you are from the last mark to get a one decimal reading (such as 3.4 km).

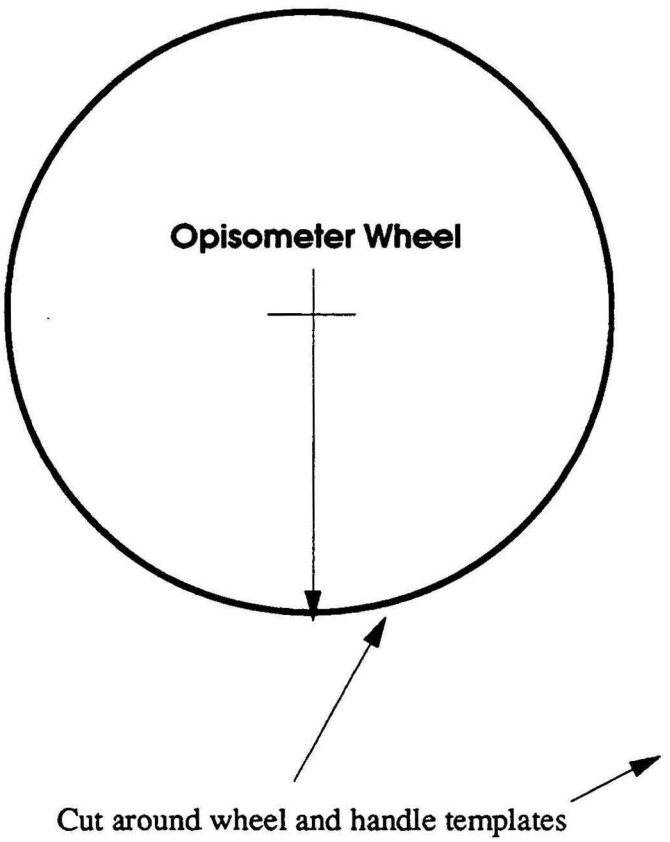
Try it out

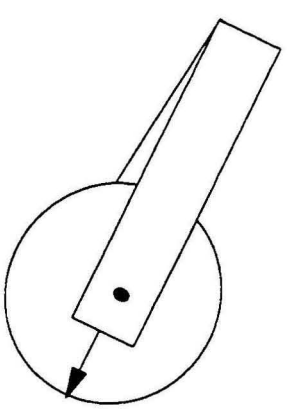
What is the shortest distance from Great Keppel Island from the mainland? _____ km

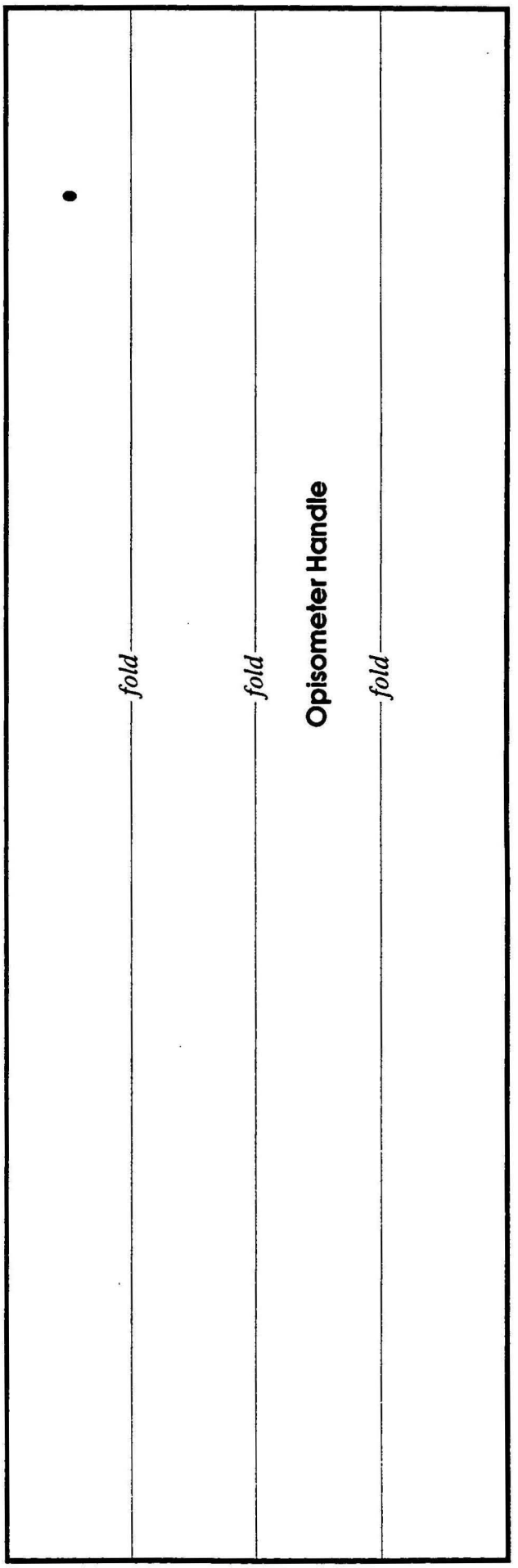
If you wanted to walk along the shore line from the top of the map to the small town of Bangalee, how far would you have to walk? _____km

If you wanted to swim along the Fitzroy River, which runs across the left hand corner of the map, from the Chimney next to the river in Rockhampton to the Slipway near the Abattoirs and you swam in the middle of the river, how far would you have to swim?
_____km

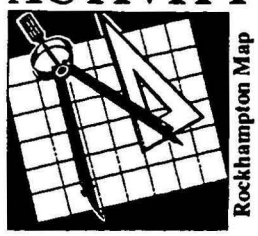
Model Opisometer







ACTIVITY



Land the aircraft

Imagine you are on an aircraft which is flying over the Rockhampton map area. The aircraft computers have failed and you have been asked to navigate the aircraft by following instructions radioed to the cockpit from the nearest airport control tower. Your Aircraft call sign is VH-ABC (Victor Hector- Alpha Bravo Charlie). The control tower will check with you the ground features you are flying over to make sure you are on track.

"Victor Hector- Alpha Bravo Charlie this is the control tower. We have your exact position. You are about to enter the Rockhampton 1:100,000 map area in the bottom right hand corner exactly. Your aircraft is heading at a bearing of 315°. Proceed at this bearing for 27km. Turn then to a bearing of 270° and travel for 2.5 km. What feature have you just passed over?"

"Victor Hector- Alpha Bravo Charlie, travel for another 14.5km exactly west. What type of transport route are you about to pass over?"

"Victor Hector- Alpha Bravo Charlie, now turn to a bearing of 022.5° (NNE) and travel for 24km. What town have you just flown over?"

"Victor Hector- Alpha Bravo Charlie, now turn to a bearing of 090° and travel for 10.7km. Then turn to a bearing of 124° and travel for 9km. Ahead of you at around 2km distance, you should see the end of a landing ground. What is the name of the tourist resort that uses this landing ground?"

"Victor Hector- Alpha Bravo Charlie, we have just had a warning that the wind is blowing strongly from the NW. This will make landing here from your current bearing impossible as the wind is coming from behind you. Please plot your route on your own paper using bearings and distances so that you land on the same landing ground but with the nose of the aircraft pointing at a bearing as close to 315° as you can. (Note the landing field is not pointing exactly to 315°). Over and out."

ACTIVITY

Rockhampton Map

Periscope Up!

Imagine you are the captain of a submarine that is travelling up the coast. It is your job to ensure the submarine does not run aground on any islands, rocks or the coast. Normal operations demand that you always keep your submarine at least 1km away from any obstacle but you stay between 8 km and 12 km from the main coastline.

Your starting point is 910010. Plot your best course using the table below. You will need to work out the bearing the submarine is to sail, the distance it will travel along this bearing and the grid reference (GR) at the end of this distance. The first few legs of the journey has already been done by the submarines navigator (who is now sick in bed).

Starting GR	Bearing	Distance	Finishing GR
910010	000	7 km	910080
910080	315	8 km	853137
853137	000	8 km	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

ACTIVITY

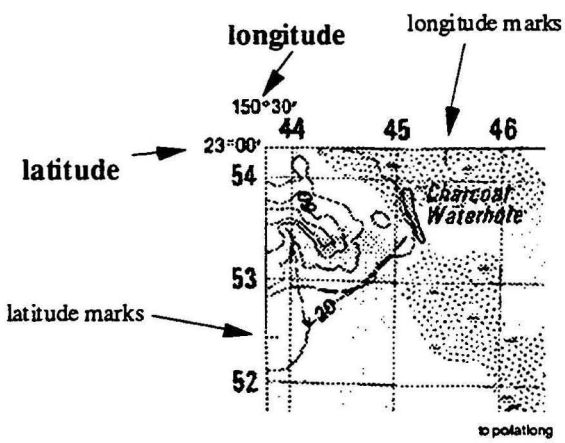
Rockhampton Map

Latitude-Longitude

Latitude and longitude can be used to identify the exact location of any point on the surface of the Earth. We can use it to find locations as well as giving people anywhere in the world an accurate position. When using this method, the latitude is always given first followed by the longitude. The first number in the latitude refers to the whole number of degrees, and the next number refers to the number of minutes. Likewise when using longitude. If the second number is 00, this means that the location is exactly on the latitude or longitude line.

Start in the top left-hand corner of the map. This is marked as latitude 23°00' and longitude 150°30'. The top right-hand corner of the map is at the same latitude (23°00') but is exactly 30 minutes further to the east — 151°00' (remember that there are 60 minutes in one degree). The bottom right-hand corner of the map is at 23°30' latitude and 151°00' longitude.

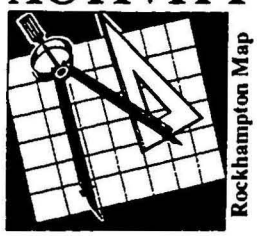
What special place is located at latitude 23°15' and longitude 150°45' ?



As well as the corner coordinates being shown, latitude marks and longitude marks occur along the edges of the map. Each mark represents one minute. The tenth mark is slightly longer. These can be used to locate places on the map using latitude and longitude coordinates.

What is the name of the island at latitude 23°04' and longitude 150°54'

ACTIVITY



Find it! Grid it!

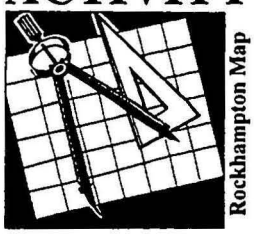
What features occur at the following grid references :—

1. 480415 _____
2. 902477 _____
3. 535084 _____
4. 468111 _____
5. 752355 _____
6. 535129 _____
7. 750257 _____
8. 697392 _____
9. 715482 _____
10. 647387 _____
11. 712050 _____
12. 630532 _____

What are the grid references for the following places :—

1. Yeppoon railway station _____
2. Ironpot Mtn _____
3. Ruin in the center of Great Keppel Island _____
4. Underwater observatory south of Middle Island _____
5. Intersection of the Rockhampton-Yepoon Road and the railway line _____
6. The end of the jetty at Emu Point _____

ACTIVITY



The key to it all

A friend has written you with a big problem. They want to go on a holiday to the Rockhampton area, but the topographic map they own has had the legend torn off and they do not know what all the symbols represent. They have sent you the list below where they describe the symbols that are confusing them. Can you work out what they are describing by using the legend?

A straight green line about 1mm thick and about one cm long?

_____

A black line with small cross lines about 2 mm apart. This line seems to run between some towns?

_____

Two parallel red lines?

_____

A solid light green area?

_____

A small black box with a cross on the top?

_____

Little black stars in a blue background?

_____

Two small black triangles joined together on a red line?

_____

ACTIVITY

Rockhampton Map

Mt. Lizard Grapes

A local farmer has just purchased a neighbours farm on which lies Mt. Lizard (GR 583526). While the farmer has been to the mountain, she wants to use the mountain slopes to grow a new type of warm weather grape. She has read all the information about the best locations to grow these grapes and has calculated that she needs a place greater than 120m above sea level but less than 300m above sea level.

Locate Mt. Lizard on the Rockhampton 1:100,000 Topographic Map.

What is the contour interval of this map ? _____

What would be the approximate maximum height of Mt. Lizard ? _____

What is the approximate height of the surrounding fields at the base of Mt. Lizard ?

_____

The map card 1:100,000 Grid Reference Guide (in black) is made up of a number of tiny squares approximately 1mm across. Each of these squares represents 100 square metres.

Approximately how much area does the farmer have to grow this new variety of grapes on Mt. Lizard?

_____

What other factors (economics, environmental, infrastructure) might the farmer need to take into consideration about growing crops in this area?

_____

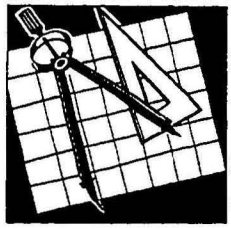
_____

_____

_____

_____

ACTIVITY



Rockhampton Map

Mobile Phone Towers

A mobile phone company wants to place signal towers on hills along the road between Rockhampton and Yeppoon. For mobile phones to work the entire length of the Rockhampton-Yeppoon Road, the position of the towers must follow these simple rules.

1. The towers must be placed on hills which are greater in elevation than 160m above sea level.

2. Each tower must be within 4km of the road.

3. Each tower must be at least 5km away from any other tower.

4. Each tower has a range of 10km.

5. The tower at Rockhampton already has been built on Peak Hill (GR 479197)

Using these rules find best positions for towers along the route and complete the table below. (Note : there are more tower sites in the table below that you might need). Give the grid reference for each tower and its approximate height above sea level. Make sure that you follow all the rules!

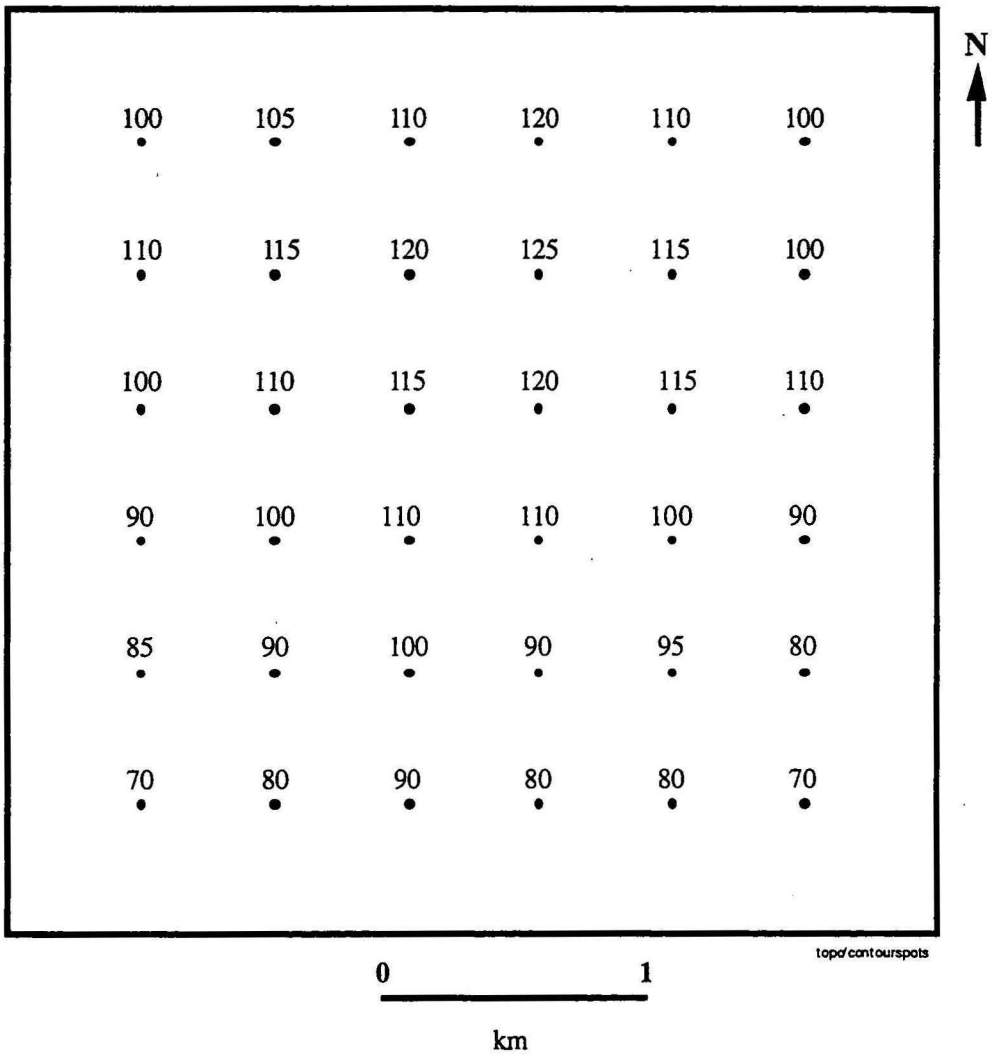
	GR	Height
Tower 1	479197	221m
Tower 2	_____	_____
Tower 3	_____	_____
Tower 4	_____	_____
Tower 5	_____	_____
Tower 6	_____	_____
Tower 7	_____	_____
Tower 8	_____	_____
Tower 9	_____	_____
Tower 10	_____	_____

ACTIVITY

Rockhampton Map

Join the elevation dots

A student surveyor has provided the spot height information in metres above sea level for a small area she has been mapping. Can you take her data and draw a contour map for the area? All you have to do is draw lines which join places of equal height. Draw contour lines for elevations 70m, 80m, 90m, 100m, 110m and 120m only — your contour interval will be 10m. Note that some spots heights are between these lines (ie. 115m)



Now try drawing contours on the more complicated spot height diagram attached using a contour interval of 10m as before . . . . .

50	55	50	45	50	45	40	35
50	60	70	50	75	50	50	40
55	65	80	85	90	75	50	45
60	75	85	100	95	80	70	50
65	70	80	95	90	75	70	60
70	75	80	90	85	95	80	75
85	80	90	95	90	100	90	80
90	100	100	110	110	115	100	90
100	110	125	115	120	120	110	95
90	100	110	125	135	125	105	100
80	90	100	115	120	120	115	110
70	80	95	115	125	115	100	100

0 1
km

topo/contourspots2

ACTIVITY

Rockhampton Map

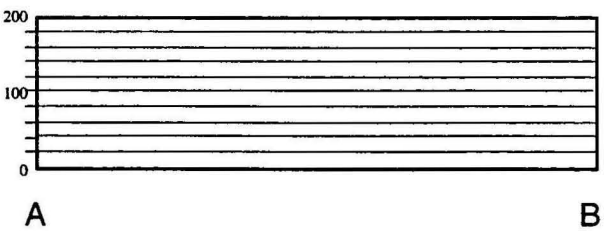
Mt Atherton section

A local football team wants to set up a training area over Mt Atherton (GR484489) — players will be asked to run over the mountain as part of their preparation for a grand final! Your job is to draw a cross section of the proposed route (a direct line) to show the players.

The starting point (A) for the run will be GR460498 and the finishing point (B) will be GR530475. Take a piece of paper with a straight edge and hold it between these two points. Mark on the paper the two points and label them (A, B).

Starting at (A), move along the paper marking where it cuts a contour line until you reach the second point (B). Label the value of each of these contour marks — you may have to follow them around on the map until you can find a value, or by counting up or down from a labelled contour (ie 100's). Be careful as the route sometimes cuts the same value contour line.

Using this piece of paper, transfer the contour height information on to the graph box below by sliding the straight edge up and down to the corresponding heights on the graph. Place a dot on the graph paper at each point the contour was marked on the piece of paper making sure that the starting point (A) stays on the side of the graph When you have placed a dot for each of the contour values, draw a curved line through the points to show the approximate shape of the topography.

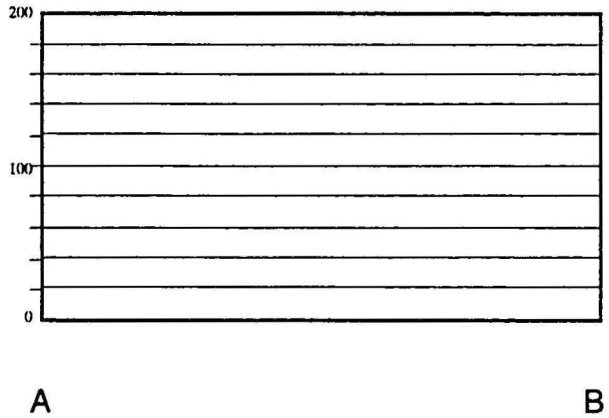


This section shows an exaggerated view of the route. The vertical scale is 1/10,000 and the horizontal scale is 1/10,000.

Calculate the vertical exaggeration factor by dividing the vertical scale by the horizontal scale ie.

$$VE = \frac{VS}{HS} = \frac{\frac{1}{10{,}000}}{\frac{1}{100{,}000}} = \underline{\qquad\qquad\qquad\qquad}$$

Using the original information, draw the same section in the graph box below. This has a vertical exaggeration of 20.

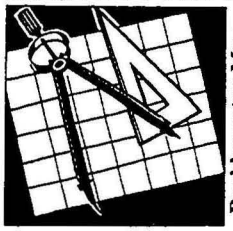


Which of the two cross sections would you show the football team players and why?

In the space below, try and draw the same section using a vertical exaggeration of 1 (ie use the same scale — 1cm=1000m — for both the horizontal and vertical scale.

Why do you think a greater than 1 vertical exaggeration may be used when drawing most cross sections?

ACTIVITY



Rockhampton Map

Ride the rapids

Jayne Binkley and her friend Chi Hun Liu have just purchased a new inflatable boat which they want to use to ride the rapids in the local rivers. They know the new boat will be different from their old boat, so they plan to test the boat out on Limestone Creek, which they have found on the Rockhampton Map. As both Jayne and Chi Hun have not been to Limestone so they need to work out the best place to be dropped off so they can float downstream.

Their two preferred locations to be dropped off are:
1. Where Limestone Creek runs under the Rockhampton-Yeppoon Road (GR 627355) or
2. Where Limestone Creek crosses the road near Plain Creek (GR 607443).

Chi Hun knows that because creeks only flow downhill, contour information can be used to find out the direction a creek is flowing. On the map Limestone Creek will cross contour lines. To work out the flow direction, find two places on the map (A,B) where Limestone Creek crosses contour lines and then find the value of these lines.

Grid Reference of location A : _____ Contour value _____m

Grid Reference of location B : _____ Contour value _____m

Limestone Creek is flowing in the direction from the higher contour line value to the lower contour line value that it crosses. What is the general flow direction of Limestone Creek?

_____

Which is the best of the two preferred drop off locations for Jayne and Chi Hun to start their journey?

_____

The other location will become their pick up point. Approximately, what drop in elevation will the Limestone creek fall between the drop off point and the pick up point?

_____m

Measure the distance they will travel between the two points using the scale and some string, or the opisometer, then calculate the gradient of Limestone Creek by dividing the drop in elevation by the distance of the trip.

_____m per km

ACTIVITY

Advanced

Jacobs River Map

State Boundaries

The boundaries between the states and territories in any country are decided after many months, and often years, of debate between the different governments. The process involves the accurate surveying of the topography which, in the past, often led to the first accurate maps of a country to be drawn.

In many cases the boundaries between states follow topographic features. In other cases the boundaries are straight lines between two defined points.

Part of the boundary between the states of Victoria and New South Wales occurs on the Jacobs River 1:100,000 topographic map.

Find the symbol on the map face that has been used to show the position of the state boundary. Draw the symbol in the space below.

Why do you think that this symbol has not been included in the legend?

_____

_____

Starting from the south east section of the map, the state boundary runs in a straight line across to what topographic feature before it changes direction?

_____

For what distance does the boundary follow this straight line on the map?

_____ km

From this point, what feature does it follow until it leaves the top of the map?

_____

For what distance does the boundary follow this feature on the map?

_____ km

ACTIVITY

Jacobs River Map

Advanced

Vegetation trail

You have been asked by Kosciusko National Park to write a guide on the types of vegetation that occurs on a walking trail which runs from Dead Horse Gap to Cascade Hut. The walking trail follows the Cascade Trail vehicular track.

Locate the start of the trail at Dead Horse Gap (GR 131571). According to the legend, what type of vegetation would you expect to find here?

_____

If you followed the trail southwards, how far would you have to walk before you crossed The Big Boggy Creek for the first time?

_____km

After you leave the creek valley (still heading roughly southwards along the trail), you climb a ridge. What type of vegetation would you find at the top of the ridge (GR 133540).

_____

As you continue to walk down the hill towards Cascade hut the trail has a tight corner to the left (GR 118521). What type of vegetation would you see here?

_____

Finally, what vegetation type would find at Cascade Hut (GR 124506)?

_____

Often vegetation type relates directly to the topography ie. dense forest often is found on the southern slopes of hills.

What relationship is there between vegetation and topography along this trail?

_____

_____

_____

ACTIVITY

Jacobs River Map

Advanced

Hydro Power

An engineering company has put up a proposal to build a hydro-electric power station on the Pinch River. To do this they have to build a dam across the river then allow the water from the dam to travel through a turbine before it returns to the river. They have selected the Pinch River because it lies in a steep sided valley and already has an access road. The proposed dam wall will be between GR 201309 and GR 214311.

How long in metres will the top of the dam wall be? _____

At what height above sea level will the top of the dam wall be ? _____

What would be the maximum depth of the water at the dam wall when the dam is full (assume that the water will reach the top of the dam wall)

_____

How far from the middle of the dam wall will the lake formed by the dam extend?

_____ km

The water inlet pipe from the dam to the turbine will be placed at GR 212311. What is the height above sea level of this inlet pipe?

_____

The turbine needs to be built 200m lower than the inlet pipe on the dam wall so there is enough water pressure to generate electricity. The turbine also needs to be on the river so that the water, once used, is returned to the natural river course. Approximately how far from the inlet pipe position in kilometres will the turbine need to be?

_____ km

The water released from the turbine will churn up the river and the water entering the Snowy River will be slightly muddy. The local water authority requires the building of a water quality monitoring station 5 km down stream of the turbine. At what grid reference would this monitoring station be built?

_____

The position of this dam and power plant will have some strong opposition from environmental groups. What is one major argument for not allowing the dam to be built?

_____

ACTIVITY

Jacobs River Map

Advanced

Chairlift ride

A company wishes to build a scenic chairlift ride for tourists in the mountains. The chairlift ride will take passengers over the tops of the vegetation so they get a birds-eye view of the environment.

The planned chairlift will start at a base station located at GR 058133 and finish at GR 031208. What features are located at the two end points of the chairlift?

GR 058133 _____

GR 031208 _____

What will be the total length of the chairlift ride if passengers start at and return to the base station (ie. return trip)?

_____ m

If the chairlift moves at 500m every minute, how long will it take the passengers to complete the ride?

_____ minutes

The company has asked you to draw a cross-section with a VE of 2 of the path of the chairlift. Use space below to draw this section.

The chairlift towers can be no further than 750 metres apart. (The company wants as few towers as possible to reduce costs). Each tower is 80m tall. Work out the best positions for these towers on the cross section and draw their position and heights on. Remember to keep the chairlift above the vegetation (ie a tower will have to be at the top of all hills you cross).

An introduction to topographic maps

Answers

ACTIVITY

As the crow flies

The shortest distance between two points is a straight line. But we can not always travel between two places "as the crow flies" and are forced to follow roads, rivers or railway lines. This can make us travel much greater distances, such as between Rockhampton and Yeppoon which as on the Rockhampton 1:100,000 Topographic Map.

1. Find the railway station at Glenmore Station in Rockhampton. Railway lines are shown as black crossed lines and railway stations are shown as dots on the railway lines.

2. Find the railway station at Yeppoon.

3. Using a straight piece of paper, measure the direct distance between Glenmore Station and Yeppoon Station. Remember that one centimetre on this map equals one kilometre on the ground.

The direct distance between Glenmore Station and Yeppoon Station is 35.3 km.

4. Using a piece of string, measure the distance between the two stations along the railway line. Mark a dot on the string with a pen at Glenmore station then hold the string on the path of the railway line following each curve of the track all the way to Yeppoon station. Mark the string again. Measure the length of the string between the two marks and convert the measurement into kilometres.

The distance between Glenmore Station and Yeppoon Station by rail is 55.8 km.

5. Using a piece of string again, measure the most direct route between the two stations by road. Roads are marked as red lines on the map

The distance between Glenmore Station and Yeppoon Station by road is 40.6 km.

ACTIVITY

Land the aircraft

Imagine you are on an aircraft which is flying over the Rockhampton map area. The aircraft computers have failed and you have been asked to navigate the aircraft by following instructions radioed to the cockpit from the nearest airport control tower. Your Aircraft call sign is VH-ABC (Victor Hector- Alpha Bravo Charlie). The control tower will check with you the ground features you are flying over to make sure you are on track.

"Victor Hector- Alpha Bravo Charlie this is the control tower. We have your exact position. You are about to enter the Rockhampton 1:100,000 map area in the bottom right hand corner exactly. Your aircraft is heading at a bearing of 315°. Proceed at this bearing for 27km. Turn then to a bearing of 270° and travel for 2.5 km. What feature have you just passed over?"

Keppel Sands township (Water storage tank)

"Victor Hector- Alpha Bravo Charlie, travel for another 14.5km exactly west. What type of transport route are you about to pass over?"

railway line

"Victor Hector- Alpha Bravo Charlie, now turn to a bearing of 022.5° (NNE) and travel for 24km. What town have you just flown over?"

Yeppoon

"Victor Hector- Alpha Bravo Charlie, now turn to a bearing of 090° and travel for 10.7km. Then turn to a bearing of 124° and travel for 9km. Ahead of you at around 2km distance, you should see the end of a landing ground. What is the name of the tourist resort that uses this landing ground?"

Fishermans Beach Tourist Resort

"Victor Hector- Alpha Bravo Charlie, we have just had a warning that the wind is blowing strongly from the NW. This will make landing here from your current bearing impossible as the wind is coming from behind you. Please plot your route on your own paper using bearings and distances so that you land on the same landing ground but with the nose of the aircraft pointing at a bearing as close to 315° as you can. (Note the landing field is not pointing exactly to 315°). Over and out."

ACTIVITY

Periscope Up!

Imagine you are the captain of a submarine that is travelling up the coast. It is your job to ensure the submarine does not run aground on any islands, rocks or the coast. Normal operations demand that you always keep your submarine at least 1km away from any obstacle but you stay between 8km and 12km from the from the main coastline.

Your starting point is 910010. Plot your best course using the table below. You will need to work out the bearing the submarine is to sail, the distance it will travel along this bearing and the grid reference (GR) at the end of this distance. The first few legs of the journey has already been done by the submarines navigator (who is now sick in bed).

Starting GR	Bearing	Distance	Finishing GR
910010	000	7km	910080
910080	315	8km	853137
853137	000	8km	_____

Each person will have a different set of answers!

ACTIVITY

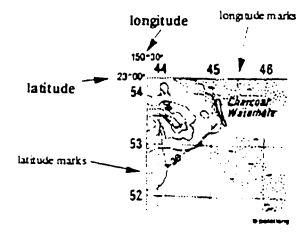
Latitude-Longitude

Latitude and longitude can be used to identify the exact location of any point on the surface of the Earth. We can use it to find locations as well as giving people anywhere in the world an accurate position. When using this method, the latitude is always given first followed by the longitude. The first number in the latitude refers to the whole number of degrees, and the next number refers to the number of minutes. Likewise when using longitude. If the second number is 00, this means that the location is exactly on the latitude or longitude line.

Start in the top left-hand corner of the map. This is marked as latitude 23°00' and longitude 150°30'. The top right-hand corner of the map is at the same latitude (23°00') but is exactly 30 minutes further to the east — 151°00' (remember that there are 60 minutes in one degree). The bottom right-hand corner of the map is at 23°30' latitude and 151°00' longitude.

What special place is located at latitude 23°15' and longitude 150°45'?

Center of the map



As well as the corner coordinates being shown, latitude marks and longitude marks occur along the edges of the map. Each mark represents one minute. The tenth mark is slightly longer. These can be used to locate places on the map using latitude and longitude coordinates.

What is the name of the island at latitude 23°04' and longitude 150°54'

North Keppel Island

ACTIVITY

Rockhampton Map

Find it! Grid it!

What features occur at the following grid references :—

1. 480415 Mt Mungo Wappa
2. 902477 Outer Rocks
3. 535084 Settling Ponds
4. 468111 Chimney
5. 752355 Bluff Rock (Iron Pot Rock)
6. 535129 Mt Dick
7. 750257 Cemetery
8. 697392 Beak Bridge
9. 715482 Iwasaki International Resort
10. 647387 Training track
11. 712050 Balnagawan Dam
12. 630532 Water Storage tank

What are the grid references for the following places :—

1. Yeppoon railway station 687403
2. Ironpot Mtn 536301
3. Ruin in the center of Great Keppel Island 908 353
4. Underwater observatory south of Middle Island 870358
5. Intersection of the Rockhampton-Yepoon Road and the railway line 662 378
6. The end of the jetty at Emu Point 778267

Allow ±1 to final figure for eastings & northings

ACTIVITY

Rockhampton Map

The key to it all

A friend has written you with a big problem. They want to go on a holiday to the Rockhampton area, but the topographic map they own has had the legend torn off and they do not know what all the symbols represent. They have sent you the list below where they describe the symbols that are confusing them. Can you work out what they are describing by using the legend?

A straight green line about 1mm thick and a about one cm long?

a windbreak about 1km long

A black line with small cross lines about 2 mm apart. This line seems to run between some towns?

a railway line

Two parallel red lines?

divided road

A solid light green area?

dense vegetation

A small black box with a cross on the top?

church

Little black stars in a blue background?

Rock, bare or awash

Two small black triangles joined together on a red line?

gate

ACTIVITY

Rockhampton Map

Mt. Lizard Grapes

A local farmer has just purchased a neighbours farm on which lies Mt. Lizard (GR 583526). While the farmer has been to the mountain, she wants to use the mountain slopes to grow a new type of warm weather grape. She has read all the information about the best locations to grow these grapes and has calculated that she needs a place greater than 120m above sea level but less than 300m above sea level.

Locate Mt. Lizard on the Rockhampton 1:100,000 Topographic Map.

What is the contour interval of this map ? 20m

What would be the approximate maximum height of Mt. Lizard ? 225m

What is the approximate height of the surrounding fields at the base of Mt. Lizard ?

60m

The map card Grid Reference Guide is made up of a number of tiny squares approximately 1mm across. Each of these squares represents 100 square metres.

Approximately how much area does the farmer have to grow this new variety of grapes on Mt. Lizard?

0·5 square km

What other factors (economics, environmental, infrastructure) might the farmer need to take into consideration about growing crops in this area?

- location of markets, demand for product, location of nearest transport routes, location of trained workers (grape pickers), climate (rainfall) etc

ACTIVITY

Rockhampton Map

Mobile Phone Towers

A mobile phone company wants to place signal towers on hills along the road between Rockhampton and Yeppoon. For mobile phones to work the entire length of the Rockhampton-Yeppoon Road, the position of the towers must follow these simple rules.

1. The towers must be placed on hills which are greater in elevation than 160m above sea level.
2. Each tower must be within 4km of the road.
3. Each tower must be at least 5km away from any other tower.
4. Each tower has a range of 10km.
5. The tower at Rockhampton already has been built on Peak Hill (GR 479197)

Using these rules find best positions for towers along the route and complete the table below. (Note : there are more tower sites in the table below that you might need). Give the grid reference for each tower and its approximate height above sea level. Make sure that you follow all the rules!

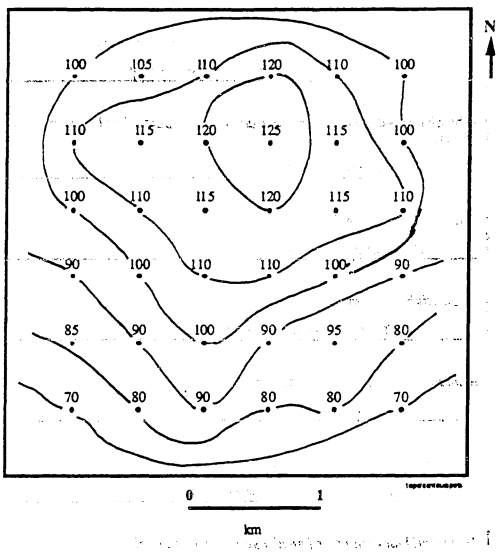
	GR	Height
Tower 1	479197	221m
Tower 2	547261	199m
Tower 3	566333	235m
Tower 4	617375	173m
Tower 5	688416	163m
Tower 6		
Tower 7		
Tower 8		
Tower 9		
Tower 10		

Suggest no. of towers only. Note that none of these towers are in National Parks!!

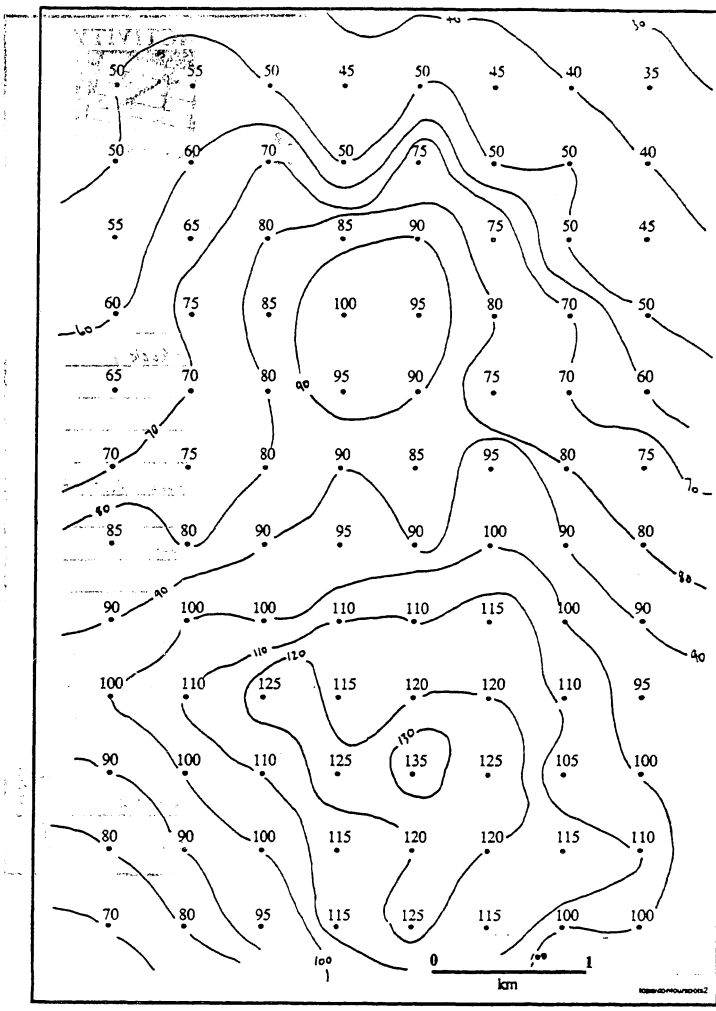
ACTIVITY

Join the elevation dots

A student surveyor has provided the spot height information in metres above se level for a small area she has been mapping. Can you take her data and draw a contour map for the area? All you have to do is draw lines which join places of equal height. Draw contour lines for elevations 70m, 80m, 90m, 100m, 110m and 120m only — your contour interval will be 10m. Note that some spots heights are between these lines (ie. 115m)



Now try drawing contours on the more complicated spot height diagram attached using a contour interval of 10m as before . . . . .



ACTIVITY

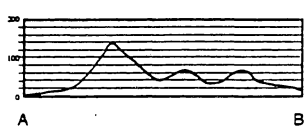
Mt Atherton section

A local football team wants to set up a training area over Mt Atherton (GR484489) — players will be asked to run over the mountain as part of their preparation for a grand final! Your job is to draw a cross section of the proposed route (a direct line) to show the players.

The starting point (A) for the run will be GR460498 and the finishing point (B) will be GR530475. Take a piece of paper with a straight edge and hold it between these two points. Mark on the paper the two points and label them (A, B).

Starting at (A), move along the paper marking where it cuts a contour line until you reach the second point (B). Label the value of each of these contour marks — you may have to follow them around on the map until you can find a value, or by counting up or down from a labelled contour (ie 100's). Be careful as the route sometimes cuts the same value contour line.

Using this piece of paper, transfer the contour height information on to the graph box below by sliding the straight edge up and down to the corresponding heights on the graph. Place a dot on the graph paper at each point the contour was marked on the piece of paper making suer that the starting point (A) stays on the side of the graph When you have placed a dot for each of the contour values, draw a curved line through the points to show the approximate shape of the topography.

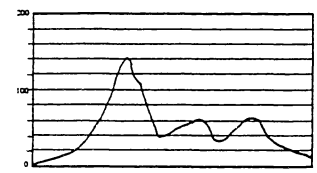


This section shows an exaggerated view of the route. The vertical scale is 1/10,000 and the horizontal scale is 1/10,000.

Calculate the vertical exaggeration factor by dividing the vertical scale by the horizontal scale ie.

$$VE = \frac{VS}{HS} = \frac{\frac{1}{10,000}}{\frac{1}{100,000}} = \frac{1}{10,000} \times \frac{100,000}{1} = \frac{10,000}{1,000} = \frac{10}{1} = 10$$

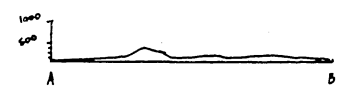
Using the original information, draw the same section in the graph box below. This has a vertical exaggeration of 20.



Which of the two cross sections would you show the football team players and why?

The first - as it is closer to the real topography /terrain that the second

In the space below, try and draw the same section using a vertical exaggeration of 1 (ie use the same scale — 1cm=1000m — for both the horizontal and vertical scale.



Why do you think a greater than 1 vertical exaggeration may be used when drawing most cross sections?

Because some of the detail in the topography is lost.

ACTIVITY

Ride the rapids

Jayne Binkley and her friend Chi Hun Liu have just purchased a new inflatable boat which they want to use to ride the rapids in the local rivers. They know the new boat will be different from their old boat, so they plan to test the boat out on Limestone Creek, which they have found on the Rockhampton Map. As both Jayne and Chi Hun have not been to Limestone So they need to work out the best place to be dropped off so they can float downstream.

Their two preferred locations to be dropped off are:
1. Where Limestone Creek runs under the Rockhampton-Yeppoon Road (GR 627355) or
2. Where Limestone Creek crosses the road near Plain Creek (GR 607443).

Chi Hun knows that because creeks only flow downhill, contour information can be used to find out the direction a creek is flowing. On the map Limestone Creek will cross contour lines. To work out the flow direction, find two places on the map (A,B) where Limestone Creek crosses contour lines and then find the value of these lines.

Grid Reference of location A : 637338 Contour value 60 m

Grid Reference of location B : 575455 Contour value 20 m

Limestone Creek is flowing in the direction from the higher contour line value to the lower contour line value that it crosses. What is the general flow direction of Limestone Creek?

North to North West

Which is the best of the two preferred drop off locations for Jayne and Chi Hun to start their journey?

Where Limestone Creek runs under Rockhampton-Yeppoon Rd.

The other location will become their pick up point. Approximately, what drop in elevation will the Limestone creek fall between the drop off point and the pick up point?

35 m Take into consideration that drop off/pick up points are not exactly where creek crosses contours

Measure the distance they will travel between the two points using the scale and some string, or the opisometer, then calculate the gradient of Limestone Creek by dividing the drop in elevation by the distance of the trip.

35m/14km = 2·5 m per km

ACTIVITY

State Boundaries

The boundaries between the states and territories in any country are decided after many months, and often years, of debate between the different governments. The process involves the accurate surveying of the topography which, in the past, often led to the first accurate maps of a country to be drawn.

In many cases the boundaries between states follow topographic features. In other cases the boundaries are straight lines between two defined points.

Part of the boundary between the states of Victoria and New South Wales occurs on the Jacobs River 1:100,000 topographic map.

Find the symbol on the map face that has been used to show the position of the state boundary. Draw the symbol in the space below.

Why do you think that this symbol has not been included in the legend?

Because it is not a very common feature and the legend is a standard for all topo maps

Starting from the south east section of the map, the state boundary runs in a straight line across to what topographic feature before it changes direction?

Headwaters of the Murray River

For what distance does the boundary follow this straight line on the map?

30·5 km

From this point, what feature does it follow until it leaves the top of the map?

Left bank of the Murray River

For what distance does the boundary follow this feature on the map?

≈ 76 km

ACTIVITY

Vegetation trail

You have been asked by Kosciusko National Park to write a guide on the types of vegetation that occurs on a walking trail which runs from Dead Horse Gap to Cascade Hut. The walking trail follows the Cascade Trail vehicular track.

Locate the start of the tail at Dead Horse Gap (GR 131571). According to the legend, what type of vegetation would you expect to find here?

Scattered scrub

If you followed the trail southwards, how far would you have to walk before you crossed The Big Boggy Creek for the first time?

1·1 km

After you leave the creek valley (still heading roughly southwards along the trail), you climb a ridge. What type of vegetation would you find at the top of the ridge (GR 133540).

Dense scrub

As you continue to walk down the hill towards Cascade hut the trail has a tight corner to the left (GR 118521). What type of vegetation would you see here?

Medium scrub

Finally, what vegetation type would find at Cascade Hut (GR 124506)?

Scattered scrub

Often vegetation type relates directly to the topography ie. dense forest often is found on the southern slopes of hills.

What relationship is there between vegetation and topography along this trail.

Steep slopes have dense scrub –
Flat areas have scattered scrub

ACTIVITY

Hydro Power

An engineering company has put up a proposal to build a hydro-electric power station on the Pinch River. To do this they have to build a dam across the river then allow the water from the dam to travel through a turbine before it returns to the river. They have selected the Pinch River because it lies in a steep sided valley and already has an access road. The proposed dam wall will be between GR 201309 and GR 214311.

How long in metres will the top of the dam wall be? 1250 m

At what height above sea level will the top of the dam wall be ? 600 m

What would be the maximum depth of the water be at the dam wall when the dam is full (assume that the water will reach the top of the dam wall)

~225 m

How far from the middle of the dam wall will the lake formed by the dam extend?

6 km

The water inlet pipe from the dam to the turbine will be placed at GR 212311. What is the height above sea level of this inlet pipe?

500m

The turbine needs to be built 200m lower than the inlet pipe on the dam wall so there is enough water pressure to generate electricity. The turbine also needs to be on the river so that the water, once used, is returned to the natural river course. Approximately how far from the inlet pipe position in kilometres will the turbine need to be?

3·6 km

The water released from the turbine will churn up the river and the water entering the Snowy River will be slightly muddy. The local water authority requires the building of a water quality monitoring station 5 km down stream of the turbine. At what grid reference would this monitoring station be built?

GR262293

The position of this dam and power plant will have some strong opposition from environmental groups. What is one major argument for not allowing the dam to built?

It is in a National Park

ACTIVITY

Chairlift ride

A company wishes to build a scenic chairlift ride for tourists in the mountains. The chairlift ride will take passengers over the tops of the vegetation so they get a birds-eye view of the environment.

The planned chairlift will start at a base station located at GR 058133 and finish at GR 031208. What features are located at the two end points of the chairlift?

GR 058133 bend in the Black Mountain track

GR 031208 Cleft Peak

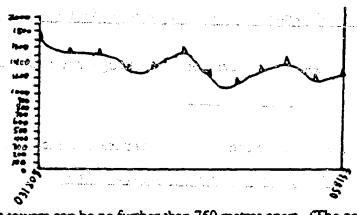
What will be the total length of the chairlift ride if passengers start at and return to the base station (ie. return trip)?

16,000 m

If the chairlift moves at 500m every minute, how long will it take the passengers to complete the ride?

32 minutes

The company has asked you to draw a cross-section with a VE of 2 of the path of the chairlift. Use space below to draw this section.



The chairlift towers can be no further than 750 metres apart. (The company wants as few towers as possible to reduce costs). Each tower is 800m tall. Work out the best positions for these towers on the cross section and draw their position and heights on. Remember the keep the chairlift above the vegetation (ie a tower will have to be at the top of all hills you cross.

The Division of National Mapping (NATMAP) is the mapping authority of the Commonwealth government. Since 1945 mapping in Australia has been coordinated by the National Mapping Council which consists of representatives from NATMAP, the Army and Navy mapping organisations, the Australian Survey Office and the State government mapping organisations. The Royal Australian Survey Corps contributes many maps to this 1:100 000 series and all the States contribute to the program.

1:100 000 MAP SERIES

Started in 1968, the series will eventually extend over the more closely settled areas of Australia. Initially conceived as a tool for national development, administration and defence, these maps meet a wide range of professional and recreational needs. In addition to natural and man-made detail, they show the height of the ground by 20 metre contours (a few mountain sheets have 40 metre contours) and carry the Australian Map Grid, enabling locations to be precisely recorded.

Brochures showing the maps already published are available from NATMAP Sales Offices.

OTHER NATMAP PRODUCTS

NATMAP produces two other topographic map series covering Australia—one at 1:250 000 scale and the other at 1:1 million scale—and distributes topographic maps produced by the Royal Australian Survey Corps. Other NATMAP products include wall maps of Australia, maps of Antarctica, bathymetric maps of the continental shelf, the Atlas of Australian Resources, the Atlas of Population and Housing, the Australia 1:5 million map series, land use maps and vertical air photographs. All products are for sale—call in or write to a NATMAP Sales Office if you would like more information.

9051 ROCKHAMPTON

QUEENSLAND EDITION 2

TOPOGRAPHIC MAP
1:100 000 scale
(1 cm to 1 km)

SALES OUTLETS

You can inspect and buy any of the maps so far published at the NATMAP Sales Offices in Canberra, Melbourne and Sydney. These offices are listed under the National Mapping entry in the Commonwealth Government section of the telephone directory. Selections of maps are stocked at the State mapping organisations and by the many map retailers—map dealers, bookshops, newsagents, tourist information centres and camping goods shops—throughout Australia and overseas. Some of these are listed in the yellow pages of the telephone directory under "Maps". If in doubt, a NATMAP Sales Office will be able to give you the name of a retailer near you.

SHEET 9051 EDITION 2
NATIONAL TOPOGRAPHIC MAP SERIES

ROCKHAMPTON

SCALE 1 : 100 000

km 0 1 2 3 4 5 6 7 8 km

HEIGHTS IN METRES. CONTOUR INTERVAL 20 METRES

Horizontal Datum: Australian Geodetic Datum 1966
Vertical Datum: Australian Height Datum 1971
Transverse Mercator Projection: Australian Map Grid

PUBLISHED by authority of the Minister for National Development and Energy

PRODUCED AND DISTRIBUTED by the Division of National Mapping

MAP RELIABILITY: Topographic information shown on this map is correct to 1981

MAP ACCURACY: The average accuracy of this map is ± 25 metres in the horizontal position of well defined detail and ± 5 metres in height

ROAD CLASSIFICATION: Roads are classified according to their intended function as part of the national road system

GRID CONVERGENCE 0.9°
GRID/MAGNETIC ANGLE 8.7°

True north, grid north and magnetic north are shown diagrammatically for the centre of the map. Magnetic north is correct for 1983 and moves easterly by 0.1° in about three years.

INDEX TO ADJOINING SHEETS
(not necessarily published)

PRINCHESTER 8952	BAYFIELD 9052	CORAL SEA
RIDGELANDS 8951	ROCKHAMPTON 9051	CAPE CAPRICORN 9151
MOUNT MORGAN 8950	BAJOOL 9050	CLARSTONE 9150

This map is part of sheet
SF 56-13 ROCKHAMPTON
in the 1:250 000 scale series

Roads for Public Use classified according to their intended function as part of the national road system	Sealed	Unsealed
Divided road		
Principal road; National route marker	31	
Secondary road; Embankment; Cutting		
Minor road; Cattle grid; Road bridge		
Vehicle track; Gate		
Other Roads (Use may be restricted)		
Road		
Vehicle track		
Walking track		

Railway, multiple track; Station; Railway bridge
Railway, single track; Railway tunnel
Light railway or tramway
Power transmission line
Fence; Levee or bank
Mine; Windmill; Yard; Quarry
Building(s); Church; Ruin; Drive-in theatre
Trig station; Bench mark with height; Spot height — BM 29 · 220
Cliff; Contour with value; Depression contour — 440
Sandridges
Vegetation: dense; medium; scattered
Tropical rainforest; Pine plantation
Orchard, plantation or vineyard; Mangrove
Windbreak
Lake, perennial; Stream, perennial
Lake, intermittent; Stream, intermittent
Lake, mainly dry; Stream, mainly dry
Swamp, perennial; intermittent
Land subject to inundation; Rice field
Bore or well; Spring; Tank or small dam
Breakwater; Pier; Wharf
Wreck, exposed; Lighthouse
Rock, bare or awash; Foreshore flat; Sand
Reef; Rock ledge; Saline coastal flat

UNIVERSAL GRID REFERENCE

BEFORE GIVING A GRID REFERENCE, CIVILIAN USERS SHOULD STATE THE NUMBER AND NAME OF THIS MAP:

9051 ROCKHAMPTON

GRID ZONE DESIGNATION: 56K

100 000 METRE SQUARE IDENTIFICATION

KV
KU

IGNORE the SMALLER figures of any grid number; these are for finding the full co ordinates. Use ONLY the LARGER figures of the grid number; example: 145 000

TO GIVE A STANDARD REFERENCE ON THIS SHEET TO NEAREST 100 METRES

SAMPLE POINT: • Mount Hedlow

1 Read letters identifying 100 000 metre square in which the point lies: KV
2 Locate first VERTICAL grid line to LEFT of point and read LARGE figures labelling the line either in the top or bottom margin, or on the line itself: 53
3 Estimate tenths from grid line to point: 6
4 Locate first HORIZONTAL grid line BELOW point and read LARGE figures labelling the line in either the left or right margin, or on the line itself: 31
5 Estimate tenths from grid line to point: 4

SAMPLE REFERENCE: KV 536 314

If reporting beyond 18° in any direction, prefix Grid Zone Designation, as: 56KKV536314

Black numbered grid lines are 1000 metre intervals of the Australian Map Grid. Zone 56
Grid values are shown in full only at the south west corner of the map

WORLD GEODETIC SYSTEM

To convert World Geodetic System 1972 to Australian Geodetic Datum 1966 coordinates on which this map is based:

Increase the numerical value of latitudes by 5.5", equivalent to 169 metres
Decrease the numerical value of longitudes by 3.3", equivalent to 94 metres
To obtain heights above mean sea level, decrease satellite heights by 5.3 metres

Inclusion of a name on this map does not imply its approval by the relevant nomenclature authority.

NOTES FOR THE MAP USER

This map has been compiled from air photographs, with supplementary information on man-made detail supplied by many organisations and individuals. This information has been verified and corrected in the field by either ground or aerial inspection; the date appears in the map reliability note.

A truly exhaustive check would be too lengthy a process to be feasible; and maps get out of date. These factors should be borne in mind when using the map for navigation—for example, an old vehicular track still clearly distinguishable from the air and shown on the map may be overgrown and difficult to follow on the ground. On the other hand, new roads and new tracks may have been made since the map was published.

Every effort has been made to show all features necessary to make the map a useful general reference. Specialist map users who would like additional information for their particular activities can annotate their maps to suit their requirements. However, if you discover features that are not shown on the map, due to either omission or new development, and think they would be of interest to most users, please notify the Director, Division of National Mapping, PO Box 31, Belconnen, 2616. Grid references and sketch maps are of great assistance. NATMAP will then check the information and, if desirable, incorporate these features in the next edition.

NMP/82/045 Printed by C. J. Thompson, Commonwealth Government Printer

SHEET 9051
ROCKHAMPTON
QUEENSLAND
EDITION 2

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In the sparsely populated central areas of Australia, orthophotomaps at 1:100 000 scale are being published. They show the nature of the country as it appears on an air photograph, but are true to scale, and also carry 20-metre contours and the Australian Map Grid.

Brochures showing the maps of each kind already published are available from Natmap Sales Offices.

OTHER NATMAP PRODUCTS

NATMAP produces two other topographic map series covering Australia—one at 1:250 000 scale and the other at 1:1 million scale—and distributes topographic maps produced by the Royal Australian Survey Corps to civilian users. Other products include wall maps of Australia, maps of Antarctica, bathymetric maps of the continental shelf, the Atlas of Australian Resources, land use maps, vertical air photographs, and satellite imagery. All products are for sale to the general public—call in or write to a NATMAP Sales Office if you would like more information.

SALES OUTLETS

You can inspect and buy any of the maps so far published at the NATMAP Sales Offices in Canberra, Melbourne and Sydney. These offices are listed under the National Mapping entry in the Commonwealth Government section of the telephone directory. Selections of maps are stocked by many map retailers throughout Australia and overseas—map dealers, bookshops, newsagents, tourist information centres and camping goods shops. Some of these are listed in the Yellow Pages under "Maps". If in doubt, a NATMAP Sales Office will be able to give you the name of a retailer near you.

8524 JACOBS RIVER

NEW SOUTH WALES AND VICTORIA

EDITION 1

1:100 000 TOPOGRAPHIC MAP (1 cm to 1 km)

REFER TO THIS MAP AS:
SHEET 8524 (EDITION 1) 1979
NATIONAL TOPOGRAPHIC MAP SERIES

JACOBS RIVER

SCALE 1 : 100 000

km 0 1 2 3 4 5 6 7 8 9 10 km

ELEVATIONS IN METRES. CONTOUR INTERVAL 20 METRES

Horizontal Datum: Australian Geodetic Datum 1966
Vertical Datum: Australian Height Datum 1971
Transverse Mercator Projection: Australian Map Grid

PUBLISHED by authority of the Minister for National Development and Energy

PRODUCED by the Division of National Mapping using material supplied by the Snowy Mountains Hydro Electric Authority and the Central Mapping Authority of New South Wales

DISTRIBUTED by the Division of National Mapping

MAP RELIABILITY: Topographic information shown on this map is correct to 1979

MAP ACCURACY: The average accuracy of this map is ±25 metres in the horizontal position of well defined detail and ±5 metres in elevation

ROAD CLASSIFICATION: Roads are classified according to their intended function as part of the national road system

Built-up area; National route marker
Principal road and highway; Cutting
Secondary road; Embankment
Minor road; Road bridge
Vehicular track
Gate; Cattle grid
Railway, multiple track; Station; Railway bridge
Railway, single track; Railway tunnel
Light railway or tramway
Power transmission line
Fence; Levee or bank
Mine; Windmill; Yard; Quarry
Building(s); Church; Ruin; Drive-in theatre
Trig station; Bench mark with elevation; Spot elevation ... BM 306 · 220
Cliff; Contour with value; Depression contour ... 200
Sandridges
Forest, dense; medium; scattered
Scrub, dense; medium; scattered
Tropical rainforest; Pine plantation
Orchard, plantation or vineyard; Mangrove
Windbreak
Lake, perennial; Stream, perennial
Lake, intermittent; Stream, intermittent
Lake, mainly dry; Stream, mainly dry
Swamp, perennial; intermittent
Land subject to inundation; Rice field
Bore or well; Spring; Tank or small dam
Breakwater; Pier; Wharf
Wreck, exposed; Lighthouse
Rock, bare or awash; Foreshore flat; Sand
Reef; Rock ledge ; Saline coastal flat

UNIVERSAL GRID REFERENCE
BEFORE GIVING A GRID REFERENCE, CIVILIAN USERS SHOULD STATE THE NUMBER AND NAME OF THIS MAP:
8524 JACOBS RIVER

GRID ZONE DESIGNATION: 55H
100 000 METRE SQUARE IDENTIFICATION: EV FV; 400
IGNORE the SMALLER figures of any grid number. These are for finding the full co-ordinates. Use ONLY the LARGER figures of the grid number: example: 400000

TO GIVE A STANDARD REFERENCE ON THIS SHEET TO NEAREST 100 METRES
SAMPLE POINT: 1828 A THE PILOT
1 Read letters identifying 100 000 metre square in which the point lies: FV
2 Locate first VERTICAL grid line to LEFT of point and read LARGE figures labelling the line either in the top or bottom margin, or on the line itself: 97
3 Estimate tenths from grid line to point: 6
4 Locate first HORIZONTAL grid line BELOW point and read LARGE figures labelling the line in either the left or right margin, or on the line itself: 31
5 Estimate tenths from grid line to point: 5
SAMPLE REFERENCE: FV076315
If reporting beyond 18° in any direction, prefix Grid Zone Designation, as: 55HFV076315

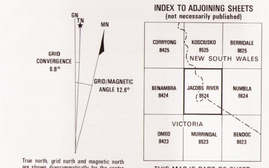
Black numbered grid lines are 1000 metre intervals of the Australian Map Grid, Zone 55
Grid values are shown in full only at the south west corner of the map

WORLD GEODETIC SYSTEM

To convert World Geodetic System 1972 to Australian Geodetic Datum 1966 coordinates on which this map is based:

Increase the numerical value of latitudes by 5.4", equivalent to 166 metres
Decrease the numerical value of longitudes by 3.9", equivalent to 97 metres
To obtain heights above mean sea level, decrease satellite heights by 13 metres

INDEX TO ADJOINING SHEETS (not necessarily published)



True north, grid north and magnetic north are shown diagrammatically for the centre of the map. Magnetic north is correct for 1980 and moves easterly by 0.1° in about three years

THIS MAP IS PART OF SHEET SJ 55-3 TALLANGATTA IN THE 1:250 000 SCALE SERIES

NOTES FOR THE MAP USER

This map has been compiled from air photographs, with supplementary information on man-made detail supplied by many organisations and individuals. This information has been verified and corrected in the field by either ground or aerial inspection; the date appears in the map reliability note.

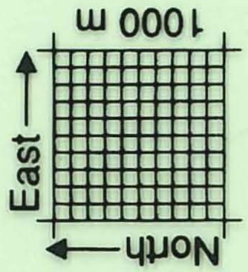
A truly exhaustive check would be too lengthy a process to be feasible; and maps get out of date. These factors should be borne in mind when using the map for navigation—for example, an old vehicular track still clearly distinguishable from the air and shown on the map may be overgrown and difficult to follow on the ground. On the other hand, new roads and new tracks may have been made since the map was published.

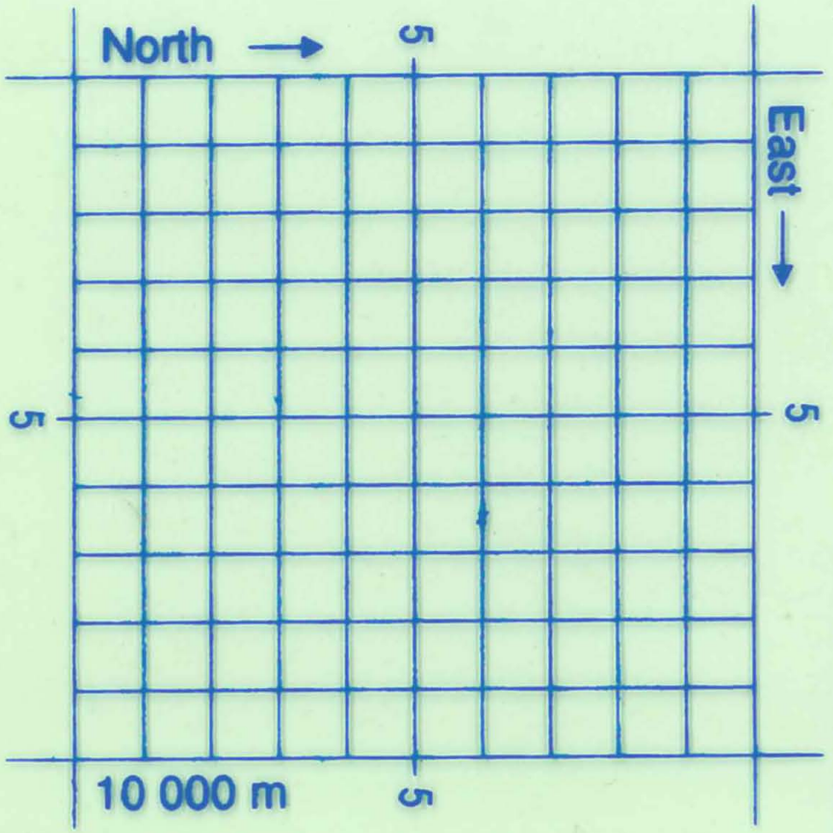
Every effort has been made to show all features necessary to make the map a useful general reference. Specialist map users who would like additional information for their particular activities can annotate their maps to suit their requirements. However, if you discover features that are not shown on the map, due to either omission or new development, and think they would be of interest to most users, please notify the Director, Division of National Mapping, P.O. Box 548, Queanbeyan, 2620. Grid references and sketch maps are of great assistance. NATMAP will then check the information and, if desirable, incorporate these features in the next edition.

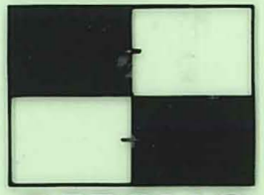
NMP/80/021 C. J. Thompson, Commonwealth Government Printer

SHEET 8524
JACOBS RIVER
NEW SOUTH WALES
AND VICTORIA
EDITION 1 1979

STOCK NO R651X8524







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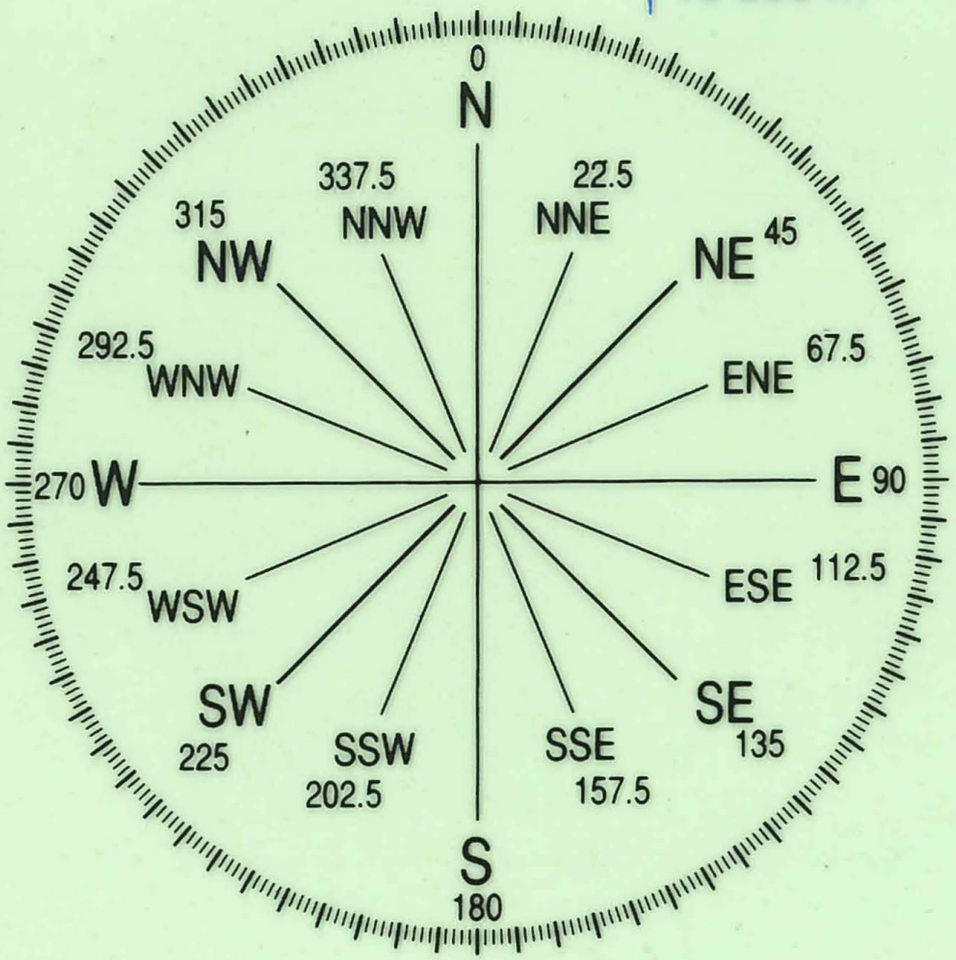

AGSO

AUSTRALIAN GEOLOGICAL SURVEY ORGANISATION

(06) 249 9519

Kilometres (1:100 000)

0 1 2 3 4 5 6 7 8 9 10

Kilometres (1:250 000)

0 5 10 15 20 25

30-2/65

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